Impact of Noise on Nurses in PICUs

Nurses' Perspectives on Clinical Alarms

Quiet Time and Lower Nurse Stress Levels

Nurse and Physician Agreement on Futility

Nurse Burnout and Resilience

Promoting Resilience in the PICU

Nurses’ Knowledge of NMBAs

Mechanical Ventilation Antioxidant Trial

Hand Massage Performed by Family

Severe and Disabling Septic Shock
Provide an extra measure of protection for your patients against ET tube occlusion.

The AnchorFast Guard oral endotracheal tube fastener features an integrated tube protection sleeve to help prevent tube occlusion.

Call 1.888.740.8999 or visit www.anchorfast1.com

eLearning now available
www.hollister.com/eLearning/AnchorFastGuard

CAUTION: Federal (USA) Law restricts this device to sale by or on the order of a physician. Prior to use of the AnchorFast Guard oral endotracheal tube fastener, be sure to read the entire product Instructions for Use package insert that accompanies the product.
Online NOW
from AACN

376 Abstracts of articles available exclusively online at www.ajcconline.org

- e72 The pH of Feeding Tube Aspirates From Critically Ill Infants
  Kathleen L. Meert, Mary Caverly, Lauren M. Kelm, and Norma A. Metheny

- e78 Perceptions Related to Falls and Fall Prevention Among Hospitalized Adults
  Renee Samples Twibell, Debra Siela, Terrie Sproat, and Gena Coers

Coming in November …
Arif Rahu and colleagues evaluate the validity and sensitivity of 6 pain scales in critically ill communicative and noncommunicative intubated adults.

Healthy Work Environments

377 Impact of Noise on Nurses in Pediatric Intensive Care Units
J’ai Watson, Angela Kinstler, William P. Vidonish III, Michael Wagner, Li Lin, Kermit G. Davis, Susan E. Kotowski, and Nancy M. Daraiseh

387 Nurses’ Perspectives on Clinical Alarms
Linda Honan, Marjorie Funk, Michaela Maynard, Deborah Fahs, J. Tobey Clark, and Yadin David

396 Decreased Stress Levels in Nurses: A Benefit of Quiet Time
Heather C. Riemer, Joanna Mates, Linda Ryan, and Bonnie J. Schleder

On the Cover
Detail from “Drama Resolved”
Marlene Burns
36” x 36”
Mixed media on canvas
2015

To view other works by Marlene Burns
Visit her online gallery,
www.art-marleneburns.com
Healthy Work Environments

403 Concordance of Nurses and Physicians on Whether Critical Care Patients Are Receiving Futile Treatment

412 Burnout and Resilience Among Nurses Practicing in High-Intensity Settings
Cynda Hylton Rushton, Joyce Batcheller, Kaia Schroeder, and Pamela Donohue

422 Promoting Staff Resilience in the Pediatric Intensive Care Unit
K. Jane Lee, Michael L. Forbes, Gloria J. Lukasiewicz, Trisha Williams, Anna Sheets, Kay Fischer, and Matthew F. Niedner

Pulmonary Critical Care

431 Intensive Care Nurses’ Knowledge About Use of Neuromuscular Blocking Agents in Patients With Respiratory Failure
Erin N. Frazee, Heather A. Personett, Seth R. Bauer, Amy L. Dzierba, Joanna L. Stollings, Lindsay P. Ryder, Jennifer L. Elmer, Sean M. Caples, and Craig E. Daniels

440 Mechanical Ventilation Antioxidant Trial
Kimberly P. Howe, John M. Clochesy, Lawrence S. Goldstein, and Hugh Owen

Families in Critical Care

446 Benefit to Family Members of Delivering Hand Massage With Essential Oils to Critically Ill Patients
Charlsea Prichard and Patricia Newcomb

Cases of Note

450 A Young Man With Severe and Disabling Complications of Septic Shock
L. E. M. Haas, R. S. van der Ploeg, J. J. Quak, J. P. J. Burgmans, and M. Otten

372 Editorial
Our View of Courageous Care
Cindy L. Munro and Richard H. Savel

375 Clinical Pearls

385 Evidence-Based Review and Discussion Points
Ronald L. Hickman

453 ECG Puzzler
ECG Changes During Neurologic Injury
Salah S. Al-Zaiti, Elizabeth A. Crago, Marilyn Hrvnak, Teri M. Kozik, Michele M. Pelter, and Mary G. Carey

455 Education Directory
Visit AJCC’s Web site, www.ajcconline.org, to submit a manuscript or for author guidelines, full text of selected articles, OnlineNOW articles, digital edition access, eLetters, links to AACN’s online continuing education tests, and more.
The AACN National Teaching Institute (NTI) is held annually in May, and provides an opportunity for critical care nurses to refresh their knowledge, recharge their enthusiasm, and reconnect with the national critical care nursing community. NTI is also the time when the AACN president-elect unveils the theme that will frame the upcoming year. This year, incoming president Karen McQuillan has chosen “Courageous Care” as the AACN theme. In her keynote address at NTI, McQuillan said, “We nurses show courage daily. To me, we demonstrate Courageous Care each time we step up and challenge ‘the way we’ve always done things’ — because it’s what is needed. We demonstrate Courageous Care when we say we don’t understand something and then go and learn about it in order to gain the knowledge to care for complex patients.”

Courageous care is at the heart of both quality improvement efforts and research, and knowledge is its foundation. It takes courage to challenge established practices, even when evidence for improvement is strong. It takes courage to discover new knowledge to guide care. It also takes courage to engage our colleagues and initiate improvements in the work environment.

In some instances, the information needed to improve outcomes for critically ill patients is already available, but has not been incorporated into local practice. Nurses who challenge the status quo and seek to replace comfortable old practices with new evidence-based practices exhibit courageous care. The barriers to implementing changes in the clinical setting can be significant. Hurdles may include financial constraints and administrative concerns. The culture of the unit and resistance of individuals to suggested changes can impede introduction of new practices in the unit even when evidence for change is substantial.

Courageous care requires that nurses understand the barriers and persevere in addressing them. Individual nurses may be champions of change in their units, but in order for change to be effective, these individual champions must be able to engage others in enacting and sustaining new practices.

Quality Improvement

Quality improvement can support courageous care by providing structure for efforts aimed at improving care at local sites. In a recent American Journal of Critical Care (AJCC) article describing quality improvement metrics and processes, the authors state, “Critical care nurses often perform most of the care, patient assessments, and evaluations in the ICU, which places them in the perfect position to identify, initiate, evaluate, and sustain quality initiatives.”

No matter how well positioned nurses are to identify opportunities for improving care, change will not occur unless nurses act courageously. Quality
improvement projects extend courageous care beyond the nurse’s interaction with an individual patient, and provide benefits far beyond the initial target.

**Research**

Conducting original research to build the knowledge base for nursing care is also a manifestation of courageous care. Whereas quality improvement projects seek to enhance care by applying knowledge to a local situation, research seeks to find new knowledge that can be broadly applied. Many nursing activities arise from tradition or opinion, but have not been examined scientifically. Nursing research is needed to substantiate or refute the efficacy of long standing traditions of care. Further, it is necessary to actually test theoretically attractive new interventions. For example, what evidence do we have regarding optimal turning frequency for critically ill patients? Providing a “quiet time” for critically ill patients during the day has been widely adopted as a way of providing rest, but there is little research evaluating the practice. Might dimming lights and encouraging daytime sleep exacerbate circadian rhythm problems? Courageous care requires that we be willing to examine interventions impartially in order to fully understand risks and benefits.

Whereas it is important for nurses to embrace courageous care as individuals, it is also important for nurses to act as catalysts for courageous care within the interdisciplinary health care team. It is our responsibility to assist all members of the team to practice to the full extent of their education and training, and to support the synergy created by interdisciplinary care. More research about interdisciplinary teams is needed. An example of research about disciplinary perspectives is provided by Neville and colleagues in this issue of *AJCC*. They report an examination of nurse and physician perceptions of futile care. Nurses and physicians evaluated the same patients on the same days, there was low concordance in their judgments about which patients were receiving futile treatment. The authors suggest that physician judgments may focus on mortality risk, whereas nursing judgments might be more influenced by patients’ suffering and nurses’ awareness of patient and family goals. Importantly, the group of patients for whom nurses and physicians agreed treatment was futile had the highest 6-month mortality—greater than either patients whose care was assessed as futile by physicians alone, or by nurses alone. They conclude that sharing of perceptions and collaborative relationships among providers is important.

**Healthy Work Environments**

The work environment can discourage or facilitate courageous care. Because healthy workplace environments are a crucial component of patient safety, courageous care must directly address any factors that undermine healthy work environments. Addressing workplace issues requires particular courage, as unhealthy behaviors may be deeply rooted and systemic. The AACN Healthy Work Environment Initiative focuses on 5 factors that are crucial to optimal nursing contributions and patient outcomes (skilled communication, true collaboration, effective decision making, appropriate staffing, meaningful recognition, and authentic leadership). Healthy work environments nurture courage in nurses and support efforts to effect changes that improve patient outcomes. For example, when nurses communicate skillfully, they are better able to state their case about what changes are needed and why. They are also able to understand and respect the viewpoints of others.

Nurses in a healthy work environment go beyond identifying issues—they engage colleagues, patients, and families in finding and implementing solutions to problems. AACN offers resources to assist in creating healthy work environments, which are important supports for courageous care. The TeamSTEPPS program, jointly developed by the Department of Defense’s Patient Safety Program and the Agency for Healthcare Research and Quality, encourages a healthy work environment that supports a culture of patient safety by providing interdisciplinary training and materials to improve communication and teamwork skills.

---

**About the Authors**

*Cindy L. Munro* is coeditor in chief of the *American Journal of Critical Care*. She is associate dean for research and innovation at the University of South Florida, College of Nursing, Tampa, Florida. *Richard H. Savel* is coeditor in chief of the *American Journal of Critical Care*. He is director, surgical critical care at Maimonides Medical Center and a professor of clinical medicine and neurology at the Albert Einstein College of Medicine, both in New York City.
Conclusion
There are many opportunities for critical care nurses to exhibit courageous care. Nurses do so in advocating for individual patients and their families, as well as in conducting quality improvement projects and research. At its best, however, courageous care is a team sport. Individual courage can and should be contagious, spreading throughout the health care team and resulting in better outcomes.

The statements and opinions contained in this editorial are solely those of the coeditors in chief.

FINANCIAL DISCLOSURES
None reported.

REFERENCES
4. Neville TH. Nurse and physician concordance on whether critical patients are receiving treatment perceived to be futile: opportunity for collaboration. Am J Crit Care. 2015;24(5):403-411

To purchase electronic or print reprints, contact American Association of Critical-Care Nurses, 101 Columbia, Aliso Viejo, CA 92656. Phone, (800) 899-1712 or (949) 362-2050 (ext 532); fax, (949) 362-2049; e-mail, reprints@aacn.org.

Looking to increase your presence within the nursing community?

Take advantage of evidence-based, interdisciplinary knowledge for high acuity and critical care as published in the American Journal of Critical Care. AACN content can be tailored to fit your marketing and promotional needs and can be delivered via print or electronic format.

The American Association of Critical-Care Nurses content is available as:

- Customized Article Reprints
- Sponsored Content Collections (by topic, specialty, etc.)
- Licensed content for special publications or marketing campaigns

Electronic content is user friendly, mobile ready, can be posted to your company website, and/or distributed via e-mail or social media campaigns.

Contact us today to discuss the many options available:

Matt Neiderer
Matt.neiderer@sheridan.com • 800-635-7181 ext. 8265
Clinical Pearls

Mary Jo Grap, RN, PhD, ACNP, Section Editor

Clinical Pearls is designed to help implement evidence-based care at the bedside by summarizing some of the most clinically useful material from select articles in each issue. Readers are encouraged to photocopy this ready-to-post page and share it with colleagues. Please be advised, however, that any substantive change in patient care protocols should be carefully reviewed and approved by the policy-setting authorities at your institution.

Impact of Noise on Nurses in Pediatric Intensive Care Units

Nurses strive to create a healing environment for their patients but may not be aware of all the ways the intensive care unit (ICU) environment affects their own health. A study by Daraiseh and colleagues of how noise affects nurses in the ICU demonstrated that hospital leaders can promote a healthy work environment by being aware of the following key points:

• Current ICU practices result in noise that exceeds recommended levels, which makes it difficult for institutions to comply with recommended guidelines.
• Increased awareness of the health impact of noise on both patient and staff is needed to enhance the meaningfulness of reduction strategies.
• Interventions must go beyond a focus on alarms and extend to behavioral strategies for noise reduction, such as quiet rooms and quiet times. A multifaceted strategy will be the most successful.
• Noise can potentially lead to short- and long-term adverse health effects.

Nurses’ Knowledge About Neuromuscular Blocking Agents

For patients with severe acute respiratory distress syndrome (ARDS), recent evidence suggests initiation of early continuous infusion neuromuscular blocking agents (NMBAs) improves patient oxygenation, and reduces inflammation and mortality. Despite the possible benefits of NMBAs for ARDS, prolonged use may contribute to increased risk for corneal ulcers, skin breakdown, venous thromboembolism, ventilator-associated pneumonia, and musculoskeletal debility. Frazee and colleagues studied nurses’ knowledge of NMBAs’ therapeutic properties, adverse effects, and associated monitoring parameters. They found the following:

• Most contemporary critical care nurses recognize that paralytics do not provide analgesia or sedation, which is much improved from previous studies.
• Nurses infrequently identified the correct method of NMBAs’ elimination, particularly with aminosteroidal NMBAs such as vecuronium or pancuronium.
• Recognition and prevention of risk is important, but 20% to 40% of nurses in the study were unfamiliar with adverse effects of the agents.
• Titration strategies for NMBAs should be tailored according to indication for therapy. In respiratory failure, pairing gas exchange and ventilator synchrony with peripheral nerve stimulation may be preferred.

Nurses’ Perspectives on Clinical Alarms

The alarm systems created to enhance patient safety have become a significant safety concern. In a study of nurses’ perspectives on clinical alarms, nurses told Honan and colleagues that in addition to causing sentinel events, the noise pollution caused by alarms is associated with increased patient anxiety, sleep deprivation, ICU psychosis, and delirium in patients. They recommend the following:

• All front-line health care workers should foster an attitude of teamwork to improve patient care, and respond to alarms regardless of patient assignment.
• Standards of competencies for monitor watchers must be developed and assessed annually.
• Nursing school curricula should include instruction about differentiation of nuisance versus significant alarms, alarm troubleshooting, and recognition that alarms are adjuvant to clinical observation, not a primary source of patient information.
• The ultimate responsibility for alarms must rest with the bedside clinician. Therefore, physician/nurse rounding and nursing authority to alter alarm parameters is optimal.
• Responsibility and accountability needs to be shared between device manufacturers and nurses, so that nurses’ voices are heard.

Nurse-Physician Agreement on Futile Treatment

Nurses and physicians describe critical care that is not expected to provide meaningful benefit to a patient as futile, but providing such treatment is common and associated with moral distress. Neville and colleagues surveyed critical care physicians and nurses to identify patients perceived to be receiving futile treatment, compared nurses’ and physicians’ assessments, and also patient survival. They found the following:

• Nurses and physicians perceived futility differently and only 44% of patients were assessed by both groups as receiving futile treatment.
• Reasons that patients were perceived to receive futile critical care were similar for nurses and physicians.
• Physicians’ assessments of futile treatment corresponded more closely than did nurses’ assessments with patients dying in the hospital or within 6 months after discharge.
• When nurse and physician both assessed a patient as receiving futile treatment, the patient was far more likely to die in the hospital than when the patient was assessed as receiving futile treatment by either the nurse or the physician.
THE pH OF FEEDING TUBE ASPIRATES FROM CRITICALLY ILL INFANTS

By Kathleen L. Meert, MD, Mary Caverly, RN, MSN, WCC, CPNP, Lauren M. Kelm, RN, MSN, CCRN, CPNP, and Norma A. Metheny, RN, PhD

Background The extent to which gastric acid inhibitors and feedings affect gastric pH in infants is unclear.

Objectives To compare pH values of gastric aspirates from infants according to use or no use of gastric acid inhibitors and feedings.

Methods Colorimetric pH tests were used to measure the pH of aspirates from feeding tubes in 54 critically ill infants; 29 of the gastric aspirates were from infants who did not receive acid inhibitors or feedings, 13 were from infants who received acid inhibitors but no feedings, 3 were from infants who received feedings but no acid inhibitors, and 5 were from infants who received both acid inhibitors and feedings. The remaining 4 feeding tubes were in nongastric sites.

Results Individual pH readings of 5.5 or less were found in 97% of the gastric aspirates from infants with no recent feedings or acid inhibitors, 77% of the gastric aspirates from infants with no recent feedings or acid inhibitors, 77% of the gastric aspirates from infants who received acid inhibitors, and 67% of the gastric aspirates from infants with recent feedings. Among 2 esophageal aspirates and 2 duodenal aspirates, 1 of each type had a pH less than 5.5. A pH cut point of 5.5 or less did not rule out esophageal or duodenal placement.

Conclusions The pH of gastric aspirates from critically ill infants is often 5.5 or less, regardless of the use of acid inhibitors, feedings, or both. Most likely a cut point of 5.5 or less would rule out respiratory placement because tracheal pH is typically 6.0 or higher. (American Journal of Critical Care. 2015;24:e72-e77)

PERCEPTIONS RELATED TO FALLS AND FALL PREVENTION AMONG HOSPITALIZED ADULTS

By Renee Samples Twibell, RN, PhD, CNE, Debra Siela, RN, PhD, CCNS, ACNS-BC, CCRN, CNE, RRT, Terrie Sproat, RN, BS, and Gena Coers, RN, BS

Background Prevention of falls during hospitalization depends in part on the behaviors of alert patients to prevent falls. Research on acutely ill patients’ intentions to behave in ways that help prevent falls and on the patients’ perceptions related to falls is limited.

Objective To explore hospitalized adults’ perceptions related to risk for falling, fear of falling, expectations of outcomes of falling, and intention to engage in behaviors to prevent falls.

Methods Adult, alert, acutely ill inpatients (N = 158) at risk for falling completed a survey consisting of 4 scales and 3 single items. Nurses’ assessments and patients’ perceptions of the risk for falling were compared.

Results Decreased intentions to engage in behaviors to prevent falls were correlated with patients’ increased confidence in their ability to perform high-risk behaviors without help and without falling (P < .001), decreased fear of falling (P < .001), and decreased perceived likelihood of adverse outcomes if they did fall (P < .001). Although nurses’ assessments indicated a risk for falls, 55.1% of the patients did not perceive a high likelihood of falling while hospitalized. Whereas 75% of patients intended to ask for help before getting out of bed, 48% were confident that they could get out of bed without help and without falling.

Conclusions Although assessments may indicate a risk for falling, acutely ill inpatients may not perceive they are likely to fall. Patients’ intentions to engage in behaviors to prevent falls vary with the patients’ fall-related perceptions of confidence, outcomes, and fear related to falling. (American Journal of Critical Care. 2015;24:e78-e85)
Impact of Noise on Nurses in Pediatric Intensive Care Units

By J’ai Watson, MS, Angela Kinstler, RN, MSN, CNI, William P. Vidonish III, MBA, IE, Michael Wagner, PhD, Li Lin, MS, Kermit G. Davis, PhD, CPE, Susan E. Kotowski, PhD, CPE, and Nancy M. Daraiseh, PhD

Background Excessive exposure to noise places nurses at risk for safety events, near-misses, decreased job performance, and fatigue. Noise is particularly a concern in pediatric intensive care units, where highly skilled providers and vulnerable patients require a quiet environment to promote healing.

Objective To measure noise levels and noise duration on specialty pediatric intensive care units to explore sources of noise and its effects on the health of registered nurses.

Methods In a cross-sectional pilot study, levels and sources of noise in 3 different specialty pediatric intensive care units were assessed. Fifteen nurses were observed for 4-hour sessions during a 24-hour period. Sound pressure levels (noise) and heart rate were measured continuously, and stress ratings were recorded. Descriptive statistics were calculated for noise (level, source, location, and activity), heart rate, and stress. The Pearson correlation coefficient was calculated to analyze the relationship between heart rate and noise.

Results Mean noise level was 71.9 (SD, 9.2) dBA. Mean heart rate was 85.2/min (SD, 15.8/min) and was significantly associated with noise, unit, within-unit location, nurse sources, and noise activities. The most frequent sources of noise were patients’ rooms, care activities, and staff communications.

Conclusions Noise levels in pediatric intensive care units exceed recommended thresholds and require immediate attention through effective interventions. Although noise was not associated with stress, a significant correlation with increased heart rate indicates that noise may be associated with adverse health outcomes. (American Journal of Critical Care. 2015;24:377-384)

©2015 American Association of Critical-Care Nurses
doi: http://dx.doi.org/10.4037/ajcc2015260
Persistent noise disturbs a hospital’s healing environment. Noise is particularly evident in intensive care units (ICUs), environments with high-acuity patients and activity and persistent sounds from monitor alarms, mechanical ventilators, and medical staff. Previous research on noise was largely focused on patients’ experiences and outcomes in neonatal ICUs (NICUs).\textsuperscript{1-5} Minimal research has been done on the impact of noise on health care providers.\textsuperscript{6}

In 1974, the Office on Noise Abatement and Control within the US Environmental Protection Agency stated that noise could produce serious physical and psychological stress.\textsuperscript{7} In order to protect patients and health care professionals, the agency recommended that sound pressure levels (SPLs) in hospitals should not exceed 45 dBA during the day and 35 dBA during the night. SPLs are measured in decibels, a logarithmic scale such that a 10-dB increase in sound level correlates with a doubling in perceived loudness. The decibel A scale is a frequency-weighted adjustment such that higher frequencies, which cause more hearing damage in humans, are weighted more heavily. The 45-dBA limit was identified to prevent workers from becoming annoyed or unable to carry out normal work duties. A limit of 70 dBA during a 24-hour period would prevent measurable noise-induced hearing loss.\textsuperscript{8} The World Health Organization\textsuperscript{9} stated that mean values for an 8-hour time-weighted average should not exceed 30 dBA, with peaks no greater than 40 dBA. In studies\textsuperscript{1-6} on noise in ICUs, SPLs ranged from 35 dBA to more than 120 dBA, clearly exceeding recommendations.

Elevated SPLs can be attributed to many sources, including monitor alarms, medical equipment, care activities, and staff conversations.\textsuperscript{1-3,5,10} In a survey\textsuperscript{11} of 100 critical care nurses, the nurses reported that continual beeping alarms were the source of the most noise disturbances. Carvalho et al\textsuperscript{2} discovered that the most elevated SPLs were due to conversations among pediatric ICU (PICU) staff members; SPLs were 60 to 70 dBA at baseline and reached a maximum of 120 dBA. The study by Carvalho et al was the first investigation to show that staff behavior and conversations were associated with noise levels. Results of other studies\textsuperscript{12,13} have linked the number of staff on a unit, patient behaviors, the number of visitors, and patient acuity to elevated noise levels.

The need for close contact with patients during care places nurses at increased risk for exposure to noise. With nurses typically working shifts of 8 to 12 hours and continually exposed to excessive noise during that time, the duration of exposure could be sufficient to be a health risk. Moreover, a noise greater than 85 dBA for 8 hours can lead to hearing loss.\textsuperscript{7,14} Research\textsuperscript{1-3,5,16} on the effects of workplace noise has indicated that noise is a distraction and an interruption to care activities and mental tasks that could lead to medical errors, task inaccuracy (mistakes that do not lead to an actual error), and miscommunication.

A few investigators\textsuperscript{6,17,18} have examined the health impact of noise; the effects included increased heart rate, increased perceived stress, annoyance, burnout, and job dissatisfaction. The physiological and psychological health effects of noise on ICU nurses were examined in 2 studies. Ryherd et al\textsuperscript{18} investigated how noise contributed to a negative NICU work environment with SPLs exceeding 50 dBA for 90% of the observation time. Among the nurses, 91% thought that noise could adversely affect their work environment, 66% felt irritated and fatigued, 43% admitted concentration problems, and 40% experienced tension headaches.

### Hospital sound pressure levels should not exceed

- 45 dBA during the day,
- 35 dBA at night.

---

**About the Authors**

J’ai Watson is a graduate student, Low Back Biomechanics and Workplace Stress Laboratory, Department of Environmental Health, University of Cincinnati, and the James M. Anderson Center for Health Systems Excellence, Cincinnati Children’s Hospital Medical Center, Cincinnati, Ohio. Angela Kinstler is clinical director, Cardiac Intensive Care Unit, William P. Vidonish is a project manager, and Li Lin is a statistician, Center for Professional Excellence, Cincinnati Children’s Hospital Medical Center. Michael Wagner is an associate professor, Department of Biomedical Informatics, Cincinnati Children’s Hospital Research Foundation, Cincinnati, Ohio. Kermit G. Davis is an associate professor, Low Back Biomechanics and Workplace Stress Laboratory, Department of Environmental Health, University of Cincinnati. Susan E. Kotowski is an assistant professor, Department of Biomedical Informatics, University of Cincinnati. Nancy M. Daraiseh is an assistant professor, Research in Patient Services, James M. Anderson Center for Health Systems Excellence, Division of Biostatistics and Epidemiology, Cincinnati Children’s Hospital Medical Center.

Corresponding author: Nancy M. Daraiseh, PhD, Cincinnati Children’s Hospital Medical Center, 3333 Burnet Ave, MLC 7014, Cincinnati OH 45229-3026 (e-mail: nancy.daraiseh@cdhmc.org).
A noise dosimeter was used to measure noise at 1-minute intervals.
each were carried out during the day, evening, and night shifts, Monday through Friday. In order to include any variability, the shifts were distributed during an entire week so that measures were not obtained on a particularly noisy day or a quiet day.

Participating nurses were asked for their birth date, height, weight, years of experience, and current stress level. Each participant was then fitted with a cleaned and calibrated noise dosimeter and heart rate monitor. The microphone for the noise dosimeter was attached along the anterior part of nurse’s shirt collar.

An observer followed each nurse for 4 hours, documenting noise sources, location, and nurse activity at 5-minute intervals on the noise log. Additionally, observers carried a noise meter to document noise sources when levels exceeded a 75-dBA threshold. The value of 75 dBA was used because the National Institute on Deafness and Other Communication Disorders reported that sounds less than 75 dBA are unlikely to cause physiological damage.20 Interrater agreement was assessed before data collection. Participants received a $5 gift certificate at the end of observations.

Data Management and Analyses

Because data on noise source, location, and activity were obtained at 5-minute intervals, all other sampling was converted to this rate. Because noise was sampled every minute, a mean of every 5 data points was calculated to obtain a 5-minute sample rate. Heart rate data were collected at 15-second intervals, so the mean of every 20 data points was used as the 5-minute sample rate. Two nurses were observed twice because of the lack of available staff. Only a single randomly chosen observation for each of the 2 duplicates was included in the analyses.

Statistical Analysis

Descriptive statistics were calculated for noise and health outcomes. Because this investigation was a pilot study and the sample size was small, results may not be representative of a larger population. Thus, the choice was made to analyze the data by unit to identify any statistically significant associations or larger effect sizes that would indicate the need for a larger study. The Pearson correlation coefficient was calculated to study the relationship between heart rate and SPLs, and analysis of variance was used to examine differences in noise level and heart rate between the 3 units. Repeated-measure analysis of covariance was used to compare the stress levels between the 3 time points (before, during, and after) and units by using the baseline stress level as a covariate. Tukey-Kramer pairwise comparison adjustment was applied for significant factors. The effect size (Cohen d) was computed to estimate the magnitude of the difference. SAS, version 9.3, software (SAS Institute, Inc) and a 2-sided significance level of .05 were used for analysis.

Results

The sample population consisted of 1 man and 14 women. The mean age was 32.6 years (range, 27-43 years). More than 3000 total noise observations were collected on all 3 ICUs. Distributions of age and sex were similar to those of the medical center’s inpatient nurse population, which were 11.2% male, 88.8% female, and mean age of 36.0 years. Thus, the sample was representative of all nurses (male to female ratio of 1 to 19).21

Sound Pressure Levels

The overall mean SPL was 71.9 (SD, 9.2) dBA; 35.5% of the SPLs were greater than 75 dBA (Table 2). The mean and percentage of time spent at noise levels greater than 75 dBA were slightly greater in the CICU than in the other 2 units. The SPLs in the CICU were significantly higher than those in the PICU (difference, 5.2 dBA; 95% CI, 4.3-6.1 dBA; P < .001). The SPLs in the NICU were significantly higher than those in the PICU (difference, 4.6 dBA; 95% CI, 4.3-6.1 dBA; P < .001).
Noise Source, Location, and Activity

The loudest noise sources (Table 2) were in-room equipment (mean, 72.9 dBA) and staff communications (mean, 72.8 dBA). The loudest location was gathering rooms (mean, 81.9 dBA) during employee interactions (mean, 73.4 dBA). The most frequent noise source (Table 3) was staff communication (57.5%) in patients’ rooms (62.7%) during support activities (38.3%).

SPLs exceeding 75 dBA most often were due to staff communication (62.8%) in gathering rooms (69.8%) during employee interactions (75.9%).

Mean Heart Rate and Correlations with SPLs

Mean heart rate was significantly higher in the NICU than in the CICU and the PICU (Table 4). Overall, heart rate was positively correlated with SPL ($r = 0.19; P < .001$; Table 5). Noise and heart rate were significantly associated in the NICU and the PICU, by patient/family communication, staff communication, and in-room equipment; in patients’ rooms; and for all measured nurse activities.

Mean Stress Levels for Nurses

Nurses’ stress level did not differ significantly among the 3 units (Table 6). However, some effect sizes ranged from moderate to large, especially among the 3 time points ($d > 0.8$), indicating that the nonsignificant results might be due to the low statistical power and small sample size.

Discussion

The aim of this pilot study was to measure SPLs and noise sources in specialty pediatric ICUs. When noise sources and the potential impact of noise on nurses’ health are known, targeted interventions and behavioral changes can be implemented to reduce high levels of noise.

Noise Levels

All 3 units had excessively high mean noise levels (>68 dBA), and more than a third of the time the mean levels were greater than 75 dBA. Keep in mind, the minimum level of 45 dBA is the threshold that protection agencies$^9,22,23$ recommend for mean sound levels. Other, more achievable standards, as suggested by White,$^24$ recommend that

<table>
<thead>
<tr>
<th>Noise Source</th>
<th>Frequency</th>
<th>%a</th>
<th>Noise Source</th>
<th>Frequency</th>
<th>%a</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staff comm</td>
<td>324</td>
<td>57.5</td>
<td>Staff comm</td>
<td>125</td>
<td>62.8</td>
</tr>
<tr>
<td>In-room eq</td>
<td>71</td>
<td>12.6</td>
<td>Doors opening</td>
<td>38</td>
<td>19.1</td>
</tr>
<tr>
<td>Doors</td>
<td>66</td>
<td>11.7</td>
<td>Communication</td>
<td>12</td>
<td>6.0</td>
</tr>
<tr>
<td>Patient/fam</td>
<td>49</td>
<td>8.7</td>
<td>Patient/fam</td>
<td>5</td>
<td>2.5</td>
</tr>
<tr>
<td>Communication</td>
<td>26</td>
<td>4.6</td>
<td>In-room eq</td>
<td>4</td>
<td>2.0</td>
</tr>
<tr>
<td>Otherb</td>
<td>27</td>
<td>4.8</td>
<td>Otherb</td>
<td>15</td>
<td>7.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Noise Location</th>
<th>Frequency</th>
<th>%a</th>
<th>Noise Location</th>
<th>Frequency</th>
<th>%a</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients' rooms</td>
<td>365</td>
<td>62.7</td>
<td>Gathering rooms</td>
<td>139</td>
<td>69.8</td>
</tr>
<tr>
<td>Outside rooms</td>
<td>157</td>
<td>27.0</td>
<td>Patient's room</td>
<td>36</td>
<td>18.1</td>
</tr>
<tr>
<td>Gathering rooms</td>
<td>39</td>
<td>6.7</td>
<td>Outside rooms</td>
<td>18</td>
<td>9.0</td>
</tr>
<tr>
<td>Auxiliary rooms</td>
<td>21</td>
<td>3.6</td>
<td>Auxiliary rooms</td>
<td>6</td>
<td>3.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Noise Activity</th>
<th>Frequency</th>
<th>%a</th>
<th>Noise Activity</th>
<th>Frequency</th>
<th>%a</th>
</tr>
</thead>
<tbody>
<tr>
<td>Support activities</td>
<td>215</td>
<td>38.3</td>
<td>Support activities</td>
<td>151</td>
<td>75.9</td>
</tr>
<tr>
<td>Employee interactions</td>
<td>210</td>
<td>37.4</td>
<td>Patient interactions</td>
<td>18</td>
<td>9.0</td>
</tr>
<tr>
<td>Patient interactions</td>
<td>42</td>
<td>7.5</td>
<td>Otherb</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>Otherb</td>
<td>95</td>
<td>16.9</td>
<td>Otherb</td>
<td>30</td>
<td>15.1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Intensive care unit</th>
<th>Mean (SD)</th>
<th>Median (interquartile range)</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neonatal</td>
<td>94.6 (16.7)</td>
<td>92 (83-104)</td>
<td>67-184</td>
</tr>
<tr>
<td>Cardiac</td>
<td>81.4 (12.3)</td>
<td>83 (72-91)</td>
<td>53-106</td>
</tr>
<tr>
<td>Pediatric</td>
<td>81.4 (15.3)</td>
<td>80 (71-91)</td>
<td>52-179</td>
</tr>
<tr>
<td>Overall</td>
<td>85.2 (15.8)</td>
<td>84 (75-94)</td>
<td>52-184</td>
</tr>
</tbody>
</table>
background noise levels not exceed 50 to 55 dBA and that intermittent noise levels not exceed 70 dBA. Despite recommendations, our current findings and other research\(^1\)\(^-\)\(^4\) have shown that these levels are difficult to attain, much less maintain. Morrison et al\(^6\) found that recommended levels have not been achieved since 1997. The results of Darbyshire and Young\(^\)\(^5\)\(^-\)\(^6\) were similar. In their study, mean SPLs always exceeded 45 dBA and were 52 to 59 dBA for 50% of the time in adult ICUs. Other investigators\(^2\)\(^,\)\(^25\)\(^,\)\(^26\) found SPLs ranging from 59 to 96 dBA in PICUs.

In our study, SPLs in the CICU and the NICU were significantly higher than those in the PICU. This difference may be due to the remodeling of the PICU with laminate plank flooring, specifically for noise reduction. The floors in the other 2 ICUs were vinyl composite tile. Our results suggest that flooring may have a nearly 5-dBA impact on the mean noise levels.

### Noise Sources, Location, and Activities

In our current study, an observer followed nurses and documented sources of noise, the location at which the noise occurred, and the nursing activity taking place in a coordinated effort with measurements from the personal dosimeter. In previous studies, researchers placed a noise meter in various locations of the hospital or unit (eg, centrally located or adjacent to the central station, on walls or ceilings or both)\(^2\)\(^,\)\(^4\) or did not state the location of measurement devices.\(^27\) Placing the noise meter along the anterior part of the nurse’s shirt collar allowed a specific understanding of noise from the nurse’s perspective\(^18\); that is, following the pathway during the natural course of work.

For SPLs exceeding 75 dBA, our results indicate that the top general sources of noise were also the most frequent. Staff communication and noise from equipment are the most prevalent sources of noise in PICUs that hospitals struggle to eliminate.\(^2\)\(^,\)\(^27\) Equipment may be consistently causing noise so that staff, patients, and patients’ families must raise their voices to be heard. Reduction in equipment alarms may improve communication, particularly at the patient’s bedside where equipment is typically located. However, a balance must be obtained without compromising patient safety. Closing doors is a commonly used practice to help reduce in-room noise; however ICU patients can be exposed to more noise with closed doors, presumably because most noise emanates from equipment within the room.\(^28\)

Location and activity data indicated that the nurses spent the majority of time inside or directly outside patients’ rooms, interacting with staff or carrying out patient support activities. However, noise exceeded 75 dBA primarily in gathering rooms (break rooms or conference rooms). If the SPLs in the latter 2 locations exceed 75 dBA, then the reprieve staff seek, the information exchange, and/or decision making desired may be difficult to achieve because of the high noise levels. Additionally,
employee interactions, the major activity occurring at or above noise threshold levels, indicate that the implementation of behavioral modifications would be an effective means of noise reduction.27

Noise and Health

The mean heart rate, overall and per unit, did not exceed the normal range of 60/min to 100/min.29 However, heart rates for NICU nurses were significantly higher than those of nurses in the CICU and the PICU. The significant, albeit small, association between heart rate and noise5 may be an explanation for this phenomenon (SPLs in the CICU and the NICU were significantly higher than those in the PICU). Of interest, we found significant correlations between heart rate and SPLs for being in a patient’s room, communication with staff, communications between patients and patients’ families, and during all nursing activities, indicating that direct care may be a confounding factor for this finding.

A counterintuitive outcome was the low self-reported stress levels, although, using the same survey we did, Morrison et al6 had similar results in a PICU (ratings, 0-88; median, 9.5). The normal mean heart rate and low stress levels may indicate that critical care nurses have either developed effective coping strategies to counteract the effects noise or are unaware of the impact noise has on stress levels and do not acknowledge that they are stressed.12,30,31

Conclusions

Our results confirm previous research findings1,27 that SPLs in ICUs often exceed recommended thresholds. With the increase in complexity in patient care and in technology required to treat changes in medical conditions, this trend is unlikely to subside. ICU nurses are in a unique position to institute change by leading noise-reducing interventions, participating in teams to design new units or redesign existing units, and influencing shared-governance councils to change policy and practice. However, reasons for making and sustaining change must be meaningful to nurses and administrators in order for continued engagement and success in noise-reduction strategies. Therefore, serious efforts must be made to improve nurses’ knowledge of the effects of excessive exposure to noise. Education is lacking12 on the adverse impact of excessive noise on patients (decreased wound healing, sleep deprivation, cardiovascular stimulation, ICU psychosis, decreased auditory and central nervous system development and function)12,28,32-34 and on care providers’ health11,18,35 and performance.36 Without an improved understanding of the risk of noise exposure, reduction efforts will have little or no effect on lowering SPLs.4,37

Limitations

We acknowledge the limitations due to the small sample size; this investigation was a unique observational pilot study linking SPLs to a variety of environmental sources. A larger scale study requires increases in human and hospital resources. Therefore, the lack of a significant association with stress may have been due to the small sample size and low statistical power. Inclusion of overall area noise measures and objective stress measures with advanced analyses with controls for potential confounders can be applied in future studies. Finally, resource constraints limited observation to a 24-hour period for each unit. Longer observations may allow greater data collection, providing more information on noise sources and variability. The category of Other in the noise sources figured prominently in the results, prompting the future need for explicit documentation of these sources in addition to the predefined categories. Furthermore, the adverse effect of noise on heart rate and ultimately on the health of the nurses could not be totally understood because of the small sample size. A large longitudinal study with longer periods of observation is needed to determine the adverse health outcomes due to noise.

ACKNOWLEDGMENTS

This work was made possible by support from the Cincinnati Children’s Hospital Medical Center, Department of Patient Services. We acknowledge Dr Cheryl Hoying, senior vice president, for her support throughout the project. We also thank the unit nurses who assisted in coordinating the study. Finally, we thank Mr Alexander Rodenhauser for his contribution to the preparation of the manuscript.

FINANCIAL DISCLOSURES

None reported.

eLetters

Now that you’ve read the article, create or contribute to an online discussion on this topic. Visit www.ajcconline.org and click “Submit a response” in either the full-text or PDF view of the article.


To purchase electronic or print reprints, contact American Association of Critical-Care Nurses, 101 Columbia, Aliso Viejo, CA 92656. Phone, (800) 899-1712 or (949) 362-2050 (ext 532); fax, (949) 362-2049; e-mail, reprints@aacn.org.
The intensive care unit (ICU) is a healing environment that is often plagued with disturbingly high levels of noise. The exposure to environmental noise generated by monitors, mechanical ventilators, and even other health care professionals often goes unnoticed by critical care clinicians, but it can have injurious effects on their health. Despite the effects of environmental noise on the health of critical care clinicians, a significant proportion of previous noise research in the ICU has primarily focused on patient or family outcomes. There are few studies that have examined the impact of ICU noise on the health of critical care nurses.

To examine the effects of ICU noise on the health of critical care nurses, the authors conducted a cross-sectional observational study among nurses in pediatric ICUs. The authors collected data on ICU noise levels, sources of noise, and the relationship between ICU noise levels and the health outcomes of critical care nurses (i.e., heart rate and perceived stress). A total of 15 critical care nurses from 3 pediatric ICUs participated in this study. Data were collected using a heart rate monitor, a noise dosimeter, and a measure of self-reported stress. Each participant was observed by a data collector to document noise sources and the participant’s activities during each observation recorded.

The findings of this study confirmed ICU noise levels that exceeded recommended thresholds and an association between heart rate and ICU environmental noise level was determined. The most frequent sources of ICU noise found were in-room noise, patient care activities, and staff conversations. The authors conclude that the elevated levels of noise in the ICU environment have substantial consequences for nurses. The study highlights the need for interventions to reduce noise levels in the ICU to promote the health and wellbeing of critical care nurses.

Investigator Spotlight

Nancy Daraiseh, PhD, is an industrial engineer and scientist at the Cincinnati Children’s Hospital Medical Center in Cincinnati, Ohio. She has more than 15 years of experience in pediatric and adult care with a focus on occupational safety, human factors, and ergonomics that influence the experiences of patients and their families. Using a multidisciplinary approach, Daraiseh and the study’s coauthors sought to understand the impact of workplace noise on the health and psychological well-being of critical care nurses.

As an occupational safety and health scientist, Daraiseh’s primary focus is on changing environments of care to promote healing and health. She says there are many aspects of the work environment, such as layout, lighting, and temperature regulation, that are more challenging for clinicians to modify; however, she believes critical care clinicians can implement changes that reduce environmental noise levels. Her advocacy for noise reduction in the ICU has resulted in an expanded view of the impact of environmental noise, from viewing it as a challenge that solely affects patients to exploring its impact on critical care nurses.

Daraiseh says the researchers were initially concerned that participation in the study would be low because nurses would not want to be observed. “However, we found that most nurses were not only willing to participate, but were also willing to be observed without notice,” she says. An unforeseen success for Daraiseh and her coauthors was how eager and excited nurses were to be involved in their research.
ICU contributes to adverse health outcomes for critical care nurses and effective noise reduction strategies are needed.

Information From the Authors
Nancy Daraiseh, PhD, lead author on this article provides additional information about the study. She comments that the study goal was to contribute to the literature on ICU noise research, highlight the impact of ICU environmental noise on the health of critical care nurses, and provide evidence to assist future noise reduction efforts.

According to Daraiseh, the lack of research examining the effects of environmental noise on the health of critical care nurses was the primary motivation for this study. “Nurses are exposed to excessive levels of environmental noise when providing care to critically ill patients, but we know very little about the cumulative effects of environmental noise on the health of nurses working in these ICUs,” she says.

The excessive environmental noise in ICUs is an occupational health concern for critical care nurses. Daraiseh points out that critical care nurses are repeatedly exposed to environmental noise that exceed recommended thresholds for prolonged periods of time and little has been done to remedy this. “Exposure to high noise levels found in our study and others are likely to affect nurses’ productivity and impair their ability to effectively make decisions, regulate emotions, and perform vital skills needed to ensure quality care,” she notes. Daraiseh suspects that examining the effects of noise in the ICU on the health of critical care nurses will lead to noise reduction efforts that will positively affect the health of nurses and their critically ill patients.

Implications for Practice
The author encourages readers of the American Journal of Critical Care to consider strategies for noise reduction to enhance the health of patients and clinicians. She adds, “Based on our work, strategies such as quiet rooms and specified quiet times are reasonable and may effectively abate noise levels.”

According to Daraiseh, future noise research in the ICU would benefit from mixed methods that examine subjective and biological markers of the stress, longer observational periods, and long-term consequences of noise exposure on the health of critical care nurses. Critical care nurses are in a unique position to help change organizational and unit culture by advocating for noise reduction to enhance the quality of patient care and the health of all employees working in an ICU.

Discussion Points

A. Description of the Study
- What are the major concepts of the study?
- What is the purpose of the study?

B. Literature Evaluation
- What are the recommended Environmental Protection Agency thresholds for sound in the hospital?
- What is the state of the science on environmental noise regarding the outcomes of health care professionals?

C. Sample
- Who was eligible to participate in this study?
- How many participants were included in this study?

D. Methods and Design
- What is the research design and how often were data collected?
- How often were noise measurements conducted?

E. Results
- What were the major findings of this project?
- How can you use the findings of this project to improve the quality of your nursing care?
NURSES’ PERSPECTIVES ON CLINICAL ALARMS

By Linda Honan, RN, PhD, CNS-BC, Marjorie Funk, RN, PhD, Michaela Maynard, RN, MSN, MPH, Deborah Fahs, RN, DNP, FNP-BC, J. Tobey Clark, MSEE, CCE, and Yadin David, EdD, CCE

Background Alarm hazards are a critical issue in patient safety. Of all health care providers, nurses are the ones most directly affected by the multitude of clinical alarms. 

Objectives To qualitatively explore nurses’ experiences with clinical alarms.

Methods The Krippendorff method for content analysis was used to analyze comments provided by 406 nurses in a national survey on perceptions of clinical alarms.

Results Six interrelated themes emerged: dissonance and desensitization; pollution, panic, and pathology; calling for accountability; calling for authority of nurses; clinical alarm management is crucial but not a panacea; and hope for the future.

Conclusions Nurses are concerned about the impact of alarm fatigue on nurses and patients, recognize the importance of nurses’ role in reducing noise pollution, and offer valuable insight into strategies that can mitigate alarm hazards. (American Journal of Critical Care. 2015; 24:387-395)
Alarms emanating from a myriad of devices are ubiquitous in hospitals. Alarm fatigue occurs when clinicians become overwhelmed by the sheer number of alarms, many of which are false or require no action. This situation can result in desensitization to alarm signals. Consequently, the response to alarms may be delayed, or alarms may be missed altogether. Alarms were designed to alert clinicians to both patient- and equipment-related problems. As alarm fatigue becomes pervasive among clinicians, the alarm systems that were created to enhance safety have become an urgent concern in patient safety.

In recent years, numerous reports of alarm-related deaths have been in the news. In February 2010, the first of a series of articles on alarm hazards by Liz Kowalczyk appeared in the Boston Globe. Kowalczyk noted that “a Massachusetts General Hospital patient died last month after the alarm on a heart monitor was inadvertently left off, delaying the response of nurses and doctors to the patient’s medical crisis.”

How common are deaths related to alarms? An examination of the Manufacturer and User Facility Device Experience database of the Food and Drug Administration revealed 566 deaths linked to monitor alarms from 2005 to 2008. The sentinel event database of The Joint Commission includes reports of 98 alarm-related events that occurred between 2009 and 2012. Of the 98 reported events, 80 resulted in death, 13 in permanent functional loss, and 5 in unexpected additional care or extended stay. Because of probable underreporting of cases, most likely the number of deaths is far higher. For example, almost 1 in 5 respondents (18%) to a survey of health care providers reported experience with adverse patient events related to alarms in the preceding 2 years. Adverse events also were most likely underreported; 49% of the participants did not know if an adverse event had occurred in their hospital during the preceding 2 years.

Numerous organizations, including the Healthcare Technology Foundation (HTF), the ECRI Institute, the Association for the Advancement of Medical Instrumentation, the American Association of Critical-Care Nurses, and The Joint Commission, have recognized alarm hazards as a critical issue in patient safety. The ECRI Institute, a nonprofit health services research organization, named alarm hazards as No. 1 of the top 10 health technology hazards for the years 2012 through 2014. The American Association of Critical-Care Nurses has made alarm safety a priority; the organization has produced an online toolbox of evidence-based resources, including a practice alert on alarm management and webinars. The Joint Commission recently established a National Patient Safety Goal on alarm management.

Of all health care providers, nurses are the ones most directly affected by the multitude of clinical alarms. Nurses are constantly exposed to the cacophony of alarms and must attend to, interpret, and act on alarm signals, all while completing their usual patient care duties. Yet, research on nurses’ perception of alarms is limited.

In a qualitative study in a Canadian hospital, Varpio et al conducted 14 interviews of nurses on an inpatient pediatric unit. Nurses expressed frustration with the frequent alarms and interruptions of work flow generated by the alarms.

Siebig et al conducted a written survey of 160 physicians and 114 nurses from 185 randomly selected intensive care units (ICUs) in Germany. The respondents estimated that most alarms do not result in clinical consequences. The survey also revealed dissatisfaction with alarm frequency and specificity of current alarm systems.

Under the auspices of the HTF, 3 of us (M.F., J.T.C., and Y.D.) developed and administered national clinical alarms surveys in 2005/2006 and
2011 and received a total of 5605 responses from a broad range of health care providers. The surveys elicited primarily objective responses, which have been previously reported. However, the surveys also included several areas for respondents’ comments; the nurse-specific responses of the more than 2000 nurses who participated in the clinical alarms surveys have not been reported or previously analyzed. In this article, we present the analysis of the nurse-specific comments from the 2011 HTF Clinical Alarms Survey.

Methods

The findings reported are the results of a secondary analysis of the HTF survey data in which health care professionals were queried about their experience with clinical alarms. The parent study, which addressed attitudes and practices related to clinical alarms, was conducted via a national online survey by using Survey Monkey from August 8, 2011, to September 10, 2011. The survey started with 4 work-related demographic questions. These were followed by 20 general statements about clinical alarms that prompted respondents to rate the respondents’ level of agreement with the statement by choosing 1 of 5 options (strongly agree, agree, neutral, disagree, and strongly disagree). The next section contained 4 questions related to the occurrence of adverse events, use of monitor watchers, alarm improvement initiatives, and new technological solutions to alarm management. The final section contained a list of 9 issues that potentially inhibit effective management of clinical alarms. Respondents ranked the issues on a scale of 1 (most important) to 9 (least important). The survey included space for comments in each section. The methods are described in detail elsewhere.

Nine different national organizations supported the parent study and offered links to the online survey directly on the organizations’ respective websites. This article reports the results of an analysis of the responses of registered nurses to open-ended requests for comments. The study was deemed exempt by the human investigations committee at Yale University, New Haven, Connecticut.

A total of 410 nurses (29.0% of the 1414 nurses in the parent study) responded to requests for comments. Comments unrelated to the research were removed, resulting in an analytic sample of the comments of 406 nurses. Almost all nurses who provided comments worked in inpatient hospital settings (98.5%), a majority practiced in ICUs (69.4%), and most had worked for more than 11 years (76.3%).

Content analysis is a qualitative method useful for analyzing comments obtained in open-ended surveys. Krippendorff defines content analysis as “a research technique for making replicable and valid inferences from texts (or other meaningful matter) to the contexts of their use.” He further notes that this research technique “provides new insights, increases a researcher’s understanding of particular phenomena, or informs practical actions.” Krippendorff’s method was used to identify the repetitive themes of nurses’ experience with clinical alarms.

A total of 790 comments were analyzed. The comments ranged in length from 2 words to 268 words, with a mean length of 23 words for a total dataset of 13,544 words. Three of the authors (L.H., M.F., and M.M.) read in entirety each of the comments so that a sense of the whole could be determined and then reread the dataset and inductively coded the comments by selecting passages that related to the respondent’s experience with alarms. Inductive coding was used to perform a line-by-line analysis of transcripts. Exact words, phrases, or sentences that the nurses wrote were highlighted; unique comments and recurrent passages were noted; and data that shared characteristics were categorized. Because the data were from a national survey of nurses, inductive coding rather than coding with an a priori framework was deliberately selected to proceed from nurse-specific comments to a larger whole on the phenomenon of alarm fatigue. After independent coding of the data, the 3 authors met to compare coding and selection of categories. The interrater reliability, calculated as the percentage agreement of the total number of categories, was 274/315, or 87.0%.

Using Krippendorff’s analytical technique of clustering, the categories we developed that shared characteristics, patterns, or attributes were clustered and collapsed into thematic units. Dendograms, or treelike diagrams, were used to illustrate how data were collapsed into thematic units (see Table).

To ensure methodological integrity, the first author (L.H.) created an audit trail to record reflections, evidence of consistency in coding, and interpretations of data. Other authors (M.F. and M.M.) reviewed the audit and discussed the selection of key characteristics, relationships, and categories and the development of themes until agreement was reached on the final coding scheme. Numerous comments are included in the following material to enhance the credibility of the findings.

Results

Content analysis revealed 6 interrelated themes.
Theme 1: Dissonance and Desensitization

A preponderance of comments related to the auditory dissonance faced by nurses daily that results in aural desensitization. As technology has evolved and proliferated in acute care institutions, so has the number of alarms. Nurses described the sounds by using a myriad of terms, including “noxious,” “unnerving,” “ominous,” and “strident.” The “constant” auditory dissonance leads nurses to fear for the impact on young nurses’ hearing, calling the “constant white noise” an “occupational hazard.” Nurses become desensitized to the “shrill” alarms that are “a part of the everyday sound of the unit.” They ponder why alarms on intravenous devices, feeding pumps, chairs or beds, mattresses, and sequential compression devices all must make a sound as if the alarms are “proclaiming life or death.” Nurses complain that the various mechanical technologies “all sound the same” when an alarm goes off because no standards for alarm sounds exist; the devices are “too sensitive to patient movement” and “too noisy, too complex to shut them up once and for all.”

Not only do the barrage of alarms and lack of tone standardization lead to an inability to identify which alarm is sounding, but the number of “spurious” alarms leads to an “anesthetized” response to the alarms. One nurse’s comment illustrates this belief: “The monitors are so very sensitive. One little patient movement and they are alarming. All the false alarms lead to lack of response for real alarms.” As a result, nurses note that they “disassociate,” “discount,” and become “numb” to alarms as a means of “self-preservation.” As one nurse noted:

“It seems that when an issue arises regarding a patient, the solution is always to add another alarm or to increase the volume of existing alarms. We are absolutely inundated with alarms, every piece of equipment that we use in critical care has a distinctive and often louder alarm which frequently go off for nuisance events. This is stressful for patients, family members, and staff and makes it very easy to “tune out” alarms as a means of self-preservation. Participants compared the specious alarms to a “cry wolf” situation in which they no longer “trust” the alarms. As a result of this “alarm fatigue and alarm exhaustion,” they “tune out” the “disruptive” ubiquitous noises that are habitual in their environment.

Theme 2: Pollution, Panic and Pathology

The “noise pollution” customary to health care professionals causes undue panic in patients, patients’ family members, and visitors. Nurses’ comments suggest that noise pollution is associated with comorbid conditions such as “increased patient anxiety,” “sleep deprivation,” “ICU psychosis,” and “delirium” in patients.

Nurses noted that patients and patients’ visitors often complain about the “constant alarming”
with little impact of the alarms seen in the hospital environment. The continual alarms are described as "distracting," "annoying," "upsetting," and "frightening" to patients and visitors and are causing them to feel unnecessary "panic." One nurse described the public response to alarms:

The alarm problem is so horrible, and equipment manufacturers and hospitals are so alarm gung ho, I can’t imagine this will ever get fixed. Our patients suffer greatly by the constant alarms 24/7. Wouldn’t you? And the families think we are crazy because we don’t view the each alarm as a crisis like they do.

Nurses are concerned that noise pollution is associated with the comorbid conditions previously described, along with nervousness and fear, which complicate patients’ already unstable status.

**Theme 3: Calling for Accountability**

A call for accountability was noted in the comments across 3 domains: the personal-professional, the institution, and national organizations. On the personal-professional level, nurses call for vigilance in answering alarms and note that “everyone on the unit needs to be proactive in responding to alarms. We cannot become complacent and just silence, silence, silence.” The attitude of “not my patient, not my responsibility” must end. The respondents noted wide variability in nurses’ responsiveness: from “deaf nurses” to those that “wait for the primary nurse to answer alarms,” and nurses that “turn alarms off or down when they alarm with every movement of the patient and then don’t even look when someone else asks them to check out the patient. Scary!” Many nurses called for “changing the culture to never shutting alarms off” and preventing the resetting of alarms without direct observation of the patient in institutions that have central alarm systems. Collaboration, integrity, and teamwork are suggested in making inroads into this important problem. Additionally, alarms on intravenous infusion pumps appear to be particularly troublesome, especially on medical-surgical units. One simple cost-effective solution is to ensure that the equipment’s battery is charged. Ultimately, participants suggest that all frontline health care workers should foster an attitude of teamwork to improve patient care. As one nurse noted, “Make every patient’s care a team effort. . . .If you hear an alarm respond—whether it’s your patient or not.”

Institutionally, a majority of the nurses called for “monitor watchers,” particularly in “densely populated units” where patient to nurse ratios are high, visibility of patients is decreased, and locating the source of alarms is difficult. Older, larger units appear to be particularly difficult for identifying the source and location of some alarms; however, new units are not without issues: “The newness of the hospital affects the recognition of the location of an IV machine alarm. The alarm seems to bounce off the wall or door so the location of the alarm is not accurate.” The nurses’ comments indicate concern about patient safety in institutions that have unattended central alarm monitors; additionally, the nurses call for standards of competencies for monitor watchers and note that if institutions do employ monitor watchers, in many instances they are untrained.

Nurses’ comments suggest that the staffing ratio also influences patient safety: “Frequently alarms are missed because of inadequate staffing and no monitor tech.” Working short-staffed and with high-acuity patients influences nurses’ response time to alarms. Although the nurses recognize that newer technology is available that may decrease nuisance alarms, the nurses’ “units and facilities are not always able to replace outdated, or outmoded equipment due to budgetary constraints.” Many nurses noted that “with the state of health care today, upgrading is not an option due to finances,” and in the rare comments from nurses in hospitals that employ monitor watchers, nurses were concerned that these positions would be eliminated “for cost savings.”

Educational institutions also have a role in alarm management according to participants, who suggest that “alarm safety should begin in nursing school.” Curricula should include differentiating nuisance alarms from important alarms, troubleshooting alarms, and recognizing that alarms are an addition to clinical observation rather than a primary source of information. Additionally, participants suggested requiring annual competency training related to alarms, with particular emphasis on resetting alarm parameters specific to each patient’s condition, and auditory pattern recognition of alarms.

Finally, some participants suggested calling on national organizations to implement protective structures that improve patient safety and noted that the current standard “did not help at all—only confusing.” One nurse wrote the following:

Maybe falls have decreased, but other patients’ not getting nursing attention is an adverse event in my opinion. How would I know if alarms have been missed? I would not have been able to hear them. Let’s hire more people to take care of sick people. Why doesn’t The Joint Commission require that?
The call for national commitment to solving problems with clinical alarms is a shared charge among nurses, health care institutions, and national organizations.

**Theme 4: Calling for Authority of Nurses**

Participants’ statements suggest that alarm pollution can be decreased when nurses have authority to alter alarm settings; however, in some institutions, only physicians can change the alarm settings. The following is an excerpt from a nurse’s comment:

> Clinical alarm policies are atrocious in my unit. Parameters are set by physician order, not nurse, and are required to exactly reflect call-for parameters. Alarms should be within reasonable range of call-for parameters, but exact limits should be determined by nurse at bedside. Alarms should not be set unless actionable. . . . If no nurse action is necessary, the alarm is not necessary. . . . Physicians are severely undereducated regarding the detrimental effects of nuisance alarms and sometimes order alarm parameters based on “hemodynamic goals” that they are aware are significantly different than current patient condition, resulting in constant “panic” alarms which the nurse is prohibited from changing per policy. It is difficult to obtain a physician order to change a parameter on the night shift. . . ., resulting in entire nights where patient, nurse and rest of unit must listen to high-alert alarms that serve no purpose.

Many comments specified 2 clinical situations often associated with alarm pollution: chronic atrial fibrillation and do-not-resuscitate orders. These situations are ones in which the alarms are continuous and easily attended to by, respectively, turning off the irregular heart rhythm and altering heart rate and blood pressure parameters. However, the inability to alter parameters limits nurses’ interventions. Thus, “so much time is wasted addressing alarms that do not provide any useful information.”

Other nurses noted that although their institutions allow altering alarm parameters, many nurses are “reluctant to ‘tweak’ alarms.” The hesitancy to alter alarm parameters has been associated with issues of liability for nurses. The following statements illustrate this clinical conundrum of altering alarm parameters to decrease nuisance alarms vs perceived increased liability when standard parameters are changed:

> I hope nurses have more control of their patients’ alarm settings based on patients’ condition, history, etc, without concern about potential liability.

Documentation of alarms is more geared toward covering the hospital if the preset parameters are changed. If a parameter is changed, there is no required documentation to justify the reason. It makes the nurse feel unprotected. Conversely, not individualizing alarms puts the patient and nurse at risk for alarm fatigue and failing to recognize and respond to true changes in patient condition.

We remain in the infancy of monitoring, but we have put the bar or responsibility very high, so a lot of frontline staff feel thrown under the bus when things go wrong.

Many comments noted that the ultimate responsibility and authority for clinical alarms must rest with the bedside clinician, who has the “awareness/judgment/experience of most appropriate settings for patient clinical pictures and changing alarm settings as the patient’s condition changes.” But when that autonomy is balanced against legal liability, many nurses commented that the alarms are not altered from the standard parameters because the nurses “are afraid they’ll miss something.”

**Theme 5: Clinical Alarm Management Is Crucial but Not a Panacea**

The nurses’ comments suggest that patient safety would be improved by having a trained monitor watcher observe the clinical parameters. Many nurses wrote that they are working “short-staffed,” at a “hectic pace” with outdated equipment that does not allow for observation of multiple patient alarms when caring for another patient; thus, the nurses think monitor watchers “safeguard patient care,” and are considered a second set of eyes on patients. However, some nurses who have a designated central monitoring person expressed that it is not a panacea because the monitor watchers increase interruptions to the nurses’ daily routine when alarms are observed. And a few nurses provided examples of potential safety hazards when clinical alarms were reset without notifying the primary nurse. The nurses suggested that a collaborative approach is essential, with a nurse assuming primary responsibility and alarm staff providing secondary surveillance.

Within the comments from the 406 nurses who participated in this study, 1 sentinel event was detailed and 6 potential events were noted. None of the comments (on the sentinel event or the 6 near-miss events) indicated whether or not the institutions had trained monitor watchers available. The following is the description of the sentinel event: “A patient actually died at a facility I worked because the nurses did not pay attention to the
alarms—patient was in V-tach/v-fib for 10 minutes before someone noticed. The 6 potential events included inability of a medical technician to recognize and respond when a patient’s rhythm changed from “NSR to a junctional rhythm and then VT to coarse V fib,” instances when bilevel positive airway pressure alarms “have been cut off and the patient has developed acute distress,” not recognizing a “lead-off” alarm when “the patient had taken himself off the monitor, tore out his IV, and then got out of bed and fell,” lack of recognizing “puleless electrical activity—rhythm looked good, no pulse only found by checking the patient,” and 2 instances in which “red alarms” were missed.

The majority of participants did not work with monitor watchers but thought that monitor watchers were an important element in patient protection and expressed that it is “a very dangerous practice” that staff are “not watching the monitors for periods of time.” One nurse whose institution hired monitor technicians commented, “We added monitor techs in our PICU a few years ago and they are definitely an added safeguard. This staff notifies RNs when an alarm is not acknowledged in a prompt time frame, if leads come off, or if someone’s tracings aren’t on the monitors.”

Theme 6: Hope for the Future

The nurses’ future aspirations include technological development, expanding nurses’ influence, and development of monitoring guidelines. Specifically, the nurses suggested that monitor technology that recognizes trends in values will decrease nuisance alarms. For example, for patients with atrial fibrillation, the technology would recognize the irregular rhythm and alter parameters accordingly, or with “transient labile Spo2, varying with movement, cough, etc, if the drop . . . recovers within 15-30 seconds, it would be nice if this either didn’t trigger an alarm at all or would result in automatic modification of parameters.” The nurses recommended enlarging the monitoring screens in patients’ rooms to allow for display of any high-priority alarms on other patients. Because the participants in the survey are concerned that the cacophony of alarms might be an occupational hazard, they would like ranges in alarm volume. They suggest that older nurses with hearing impairment could benefit from a higher volume, whereas younger nurses could decrease the volume. Better sound differentiation that will aid in identification of which device is sounding an alarm is essential; the nurses noted that achieving this change requires that manufacturers of devices be aware of the concerns of bedside nurses. The nurses request that they be involved in evaluating and purchasing equipment for their units.

Nurses also expect their voices to be heard interprofessionally. They suggested that nurses and physicians should make rounds together to decide what monitoring should be continued and to determine monitoring parameters, and they noted that the current practice of keeping monitoring “in place for extended periods of time thereby confounds the situation.” In particular, the nurses suggested that continuous monitoring of oxygen saturation is especially difficult and a primary source for nuisance alarms.

Discussion

Although alarms were designed to alert hospital staff to potentially life-threatening events, our findings reveal the need for restructurting, reassessing, and streamlining the use of alarms. As technology has advanced, so has the use of multiple alarm systems that nurses described as “constant,” “noxious,” and “a nuisance.” Although alarms are meant to serve patients’ welfare, nursing staff, patients, and patients’ families seem to be subjected to excessive and continual noise pollution, angst, and distraction, which may result in fear, panic, and sentinel events.

Nurses describe alarms as a constant auditory dissonance leading to desensitization, supporting the 2014 ECRI Institute’s designation of “alarm hazards” as the leading health technology hazard. Clearly, patient safety is affected if nurses become fatigued and numbed to the incessant sounds and thus may not readily respond to alarms that signify true emergencies. The Food and Drug Administration reported that 566 patients within 4 years died as a result of alarm-related events; however, this number most likely represents significant underreporting. Research has indicated that 72% to 99% of alarms are false or require no action. In the end, patients may suffer, not only because of sleep deprivation and delirium caused by constant stimulation but also because of the resulting serious safety issues.

Accountability in answering alarms is also a concern. The participants in our study thought that every nurse, not just a patient’s assigned nurse, must be attentive to alarms. MedStar Washington Hospital Center, Washington, DC, has implemented a “no pass” policy that dictates that if an employee (from housekeepers to hospital administrators) passes a patient’s room and hears an alarm, the employee must ascertain that the patient is breathing and call for help if necessary.

Nurses were resolute in support for monitor watchers, particularly in step-down and densely populated units. Although they thought that monitor watchers provided a safety net, nurses expressed...
concerns about weak or nonexistent competency standards. Nurses were disturbed about delays in answering alarms and in silencing alarms without direct observation of a patient’s condition. Poorly trained monitor watchers who could not differentiate false from true alarms interfered with patient care because the nurses were contending with potentially even more false alarms. Although 53% of all respondents to the 2011 survey thought monitor watchers were helpful,5 little evidence supports their use. The results of single-site studies22,23 published in 1997 indicated that monitor watchers were not associated with lower rates of most adverse outcomes. Multisite studies are needed to determine the impact of monitor watchers on patient outcomes. As some nurses indicated, middleware (software that enables communication and management of data between systems) that incorporates smart phones may be more effective in enhancing alarm safety than are monitor watchers for ancillary notification of alarm signals.

Nurses also suggested several ways in which manufacturers could improve devices to minimize alarm fatigue. In an observational study published in 2014, Drew et al20 found that more than 2.5 million unique monitor alarms in 5 ICUs sounded during a period of 31 days. Nurse scientists annotated 12,671 of these alarms and found that 88.8% of them were false or clinically irrelevant. Drew et al20 proposed a number of solutions that manufacturers could incorporate into monitors that would be helpful for nurses, including use of all available electrocardiographic leads to identify leads without artifact and those with adequate QRS amplitude, prompts to help in tailoring alarm settings, and delays for certain parameters before alarms are triggered. As nurses pointed out in our study, upgrading to the latest monitoring systems has marked financial implications, but perhaps upgrades should be a priority if they can reduce alarm fatigue and enhance patient safety.

Nurses advocated for improved staffing ratios because insufficient staffing can lead to missed high-priority alarms. Although nurses realized that they, not the alarm systems, are ultimately responsible for patient safety, they thought that sufficient staffing might make nurses less dependent on alarms.

Alarm parameters determined by physicians without input from nurses that result in alarms that require no action were yet another cause for frustration. Although nurses agreed that physicians should set reasonable parameters, they also thought that the bedside nurse should set limits appropriate to the individual patient. The results of other studies24-26 support the notion that nurses should have the authority and the responsibility to individualize alarm settings.

The participants in our study proposed changes to reduce nuisance alarms. The changes included use of larger screens to display high-priority alarms, the ability to adjust alarm volume, having physicians and nurses make rounds together to determine alarm parameters, discontinuing monitoring when it is no longer necessary, and nurses’ involvement in evaluating and purchasing new equipment with alarms.

Our results indicate a clear need for nurses’ involvement in reforming current policy and restructuring alarm systems with the ultimate goal of improving patient safety. In their unique role at the bedside, nurses are the most directly affected by the multitude of alarms and can provide creative and effective solutions to the hazard that alarms have become. Perhaps if the experiences and ideas of nurses are heard, hospitals can be transformed into safer environments.

ACKNOWLEDGMENTS
We are grateful to the members of the Healthcare Technology Foundation who developed and administered the Clinical Alarms Survey or reviewed this manuscript: Thomas L. Bauld, PhD, CCE; Paul Coss, RN; William Hyman, ScD, PE; Jennifer Jackson, BSBME, MBA, CCE; James P. Keller, MSBE; Jennifer C. Ott, MSBME, CCE; Nancy A. Pressly; and Paul Sherman, CCE.

FINANCIAL DISCLOSURES
None reported.

REFERENCES
2. Funk M, Clark JT, Bauld TJ, Ott JC, Coss P. Attitudes and practices of single-site studies reviewed this manuscript: Thomas L. Bauld, PhD, CCE; Paul Coss, RN; William Hyman, ScD, PE; Jennifer Jackson, BSBME, MBA, CCE; James P. Keller, MSBE; Jennifer C. Ott, MSBME, CCE; Nancy A. Pressly; and Paul Sherman, CCE.

FINANCIAL DISCLOSURES
None reported.

REFERENCES


To purchase electronic or print reprints, contact American Association of Critical-Care Nurses, 101 Columbia, Aliso Viejo, CA 92656. Phone, (800) 899-1712 or (949) 362-2050 (ext 532); fax, (949) 362-2049; e-mail, reprints@aacn.org.
DECREASED STRESS LEVELS IN NURSES: A BENEFIT OF QUIET TIME

By Heather C. Riemer, RN, BA, CCRN, Joanna Mates, RN, MSN, Linda Ryan, RN, PhD, AHN-BC, and Bonnie J. Schleder, EdD, APN, CCRN

Background The benefits of quiet time, a therapeutic method of improving the health care environment, have been evaluated in patients, but only a few studies have examined the effects of quiet time on intensive care nurses.

Objective To evaluate the effects of implementing quiet time in a medical-surgical intensive care unit on levels of light, noise, and nurses’ stress.

Methods Quiet time consisted of turning down the unit lights for a designated time. Levels of light, noise, and nurses’ stress were measured. Nurses’ stress levels were measured by using a 100-point visual analog scale; unit noise, by using a digital sound level meter (model 407736, Extech Instruments); and unit light, by using an illumination light meter (model 615, Huygen Corporation). Measurements were obtained 30 minutes before and 30 minutes, 1 hour, and 2 hours after implementation of quiet time.

Results Analysis of variance and comparisons of means indicated that both light levels and nurses’ stress levels were significantly decreased after quiet time (both $P<.001$). Noise levels were also decreased after quiet time, but the decrease was not significant ($P=.08$).

Conclusions Use of quiet time resulted in decreased light levels and decreased stress levels among nurses. Quiet time is an easily performed energy-saving intervention to promote a healthy work environment. (American Journal of Critical Care. 2015;24:396-402)
Nursing theorists Nightingale\(^1\) and Watson\(^2\) advocated for creating healing environments to benefit both patients and nurses. In intensive care units (ICUs), nurses must cope with a dynamic stressful environment.\(^3\) Nurses perceive this environment as a top health and safety concern.\(^4-6\) The American Association of Critical-Care Nurses emphasizes the importance of creating healthy work environments for nurses.\(^7\) This focus leads to interventions to generate positive outcomes and creates an environment where nurses can optimally contribute. The honor society of nursing, Sigma Theta Tau International, focuses on the emotional regulation of stress as a component of the healthy work environment.\(^8\) Inadequacy in the physical environment of an ICU contributes to nurses’ stress, fatigue, and burnout.\(^9\)

Noise and lighting are 2 independent variables of the ICU that contribute to nurses’ stress.\(^9\) ICUs are brightly lit, chaotic, and noisy environments that can overstimulate patients and staff. ICU light and noise levels generally exceed healthy parameters and are recognized as environmental pollutants.\(^10\)

In order to limit environmental pollutants in the hospital, optimal light and sound levels have been recommended. The Illuminating Engineering Society recommends that light levels be set at 108 lux (to convert lux to lumens per square foot, divide by 10.76), with a maximum of 323 lux, during the day. The higher value (323 lux) is the level needed to read a book in a hospital room.\(^11\)

The World Health Organization recommends sound levels of 35 dB or less in patients’ rooms.\(^12\) Sound levels in the ICU exceed this recommendation. In a comprehensive and systematic analysis of 3 hospital units, mean noise levels were 55 to 60 dB throughout a 24-hour period.\(^13\) In a research study of 5 intensive care units, mean noise levels were greater than 45 dB at all times and between 52 and 59 dB more than 50% of the time. Even at levels of 45 dB, noise disrupts routine communication and activity.\(^15\)

In noisy, busy ICUs, conversations naturally increase because of the Lombard effect, the propensity for speakers to involuntarily increase the pitch, intensity, and duration of their voice in the presence of noise.\(^16\) This noise pollution results in adverse outcomes, including hypertension, ischemic heart disease, sleep disturbances, and impaired wound healing. Uncontrolled noise triggers the human stress response, activating the sympathetic nervous system to release epinephrine and norepinephrine, which constrict the vessels and elevate blood pressure and heart rate.\(^17,18\)

Excessive noise levels have adverse effects on both the physical and the psychological state of the body, resulting in stress. People generally adapt to noisy work environments by becoming intensely focused, thereby becoming less interpersonally engaged. The frequency of errors is also related to excessive noise and is correlated with tension.\(^19\) Noise-induced stress is an independent predictor of burnout.\(^15\) Employees who suffer burnout can experience emotional exhaustion, depersonalization, and a feeling of decreased personal accomplishment.\(^20\)

Light exposure also results in physical and psychological effects, because of its influence on the body’s 24-hour circadian rhythm. Circadian rhythm affects hormones such as melatonin.\(^21\) If exposure to light is too great, secretion of melatonin is decreased and its stress-protective effects are minimized. Light and noise also stimulate the release of corticosteroids (cortisol) and catecholamines, which are physiologically associated with excessive stress levels.\(^18,22\)

Exposure to light, especially artificial lighting, can produce psychological adverse effects on nurses.\(^23\) These effects can change a person’s mood and alter alertness. Dynamic lighting, which has light settings with different combinations of intensity and color temperature, is used to support both mental alertness and relaxation.\(^24\) The changes in light settings are similar to the changes in daylight, which varies in intensity and color. The variation in intensity through interventions such as dynamic lighting can be used...
to stimulate the natural activation and relaxation cycle needed for a healthy work environment.23

A therapeutic method of improving the environment is the implementation of quiet time. Trials of quiet time have been successful, and the method is used as a therapeutic patient intervention in some hospitals. Gardner et al26 used quiet time as a therapeutic intervention in a fast-paced, acute care environment to lower the noise level at certain times during the day to promote patients’ rest. In another study,27 when quiet time was implemented in a neurological ICU, significantly lower noise and light levels resulted in greater sleep for patients. To expand this concept, Morrison et al28 evaluated the impact of noise on nurses’ stress and annoyance in a pediatric ICU. A significant correlation occurred between higher sound levels and greater subjective stress and annoyance; however, the effect of light was not measured in the study.28

Because lowering noise levels can beneficially affect relaxation and patients’ well-being, we assessed whether a simple measure such as turning down the lights to initiate quiet time affected noise and stress levels of nurses working in a medical-surgical ICU.

Methods
The study was reviewed and approved by the appropriate institutional review board and was completed in accordance with ethical standards set forth in the Helsinki Declaration of 1975. Information about the study was introduced to all registered nurses in the ICU at mandatory staff meetings. Nurses were asked to volunteer to participate, and those who were interested were thoroughly educated on the study procedures, use of the 100-point visual analog scale (VAS) of the Perceived Stress survey,29 and the risks and benefits of the study. Permission was obtained from Goodfellow29 to use the Perceived Stress survey. Data collection was performed solely by 2 trained nurse researchers to maintain consistency in methods. Informed consent and demographic data were obtained from all the participating nurses. The intervention and methods for collecting data were kept simple so that the study could be easily performed and reproduced.

Sample Population
The sample consisted of day-shift registered nurses who worked in the medical-surgical ICU. Day shift was defined as the shift from 7 AM to 7:30 PM. The day-shift nurses were the only eligible candidates because quiet time was implemented from 2 PM to 4 PM. Nurses were included in the sample if they consented to participate in the study, served as a primary nurse, and were present in the ICU from 2 PM to 4 PM. Agency and float nurses who consented to participate in the study were included in the sample if they were intensive care nurses. Nurses were excluded from the sample if they were non-ICU nurses who were in the ICU taking care of overflow patients who did not require intensive care. These nurses were excluded because the researchers thought that the nurses’ stress levels might differ from those of an intensive care nurse. Nurses from other departments in the ICU at time of the data collection, such as those from the operating room, emergency department, endoscopy, or cardiac rehabilitation, were also excluded because they were not primary nurses of the ICU patients.

Data Collection
Data were collected 4 times a day for each nurse: 30 minutes before and then 30 minutes, 1 hour, and 2 hours after quiet time initiation. Data collection surveys were not completed during shifts when cardiopulmonary resuscitation or emergent situations in which a patient posed a threat to self or others occurred.

Procedure
Nurse participants for each day were assigned numbers so that they would be surveyed sequentially at the appropriate time intervals. After the nurses were assigned numbers, the researcher calibrated the digital sound level meter (model 407736, Extech Instruments) and the illumination light meter (model 615, Huygen Corporation) according to the manufacturers’ recommendations. The researcher approached nurse No. 1 for the day at the appropriate time intervals and asked the nurse to mark a point on the VAS line on the Perceived Stress survey corresponding to the intensity of the nurse’s current stress level. While the nurse completed the VAS, the researcher measured the sound and light at the location where the nurse was positioned in the unit. The researcher documented the light and sound measurements on a data collection spreadsheet. After turning down the unit’s lights at 2 PM to start quiet time, the researcher sought out the subsequent eligible nurses sequentially and repeated the process at the described intervals.

The researchers also documented in a log book instances when data were ineligible, such as when the nurses were not on the unit during the entire period of quiet time. The log book, completed demographic
surveys, and all data collection tools were kept in a locked drawer accessible solely to the researchers.

Data Analysis

Collected data were transferred into SPSS for Windows, version 20.0, software (IBM SPSS) for statistical analysis. Demographic data were evaluated descriptively to determine characteristics of the participants and are reported as number and percentages or means and standard deviations. Repeated-measures analysis of variance was used to assess the differences in light, noise, and nurses’ stress levels before and after quiet time. Statistical significance was set at the .05 level.

Results

The study consisted of 124 observations of 22 clinical nurses who worked in the ICU. Although 142 observations occurred, 18 were not included in analysis. One observation was excluded because of cardiopulmonary resuscitation of a patient; all other excluded observations were due to the nurse not being on the unit the entire time. Of the participating nurses, 18% (4) were men and 82% (18) were women; 77% (17) of the nurses worked full time, and 23% (5) worked part time. Among the participants, 27% (6) had less than 5 years of nursing experience, 36% (8) had 6 to 10 years, and 36% (8) had more than 10 years (percentages may not total 100 because of rounding).

Light level decreased significantly ($P < .001$; Figure 1) from baseline (mean, 369 lux) through 2 hours after quiet time (mean, 179 lux). Although noise decreased from baseline (mean, 62.93 dB) through 1 hour after quiet time (mean, 60.88 dB), the level began to increase at 2 hours after quiet time (mean, 61.69 dB; Figure 2). Finally, the stress scores reported by the nurses decreased significantly ($P < .001$; Figure 3) from baseline (mean, 46.36) to 2 hours after quiet time (mean, 35.36).

Comparisons of means determined that light decreased significantly over time ($P < .001$; see Table). Significant differences in light were identified between baseline and 30 minutes, 1 hour, and 2 hours after quiet time. The decrease in light 30 minutes after quiet time did not differ significantly from the decrease at 1 hour after quiet time or the decrease at 2 hours after quiet time. The difference between 1 hour and 2 hours after quiet time also was not significant.

Compared with the baseline value, noise was also decreased at 30 minutes, 1 hour, and 2 hours after quiet time (see Table). However, analysis of variance indicated that mean decibels did not decrease significantly over time ($P = .08$). In comparison, nurses’ stress levels decreased significantly over time ($P < .001$). After the lights were turned down, the baseline values differed significantly from the values at 30 minutes, 1 hour, and 2 hours after quiet time. Both the values at 30 minutes and the values at 1 hour differed significantly from the values at 2 hours after quiet time (see Table).

Discussion

Our results indicate that a significant change in light occurred after the implementation of quiet time and remained throughout the quiet time. The finding that turning down the lights resulted in significantly less light from baseline throughout the study was not surprising. What was surprising was that in a busy chaotic ICU, turning down the lights was welcomed. Nurses were initially worried about a lack of visibility due to decreased lighting. Once the nurses experienced the change in light, visibility was no longer a concern. Quiet time was also sustained after the conclusion of the research study.
The important finding in our study is that nurses’ stress decreased with the implementation of quiet time, which consisted of simply turning down the lights. Because no other interventions (e.g., coaching staff to turn off pagers, limiting procedures, or restricting family members’ visits) were performed during this time, data collection was easily done by 1 researcher per day. Light and noise
were measured at the participants' location when they filled out the Perceived Stress survey, isolating the potential environmental influence on nurses' stress at the time stress was reported.

Controlling an environmental pollutant such as light may promote a healthy work environment, because excessive light results in physiological changes that stimulate the stress response, including the release of cortisol and catecholamines. The environmental change of turning down the lights could explain the physiological decrease in nurses' stress levels. Perhaps this decrease in stress was the reason nurses in a chaotic ICU continued to turn down the lights even after the research study was completed. The nurses simply felt better.

The reduction in noise in our study is also an important physiological health outcome because noise-induced stress may result in staff burnout. More research with the measurement of noise during the full duration of quiet time might yield statistically significant results. Because the effect of noise on physiological health is known, another research approach might be to add interventions that decrease noise. Decreased noise is also a measure of patient satisfaction, and promotion of rest without distraction is viewed as a nursing function to promote healing. In institutions where noise levels have been decreased by implementation of quiet time for patients' benefits, determining the impact of the environmental change on health care workers would be useful.

**Limitations and Recommendations**

Limitations of this study included performing the intervention in a single ICU, at specific intervals, with participation by nurses who worked day shifts only. Replication of the study in additional hospitals, on different nursing units, on other shifts, and with a larger sample size of nurses and other health care workers would be useful. Such a study would help reach a wider critical care community in which the structural configuration of the unit and the composition of health care workers might differ.

Our study was performed during 5 weeks during May and June; the patient census and acuity level may differ between seasons. Additionally, we did not consider sociodemographic variables of individual nurses or patients. Future researchers might consider performing the study for a longer period, at times outside the 2-hour period we used, and including acuity, census levels, and demographic variables in the research design. Also missing from our study is a more thorough comparison of stress levels determined before quiet time. With measurements taken at more intervals throughout a shift, a researcher might be able to isolate the loudest or brightest times of day in a unit, as well as times of highest perceived stress. These results may indicate the best time to implement quiet time.

**Conclusions**

Implementation of quiet time, defined as turning down the lights in an ICU between 2 pm and 4 pm, resulted in a significantly decreased mean light level. Although noise levels also decreased over time, the change was not significant. Nurses' stress levels decreased significantly, confirming that controlling light may result in decreased stress levels and promote a healthier ICU working environment, a change that might lead to better patient care and less staff turnover. Although quiet time was an easily performed, energy-saving intervention, more research is needed to better analyze and develop interventions to promote greater physiological and psychological health for nurses, patients, and patients' families in the critical care community.

**ACKNOWLEDGMENTS**

We thank the intensive care nurses for their participation in the research study. Data analysis and manuscript review were performed by Suela Sulo, PhD, James R. and Helen D. Russell Institute for Research and Innovation, Advocate Lutheran General Hospital, Park Ridge, Illinois.

**FINANCIAL DISCLOSURES**

None reported.

**eLetters**

Now that you've read the article, create or contribute to an online discussion on this topic. Visit www.ajcconline.org and click “Submit a response” in either the full-text or PDF view of the article.

**SEE ALSO**

For more about quiet time, visit the Critical Care Nurse Web site, www.ccnonline.org, and read the article by Feldman and Sobrino-Bonilla, “Dim Down the Lights: Implementing Quiet Time in the Coronary Care Unit” (December 2014).

**REFERENCES**


To purchase electronic or print reprints, contact American Association of Critical-Care Nurses, 101 Columbia, Aliso Viejo, CA 92656. Phone, (800) 899-1712 or (949) 362-2050 (ext 532); fax, (949) 362-2049; e-mail, reprints@aacn.org.
Concordance of Nurses and Physicians on Whether Critical Care Patients Are Receiving Futile Treatment

By Thanh H. Neville, MD, MSHS, Joshua F. Wiley, MA, Myrtle C. Yamamoto, RN, Mark Flitcraft, RN, MSN, Barbara Anderson, RN, BSN, CNML, J. Randall Curtis, MD, MPH, and Neil S. Wenger, MD, MPH

Background
Nurses and physicians often describe critical care that is not expected to provide meaningful benefit to a patient as futile, and providing treatments perceived as futile is associated with moral distress.

Objective
To explore concordance of physicians’ and nurses’ assessments of futile critical care.

Methods
A focus group of clinicians developed a consensus definition of “futile” critical care. Daily for 3 months, critical care physicians and nurses in a health care system identified patients perceived to be receiving futile treatment. Assessments and patients’ survival were compared between nurses and physicians.

Results
Nurses and physicians made 6,254 shared assessments on 1,086 patients. Nurses and physicians assessed approximately the same number of patients as receiving futile treatment (110 for nurses vs 113 for physicians, \(P = .82\)); however, concordance was low as to which patients were assessed as receiving futile treatment (\(k = 0.46\)). The 110 patients categorized by nurses as receiving futile treatment had lower 6-month mortality than did the 113 patients so assessed by physicians (68% vs 85%, \(P = .005\)). Patients who were assessed as receiving futile treatment by both providers were more likely to die in the hospital than were patients assessed as receiving futile treatment by the nurse alone (76% vs 32%, \(P < .001\)) or by the physician alone (76% vs 57%, \(P = .04\)).

Conclusions
Interprofessional concordance on provision of critical care perceived to be futile is low; however, joint predictions between physicians and nurses were most predictive of patients’ outcomes, suggesting value in collaborative decision making. (American Journal of Critical Care. 2015;24:403-411)
Physicians and nurses who work in the intensive care unit (ICU) are frequently exposed to complex, and often somber, issues inherent to the care of severely ill patients. Decisions regarding life-sustaining treatment are common, and with approximately 20% of Americans dying during or shortly after an ICU stay, end-of-life care has become integral to critical care. Providing aggressive care to the sickest patients who are not expected to improve may result in providers perceiving that they are providing treatment that may be considered futile. Although defining futile treatment has been difficult and controversial, most physicians acknowledge it as a valid concept and believe that treatments that do not fulfill the goals of medicine should not be performed.

Researchers in several studies have reported that, compared with physicians, nurses experience more moral distress when confronted with these circumstances. In 1 survey, nurses not only perceived more circumstances to be morally distressing than physicians did, but nurses also gave lower ratings for the ethical ICU environment, quality of care, and level of team collaboration than physicians did. In a cross-sectional study in European ICUs, researchers reported that nurses perceived approximately the same number of patients to be receiving inappropriate treatment as physicians perceived, but the nurses described more moral distress. Nurses also graded their workload as more burdensome when they provided treatment that they deemed inappropriate. The authors attributed nurses' heightened level of distress to lack of decision-making control. In the ICU, physicians generally make medical decisions and write orders, whereas nurses implement these plans of care. Nurses are often more intimately involved with patients and patients' families and may be more attuned to suffering on emotional, physical, and spiritual levels. They may be more aware of misaligned preferences of patients and patients' families because they spend more time at the bedside than any other provider.

Understanding differences between physicians' and nurses' assessments of whether a patient is receiving inappropriate critical care may identify targets to address moral distress. Studies show that nurses are often dissatisfied with the level of physician-nurse collaboration in morally distressing situations, leading to calls for increased interdisciplinary collaboration to improve patient care. Increasing communication between physicians and nurses has been identified as a goal for improving the quality of end-of-life care in the ICU. However, very few studies have demonstrated empirically that collaboration improves patient care. Previously, we have quantified physicians' assessments of futile treatment in the ICU. Here, we evaluated the differences between physicians' and nurses' assessments and explored whether combining physicians' and nurses' assessments might improve the prognostic implications of these assessments.

**Methods**

In this study, assessments of futile treatment in critical care by attending physicians and nurses at a health care system were evaluated for 3 months. Details of the definition of futile treatment and of the data collection are provided elsewhere and are summarized here. This study was approved by UCLA's institutional review board (IRB#11-002942).

**Assessment of Futile Critical Care**

Thirteen attending clinicians who provide care for critically ill patients were convened for a focus group to describe and discuss patients for whom
they provided ICU treatment that they judged to be futile. Audiotapes were transcribed, and categories of treatment perceived to be futile were identified, for which there was consensus.

Based on the focus group discussion, a questionnaire was developed to identify patients who were receiving treatment perceived to be futile, treatment that was probably futile, or treatment that was not perceived to be futile. For patients judged to be receiving futile treatment, the provider was asked to provide the reason(s) that the treatment was perceived to be futile. From the reasons derived from the focus group: burdens grossly outweigh benefits, patient will never survive outside of an ICU, patient is permanently unconscious, treatment cannot achieve the patient’s goals, or death is imminent. Providers could also write in a reason.

Every day from December 15, 2011, through March 15, 2012, research assistants administered the questionnaire to the attending physicians and critical care nurses providing treatment in 5 ICUs in the health system: the medical ICU (MICU), the neurocritical care unit (neuro-ICU), the cardiac care unit (CCU), the cardiothoracic ICU (CT-ICU), and the academic community hospital’s mixed-use ICU. Physicians and nurses were surveyed independently and were asked to make assessments only on patients under their care. On any given day, a patient is assessed once by the nurse and once by the physician. All providers gave informed consent and filled out a brief questionnaire.

Other Data Collection

Patients’ demographic data were obtained from the hospital’s administrative data, including age, sex, ethnicity and race, type of insurance, and zip code (used to compute distance from home to hospital); source of admission; and Medicare severity diagnosis-related group (MS-DRG) weight. Sources of admission included the emergency department, outpatient setting, skilled nursing facility (SNF), long-term acute care (LTAC) facility, and transfer from an outside hospital (usually for a higher level of care). Distance from residence to the hospital was dichotomized into nonfutile versus probably futile and perceived futile. Audiotapes were transcribed, and categories of treatment perceived to be futile were identified, for which there was consensus.

Based on the focus group discussion, a questionnaire was developed to identify patients who were receiving treatment perceived to be futile, treatment that was probably futile, or treatment that was not perceived to be futile. For patients judged to be receiving futile treatment, the provider was asked to provide the reason(s) that the treatment was perceived to be futile. From the reasons derived from the focus group: burdens grossly outweigh benefits, patient will never survive outside of an ICU, patient is permanently unconscious, treatment cannot achieve the patient’s goals, or death is imminent. Providers could also write in a reason.

Every day from December 15, 2011, through March 15, 2012, research assistants administered the questionnaire to the attending physicians and critical care nurses providing treatment in 5 ICUs in the health system: the medical ICU (MICU), the neurocritical care unit (neuro-ICU), the cardiac care unit (CCU), the cardiothoracic ICU (CT-ICU), and the academic community hospital’s mixed-use ICU. Physicians and nurses were surveyed independently and were asked to make assessments only on patients under their care. On any given day, a patient is assessed once by the nurse and once by the physician. All providers gave informed consent and filled out a brief questionnaire.

Statistical Analysis

Days where both the physician and nurse assessed the same patient were identified. For these days, the number of futile, probably futile, and not futile treatment assessments by physicians versus nurses were compared by using a χ² test. A χ² test was also used to compare the number of patients assessed as receiving futile treatment by physicians, nurses, or both. The frequencies and numbers of reasons listed for a futile assessment by a physician or nurse were compared by using a χ² test and a t test, respectively.

Separate multivariate models for physicians’ and nurses’ assessments were generated to understand the predictors of an assessment of futile treatment. Only days where there was an assessment by both the physician and the nurse were included. We used a multilevel ordered probit mixed effects model to account for repeated measures on patients and providers. Models were estimated by using the MCMCglmm function in R 3.0.18 The ordered probit model assumes that the predictors have approximately equal effects on moving from nonfutile to probably futile treatment and moving from probably futile to perceived futile treatment. We tested the proportional-odds assumption for both physician and nurse models by comparing 2 models where the ordinal outcome was dichotomized into nonfutile versus probably futile and perceived futile in the first model and nonfutile and probably futile versus perceived futile in the second model. Model estimates did not differ significantly between the 2 models for either physicians or nurses, indicating that the proportionality assumption was met in both cases. We presented the mean marginal change in a patient’s probability of receiving each type of assessment for a 1-unit change in the predictor.

To evaluate the prognostic implications of an assessment of futile treatment, we compared the hospital mortality and the 6-month mortality of the patients who were assessed as receiving futile treatment by the physician but not the nurse, by the nurse but not the physician, and by both the physician and the nurse.

Results

Thirty-six critical care physicians and 288 nurses from 5 ICUs participated in the 3-month survey.
Futile treatment on day transitioned to palliative care
Death is imminent
Treatment cannot achieve patient’s goal
Permanently unconscious
Will never survive outside of an intensive care unit
Burdens grossly outweigh benefits

Reason that treatment was perceived to be futile

<table>
<thead>
<tr>
<th>Reason that treatment was perceived to be futile</th>
<th>No. (%) of patients with this reason listed</th>
<th>By physician (n = 113)</th>
<th>By nurse (n = 110)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burdens grossly outweigh benefits(^a)</td>
<td></td>
<td>65 (58)</td>
<td>87 (79)</td>
</tr>
<tr>
<td>Will never survive outside of an intensive care unit</td>
<td></td>
<td>41 (36)</td>
<td>51 (46)</td>
</tr>
<tr>
<td>Permanently unconscious</td>
<td></td>
<td>33 (29)</td>
<td>36 (33)</td>
</tr>
<tr>
<td>Treatment cannot achieve patient’s goal</td>
<td></td>
<td>59 (52)</td>
<td>66 (60)</td>
</tr>
<tr>
<td>Death is imminent</td>
<td></td>
<td>39 (35)</td>
<td>44 (40)</td>
</tr>
<tr>
<td>Patient nonadherent to treatment</td>
<td></td>
<td>1 (1)</td>
<td>1 (1)</td>
</tr>
<tr>
<td>Futile treatment on day transitioned to palliative care</td>
<td></td>
<td>30 (27)</td>
<td>25 (23)</td>
</tr>
</tbody>
</table>

\(^a\) P = .001.

Factors Associated With Nurses and Physicians’ Assessments of Futile Treatment

In the multivariate multilevel ordinal probit model for nurses (Table 2) and the model for physicians (Table 3), the patient’s age and the patient’s hospital day were associated with an increase in the mean probability for patients to be perceived as receiving futile treatment. Also, patients admitted from an outpatient setting (vs emergency department) and patients admitted to the CCU or IT-ICU (compared with the MICU) were less likely to be assessed as receiving futile treatment. In the physicians’ model, patients admitted from a SNF or LTAC and in the nurses’ model, patients with higher MS-DRG scores were more likely to be perceived as receiving futile treatment. In the nurses’ model only, female patients were also less likely to be assessed as receiving futile treatment, whereas no gender effect was apparent in the physicians’ model. Ethnicity, race, insurance, distance to the hospital, and whether the ICU was full were not significant in either model.

Outcome of Patients Perceived to Receive Futile Treatment

For both nurses and physicians, hospital and 6-month mortality were significantly higher for patients perceived as receiving futile or probably futile treatment compared with patients receiving nonfutile treatment (P < .001). The 113 patients categorized by physicians as receiving futile treatment had higher 6-month mortality than did the 110 patients so assessed by nurses (85% vs 68%, P = .005; Table 4). To evaluate whether concordance between physicians’ and nurses’ evaluations was related to patients’ outcomes, we compared patients assessed as receiving futile treatment by both the physician and the nurse with patients who were assessed as receiving futile treatment by only the nurse or only the physician (Table 5). The 66 study. Out of 7580 nurse assessments and 6897 physician assessments, there were 6254 assessments on 1086 patients that were made by both the nurse and the physician on the same patient on the same day. Nurses rated 89% of assessments as patients receiving nonfutile treatment, 5.2% of assessments as probably futile treatment, and 5.4% of assessments as futile treatment. Physicians rated 85% of assessments as patients receiving nonfutile treatment, 8.7% of assessments as probably futile treatment, and 6.7% of assessments as futile treatment. Each patient had 1 to 79 daily assessments (mean, 5.76; median, 3). Most assessments of futile treatment occurred early in the ICU stay, with 1 quarter of assessments within the first 3 days for physicians and the first 4 days for nurses. The median day of the first futile treatment assessment was day 8 for physicians and day 9 for nurses. At the patient level, nurses and physicians assessed approximately the same number of patients as receiving futile treatment (110 for nurses vs 113 for physicians); however, concordance as to which patients were assessed as receiving futile treatment was low (κ = 0.46). Forty-four patients were assessed as receiving futile treatment by only the nurse, 47 patients by only the physician, and 66 patients by both the physician and nurse. Similar disagreement between nurses and physicians was observed on the broader category of “probably futile or futile treatment” (nurse alone 145 [31%], physician alone 165 [35%], both nurse and physician 157 [34%]) rather than futile treatment only.

Reasons Why Treatment Was Considered Futile

The reasons that nurses and physicians assessed patients as receiving futile treatment were similar. For both nurses and physicians, the most common reason for treatment to be perceived as futile was that burdens grossly outweighed the benefits, and nurses used this reason more often than did physicians (nurses 79% vs physicians 58%, P = .001). Between one-third and one-half, or more, of both nurses and physicians used the following as reasons that treatment was perceived as futile: patient would never survive outside of an ICU, patient was permanently unconscious, treatment could not achieve the patient’s goal, or death was imminent (Table 1). On average, nurses listed more reasons than physicians for why they perceived patients as receiving futile treatment (2.8 vs 2.4, P = .005; Table 1). Among patients assessed by nurses to be receiving futile treatment who remained alive at 6 months, 77% had “burdens outweigh benefits” as a reason that nurses felt the critical care was futile.
patients assessed as receiving futile treatment by both providers (42% of all those assessed as receiving futile treatment) were more likely to die in the hospital than the 44 patients (28%) assessed as receiving futile treatment by the nurse alone (76% vs 32%, \( P < .001 \)) or the 47 patients (30%) assessed to be receiving futile treatment by the physician alone (76% vs 57%, \( P = .04 \)).

**Discussion**

In this study, nurses and physicians evaluated the same patients on the same days, but disagreement was considerable about which patients received treatment perceived to be futile. Nurses and physicians agreed that 66 patients were receiving futile treatment, whereas 91 patients were assessed as receiving futile treatment by 1 provider group but not the

other. The 157 patients assessed as receiving futile treatment by either the nurse or physician represented only 14.5% of the patients assessed during the 3-month study period, but equated to having at least 1 patient perceived to be receiving futile treatment in every unit nearly every day (88%-100% of days, depending on unit), and the burdens of providing treatment perceived to be futile may have been experienced by all members of the critical care team regardless of direct patient care.

Moral distress is common among critical care nurses.\(^3^,\!^4^,\!^19^,\!^22\) Moral distress has been defined as “the psychological disequilibrium and the state of negative feelings experienced when a person makes a moral decision but does not follow through by performing the moral behavior indicated by that decision.”\(^20\) In critical care, this experience is most

Table 2

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Estimated difference in probability, mean (95% CI), %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient’s age (per decade)</td>
<td>-0.99 (-1.92 to -0.03) 0.31 (0.00-0.60) 0.68 (0.02-1.32)</td>
</tr>
<tr>
<td>MS-DRG weight</td>
<td>-0.44 (-0.71 to -0.16) 0.14 (0.05-0.23) 0.30 (0.11-0.49)</td>
</tr>
<tr>
<td>Hospital day of futility assessment (per day)</td>
<td>-0.15 (-0.20 to -0.10) 0.05 (0.03-0.06) 0.10 (0.07-0.14)</td>
</tr>
<tr>
<td>Female patient</td>
<td>2.90 (0.27-5.93) -0.90 (-1.82 to -0.08) -2.00 (-4.07 to -0.17)</td>
</tr>
<tr>
<td>Patient’s race</td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>1.04 (-4.27 to 5.94) -0.36 (-1.91 to 1.35) -0.68 (-3.97 to 2.94)</td>
</tr>
<tr>
<td>Black</td>
<td>-3.38 (-8.60 to 1.22) 0.99 (-0.32 to 2.46) 2.39 (-1.03 to 6.03)</td>
</tr>
<tr>
<td>Other</td>
<td>1.11 (-4.46 to 6.45) -0.39 (-2.16 to 1.38) -0.72 (-4.22 to 3.15)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>0.36 (-3.48 to 4.11) -0.13 (-1.30 to 1.11) -0.23 (-2.78 to 2.41)</td>
</tr>
<tr>
<td>Insurance</td>
<td></td>
</tr>
<tr>
<td>Medicaid</td>
<td>-0.37 (-5.58 to 4.54) 0.09 (-1.45 to 1.69) 0.29 (-3.04 to 3.94)</td>
</tr>
<tr>
<td>Private</td>
<td>0.04 (-4.73 to 4.75) -0.04 (-1.52 to 1.41) -0.01 (-3.30 to 3.36)</td>
</tr>
<tr>
<td>Health maintenance organization</td>
<td>2.78 (-5.15 to 6.22) -0.89 (-2.03 to 0.16) -1.89 (-4.18 to 0.36)</td>
</tr>
<tr>
<td>Uninsured</td>
<td>5.59 (-4.04 to 10.17) -1.95 (-3.88 to 0.16) -3.64 (-6.82 to 0.08)</td>
</tr>
<tr>
<td>Residence &gt; 20 miles (32.3 km) from hospital</td>
<td>-0.14 (-3.20 to 3.09) 0.04 (-0.92 to 1.05) 0.10 (-2.06 to 2.28)</td>
</tr>
<tr>
<td>Source of admission</td>
<td></td>
</tr>
<tr>
<td>Outpatient setting</td>
<td>4.82 (1.28-8.29) -1.61 (-2.75 to -0.27) -3.21 (-5.51 to -0.92)</td>
</tr>
<tr>
<td>Transfer from outside hospital</td>
<td>-1.12 (-5.54 to 3.20) 0.33 (-1.11 to 1.57) 0.79 (-2.45 to 3.69)</td>
</tr>
<tr>
<td>Transfer from SNF/LTAC</td>
<td>-2.99 (-9.85 to 3.99) 0.84 (-1.03 to 2.87) 2.15 (-2.72 to 7.12)</td>
</tr>
<tr>
<td>ICU is full</td>
<td>-0.30 (-1.63 to 1.17) 0.09 (-0.37 to 0.50) 0.20 (-0.74 to 1.19)</td>
</tr>
<tr>
<td>Type of unit</td>
<td></td>
</tr>
<tr>
<td>Neurological ICU</td>
<td>2.06 (-1.43 to 5.40) -0.65 (-1.78 to 0.38) -1.41 (-3.94 to 0.76)</td>
</tr>
<tr>
<td>Cardiac care unit</td>
<td>11.94 (9.42-14.25) -4.46 (-5.51 to -3.36) -7.48 (-8.88 to -5.87)</td>
</tr>
<tr>
<td>Cardiothoracic ICU</td>
<td>11.66 (8.89-14.59) -4.12 (-5.24 to -3.00) -7.54 (-9.35 to -5.62)</td>
</tr>
<tr>
<td>Academic community hospital’s mixed-use ICU</td>
<td>0.14 (-3.91 to 4.03) -0.05 (-1.32 to 1.15) -0.08 (-2.70 to 2.80)</td>
</tr>
</tbody>
</table>

Abbreviations: ICU, intensive care unit; LTAC, long-term acute care facility; SNF, skilled nursing facility; MS-DRG, Medicare severity diagnosis-related group.

\(^a\) Estimated mean difference in percentage probability of being perceived by nurses as receiving treatment that is not futile, probably futile, or futile. A positive percentage is more in a specific category than the reference group; a negative percentage, less. Effects that were significant (\( P < .05 \)) in the model are bolded. Reference for female is male, for race is white, for Hispanic is non-Hispanic, for insurance is Medicare, for source of admission is emergency department, and for type of unit is the medical ICU. MS-DRG weight is a measurement determined by the patients’ diagnoses and the resources required during their hospitalization and used to reflect the patient’s severity of illness. An ICU was considered “full” on days when the mean census at midnight and noon showed fewer than 2 available beds (1 bed is always reserved as a “code bed”).
often experienced in the setting of treatment perceived to be futile, when nurses feel compelled to provide treatments that they perceive not to be in the patient’s best interest.3,4,7,19,21-23 Moral distress in nursing has been linked with lower job satisfaction, higher burnout, and higher job turnover.3,24-26 Thus, it is important to reduce moral distress in critical care.19,20

The difference in outcomes of patients assessed as receiving futile treatment by nurses and physicians may provide additional insight into why nurses may accumulate greater levels of moral distress than physicians accumulate. Physicians’ assessments corresponded more closely to mortality. The fact that patients assessed to be receiving futile treatment by nurses died in the hospital only 58% of the time and within 6 months 68% of the time raises the issue of how nurses defined futile treatment. Although mortality may correspond better to physicians’ assessments because physicians write orders for life-sustaining treatment (and its withdrawal),

### Table 3
Physician model: mean marginal difference in probability of a patient being perceived as receiving treatment that was not futile, probably futile, and futile\(^a\)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Estimated difference in probability, mean (95% CI), %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Not futile</td>
</tr>
<tr>
<td></td>
<td>Probably futile</td>
</tr>
<tr>
<td></td>
<td>Futile</td>
</tr>
<tr>
<td>Patient’s age (per decade)</td>
<td>-2.70 (-3.98 to -1.49)</td>
</tr>
<tr>
<td></td>
<td>1.04 (0.53-1.50)</td>
</tr>
<tr>
<td></td>
<td>1.66 (0.92-2.46)</td>
</tr>
<tr>
<td>MS-DRG weight</td>
<td>0.14 (-0.19 to 0.48)</td>
</tr>
<tr>
<td></td>
<td>-0.06 (-0.19 to 0.07)</td>
</tr>
<tr>
<td></td>
<td>-0.09 (-0.29 to 0.12)</td>
</tr>
<tr>
<td>Hospital day of futility assessment (per day)</td>
<td>-0.24 (-0.29 to -0.18)</td>
</tr>
<tr>
<td></td>
<td>0.09 (0.07-0.12)</td>
</tr>
<tr>
<td></td>
<td>0.14 (0.11-0.18)</td>
</tr>
<tr>
<td>Female patient</td>
<td>3.51 (-0.15 to 7.00)</td>
</tr>
<tr>
<td></td>
<td>-1.34 (-2.68 to 0.03)</td>
</tr>
<tr>
<td></td>
<td>-2.17 (-4.38 to 0.09)</td>
</tr>
<tr>
<td>Patient’s race</td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>0.20 (-7.04 to 6.78)</td>
</tr>
<tr>
<td></td>
<td>-0.16 (-2.69 to 2.59)</td>
</tr>
<tr>
<td></td>
<td>-0.04 (-4.28 to 4.13)</td>
</tr>
<tr>
<td>Black</td>
<td>-3.74 (-10.23 to 2.68)</td>
</tr>
<tr>
<td></td>
<td>1.28 (-0.81 to 3.51)</td>
</tr>
<tr>
<td></td>
<td>2.46 (-1.84 to 6.67)</td>
</tr>
<tr>
<td>Other</td>
<td>0.22 (-6.98 to 7.16)</td>
</tr>
<tr>
<td></td>
<td>-0.17 (-3.02 to 2.43)</td>
</tr>
<tr>
<td></td>
<td>-0.05 (-4.15 to 4.53)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>0.16 (-5.24 to 4.96)</td>
</tr>
<tr>
<td></td>
<td>-0.09 (-1.99 to 1.91)</td>
</tr>
<tr>
<td></td>
<td>-0.07 (-3.19 to 3.08)</td>
</tr>
<tr>
<td>Insurance</td>
<td></td>
</tr>
<tr>
<td>Medicaid</td>
<td>-6.86 (-13.87 to 0.76)</td>
</tr>
<tr>
<td></td>
<td>2.32 (-0.19 to 4.50)</td>
</tr>
<tr>
<td></td>
<td>4.54 (-0.45 to 9.59)</td>
</tr>
<tr>
<td>Private</td>
<td>-4.54 (-11.11 to 2.28)</td>
</tr>
<tr>
<td></td>
<td>1.52 (-0.73 to 3.59)</td>
</tr>
<tr>
<td></td>
<td>3.02 (-1.39 to 7.74)</td>
</tr>
<tr>
<td>Health maintenance organization</td>
<td>-2.13 (-6.51 to 2.63)</td>
</tr>
<tr>
<td></td>
<td>0.78 (-0.87 to 2.46)</td>
</tr>
<tr>
<td></td>
<td>1.35 (-1.65 to 4.15)</td>
</tr>
<tr>
<td>Uninsured</td>
<td>3.55 (-5.33 to 11.57)</td>
</tr>
<tr>
<td></td>
<td>-1.61 (-5.36 to 2.02)</td>
</tr>
<tr>
<td></td>
<td>-1.93 (-6.23 to 3.38)</td>
</tr>
<tr>
<td>Residence &gt; 20 miles (32.3 km) from hospital</td>
<td>-2.18 (-6.27 to 1.93)</td>
</tr>
<tr>
<td></td>
<td>0.83 (-0.73 to 2.38)</td>
</tr>
<tr>
<td></td>
<td>1.35 (-1.22 to 3.88)</td>
</tr>
<tr>
<td>Source of admission</td>
<td></td>
</tr>
<tr>
<td>Outpatient setting</td>
<td>8.02 (3.39-12.29)</td>
</tr>
<tr>
<td></td>
<td>-3.52 (-5.42 to -1.25)</td>
</tr>
<tr>
<td></td>
<td>-4.51 (-6.78 to -1.99)</td>
</tr>
<tr>
<td>Transfer from outside hospital</td>
<td>-1.93 (-7.31 to 3.50)</td>
</tr>
<tr>
<td></td>
<td>0.69 (-1.29 to 2.61)</td>
</tr>
<tr>
<td></td>
<td>1.25 (-2.37 to 4.56)</td>
</tr>
<tr>
<td>Transfer from SNF/LTAC</td>
<td>-16.53 (-26.20 to -7.39)</td>
</tr>
<tr>
<td></td>
<td>4.65 (2.50-6.78)</td>
</tr>
<tr>
<td></td>
<td>11.88 (4.63-19.56)</td>
</tr>
<tr>
<td>ICU is full</td>
<td>-0.09 (-1.19 to 1.08)</td>
</tr>
<tr>
<td></td>
<td>0.03 (-0.42 to 0.47)</td>
</tr>
<tr>
<td></td>
<td>0.06 (-0.64 to 0.75)</td>
</tr>
<tr>
<td>Type of unit</td>
<td></td>
</tr>
<tr>
<td>Neurological ICU</td>
<td>6.35 (-5.14 to 15.82)</td>
</tr>
<tr>
<td></td>
<td>-2.54 (-6.46 to 1.44)</td>
</tr>
<tr>
<td></td>
<td>-3.82 (-9.70 to 3.31)</td>
</tr>
<tr>
<td>Cardiac care unit</td>
<td>13.74 (9.74-16.94)</td>
</tr>
<tr>
<td></td>
<td>-6.78 (-8.77 to -4.71)</td>
</tr>
<tr>
<td></td>
<td>-6.96 (-8.64 to -5.22)</td>
</tr>
<tr>
<td>Cardiotoracic ICU</td>
<td>11.46 (5.35-16.70)</td>
</tr>
<tr>
<td></td>
<td>-5.19 (-7.67 to -2.22)</td>
</tr>
<tr>
<td></td>
<td>-6.28 (-9.20 to -3.25)</td>
</tr>
<tr>
<td>Academic community hospital’s mixed-use ICU</td>
<td>3.67 (-1.40 to 8.29)</td>
</tr>
<tr>
<td></td>
<td>-1.50 (-3.47 to 0.38)</td>
</tr>
<tr>
<td></td>
<td>-2.17 (-4.92 to 0.79)</td>
</tr>
</tbody>
</table>

**Abbreviations:** ICU, intensive care unit; LTAC, long-term acute care facility; SNF, skilled nursing facility; MS-DRG, Medicare severity diagnosis-related group.

\(^a\) Estimated mean difference in percentage probability of being perceived by physicians as receiving treatment that is not futile, probably futile, and futile. A positive percentage is more in a specific category than the reference group; a negative percentage, less. Effects that were significant ($P < .05$) in the model are bolded. Reference for female is male, for race is white, for Hispanic is non-Hispanic, for insurance is Medicare, for source of admission is emergency department, and for type of unit is the medical ICU. MS-DRG weight is a measurement determined by the patients’ diagnoses and the resources required during their hospitalization and used to reflect the patient’s severity of illness. An ICU was considered “full” on days when the mean census at midnight and noon showed fewer than 2 available beds (1 bed is always reserved as a “code bed”).

### Table 4
Comparison of mortality of patients assessed as receiving futile treatment by physicians vs nurses

<table>
<thead>
<tr>
<th>Variable</th>
<th>No. of patients assessed as receiving futile treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>By physicians (n = 113)</td>
</tr>
<tr>
<td>Hospital death</td>
<td>77 (68)</td>
</tr>
<tr>
<td>Death within 6 months</td>
<td>95 (85)</td>
</tr>
</tbody>
</table>
the relatively low mortality rate for patients assessed by nurses as receiving treatment perceived to be futile might suggest that nurses focused on factors such as suffering rather than survival. It is interesting to note that MS-DRG, which relates to the amount of resources used during a patient’s hospitalization, was a significant variable only in the nurses’ model of predictive factors for an assessment of futile treatment. Among patients assessed by nurses to be receiving futile treatment who remained alive at 6 months, 77% had “burdens outweigh benefits” as a reason that nurses felt that the critical care was futile. This result is consistent with the theme that nurses factor suffering more prominently into assessments of futile treatment. Nurses spend considerably more time at the bedside than do physicians and are most likely more aware of a patient’s suffering. A higher level of intimacy with patients and patients’ families may allow nurses to be privy to patients’ goals and hopes that may be unachievable given the patients’ medical conditions.

Unlike Piers et al.,7 who in a recent cross-sectional study also presented physicians’ and nurses’ assessments of perceived inappropriate care, we are able to evaluate concordance between physicians’ and nurses’ assessments and correlate those assessments with patients’ outcome. Our study shows that when nurses’ and physicians’ estimates were combined, the assessments of futility were associated with a higher mortality rate than either assessment alone. This finding suggests that a collaborative model of assessing appropriate treatment might be best, consistent with prior publications advocating for a framework of interprofessional collaboration and shared responsibility for decision making to carry out the best plan for patient care.27 Assessments of futile treatment and prognosis can be made explicit during rounds and documented in the medical record to foster discussion and consideration among all members of the health care team. Interventions should be undertaken to test whether such collaboration leads to improved decision making and perhaps less moral distress.

This study has several limitations, including the single study site and short duration. Furthermore, the categories of futile medical treatment were based on focus groups of physicians that did not include nurses. Yet, the nurses used the distribution of categories to an even greater extent than the physicians. Perspectives of patients and their families also were not included. We focused on futile treatment assessments rather than assessments that treatment was probably futile; however, the level of disagreement between nurses and physicians on the broader category of “probably futile or futile treatment” was similar, if not greater than, that for futile treatment alone. Moreover, hospital discharge and survival are crude validations of futility. A more detailed understanding of the foundation of nurses’ and physicians’ assessments of futility is needed.

In summary, exploring the differences in perception of futile treatment between nurses and physicians may provide further information about the various assumptions and bases of the conceptualization of “futile” treatment. We showed that prognostication is improved when physicians and nurses agree on the assessment of futile treatment, which suggests that increased interprofessional collaboration has the potential to improve patient care. Making such assessments explicitly—for instance, by having them stated during interdisciplinary rounds—not only may dispel misperceptions of prognosis (or enhance discussion to clarify differences in perspective), but also foster support for earlier palliation when it is needed.

FINANCIAL DISCLOSURES
This project was supported by a donation from James D. and Mary Kay Farley to RAND Health. The funder played no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; or preparation, review, or approval of the manuscript.

Table 5
Comparison of mortality of patients assessed as receiving futile treatment by a nurse only, by a physician only, and by both physician and nurse

<table>
<thead>
<tr>
<th>Variable</th>
<th>By nurse only (n = 44)</th>
<th>By physician only (n = 47)</th>
<th>By both physician and nurse (n = 66)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital death</td>
<td>14 (32)</td>
<td>27 (57)</td>
<td>50 (76)</td>
</tr>
<tr>
<td>Death within 6 months</td>
<td>18 (41)</td>
<td>38 (80)</td>
<td>57 (86)</td>
</tr>
</tbody>
</table>

All pairwise comparisons were significantly different (P < .05) except the comparison between physician only and both physician and nurse at 6 months.

REFERENCES


To purchase electronic or print reprints, contact American Association of Critical-Care Nurses, 101 Columbia, Aliso Viejo, CA 92656. Phone, (800) 899-1712 or (949) 362-2050 (ext 532); fax, (949) 362-2049; e-mail, reprints@aacn.org.
1. Which of the following statements regarding assessments of futile treatment is true?
   a. Most nurse assessments of futile treatment occurred within the patient’s first 3 days in intensive care.
   b. Most physician assessments of futile treatment occurred within the patient’s first 3 days in intensive care.
   c. The percentage of assessments of futile treatment was higher for nurses than for physicians.
   d. There was no significant difference between the percentage of physician assessments of futile treatment and the percentage of nurse assessments of futile treatment.

2. Which of the following made assessments of appropriateness or futility of an intensive care unit (ICU) patient’s care?
   a. All nurses and physicians who were caring for patients in a particular ICU that was selected from the study ICUs each day.
   b. Nurses and physicians randomly selected by research assistants from those working in 1 of the designated study ICUs.
   c. The physicians and nurses who were caring for the patients they assessed.
   d. As many of the physicians and nurses who were working in all of the designated study ICUs as possible.

3. The Medicare severity diagnosis-related group weight was used in this study for measuring which of the following?
   a. Expected hospital mortality rate.
   b. Expected 6-month mortality rate.
   c. Resources required during patients’ hospitalizations.
   d. Severity of patient’s illness.

4. A patient admitted to which of the following ICUs was most likely to be assessed as receiving futile treatment?
   a. Cardiac care unit.
   b. Neuro critical care unit.
   c. Cardiothoracic ICU.
   d. Medical ICU.

5. Treatment of a patient was most likely to be assessed as futile by both physicians and nurses in which of the following circumstances?
   a. Patient was admitted from a skilled nursing facility.
   b. Patient was admitted from an emergency department.
   c. Patient was covered by Medicare.
   d. Patient had no insurance coverage.

6. Which of the following accurately describes the effect of gender on assessment of patients’ care as futile?
   a. Nurses were more likely to make an assessment of futile treatment for male patients than for female patients.
   b. Nurses were less likely to make an assessment of futile treatment for male patients than for female patients.
   c. Physicians were more likely to make an assessment of futile treatment for male patients than for female patients.
   d. Physicians were less likely to make an assessment of futile treatment for male patients than for female patients.

7. Which of the following did the authors offer as a reason why nurses may accumulate greater levels of moral distress than physicians?
   a. Nurses’ assessments of futile treatment did not correspond with patient mortality as closely as physicians’ assessments of futility.
   b. Job satisfaction for nurses is lower than job satisfaction for physicians.
   c. Nurses assess futility of care earlier in the patient’s hospitalization than do physicians.
   d. Nurses spend more time at the patient’s bedside than any other provider.

8. Which of the following statements regarding reasons why treatment was considered futile is true?
   a. Physicians listed fewer reasons for why they perceived patients as receiving futile treatment than did nurses.
   b. Physicians used “burdens grossly outweigh the benefits” as the reason for treatment to be perceived as futile more frequently than nurses did.
   c. The most common reason for treatment to be perceived as futile by physicians only was “treatment cannot achieve patient’s goal.”
   d. The most common reason for treatment to be perceived as futile by nurses and physicians was “treatment cannot achieve patient’s goal.”

9. Which of the following statements about the number of patient assessments completed during the study is accurate?
   a. Physicians and nurses each performed more than 1 assessment per patient per day.
   b. Physicians performed only 1 assessment per patient per day, but nurses performed as many assessments as possible per patient per day.
   c. Nurses completed more patient assessments than physicians completed.
   d. Physicians completed more patient assessments than nurses completed.

10. According to the authors, which of the following would explain why nurses more often experience moral distress in critical care?
    a. They must rely on physicians for orders and ensure that the patient’s care is delivered.
    b. They feel compelled to provide treatments they do not believe are best for the patient.
    c. They are frustrated by the significant amount of resources they perceive are wasted on patients who are not expected to survive.
    d. They believe physicians and other care providers are more focused on survival than quality of life.

11. Both hospital and 6-month mortality rates were significantly higher for which of the following patient groups?
    a. Those perceived as receiving futile care by nurses only.
    b. Those perceived as receiving futile or probably futile treatment by nurses only.
    c. Those perceived as receiving futile or probably futile treatment by nurses and physicians.
    d. Those perceived as receiving futile or probably futile treatment by physicians only.

12. Which of the following was a significant limitation of this study?
    a. The small sample size.
    c. The controversy associated with attempting to define futile treatment.
    d. Use of assessments of futile treatment made by physicians and nurses only and not by other members of the critical-care team.

Test ID: A1524053 Contact hours: 1.0; pharma 0.0 Form expires: September 1, 2018. Test Answers: Mark only one box for your answer to each question.

1. a 2. a 3. a 4. a 5. a 6. a 7. a 8. a 9. a 10. a 11. a 12. a
   b  b  b  b  b  b  b  b  b  b  b  b
   c  c  c  c  c  c  c  c  c  c  c  c
   d  d  d  d  d  d  d  d  d  d  d  d

Fee: AACN members, $0; nonmembers, $10 Passing score: 9 correct (75%) Category: CERP A Test writer: Ann Lystrup, RN, BSN, CEN, CFRN, CCRN, CSPI.

For faster processing, take this CE test online at www.aacnjonline.org (“CE Articles In This Issue”) or mail this entire page to: AACN, 101 Columbia, Aliso Viejo, CA 92656.

The American Association of Critical-Care Nurses is accredited as a provider of continuing nursing education by the American Nurses Credentialing Center’s Commission on Accreditation. AACN has been approved as a provider of continuing education in nursing by the State Boards of Nursing of Alabama (#ABNP0062), California (#CEP1036), and Louisiana (#LSBN12). AACN programming meets the standards for most other states requiring mandatory continuing education credit for relicensure.
1. Define and better understand burnout and moral distress.
2. Identify the impact that burnout and resilience have among nurses.
3. Discuss the results of the study.

To read this article and take the CE test online, visit www.ajcconline.org and click “CE Articles in This Issue.” No CE test fee for AACN members.
Nurses are profoundly stressed as they attempt to practice in alignment with their personal and professional values. Acting contrary to those values threatens their sense of integrity and meaning. Socialized to provide patient- and family-centered care, nurses experience moral distress and burnout when the nurses’ values are not congruent with those of the organization in which they work. Issues of conscience are widely reported throughout health care; when the issues are repeated or unrelieved, suffering accumulates, causing nurses to contemplate leaving their positions or the profession altogether.

High stress levels among nurses can lead to substance abuse, depression, and anxiety; decreased job satisfaction; disengagement and reduced organizational loyalty; and increased intent to leave nursing practice. Burnout scores are significantly higher for hospital nurses than for other professionals, and in one study, every fifth nurse reported plans to leave his or her position within 1 year. Nurses working in high-stress areas such as critical care, pediatrics, and oncology report high levels of burnout. Burnout includes emotional exhaustion, depersonalization, and reduced personal accomplishment; emotional exhaustion has the greatest validity as a predictor of burnout. Burnout is associated with adverse health outcomes, increased turnover of nurses, and decreased patient satisfaction.

Contributors to burnout include moral distress, emotional and spiritual demands creating the perception of excessive workload, and stressors associated with physical and psychological environments. Dealing with death and dying, inadequate preparation to address the emotional and spiritual needs of patients and patients’ families, insufficient staff support, and uncertainty surrounding treatment create situations that contribute to and are involved in moral distress.

Moral distress occurs when “the person is aware of a moral problem, acknowledges moral responsibility, and makes a moral judgment about the correct action; yet, as a result of real or perceived constraints, participates in perceived moral wrongdoing.” Hamric suggests that moral distress is a major determinant of whether nurses leave their job positions. In one study, 13% of critical care nurses left their positions in response to moral distress, and 5% abandoned the profession completely. In another study, moral distress caused 25% of nurses in high-intensity work environments to leave their positions.

Resilience helps individuals mitigate moral distress and burnout. Defined as the ability to adapt coping strategies to minimize distress, resilience involves external activities such as developing problem-solving skills or engaging in work, prayer, physical exercise, play, or art. Internally, resilience includes adopting ways of thinking that lessen the impact of traumatic experiences: “[A] key influence in internal resilience is the sense of hope—the sense of meaning or purpose in life, and the sense of the value of life, even if lived strenuously in adverse circumstances.” Resilience can be cultivated through self-efficacy, hope, and coping. Tools used to measure resilience assess aspects of hope, and the correlation between hope and resilience is strong. Meaning is inversely correlated with burnout and positively correlated with gratitude and professional satisfaction. Strategies used to cultivate a greater capacity to cope with the realities of the nursing role can protect nurses against burnout and moral distress throughout the nurses’ professional careers.

Contributors to burnout include moral distress, emotional and spiritual demands creating the perception of excessive workload, and stressors associated with physical and psychological environments. Dealing with death and dying, inadequate preparation to address the emotional and spiritual needs of patients and patients’ families, insufficient staff support, and uncertainty surrounding treatment create situations that contribute to and are involved in moral distress.

Moral distress occurs when “the person is aware of a moral problem, acknowledges moral responsibility, and makes a moral judgment about the correct action; yet, as a result of real or perceived constraints, participates in perceived moral wrongdoing.” Hamric suggests that moral distress is a major determinant of whether nurses leave their job positions. In one study, 13% of critical care nurses left their positions in response to moral distress, and 5% abandoned the profession completely. In another study, moral distress caused 25% of nurses in high-intensity work environments to leave their positions.

Resilience helps individuals mitigate moral distress and burnout. Defined as the ability to adapt coping strategies to minimize distress, resilience involves external activities such as developing problem-solving skills or engaging in work, prayer, physical exercise, play, or art. Internally, resilience includes adopting ways of thinking that lessen the impact of traumatic experiences: “[A] key influence in internal resilience is the sense of hope—the sense of meaning or purpose in life, and the sense of the value of life, even if lived strenuously in adverse circumstances.” Resilience can be cultivated through self-efficacy, hope, and coping. Tools used to measure resilience assess aspects of hope, and the correlation between hope and resilience is strong. Meaning is inversely correlated with burnout and positively correlated with gratitude and professional satisfaction. Strategies used to cultivate a greater capacity to cope with the realities of the nursing role can protect nurses against burnout and moral distress throughout the nurses’ professional careers.

About the Authors
Cynda Hylton Rushton is the Anne and George Bunting Professor of Clinical Ethics, a professor of nursing and pediatrics, Johns Hopkins University, Berman Institute of Bioethics and School of Nursing, Baltimore, Maryland. Joyce Batcheller is president, CNO Solutions, Austin, Texas, and former senior vice president/systems chief nursing officer, Seton Healthcare Network, Austin, Texas. Kaia Schroeder is a former staff educator in critical care, Seton Healthcare Network. Pamela Donohue is an associate professor in pediatrics and director of clinical research, Division of Neonatology, Johns Hopkins University, School of Medicine, and Charlotte R. Bloomberg Children’s Center, Baltimore, Maryland. Anne and George Bunting is the Anne and George Bunting Professor of Clinical Ethics, a professor of nursing and pediatrics, Johns Hopkins University, Berman Institute of Bioethics and School of Nursing, Baltimore, Maryland. Joyce Batcheller is president, CNO Solutions, Austin, Texas, and former senior vice president/systems chief nursing officer, Seton Healthcare Network, Austin, Texas. Kaia Schroeder is a former staff educator in critical care, Seton Healthcare Network. Pamela Donohue is an associate professor in pediatrics and director of clinical research, Division of Neonatology, Johns Hopkins University, School of Medicine, and Charlotte R. Bloomberg Children’s Center, Baltimore, Maryland.

Corresponding author: Cynda Hylton Rushton, RN, PhD, FAAN, Berman Institute of Bioethics, 1809 Ashland Ave, Baltimore, MD 21205 (e-mail: crushto1@jhu.edu).

Objectives
The research reported in this article covers the first phase of a 2-phase project to address dimensions of creating healthy work environments. The goal of the project is to enhance nurses’ resilience while improving retention and reducing turnover through an innovative educational intervention. In phase 1, the experiences and demographics of nurses in high-stress areas were examined as

About the Authors
Cynda Hylton Rushton is the Anne and George Bunting Professor of Clinical Ethics, a professor of nursing and pediatrics, Johns Hopkins University, Berman Institute of Bioethics and School of Nursing, Baltimore, Maryland. Joyce Batcheller is president, CNO Solutions, Austin, Texas, and former senior vice president/systems chief nursing officer, Seton Healthcare Network, Austin, Texas. Kaia Schroeder is a former staff educator in critical care, Seton Healthcare Network. Pamela Donohue is an associate professor in pediatrics and director of clinical research, Division of Neonatology, Johns Hopkins University, School of Medicine, and Charlotte R. Bloomberg Children’s Center, Baltimore, Maryland.

Corresponding author: Cynda Hylton Rushton, RN, PhD, FAAN, Berman Institute of Bioethics, 1809 Ashland Ave, Baltimore, MD 21205 (e-mail: crushto1@jhu.edu).
Table 1
Survey instruments used in phase 1, with descriptive information

<table>
<thead>
<tr>
<th>Measure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maslach Burnout Inventory (used with permission)</td>
<td>The most widely used measure of burnout, this 22-item instrument is used to assess (via a 7-point Likert scale) 3 aspects of the burnout syndrome: emotional exhaustion, 9 questions; depersonalization, 5 questions; and personal accomplishment, 8 questions. Higher scores reflect greater intensity; mean (SD) scores for medical professionals on the 3 subscales are 22.19 (9.53) for emotional exhaustion, 7.12 (5.22) for depersonalization, 36.53 (7.34) for personal accomplishment. Reliability and validity of the Maslach Burnout Inventory and its subscales are well established (0.90 for emotional exhaustion; 0.79 for depersonalization, 0.71 for personal accomplishment).</td>
</tr>
<tr>
<td>Moral distress scale</td>
<td>A shortened form of the original 38-item scale, this 19-item version is used to measure the intensity and frequency of moral distress in clinical situations in hospital practice, including individual responsibilities (physician practice, nursing practice, and institutional factors), care not in the patient’s best interest (futile care), deception, and euthanasia. Studies have indicated the reliability and validity of the original scale and subsequent revisions, including the 19-item version (Cronbach $\alpha$, 0.83 [0.81 for physicians, 0.85 for nurses]). Composite scores (reflecting both the frequency and intensity of moral distress) range from 0 to 304 for the 19-item version. Higher scores indicate greater levels of moral distress. Among nurses with a mean (SD) score of 70.21 (33.22), 45% considered leaving or had left the profession.</td>
</tr>
<tr>
<td>Perceived stress scale</td>
<td>Designed for use with community samples and relatively free of content specific to any subpopulation, this 10-item scale is used to rate the respondent’s stress during the past month by using a 5-point Likert scale. This tool was added to help interpret the Moral Distress Scale by differentiating moral distress from generalized life stressors. Higher total scores, ranging from 0 to 40, indicate greater levels of perceived stress. Norms based on 1406 female respondents (out of 2387 total) to a Harris Poll showed a mean score of 13.7 (SD, 6.6).</td>
</tr>
<tr>
<td>Resilience scale (used with permission)</td>
<td>This 25-item scale is used to measure hardiness, faith, support/purpose, and persistence factors by using a 5-point Likert scale. Total scores range from 0 to 100, with higher scores indicating greater resilience. Also known as the CD-RISC (Connor-Davidson Resilience Scale), the instrument has demonstrated reliability (Cronbach $\alpha$, 0.64-0.76) and convergent validity (stress $r = 0.32$; social support $r = 0.36$). The mean (SD) normative resilience score is 80.4 (12.8); scores greater than 92 are considered evidence of resilience.</td>
</tr>
<tr>
<td>Meaning scale</td>
<td>This 6-item scale for measuring “personal meaning in patient care” had high reliability and predictive validity in a study of genetics professionals. The study revealed a strong inverse relationship between meaning and burnout; meaning was positively associated with gratitude and modestly associated with professional satisfaction (Cronbach $\alpha$, 0.82; eigenvalue, 3.2). The measure yields a unidimensional score between 0 and 24 based on a 5-point Likert scale; higher values indicate a greater level of “finding personal meaning in patient care.”</td>
</tr>
<tr>
<td>State Hope Scale</td>
<td>This 6-item scale includes 3 agency and 3 pathway statements related to how respondents perceive themselves “right now.” Values from 1 to 8 (definitely false to definitely true) are available for each statement. Numerous studies in which this scale was used support the internal reliability, factor structure, and construct validity. For aspects of both agency and pathways, the total State Hope Scale score is the sum of all 6 items, ranging from 6 to 48; higher scores reflect greater levels of hope. The mean (SD) normative score is 37.15 (6.33).</td>
</tr>
</tbody>
</table>

Methods

A cross-sectional survey design was used to characterize the experiences of a high-stress nursing cohort. Participants came from 4 hospitals (all in 1 health system) and represented 6 high-stress units: 2 pediatric/neonatal, 2 oncology, and 2 adult critical care. The units were matched for patient characteristics, patient acuity, and other characteristics (turnover, staffing ratios). Of 180 eligible nurses initially identified, 114 agreed to participate in the study. Using the Internet, they completed a sociodemographic data sheet and 6 survey tools. The process took less than 30 minutes.

Survey instruments included the Maslach Burnout Inventory–Human Services to measure aspects of burnout; a moral distress scale to measure intensity and frequency of moral distress in hospital-based clinical care; a perceived stress scale to help differentiate moral distress from generalized life stressors; a resilience scale to assess hardness and other factors indicative of resilience; a meaning scale to measure “personal meaning in patient care”; and the State Hope Scale to rate the level of hope (Table 1).

Data were analyzed by using SPSS, version 21.0, software (IBM SPSS). Descriptive statistics were used to summarize all study measures. A 1-way analysis of variance was used to compare group means across
treatment specialty area and nurses’ experience. When the F statistic was less than 0.05, the Tukey test was performed for multiple comparisons. The Pearson correlation coefficient was used to determine linear associations between burnout and self-reported measures of well-being and between the 6 standardized study measures. Multiple variable linear regression analyses were used to identify independent predictors of burnout. Only variables related to burnout as indicated by bivariate analysis were kept in the models. Collinearity diagnostics were calculated; tolerance was greater than 0.2, and the variance inflation factor was less than 4 for variables in all models. The level of significance for this study was .05.

Results

Demographic characteristics of the study participants are shown in Table 2 and reflect the overall distribution of staff within the health system. On a scale of 1 to 10, with 10 the highest, participants rated their current physical, emotional, and spiritual well-being just higher than the midpoint: means were 6.6 (SD, 1.8) for adult critical care, 6.5 (SD, 1.8) for neonatal/pediatric critical care, and 6.7 (SD, 1.9) for medical/surgical/oncology.

Specialty areas did not differ significantly on measures of burnout; scores were remarkably similar across the 3 groups (Table 3). Scores on emotional exhaustion and depersonalization were 1 SD greater than the mean reported for the standard sample in the medical profession; personal accomplishment scores were similar among the 3 groups. Levels of moral distress were significantly higher for nurses in critical care than for nurses in other specialties. Measures of stress, resilience, hope, and meaning were similar across specialty areas.

Nurses with 3 to 10 years of experience had the highest mean scores on emotional exhaustion and depersonalization (Table 4). Resilience did
not differ significantly across years of experience, but moral distress increased and hope decreased over time.

Self-reported measures of well-being and burnout had an inverse relationship, but the relationship was not strong. Correlation coefficients for emotional exhaustion ranged from -0.34 to -0.41 and for depersonalization from -0.27 to -0.40 for physical, emotional, and spiritual well-being. All 3 domains of well-being were positively associated with personal accomplishment, with correlation coefficients ranging from 0.32 to 0.43. All correlations were significant at the .01 level.

Moderate to weak correlations were found in self-reported measures of resilience, stress, hope, moral distress, and burnout (Table 5). Burnout subscales were moderately correlated; high levels of emotional exhaustion were associated with high levels of depersonalization and low levels of personal accomplishment. The correlations between burnout and moral distress and burnout and stress were only moderate. The correlation between burnout and general stress was also moderate. As scores on moral distress and general stress increased, so too did emotional exhaustion and depersonalization. Hope and resilience were negatively correlated with emotional exhaustion and depersonalization but positively correlated with personal accomplishment.

In order to guide the intervention for phase 2 of the project, linear regression models were built to identify variables independently related to burnout.

### Table 4
Summary statistics, mean (SD), for standardized scale measurements by years of nursing experience

| Scale | 0-3 years (n = 36) | 3-10 years (n = 39) | >10 years (n = 39) | All (n = 114) | p
|-------|-------------------|---------------------|-------------------|---------------|---
| Burnout | | | | | |
| Emotional exhaustion | 29.5 (10.4) | 35.5 (10.4) | 31.1 (12.4) | 32.21 (11.3) | .06
| Depersonalization | 12.8 (6.0) | 15.3 (6.2) | 11.8 (5.6) | 13.3 (6.1) | .03c
| Personal accomplishment | 40.8 (4.0) | 40.5 (6.4) | 38.9 (5.8) | 40.0 (5.5) | .27
| Resilience | 74.5 (9.5) | 76.7 (11.1) | 71.7 (11.8) | 74.3 (11.0) | .13
| Hope | 38.5 (4.8) | 35.2 (6.9) | 33.1 (8.5) | 35.5 (7.3) | .004d
| Moral distress | 42.4 (33.7) | 64.0 (27.7) | 65.7 (39.6) | 57.8 (35.3) | .006e
| Stress | 15.2 (5.6) | 15.8 (5.9) | 18.5 (6.5) | 16.5 (6.2) | .13
| Personal meaning | 19.0 (3.3) | 19.0 (3.3) | 19.0 (3.3) | 19.0 (3.3) | .93

<table>
<thead>
<tr>
<th>Scale</th>
<th>Burnout: emotional exhaustion</th>
<th>Burnout: depersonalization</th>
<th>Burnout: personal accomplishment</th>
<th>Resilience</th>
<th>Hope</th>
<th>Moral distress</th>
<th>Stress</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burnout: depersonalization</td>
<td></td>
<td>0.64a</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Burnout: personal accomplishment</td>
<td></td>
<td>-0.48a</td>
<td>-0.37a</td>
<td>0.59a</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resilience</td>
<td>-0.31a</td>
<td>-0.23b</td>
<td></td>
<td>0.43a</td>
<td>0.51a</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hope</td>
<td>-0.34a</td>
<td>-0.31a</td>
<td>0.43a</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moral distress</td>
<td>0.49a</td>
<td>0.42a</td>
<td>-0.20b</td>
<td>-0.06</td>
<td>-0.23b</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stress</td>
<td>0.37a</td>
<td>0.20b</td>
<td>-0.39a</td>
<td>-0.44a</td>
<td>-0.43a</td>
<td>0.25a</td>
<td></td>
</tr>
<tr>
<td>Personal meaning</td>
<td>-0.17</td>
<td>-0.32a</td>
<td>0.32a</td>
<td>0.26a</td>
<td>0.09</td>
<td>0.04</td>
<td>-0.03</td>
</tr>
</tbody>
</table>

aP < .01.
bP < .05.

cDepersonalization was significantly higher in nurses practicing 3-10 years than in nurses practicing >10 years (P = .03).
dHope was significantly higher among nurses practicing <3 years than in nurses practicing >10 years (P = .003).
eMoral distress was lower among nurses practicing less than 3 years than among those practicing 3-10 years (P = .02) and those practicing >10 years (P = .01).
Emotional well-being was excluded from the models for phase 2 because of its strong association with the other independent variables and the inability to determine whether poor emotional well-being was in the causal pathway of moral distress or vice versa.

Moral distress was a significant predictor of all 3 aspects of burnout. Greater resilience protected nurses from emotional exhaustion and contributed to personal accomplishment. Spiritual well-being reduced emotional exhaustion and depersonalization; physical well-being was associated with personal accomplishment. Meaning in patient care and hope were independent predictors of the signs and symptoms of burnout. Phase 2 models explained approximately 40% of the variance in each aspect of burnout, providing a strong base on which to design an intervention to support nurses working in specialties in which burnout is high.

**Discussion**

Our results confirmed the relationship among the variables involved in burnout, including modulating factors such as resilience and hope, and support the development of strategies to reduce nurses’ vulnerability to emotional exhaustion.

Data were gathered as phase 1 of a 2-phase project to cultivate resilience among nurses in highly stressful specialty and critical care environments, where an aging population, growing needs, and increased nurse workloads add fuel to an already intense level of burnout. Nurses in high-stress areas in this study scored high on measures of burnout but still felt personal accomplishment related to their work. Nurses with spiritual well-being, hope, resilience, and higher scores on meaning in patient care were protected against burnout. This finding is consistent with findings that resilient nurses identified related factors of spirituality and optimism as resources they draw upon to cope with their stressful work environments. Institutional support of these protective factors may reduce burnout among nurses. As in studies that characterized nursing as a stressful profession, the participants in our study scored high on stress. Although a mean stress score of 13.0 has been reported for the general population (30-44 years old), the mean score for all participants (mean age, 37 years) in our study was 16.5, and scores across specialty areas were similar.

Our data support previous findings that nurses working in high-risk areas, especially critical care, are at increased risk for burnout. Sustained exposure to clinical situations in which conflicts arise about treatment goals for critically ill patients may lead nurses to act contrary to their values; the resulting moral distress and generalized stress lead to emotional and spiritual exhaustion, burnout, and suffering. These sources of suffering threaten the nurses’ authenticity and integrity and their sense of meaning, commitment, and hope.

Our data also show a strong association between burnout and resilience, consistent with the results of other studies. Participants in our study who scored lower on the burnout subscales of emotional exhaustion and depersonalization scored higher on resilience. Participants who scored higher on the personal accomplishment subscale scored higher on resilience. Higher levels of resilience were associated with increased hope and reduced stress.

Resilience scores were relatively flat across years of experience, consistent with results of Gillespie et al, who found that years of experience or employment did not explain resilience at statistically significant levels in operating room nurses. Seemingly contradictory findings were reported by Gillespie and colleagues for other nursing settings when experience was considered in the context of workplace stress but the impact of experience on resilience was not directly addressed. In subsequent research, Gillespie’s team found modest associations between years of experience and resilience, accounting for a small but statistically significant amount of variance in resilience. Published findings on resilience are mixed, pointing to the need for further research and underscoring the importance of cultivating innate resilience via transformational interventions for nurses facing high levels of workplace stress. Our finding that resilience is relatively constant over years of nursing experience suggests that cultivating the conditions of internal resilience to help nurses survive and thrive in high-intensity settings over time may be possible.

Our data show a moderate correlation between moral distress and burnout. As scores for moral distress increased, so too did emotional exhaustion and depersonalization, perhaps as a result of powerlessness or lack of control, as studies on the perception of autonomy and nurse satisfaction have suggested. Although our results suggest moral distress may not be a prerequisite for burnout, it certainly contributes to burnout.

Emotional exhaustion appears to have the greatest predictive validity for burnout. An understanding of the dynamics leading to emotional exhaustion can guide the development of mitigating interventions. As recently proposed, when clinicians become empathetically overaroused by morally distressing situations, they may engage in unregulated responses that contribute to emotional exhaustion. If emotional exhaustion is the first step in burnout, strategies to help nurses expand their coping...
capacities, increase their resilience, and regulate their emotions in morally challenging situations have the potential to reduce burnout and its consequences.\textsuperscript{72,73} Cultivating mental and emotional stability via strategies such as mindfulness can enable nurses to function in stressful and emotionally charged situations without being overwhelmed.\textsuperscript{74}

Our results also suggest that higher levels of self-reported physical and spiritual well-being are associated with decreased levels of emotional exhaustion. If this association is real, interventions to help nurses expand their repertoire of activities to support their physical well-being (eg, exercise,\textsuperscript{75-77} healthy eating,\textsuperscript{75-78} and adequate sleep\textsuperscript{79}) may help reduce burnout and mitigate moral distress. In one investigation,\textsuperscript{77} even 15 minutes of additional exercise improved the study participants’ health. Similarly, strategies to connect to the spiritual dimensions of life can offer additional resources when a person is confronting morally distressing situations.\textsuperscript{80,81}

Training for physicians in mindfulness, communication, and self-awareness can enhance spiritual well-being and improve attitudes associated with patient-centered care.\textsuperscript{80,82} Our findings suggest that nurses who are dealing with morally distressing situations could derive similar benefits from such training.

Moral distress in the nurses in our sample increased with more years of experience in nursing, in what appears to be a dose response. Nurses with 10 or more years of experience reported higher levels of moral distress than did nurses with fewer years of experience, suggestive of a cumulative impact. According to Epstein et al\textsuperscript{12} and Hamric,\textsuperscript{40} the experience of moral distress may crescendo over time. Our findings echo those of Hamric and Blackhall,\textsuperscript{52} suggesting that the intensity of moral distress in critical care has remained high over time. Recent studies and anecdotal experience with ethics consultations support this conclusion\textsuperscript{83,84} and underscore the need for individual- and system-focused interventions to mitigate the effects of moral distress in high-risk areas.\textsuperscript{85,86}

Hope is associated with resilience and is possibly a factor in mitigating stress.\textsuperscript{45-47} In our sample, nurses with the least experience reported higher levels of hope and lower levels of moral distress, generalized stress, and burnout (emotional exhaustion and depersonalization) than did nurses with more experience. Nurses with higher hope scores scored higher on personal accomplishment, suggesting that hope may fuel work satisfaction. If hope can reduce moral distress, enhance resilience, and prevent burnout, cultivating a nurse’s capacity for hope may offer an antidote to attrition in the profession and to the detrimental effects of moral distress. The correlation between hope and resilience is strong,\textsuperscript{45} and tools designed to measure resilience include aspects of hope.\textsuperscript{47} Our data suggest that hope may be an independent predictor of burnout; if so, interventions to cultivate and preserve hope can protect against burnout. The relationship between hope and burnout may be a particularly fruitful area of inquiry because resilience and moral distress were only weakly related in our study.

Resilience involves the internal stability, awareness, and flexibility that enable a person to navigate high-stress situations in ways that reduce burnout and moral distress. Because clinically challenging situations most likely will not diminish, the goal must be to enable nurses to respond in ways that protect against detrimental consequences. Reaching this goal requires attention to personal and professional values, meaning, and hope, all of which are inherently related to resilience. Future research should include an exploration of the relationship between empathy, perspective taking, and personal accomplishment and how the erosion of empathy contributes to depersonalization.

In our sample, meaning scores were moderately associated with 2 aspects of burnout, depersonalization and personal accomplishment, and higher levels of meaning were correlated with decreased depersonalization and increased personal accomplishment. In a study\textsuperscript{84} of professionals in genetics, meaning was inversely correlated with burnout and positively correlated with gratitude and professional satisfaction. These authors\textsuperscript{54} also found that clinicians with more years of experience had higher meaning scores. In our study, meaning scores decreased with more years of experience. These contradictory findings suggest that helping nurses reconnect to the meaning of their work may reduce moral distress and burnout.

Our study has some limitations. One limitation is that 114 of 180 possible participants (63%) were enrolled from a single health system. Whether investigators in other geographical locations and in other health care cultures would have results similar to our findings is unknown.

**Conclusion**

Nurses working in high-risk areas such as pediatrics, oncology, and critical care are vulnerable to burnout because of patients’ intense needs, uncertain outcomes, and the highly charged context of the nurses’ work, particularly the impact of ongoing witnessing of suffering and death. Burnout is an important contributor to retaining trained nurses in their roles. Burnout scores of hospital nurses are...
significantly high, and in 1 study, 1 of 5 nurses indicated that they intended to leave their position within 1 year. Targeting nurses in these high-risk areas will address an important segment of nurses who have the potential to most markedly affect a health care organization’s bottom line. In short, our results confirmed the relationship among the variables involved in burnout, including modulating factors such as resilience and hope, and support the development of strategies to reduce nurses’ vulnerability to emotional exhaustion.

ACKNOWLEDGMENTS
This research was performed at Johns Hopkins University and Seton Family of Hospitals. The support of the Robert Wood Johnson Executive Nurse Fellows Program made this work possible, as did the cooperation of the Seton Family of Hospitals, the members of their institutional review board who approved this study, and their nurses in high-intensity units who participated in the study and the Johns Hopkins University School of Nursing. Gratitude to Cheryl Zogg and Judith Douglas for their assistance in preparing the manuscript.

FINANCIAL DISCLOSURES
This study was supported in part by a grant from the Robert Wood Johnson Foundation, Nurse Executive Fellows Program, and financial and in-kind support from the Johns Hopkins University School of Nursing and Seton Healthcare Network.

eLetters
Now that you’ve read the article, create or contribute to an online discussion on this topic. Visit www.ajcconline.org and click “Submit a response” in either the full-text or PDF view of the article.

SEE ALSO
For more about nurses’ work environments, visit the Critical Care Nurse website, www.ccnonline.org, and read the article by Ulrich et al, “Critical Care Nurse Work Environments 2013: A Status Report” (August 2014).

REFERENCES
CE Test  Test ID A152405: Burnout and Resilience Among Nurses Practicing in High-Intensity Settings

Learning objectives: 1. Define and better understand burnout and moral distress. 2. Identify the impact that burnout and resilience have among nurses. 3. Discuss the results of the study.

1. Burnout scores are significantly higher for nurses who work in which of the following settings?
   a. Hospitals
   b. Schools
   c. Clinics
d. Home care

2. Burnout is high in the following nursing areas, except which of the following?
   a. Critical care
   b. Medical/surgical
   c. Pediatrics
d. Oncology

3. According to one study, which of the following percentages of critical care nurses left their positions in response to moral distress?
   a. 10%
   b. 13%
   c. 16%
d. 19%

4. Resilience can be cultivated through all of the following except which?
   a. Self-efficacy
   b. Psychotherapy
   c. Hope
d. Coping

5. Participants were recruited from how many hospitals?
   a. 1
   b. 2
   c. 3
d. 4

6. Which of the following descriptive statistics was used to identify independent predictors of burnout?
   a. Analysis of variance
   b. Pearson correlation coefficient
c. Multiple variable linear regression analyses
d. Bivariate analysis

7. Nurses with which of the following years of experience had the highest mean scores on emotional exhaustion and depersonalization?
   a. 1 to 5
   b. 3 to 10
   c. 5 to 10
d. 10 to 15

8. Which of the following was associated with low levels of personal accomplishment?
   a. Emotional exhaustion
   b. Stress
c. Fatigue
d. Anxiety

9. Which of the following was excluded from the models for phase 2?
   a. Hope
   b. Resilience
c. Personal accomplishment
d. Emotional well-being

10. Higher levels of resilience were associated with which of the following?
    a. Increased hope and reduced stress
    b. Decreased levels of burnout
c. Decreased depersonalization
d. Increased personal accomplishment

11. Which of the following scores were relatively flat across years of experience?
    a. Burnout
    b. Moral distress
c. Resilience
d. Stress

12. Which of the following appears to have the greatest predictive validity for burnout?
    a. Moral distress
    b. Emotional exhaustion
c. Hope
d. Depersonalization

For faster processing, take this CE test online at www.ajcconline.org ("CE Articles in This Issue") or mail this entire page to AACN, 101 Columbia, Aliso Viejo, CA 92656.

Program evaluation

Objective 1 was met
Objective 2 was met
Objective 3 was met
Content was relevant to my nursing practice
My expectations were met
This method of CNE is effective for this content
The level of difficulty of this test was:
   easy
t. medium
t. difficult
To complete this program, it took me ____ hours/minutes.

Name ____________________________
Address ___________________________
City ___________________________ State ____ ZIP __________
Country ___________ AACN Customer ID# __________
Phone ___________________________ E-mail address* __________________________
Payment by: ______ Visa ______ M/C ______ AMEX ______ Check
Card # ___________________________ Expiration Date __________
Signature __________________________

*E-mail address required to receive notification of completion, access to your test results, and certificate for passing scores.

The American Association of Critical-Care Nurses is accredited as a provider of continuing nursing education by the American Nurses Credentialing Center’s Commission on Accreditation. AACN has been approved as a provider of continuing education in nursing by the State Boards of Nursing of Alabama (#ABNP0062), California (#CEP1036), and Louisiana (#LSBN12). AACN programming meets the standards for most other states requiring mandatory continuing education credit for relicensure.
Background  Health care professionals experience workplace stress, which may lead to impaired physical and mental health, job turnover, and burnout. Resilience allows people to handle stress positively. Little research is aimed at finding interventions to improve resilience in health care professionals.

Objective  To describe the availability, use, and helpfulness of resilience-promoting resources and identify an intervention to implement across multiple pediatric intensive care units.

Methods  A descriptive study collecting data on availability, utilization, and impact of resilience resources from leadership teams and individual staff members in pediatric intensive care units, along with resilience scores and teamwork climate scores.

Results  Leadership teams from 20 pediatric intensive care units completed the leadership survey. Individual surveys were completed by 1066 staff members (51% response rate). The 2 most used and impactful resources were 1-on-1 discussions with colleagues and informal social interactions with colleagues out of the hospital. Other resources (taking a break from stressful patients, being relieved of duty after your patient’s death, palliative care support for staff, structured social activities out of hospital, and Schwartz Center rounds) were highly impactful but underused. Utilization and impact of resources differed significantly between professions, between those with higher versus lower resilience, and between individuals in units with low versus high teamwork climate.

Conclusions  Institutions could facilitate access to peer discussions and social interactions to promote resilience. Highly impactful resources with low utilization could be targets for improved access. Differences in utilization and impact between groups suggest that varied interventions would be necessary to reach all individuals. (American Journal of Critical Care. 2015;24:422-430)
Health care professionals (HCPs) experience significant workplace stress from a variety of sources. In pediatric intensive care units (PICUs), stress may result from intense skill set requirements, ethical dilemmas, caring for families who are under stress, caring for children who are suffering or dying, working with limited resources, challenging interpersonal relationships, and patient safety concerns. When serious safety events occur, HCPs are often unrecognized “second victims.” They may experience emotional abuse, bullying, intimidation, humiliation, and neglect from coworkers. Finally, disproportional physical stress exists, with injury rates for HCPs at 5.6 per 100 full-time employees, 33% higher than the rate for all of private industry. Such physical stress and pain come with attendant psychological stress. These stressors may lead to negative consequences for PICU staff, including physical symptoms, impaired mental health, compassion fatigue, resignation, job turnover, and burnout.

Some HCPs have an unhealthy response to stressors, but others thrive and succeed. It is unclear why individuals respond to stressors in such different ways. One commonly cited possibility is resilience, an evolving concept that has been developing since the 1800s. Resilience is the ability of an individual to adjust to adversity, maintain equilibrium, retain some sense of control over his or her environment, and continue to move on in a positive manner. Resilience has multiple domains and has developed within numerous areas of study. Debate continues on issues, including the challenge of objective study, the multidimensional nature of resilience, and contrasting models of resilience as a dynamic process that can be modified or developed over a lifespan versus a fixed and unchanging trait.

Despite these challenges, research on resilience has identified personal factors (including self-efficacy, competence, confidence, optimism, and intelligence), environmental factors (including social support and a sense of connectedness), and learned behaviors such as self-reflection that strongly correlate with resilient outcomes. Contemporary, validated tools for assessing resilience have been created.

High resilience correlates with lower levels of burnout, depression, and anxiety in ICU nurses, and building resilience has been advocated as a method for nurses to cope with occupational stress. To the extent that positive change can be effected, the costs of burnout, lost work hours, staff turnover, and impaired recruiting of newcomers is operationally wasteful, clinically harmful, and professionally unconscionable.

Using the theoretical framework from Jackson et al, which views resilience as an active process that can be developed and that, when strengthened, can diminish vulnerability to the negative impact of adversity in the workplace, little research has been aimed at finding effective and feasible ways to modify resilience in HCPs. Most published reports propose interventions that are vague, have limited outcome measures, or are resource-intensive. In a systematic review of 19 studies aimed at reducing occupational stress in HCPs, researchers concluded that there was limited evidence of a small but relevant reduction in stress from the studied interventions and that larger and better quality trials were needed.

Given this gap in the literature, we sought to describe the landscape of resilience-promoting resource availability, use, and helpfulness in a large cohort of PICUs with the hope of identifying an intervention that could later be implemented across multiple PICUs and assessed for efficacy. We also

About the Authors

K. Jane Lee is an associate professor in the Department of Pediatrics and Institute for Health and Society, Medical College of Wisconsin, Milwaukee, Wisconsin. Michael L. Forbes is director of clinical research and outcomes analysis in the Department of Pediatrics, Akron Children’s Hospital, Akron, Ohio. Gloria J. Lukasiewicz is an analyst for the Children’s Hospital Association, Washington, DC. Trisha Williams is a former clinical research coordinator in the Children’s Mercy Hospital and Clinics, Kansas City, Missouri. Anna Sheets is clinical director of the cardiac intensive care unit, Heart Institute, Cincinnati Children’s Hospital, Cincinnati, Ohio. Kay Fischer is former director of pediatric critical care services, Children’s Hospital of Wisconsin, Milwaukee, Wisconsin. Matthew F. Niedner is an assistant professor in the Department of Pediatrics and Communicable Diseases, School of Medicine, University of Michigan, Ann Arbor, Michigan.

Corresponding author: K. Jane Lee, MD, Children’s Hospital of Wisconsin, Division of Critical Care, 9000 W. Wisconsin Ave., MS B550B, Milwaukee, WI 53226 (e-mail: kjlee@mcw.edu).

Physical stress injury rates among health care providers are 33% higher than rates for all of private industry.
aimed to obtain baseline measurements of staff members’ resilience in anticipation of such a future prospective intervention.

Methods

This 2-phase descriptive survey study was undertaken in conjunction with the Children’s Hospital Association’s PICU FOCUS group. The study was reviewed and approved by the institutional review board at each participating institution. Study phase 1 was focused on PICU leadership teams, whereas phase 2 was focused on individual PICU staff members.

Survey Tools

The phase 1 (leadership) survey was created for this study and was used to assess unit demographics, perceptions of staffing adequacy, and perceived utility of a given list of resilience resources. The list of resources was developed by using input from nurses and physicians from 18 different institutions along with a review of the literature. Nurse managers assessed the survey for clarity and face validity, and research coordinators who had done previous work on PICU staff retention and burnout assessed the survey for content validity.

Applying Likert scales to each resilience resource, the leadership team was asked: (1) whether the resource was available at their institution, (2) how frequently they believed it was used by their staff, and (3) how helpful it seemed to be for the staff who used it. The survey also included open-ended questions regarding the most important things the institution did, and the most important unmet needs, in supporting staff resilience.

The phase 2 (PICU staff) survey included the same list of resilience resources and the same open-ended questions as the leadership survey, but solicited self-report of actual access, use, and impact of resources. The survey collected individual demographics and used validated instruments to assess resilience (Resilience Scale RS-14, http://resiliencescale.org/en/rstest/rstest_14_en.html) and teamwork climate (Safety Attitudes Questionnaire). Teamwork climate is reported as the percentage of staff who “agree” or “strongly agree” with 6 statements about the quality of teamwork in the unit:

1. Nurse input is well received in this ICU.
2. In this ICU, it is difficult to speak up if I perceive a problem with patient care. (negatively worded, reverse score)
3. The physicians and nurses work together as a well-coordinated team.
4. Disagreements in this ICU are resolved appropriately (ie, not who is right, but what is best for the patient).
5. It is easy for personnel here to ask questions when there is something that they do not understand.
6. I have the support I need from other personnel to care for patients.

The Safety Attitudes Questionnaire defines the teamwork climate “danger zone” threshold as 60% or less (when fewer than 3 of 5 people agree that the teamwork climate is good), and the threshold for “excellence” as 80% or greater (when at least 4 of 5 people agree that teamwork climate is good).

Participants

The leadership survey was distributed electronically to the PICU nurse manager at 84 member institutions of the Children’s Hospital Association. Nurse managers were directed to complete surveys with input from the PICU’s medical director, social worker, chaplain, and human resources representative as needed.

The PICU staff survey included nurses, physicians, and advance practice professionals (nurse practitioners and physician assistants). Voluntary, anonymous surveys (and 2 reminders) were distributed electronically to potential participants by a designated site coordinator.

Data Analysis

Responses to survey questions regarding utilization and impact of resources were analyzed (StatCrunch online platform) and reported by using descriptive statistics and comparative subgroup analyses. Correlation coefficients, t tests, and Mann-Whitney tests were used as appropriate. Non-parametric statistical testing for significant differences between subgroups was performed on primary Likert response data, although ordinal data were summarized into binary bins as follows for simplified reporting:

- Resource availability/awareness: Percentage of respondents indicating an awareness that an intervention is available to them at their institution
• Resource utilization: Percentage of respondents aware of resource availability that also report occasional or frequent use
• Resource impactfulness: Percentage of respondents reporting any use of resource and also rating resource as moderately or very helpful

Data are reported as median (25%-75% interquartile range, IQR) and mean (SD) as appropriate. Significance was defined as \( P < .05 \).

Qualitative analysis was done on the responses to the open-ended questions by using thematic analysis—employing systematic review of respondents’ verbatim responses by 4 co-investigators to establish consistent consensus themes and theme relationships.56

Results

Demographics

Of the 84 leadership surveys sent out, 25 completed surveys (30%) were received. Respondent teams included nurse managers (24), medical directors (9), and other disciplines (3 to 5 surveys each). Twenty PICUs from 19 institutions who participated in phase 1 (leadership) elected to participate in the phase 2 (PICU staff) survey, with unit demographics summarized in Table 1.

Responses were obtained from 1066 PICU staff members (51% response rate), including 893 nurses, 136 physicians (99 attending intensivists, 32 critical care fellows, 5 unspecified), and 37 advance practice professionals. There was no difference in years of ICU experience between nurses (median [IQR], 5 [2.5-12]) and physicians/advance practice professionals (8 [4-16]). Perception of staffing adequacy was “usually adequate” with a slight skew toward “always adequate.”

Availability, Utilization, and Impactfulness of Resources

Availability, utilization, and impactfulness of resilience resources are summarized in Table 2. The 2 most used and impactful resources were 1-on-1 discussions with colleagues and informal social interactions with colleagues out of the hospital. There were multiple differences between responses from unit leaders and responses from PICU staff, with leaders overestimating by at least 20% staff access to 7 resilience resources (39%), utilization of 10 resilience resources (56%), and impactfulness of 6 resilience resources (33%).

Of the 17 resilience resources included on the survey, 8 resources were deemed “very” or “moderately” helpful by more than 60% of staff. These resources were 1-on-1 discussions with colleagues, informal social interactions out of the hospital, taking a break from stressful patients or families, notification of a patient’s death, being sent home after the death of a patient, palliative care involvement with team, structured social events outside the hospital, and Schwartz Center rounds (a program of The Schwartz Center for Compassionate Health care that encourages compassionate care by exploring caregivers’ emotional and psychological responses to their work). Despite being identified by staff as impactful, these resources were not routinely well used across units. Looking at utilization at the unit level, only 2 of these resources (informal social interactions with colleagues out of the hospital, and notification of a patient’s death) were consistently well used, with more than 50% of staff in more than half of the units reporting “occasional” or “frequent” use. The Figure shows utilization of resources by units.

A ratio of rank-ordered impactfulness-to-utilization revealed that the 2 most impactful but underused resources were Schwartz Center rounds and being sent home after the death of a patient. Twelve of 17 resilience resources differed in utilization and/or impact between nurses and physicians/advance practice professionals. Utilization and impactfulness of resources among subgroups are summarized in Table 3.

Teamwork Climate (Safety Attitudes Questionnaire)

One-fourth of PICUs reported scores on the Safety Attitudes Questionnaire (<60% = danger,
For units in the outer quartiles (n = 9), significant differences existed between each unit’s teamwork climate versus all others’ pooled scores (P < .007). Teamwork climate was lower by 7% in PICUs where staffing was perceived as adequate only “sometimes,” “rarely,” or “never” (P < .001).

PICUs with higher teamwork climate scores reported greater utilization and impact of acute debriefings after deaths and stressful events, and greater effectiveness of institutional memorial services, autopsy reviews, and education in self-care. Staff in PICUs with lower teamwork climate scores were more likely to use out-of-hospital social mechanisms for coping and rated Schwartz Center rounds and employee assistance programs as more impactful.

**Resilience (RS-14) Scores**

Most respondents’ RS-14 resilience scores fell in the moderate to moderately high range (median, 84 [IQR, 79-88]). Individual RS-14 scores were not associated with profession, perceptions of staffing, or the unit teamwork climate. Individual perceptions of unit teamwork climate were 7% higher for those with moderately high or high resilience scores (P < .001) and 10% lower for individuals with low or very low resilience scores (P < .001). Less experienced staff (<7 years ICU) averaged 2 points lower on RS-14 than their more experienced peers did (P < .001); years of experience, however, did not correlate with perceptions of teamwork climate.

**Qualitative Results**

Themes emerged in 3 domains: institution-based leadership, unit-based leadership, and peer/individual.

**Institution-Based Leadership.** Staff viewed it as important for institution-based leadership to ensure the consistent availability (including nights and weekends) of support and specialty services such as spiritual care, social work, palliative care, ethics, psychology, and child life. Having these services in the “danger zone” (median 70% [IQR, 60%-82%]). For units in the outer quartiles (n = 9), significant differences existed between each unit’s teamwork climate versus all others’ pooled scores (P < .007). Teamwork climate was lower by 7% in PICUs where staffing was perceived as adequate only “sometimes,” “rarely,” or “never” (P < .001).
available was thought to promote resilience in 3 ways: (1) by providing direct support for the staff, (2) by providing support for patients and families, which in turn provides an opportunity for nurses to provide holistic care for their patients, and (3) by alleviating the burden on the staff to provide this support for the patients and patients’ families themselves.

Unit-Based Leadership. Staff indicated that the most important resource that a unit-based leader could provide is respectful staffing. Respectful staffing is done with consideration of the needs of the staff member (e.g., adequate staffing to meet the unit’s needs, being allowed to go home or disengage from staffing after a patient you have cared for dies, and being allowed to self-schedule). It was recognized that staffing matters also require institutional support.

Unit-based leaders should also promote the availability of organized discussions, including debriefings, and provide opportunities for emotional and intellectual closure, including facilitated funer al attendance, notifying consistent caregivers of the death of a patient, providing opportunities for memorializing, and making autopsy results available.

Peer/Individual. Themes that emerged related to individual or peer support included opportunities for self-care, good communication, teamwork, 1-on-1 discussions, and informal social activities.

Unmet Needs and Barriers. The themes for unmet needs and barriers transcended the lines of institution-based leaders, unit-based leaders, and individuals. The need to step away from a stressful situation or take a break was ubiquitous, as was the more insidious issue of chronic stress and grief that stems not from a noticeable “crisis,” but from the day-to-day exposure to smaller stressors. Barriers to meeting these needs were a lack of recognition of the problem as well as a lack of time and financial resources devoted to the problem.

Discussion

We set out to describe the landscape of resilience-promoting resource availability, use, and helpfulness in a large cohort of PICUs with the hope of identifying an intervention that could later be implemented across multiple PICUs and have its efficacy assessed. Although we identified no new interventions, we did identify a group of resources that staff members generally found to be helpful, but were not consistently well used in the cohort of PICUs studied. Availability of and access to resources in this group could be a target for improvement in units where utilization is low.

The 2 interventions reported as highly used and impactful by most respondents (1-on-1 discussions with colleagues and informal social mechanisms outside of the hospital) are interventions that may be outside the scope of what can be systematically provided by an institution or a unit—however, organizational influence could be applied to facilitate greater engagement on these fronts. Perhaps strategies such as explicit, structured peer mentoring, trigger criteria to activate 1-on-1 contact with a peer at potential times of stress, and support for coordination of extramural social gatherings could be systematically deployed.

Peer-peer discussion and off-campus gatherings build on social support and a sense of connectedness, 2 of the environmental factors that are thought to be associated with increasing resilience. A sense of connectedness among colleagues may be critical for PICU staff, as they may perceive that their unique stressors cannot be understood by “outsiders.”

The idea that these factors are important to the resilience of PICU staff is supported by our finding that within units, individuals with higher resilience scores also have the perception of greater teamwork. Also, PICUs with lower teamwork climates were more likely to use out-of-hospital social mechanisms for coping and found Schwartz Center rounds and employee assistance programs more impactful, suggesting that when PICU professionals are not getting the social support and sense of

---

**Figure** Staff utilization of resiliency resources, rank ordered from most to least impactful.
connectedness within their unit, they look outside to find this connection.

Many factors affect staff resilience. Our finding that staff with more than 7 years of experience scored higher on individual resilience but did not have different perceptions of teamwork climate than their less experienced colleagues suggests that some of the individual factors previously suggested to correlate with resilience such as self-efficacy, competence, and confidence may also be important. These individual factors could conceivably be strengthened with experience. Conversely, this finding could also be explained by either less resilient PICU staff leaving the field or more experienced staff adjusting their expectations and accepting the "instability" perceived by less experienced staff.

Additional resources for promoting resilience also could be optimized. Taking a break from stressful patients, being relieved of duty after your patient’s death, palliative care support for staff, structured social activities out of hospital, and Schwartz Center rounds are some of the 8 most highly impactful

| Table 3 Differences in resilience resource utilization and impactfulness by subgroup |
|--------------------------------|--------------------------------|--------------------------------|
|                               | By profession                | By individual resilience (R) | By unit teamwork climate (T) |
|                               | Utilization                  | Impactfulness                | Utilization                  | Impactfulness                | Utilization                  | Impactfulness                |
|                               | RN   | P    | RN   | P    | R ≥ 82 | R < 82 | R ≥ 82 | R < 82 | T ≥ 60% | T < 60% | T ≥ 60% | T < 60% |
| One-on-one discussions with colleagues | 72  | 64   | 76  | 78   | 72  | 68   | 76  | 79   | 70   | 70   | 78  | 74   | 72  | 68   | 76  | 79   |
| Informal/social mechanisms with colleagues out of hospital | 70  | 69   | 76  | 74   | 70  | 69   | 78  | 73   | 69  | 71   | 75  | 77   | 69  | 71   | 75  | 77   |
| Taking a break from stressful patients | 59c | 45   | 78d | 63   | 56  | 61   | 79  | 71   | 60  | 54   | 77  | 74   | 60  | 54   | 77  | 74   |
| Staff notification of the death of your patient | 73  | 75   | 72d | 54   | 74  | 73   | 71  | 67   | 72  | 76   | 68  | 72   | 72  | 76   | 68  | 72   |
| Being sent home/relieved of duties after a patient’s death | 50d | 13   | 66a | 25   | 45  | 50   | 67  | 62   | 48  | 46   | 66  | 64   | 48  | 46   | 66  | 64   |
| Palliative care program involvement with staff | 49  | 74d  | 62  | 60   | 55a | 48   | 63  | 58   | 52  | 56   | 62  | 62   | 52  | 56   | 62  | 62   |
| Structured social mechanisms out of hospital | 37  | 46e  | 63  | 61   | 41  | 35   | 66e | 55   | 34  | 47c  | 62  | 62   | 34  | 47c  | 62  | 62   |
| Schwartz Center rounds | 25  | 72d  | 63  | 59   | 33  | 34   | 64  | 61   | 30  | 37   | 50  | 72a  | 30  | 37   | 50  | 72a  |
| Acute debriefings after stressful events or deaths | 44  | 50a  | 62c | 49   | 46  | 42   | 59  | 60   | 48c | 39   | 64d | 50   | 48c | 39   | 64d | 50   |
| Social work involvement with staff | 50  | 58   | 59  | 49   | 52  | 50   | 63d | 46   | 52  | 51   | 58  | 55   | 52  | 51   | 58  | 55   |
| Chaplain/spiritual care available for staff | 30  | 33   | 59  | 47e  | 32  | 28   | 58  | 54   | 30  | 31   | 55  | 61   | 30  | 31   | 55  | 61   |
| Facilitation of attendance at funeral of your patient | 35  | 23   | 52e | 45   | 33  | 34   | 51  | 52   | 34  | 33   | 53  | 48   | 34  | 33   | 53  | 48   |
| Education regarding self-care, self-assessment, coping | 44  | 37   | 49  | 47   | 47  | 38   | 57d | 37   | 46  | 35   | 53a | 40   | 46  | 35   | 53a | 40   |
| Institutional memorial service | 18  | 26   | 50  | 33   | 22  | 15   | 50  | 38   | 21  | 15   | 49a | 38   | 21  | 15   | 49a | 38   |
| Autopsy results available to staff | 55  | 83d  | 38  | 54   | 68  | 67   | 47  | 39   | 64  | 77   | 47e | 35   | 64  | 77   | 47e | 35   |
| Employee assistance program | 9d  | 6    | 40  | 58   | 8   | 9    | 41  | 43   | 8   | 9    | 38  | 49a  | 8   | 9    | 38  | 49a  |
| Ethics committee involvement with staff | 14  | 22d  | 39a | 27   | 17c | 14   | 36  | 33   | 15  | 17   | 36  | 36   | 15  | 17   | 36  | 36   |

Abbreviations: P, physicians and advanced practice professionals; RN, nurses.

* Utilization indicates percentage of respondents aware of resource availability who also report occasional or frequent use.

* Impactfulness indicates percentage of respondents reporting any use of resource and also rating resource as moderately or very helpful.

* Significantly higher: P < .01.

* Significantly higher: P < .001.

* Significantly higher: P < .05.
resources that were used by fewer than half of staff in most institutions. These resources that are already seen as helpful by most staff who use them are prime candidates for institutions to increase awareness and access.

Our results also demonstrated that it is unlikely for a single intervention to satisfy the professional and personal needs of all staff members in every unit. As shown in Table 3, there were significant differences in utilization and impactfulness between professions, between individuals with higher versus lower resilience, and between individuals in units with higher versus lower teamwork climates. These results suggest that, to make the greatest impact, a set of interventions targeted to local contexts may be more advisable than focusing resources on a single intervention or program.

This study has several limitations. The survey used was developed specifically for this study and has not been previously rigorously tested for validity and reliability. We are relying on individuals’ perceptions instead of tracking actual behavior. We measured staff members’ resilience but not their underlying stress or burnout symptoms, because we were more interested in the response to stress than the stress itself. Given that resilience is multifactorial, it is impossible to assign causation to any single influence. We can only discuss associations and speculate about causality.

Conclusions

The most highly used and impactful interventions were 1-on-1 discussions with colleagues and informal social interactions outside of the workplace. We speculate that possible mechanisms to systematically facilitate access to these interventions could include explicit, structured peer mentoring, trigger criteria to activate 1-on-1 contact with a peer at potential times of stress, and support for extramural social gatherings. Additional interventions that were recognized as highly impactful were not uniformly well-used among units, and these interventions could be targets for improved awareness and access. Significant differences in utilization and impactfulness between groups suggest that multiple interventions would be necessary in order to reach all individuals. Regardless of the specific intervention targeted, our finding that the unit leadership team tended to overestimate staff access to, utilization of, and impact of resources highlights the importance of assessing efficacy directly, rather than relying on subjective assessment by institutional or unit leaders.

ACKNOWLEDGMENTS

The authors thank the member hospitals of the Children’s Hospital Association PICU FOCUS group for their contributions and participation. This work was performed at the following institutions: Akron Children’s Hospital, University of Minnesota Amplatz Children’s Hospital, Arkansas Children’s Hospital, Dell Children’s Medical Center of Central Texas, Children’s Hospital at Cabell Huntington Hospital, Children’s Hospital Los Angeles, Children’s Hospital of Illinois at OSF Saint Francis Medical Center, Children’s Hospital of Wisconsin, Cincinnati Children’s Hospital Medical Center, Cook Children’s Health Care System, University of Michigan C. S. Mott Children’s and Von Voigtlander Women’s Hospital, Helen DeVos Children’s Hospital, Inova Fairfax Hospital for Children, Kosair Children’s Hospital, MultiCare Mary Bridge Children’s Hospital and Health Center, Children’s Mercy Hospitals and Clinics, Providence Sacred Heart Medical Center and Children’s Hospital, St Joseph’s Children’s Hospital, Monroe Carell Jr Children’s Hospital at Vanderbilt.

FINANCIAL DISCLOSURES

None reported.

eLetters

Now that you’ve read the article, create or contribute to an online discussion on this topic. Visit www.ajcconline.org and click “Submit a response” in either the full-text or PDF view of the article.

REFERENCES

INTENSIVE CARE NURSES’ KNOWLEDGE ABOUT USE OF NEUROMUSCULAR BLOCKING AGENTS IN PATIENTS WITH RESPIRATORY FAILURE

By Erin N. Frazee, PharmD, Heather A. Personett, PharmD, Seth R. Bauer, PharmD, Amy L. Dzierba, PharmD, Joanna L. Stollings, PharmD, Lindsay P. Ryder, PharmD, Jennifer L. Elmer, DNP, APRN, CNS, Sean M. Caples, DO, and Craig E. Daniels, MD

Background The recent increase in use of neuromuscular blocking agents (NMBAs) in patients with acute respiratory distress syndrome is set against a backdrop of concerns about harm associated with use of these high-risk drugs. Bedside nurses play a pivotal role in the safe and effective use of these agents.

Objective To describe critical care nurses’ knowledge of the therapeutic properties, adverse effects, and monitoring parameters associated with NMBAs.

Methods A prospective, multicenter survey of medical intensive care unit nurses between July 2012 and May 2013. The web-based survey instrument was designed, pretested, and administered under the direction of a multidisciplinary group of individuals.

Results Responses from 160 nurses (22% of eligible nurses) were analyzed. Most respondents were able to identify NMBAs correctly as nonanalgesic (93%) and nonanxiolytic (83%). The perceived durations of action of NMBAs varied widely, and few nurses were familiar with patient-specific considerations related to drug elimination. Most (70%) recognized the independent associations between NMBAs and footdrop, muscle breakdown, and corneal ulceration. Pressure ulcers and a history of neuromuscular disease were the characteristics of patients perceived to most heighten the risk of NMBA use.

Conclusions Critical care nurses are knowledgeable about the importance of concurrent analgesia and sedation during use of NMBAs. Routes of elimination, duration of action, and adverse effects were less commonly known and represent areas for focused education and quality improvement surrounding use of NMBAs in the intensive care unit. (American Journal of Critical Care. 2015;24:431-439)
A knowledgeable critical care nurse is essential to the effective and safe use of neuromuscular blocking agents (NMBAs) in intensive care units (ICUs). The Institute for Safe Medication Practices considers NMBAs to be high-alert medications because of the robust historical documentation of harm associated with their use.\(^1,^2\) Indeed, prolonged use of these agents contributes to an increased risk for corneal ulcers, skin breakdown, venous thromboembolism, ventilator-associated pneumonia, and musculoskeletal debility.\(^3\) Furthermore, reports of patients recalling being paralyzed and the independent association between NMBAs and posttraumatic stress disorder raise concerns about the safety of routine use of these agents.\(^3,^7\)

Despite these previously documented risks, interest in the routine use of NMBAs among medical ICU patients has been renewed in the past several years. Specifically in patients with acute respiratory distress syndrome (ARDS), we now know that early continuous infusion of an NMBA improves oxygenation, inflammation, and mortality.\(^8,^10\) As epidemiological evidence shows, this practice shift in support of NMBA use could affect many critically ill patients.\(^11,^13\) To minimize risks for patients, critical care nurses must have a keen understanding of the importance of adequate concurrent analgesia and sedation when an NMBA is used and an appreciation for the factors that contribute to selection of patients, choice of agent, dose titration, and adverse effects.

Studies\(^14,^17\) on nurses’ knowledge about the use of NMBAs are more than a decade old and do not completely assess all aspects of competency. They also predate recent efficacy publications\(^8,^10\) in support of using NMBAs for certain subgroups of patients. Therefore, to promote the safe and effective use of NMBAs, we sought in this study to describe critical care nurses’ knowledge and beliefs about NMBAs in the modern medical ICU and identify opportunities for targeted educational initiatives and to improve practice homogeneity in the future.

**Methods**

In this multicenter, prospective, cross-sectional study, ICU nurses at 5 sites (Mayo Clinic, Rochester, Minnesota; Cleveland Clinic, Cleveland, Ohio; New York Presbyterian Hospital, New York, New York; Vanderbilt University Medical Center, Nashville, Tennessee; and The Ohio State University Wexner Medical Center, Columbus, Ohio) completed a web-based survey between July 2012 and May 2013. The study protocol was reviewed and approved by the institutional review board at each participating site. The questionnaire responses are a subset of a larger database of survey responses from licensed providers in multiple disciplines, including nurses, physicians, nurse practitioners, physician assistants, pharmacists, and respiratory therapists. For their responses to be eligible for inclusion in this study, more than 25% of the individual’s clinical practice must have been in an ICU consisting of more than 50% medical patients at 1 of the 5 large, academic medical centers involved in the study. The included academic medical centers each have approximately 700 to 1400 adult hospital beds and 24 to 65 medical ICU beds. At the time of the study, all included institutions had an electronic medical record and used computerized provider order entry (CPOE). Two centers had clinical protocols for NMBA use that were helpful in selection of patients, dosing, and monitoring.

A 16-question web-based survey was designed expressly for this study in conjunction with the Mayo Clinic Survey Research Support Center. Study
The survey had 2 sections: 1 on general knowledge and 1 on perceptions of use of these agents in patients with acute respiratory distress syndrome.
would be needed to provide a 95% confidence interval of 52% to 68% for the population response. All analyses were performed with JMP version 9 statistical software (SAS Institute Inc).

**Results**

Of the 717 eligible medical ICU nurses contacted for participation, 160 (22%) submitted partial or complete responses suitable for analysis (Figure 1). All knowledge questions were answered by 155 respondents (97%).

**Therapeutic Properties**

The aminosteroidal and benzylisoquinolinium NMBAs studied were correctly identified as nonanalgesic by 95% and 94% of survey respondents, respectively. In a combined analysis, 148 respondents (92%) were able to identify both agents correctly as nonanalgesic (see Table). A similar number of participants correctly identified lorazepam as nonanalgesic (n = 144, 90%). The absence of anxiolytic properties among NMBAs was significantly less commonly identified by respondents (n = 132, 82%) than the absence of analgesic properties ($P = .007$). Unsure/no opinion was the most common answer among incorrect responses regarding anxiolytic properties of NMBAs (pancuronium: 19 out of 25 incorrect responses; atracurium: 13 out of 20 incorrect responses).

**Pharmacokinetics**

Marked inconsistencies existed among respondents in the perceived duration of action of each NMA (Figure 2). Less than half of respondents correctly identified the intermediate duration of action of atracurium (46%) and vecuronium (40%), and the responses showed marked heterogeneity. In contrast, homogeneity was increased among the responses to the reference analgesic and sedative agents under study, hydromorphone (65% perceived it to be intermediate duration of action) and

<table>
<thead>
<tr>
<th>Survey item</th>
<th>No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Analgesic</strong></td>
<td></td>
</tr>
<tr>
<td>Correctly identified the following NMA as nonanalgesic</td>
<td></td>
</tr>
<tr>
<td>Vecuronium</td>
<td>152 (95)</td>
</tr>
<tr>
<td>Cisatracurium</td>
<td>150 (94)</td>
</tr>
<tr>
<td>Both NMBAs correct</td>
<td>148 (92)</td>
</tr>
<tr>
<td><strong>Anxiolytic</strong></td>
<td></td>
</tr>
<tr>
<td>Correctly identified the following NMBAs as nonanxiolytic</td>
<td></td>
</tr>
<tr>
<td>Pancuronium</td>
<td>135 (84)</td>
</tr>
<tr>
<td>Atracurium</td>
<td>140 (88)</td>
</tr>
<tr>
<td>Both NMBAs correct</td>
<td>132 (82)</td>
</tr>
<tr>
<td><strong>End-organ elimination</strong></td>
<td></td>
</tr>
<tr>
<td>Correctly identified drug elimination properties of the following NMBAs</td>
<td></td>
</tr>
<tr>
<td>Aminosteroidalals</td>
<td></td>
</tr>
<tr>
<td>Vecuronium (primarily hepatic)</td>
<td>66 (41)</td>
</tr>
<tr>
<td>Pancuronium (primarily renal)</td>
<td>68 (42)</td>
</tr>
<tr>
<td>Both aminosteroidal NMBAs correct</td>
<td>44 (28)</td>
</tr>
<tr>
<td>Benzylisoquinoliniums</td>
<td></td>
</tr>
<tr>
<td>Atracurium (end-organ neutral)</td>
<td>89 (56)</td>
</tr>
<tr>
<td>Cisatracurium (end-organ neutral)</td>
<td>103 (64)</td>
</tr>
<tr>
<td>Both benzylisoquinolinum NMBAs correct</td>
<td>65 (41)</td>
</tr>
</tbody>
</table>
propofol (82% perceived it to possess a short duration of action). Given the importance of ICU nurses in individualizing treatment plans and weaning patients off of CNS-active agents, survey items were included to investigate the perceived risk of NMBA accumulation in patients with hepatic or renal dysfunction. Only 8 respondents (5%) correctly identified all 4 NMBA drugs’ elimination considerations. The end-organ neutrality of benzylisoquinolinium NMBAs was identified more commonly than were the implications of renal or hepatic dysfunction on elimination of aminosteroidal NMBAs (41% vs 28%, respectively; \( P = .01 \); see Table).

### Adverse Effects

Four out of every 5 nurses recognized independent associations between NMBAs and both footdrop and muscle breakdown. In only 34% of cases, nursing staff recognized the independent association between use of an NMBA and consciousness (Figure 3). We studied whether nurses attributed other likely unrelated biochemical and clinical effects to the use of NMBAs. Few nurses inaccurately reported a relationship between NMBA use and hyperglycemia (8%), infection (11%), or hypomagnesemia (16%). Lactic acidosis and delirium were incorrectly identified as independently related to NMBA use in 28% and 32% of responses, respectively.

Respondents were also asked to classify the degree to which a series of baseline factors and concurrent therapies modified the risk profile of continuous infusion of an NMBA. As this pertains to providers’ perceptions and beliefs, no answers for these items were considered incorrect. Respondents could select from the following options: substantial increase in risk, slight increase in risk, no change in risk, or unsure. Among the factors under study, respondents believed that pressure ulcers and a history of a neuromuscular disorder most increased the risks associated with NMBA therapy (Figure 4). Although concomitant corticosteroids were perceived to heighten the risk associated with continuous infusion of an NMBA by 77 respondents (48%), the majority classified this increase in risk as slight (58 “slight increase” out of 77 responses for increased risk).

### Titration

When asked to select the best primary method to guide titration of a continuous infusion of an NMBA in patients with ARDS, 82 nurses (51%) preferred degree of ventilator synchrony or other oxygenation/ventilation parameters. Train-of-4 (TOF) monitoring with peripheral nerve stimulation (PNS) was selected less often (n = 65, 41%), although this difference was not statistically significant (\( P = .06 \)).

---

**Figure 2** Perceived durations of action of 2 paralytic agents (atracurium and vecuronium) and 2 reference agents (propofol and hydromorphone). Fewer than half of respondents identified the correct duration of action for each paralytic agent (denoted by an asterisk in the figure). In contrast to the consistent responses noted with the reference agents, distinct variability existed in the perceived durations of paralytic activity.

**Figure 3** Percentage of respondents who endorsed an independent association between major adverse effects and use of neuromuscular blocking agents.

**Discussion**

Recent evidence suggesting the utility of NMBAs in patients with ARDS falls on a backdrop of the potential for serious adverse effects. The bedside nurse is one of the key team members responsible for ensuring the safe and effective use of NMBAs in critically ill patients. It is for this reason that we sought to evaluate critical care nurses’ knowledge about NMBAs. Paralytic agents were identified as nonanalgesic by 92% of nurses, but only 82% of nurses recognized that NMBAs lack sedative properties. Nurses infrequently identified the correct method of NMBA elimination, particularly with aminosteroidal NMBAs. Approximately 20% to 40% of respondents were unfamiliar with major adverse effects of the drugs (muscle breakdown, corneal...
ulceration, and venous thromboembolism). With respect to monitoring, nurses preferred to use ventilation/oxygenation parameters rather than TOF monitoring to guide dose titration in patients with ARDS.

Although the evidence is limited, researchers in previous studies have described nurses’ knowledge about NMBA pharmacology. In early work by Loper and colleagues, 14 258 ICU nurses at a single center were surveyed to assess their knowledge about NMBA. Ninety percent of respondents were either unsure or believed that pancuronium provided anxiolysis. With respect to pain control, one-third of ICU nurses reported a lack of familiarity or believed that pancuronium provided analgesia. A separate structured needs assessment pertaining to analgesia, sedation, and paralysis in a surgical ICU revealed frequent insufficiency of sedation and analgesia during use of NMBA. The authors identified this as a key clinical issue that adversely affected patient care and outcomes. In contrast to previous work, nurses in the present study more frequently recognized the absence of analgesic properties among NMBA, but 1 in 5 still failed to note the absence of anxiolysis. The explanation for this partial improvement is unknown, but it may relate to increased awareness of pain, agitation, and delirium in critically ill patients with the recent release of updated guidelines. Also, the abundant educational resources and advanced credentials now available to ICU nurses through national organizations such as the American Association of Critical-Care Nurses and the Society of Critical Care Medicine may have resulted in an increased understanding of the importance of concomitant analgesia/sedation when NMBA are used. The heightened emphasis on pain assessment and control by The Joint Commission may also explain the difference in familiarity with analgesia and anxiolysis.

In addition to the therapeutic effects, reviews and continuing education modules on NMBA also highlight the importance of nursing competency in drug pharmacokinetics, selection of patients and agents, adverse effects, and titration. Unfortunately, we are unaware of published studies measuring such knowledge. In our study, ICU nurses commonly misidentified the correct mechanism of drug elimination, perceived durations of action of NMBA varied widely, and certain adverse effects were underrecognized. The bedside nurse is the multidisciplinary team member most closely involved with weaning ICU patients off of CNS-active agents in. Failure to predict the offset of paralytic activity correctly, particularly in the setting of end-organ dysfunction, may place patients at increased risk of exposure to insufficient analgesia and sedation during the NMBA weaning process. Our findings suggest that an opportunity also exists to heighten the emphasis on screening for muscle breakdown, corneal ulceration, and venous thromboembolism in the nurses’ daily clinical assessments. Future quality improvement and educational initiatives should seek to address these knowledge gaps.

Unlike previous studies in which nurses were surveyed about the NMBA titration practice at their sites, we instead inquired about NMBA titration preference, specifically in patients with ARDS because of the recent favorable reports on use of NMBA for this indication; the differences were revealing. Foster and colleagues did a survey of 483 critical care nurse managers across the United States, asking about NMBA use and titration with a particular focus on PNS. Of the 185 centers that reported NMBA use, 116 (63%) monitored NMBA with PNS, and 111 of those also used the TOF technique. Eighty-three percent of respondents reported dose titration of NMBA to PNS response, which is in line with guideline recommendations from 2002. Although the difference did not reach statistical significance, in the present evaluation, we found that more nurses favored using titration to respiratory criteria (51%) rather than TOF (41%) for monitoring effects of NMBA in patients with ARDS. Studies that have compared TOF-guided NMBA titration to titration based on subjective clinical assessments in patients with mixed indications for paralysis have yielded disparate results. Rudis et al reported that lower doses of NMBA were used and recovery from paralytic agents was faster in patients randomized to TOF-guided therapy, whereas 2 other studies showed no difference between groups in total paralysis time, recovery time, and amount of drug used. In a randomized controlled trial of 102 patients with ARDS who were given cisatracurium,
researchers reported no difference in plateau pressure, ratio of PaO₂ to fraction of inspired oxygen, \( \text{Paco}_2 \), or pH between patients titrated to a TOF of 0/4 versus 2/4, but the authors did note a reduction in total drug used and recovery time among patients titrated to a TOF of 2/4. On the basis of these data, we suggest that providers pair TOF with clinical criteria to develop individualized titration plans that consider the indication for NMBA therapy. Indeed, management of an ICU patient with severe respiratory failure most likely requires a different approach to titration than management of a patient with elevated intracranial pressure.

This study had several possible limitations. Although the focus of the study is ICU nurses, many other members of the multidisciplinary team share responsibility for ensuring safe use of NMABs in practice. Coverage error may have existed between the target population of all medical ICU nurses and the sampling frame used in this study. The study was performed at 5 large academic medical centers. Facilities with fewer than 150 hospital beds or fewer than 10 ICU beds provide concurrent analgesia and sedation during NMBA less often and use PNS less often than larger centers do. If present, this bias most likely resulted in conservative estimates of NMBA knowledge gaps, but caution should still be used when generalizing these findings to smaller institutions. The results of this study may also be affected by nonresponse error. The response rate in this web-based survey was 22%, even after 3 reminder notifications were distributed to study participants by a local representative. We cannot exclude the possibility that nonresponders systematically differed from responders, but our findings are similar to the 25% response rate documented in a paper-and-pencil questionnaire distributed to physicians on a similar topic. Last, we did not measure baseline academic training, years of practice experience, postgraduate advanced credentialing in critical care, or involvement in national organizations (eg, American Association of Critical-Care Nurses, Society of Critical Care Medicine) and thus cannot comment on how these factors may have influenced the responses.

Conclusion

Current medical ICU nurses demonstrated a keen understanding of the importance of analgesia and sedation during therapeutic paralysis. Future educational efforts to improve the safe and effective use of NMABs should address the knowledge gaps identified in this study, including adverse effects and NMBA pharmacokinetics, which may directly affect dose adjustment and concomitant interventions. Last, a reappraisal of therapeutic goals of NMBA and titration strategies in patients with ARDS is warranted because ventilation and oxygenation should be considered in conjunction with PNS response.

FINANCIAL DISCLOSURES

This study was partially funded by a research grant from Mayo Clinic Pharmacy Services Discretionary Fund, Rochester, Minnesota.

eLetters

Now that you’ve read the article, create or contribute to an online discussion on this topic. Visit www.ajcconline.org and click “Submit a response” in either the full-text or PDF view of the article.

SEE ALSO

For more about neuromuscular blocking agents, visit the Critical Care Nurse website, www.ccnonline.org, and read the article by Wilson et al, “Residual Neuromuscular Blockade in Critical Care” (June 2012).

REFERENCES


To purchase electronic or print reprints, contact American Association of Critical-Care Nurses, 101 Columbia, Aliso Viejo, CA 92656. Phone, (800) 899-1712 or (949) 362-2050 (ext 532); fax, (949) 362-2049; e-mail, reprints@aacn.org.
1. Complications related to prolonged use of neuromuscular blocking agents (NMBAs) include which of the following?
   a. Musculoskeletal debility, community-acquired pneumonia
   b. Posttraumatic stress disorder, malnutrition, skin breakdown
   c. Corneal abrasions, ventilator-associated pneumonia, malnutrition
   d. Corneal abrasions, skin breakdown, venous thromboembolism

2. The investigators’ questionnaire demonstrated which of the following types of reliability?
   a. Content
   b. External
   c. Parallel-Forms
   d. Internal

3. Which of the following NMBAs were studied?
   a. Atracurium and rocuronium
   b. Cisatracurium and rocuronium
   c. Atracurium and vecuronium
   d. Tubocurarine and vecuronium

4. Exclusion criteria included which of the following?
   a. Nonresponse, no identification of intensive care unit provider role or multiple role identified, no institutional affiliation reported
   b. Employment in an academic medical center
   c. Completion of only 1 section of the survey
   d. Institution with an electronic medical record

5. Which of the following is the preferred method among respondents of N MBA titration for acute respiratory distress syndrome?
   a. Use of medication half-life
   b. Use of train-of-4 testing
   c. Use of respiratory criteria
   d. Use of peripheral nerve stimulator

6. Which of the following were identified as limitations of this study?
   a. Not enough patients receiving NMBAs within trial
   b. Too many small institutions (<150 hospital beds) included
   c. Not enough large medical centers included
   d. High nonresponse rate by providers, lack of collection of baseline variable such as years of experience

7. A new nurse asks how you know when to titrate up the NMA. You explain that the NMA is increased when the patient:
   a. Experiences ventilator asynchrony
   b. Train-of-4 demonstrates 0 out of 4
   c. Follows commands
   d. Requires pressure support ventilation

8. Which of the following was the total number of responses included in the study?
   a. 717
   b. 160
   c. 557
   d. 553

9. A patient is exhibiting signs of renal and liver failure. Which of the following is the most appropriate NMA to use?
   a. Cisatracurium
   b. Propofol
   c. Vecuronium
   d. Pancuronium

10. After NMBAs are stopped and a patient is extubated, the nurse needs to monitor for which of the following residual complications of NMBAs?
    a. Hyperglycemia
    b. Infection
    c. Posttraumatic stress disorder
    d. Hypomagnesium

11. Which of the following concurrent conditions did nurses identify as increasing the risk profile for NMBAs?
    a. Lactic acidosis and hyperglycemia
    b. History of neuromuscular disorder and presence of pressure ulcers
    c. Delirium and posttraumatic stress disorder
    d. Stress ulcer and venous thromboembolism formation

Test ID: A1524052 Contact hours: 1.0; pharma 0.0 Form expires: September 1, 2018. Test Answers: Mark only one box for your answer to each question.

For faster processing, take this CE test online at www.aacsonline.org (“CE Articles in This Issue”) or mail this entire page to: AACN, 101 Columbia, Aliso Viejo, CA 92656.
MECHANICAL VENTILATION
ANTIOXIDANT TRIAL

By Kimberly P. Howe, RN, PhD, John M. Clochesy, RN, PhD, Lawrence S. Goldstein, MD, and Hugh Owen, PharmD

Background Many patients each year require prolonged mechanical ventilation. Inflammatory processes may prevent successful weaning, and evidence indicates that mechanical ventilation induces oxidative stress in the diaphragm, resulting in atrophy and contractile dysfunction of diaphragmatic myofibers. Antioxidant supplementation might mitigate the harmful effects of the oxidative stress induced by mechanical ventilation.

Objective To test the clinical effectiveness of antioxidant supplementation in reducing the duration of mechanical ventilation.

Methods A randomized, prospective, placebo-controlled double-blind design was used to test whether enterally administered antioxidant supplementation would decrease the duration of mechanical ventilation, all-cause mortality, and length of stay in the intensive care unit and hospital. Patients received vitamin C 1000 mg plus vitamin E 1000 IU, vitamin C 1000 mg plus vitamin E 1000 IU plus N-acetylcysteine 400 mg, or placebo solution as a bolus injection via their enteral feeding tube every 8 hours.

Results Clinical and statistically significant differences in duration of mechanical ventilation were seen among the 3 groups (Mantel-Cox log rank statistic = 5.69, $df = 1$, $P = .017$). The 3 groups did not differ significantly in all-cause mortality during hospitalization or in the length of stay in the intensive care unit or hospital.

Conclusions Enteral administration of antioxidants is a simple, safe, inexpensive, and effective intervention that decreases the duration of mechanical ventilation in critically ill adults. (American Journal of Critical Care. 2015;24:440-445)
Although mechanical ventilation is a life-saving procedure when patients experience respiratory failure, it is usually intended to be brief, with the goal of patients being weaned off of mechanical ventilation once the underlying disease process is reversed and no other complications remain.¹ It is estimated that between 4% and 13% of patients who receive mechanical ventilation require it for a prolonged period.²,³ In the United States, more than 100,000 patients are chronically critically ill, and most of them require mechanical ventilation.⁴ The cost associated with caring for these chronically critically ill patients exceeded $3.3 billion annually in 1991. The process of liberating patients from mechanical ventilation is not only costly in dollars but also in time and effort. Despite the large investment of time, effort, and money, the prevalence of prolonged mechanical ventilation has not decreased.⁵ Inflammatory processes have been identified as potential barriers to the ability to resume breathing spontaneously.⁶ A growing body of literature⁷-¹² supports the notion that mechanical ventilation induces oxidative stress in the diaphragm by increasing oxidant production, resulting in atrophy and contractile dysfunction of diaphragmatic myofibers.

Oxidative stress can activate inflammatory cascades, which in turn can result in greater generation of reactive oxygen species.¹³-¹⁵ Antioxidant supplementation has the potential to mitigate the harmful effects of the oxidative stress induced by mechanical ventilation. A recent series of systematic reviews¹⁶-¹⁹ suggest that supplementation with high doses of trace elements and vitamins may improve outcomes of critically ill patients. The purpose of this study was to test the clinical effectiveness of antioxidant supplementation in reducing the duration of mechanical ventilation.

Materials and Methods

Design

A prospective, randomized, placebo-controlled double-blind design was used to test whether enterally administered antioxidant supplementation would decrease the duration of mechanical ventilation. Patients received either the placebo; vitamin C and vitamin E; or vitamin C, vitamin E, and N-acetylcysteine every 8 hours as a bolus dose via enteral feeding tubes. Patients received antioxidant supplementation for 28 days or until they were weaned from mechanical ventilation, whichever was shorter.

Antioxidants

Antioxidant supplements included 1000 mg vitamin C (ascorbic acid), 1000 IU vitamin E (α-tocopherol), and 400 mg N-acetylcysteine administered every 8 hours via enteral feeding tube. The “antioxidant supplements” were prepared in the research pharmacy and placed in 3 syringes containing 5 mL each with an inert yellow coloring agent added to the placebo and vitamin C solutions. To further mask group assignment, patients in group 1 received three 5-mL doses of placebo; patients in group 2 received a 5-mL dose of vitamin C, a 5-mL dose of vitamin E, and a 5-mL dose of placebo; and patients in group 3 received a 5-mL dose of vitamin C, a 5-mL dose of vitamin E, and a 5-mL dose of N-acetylcysteine.

The research pharmacy provided the appropriate supplement on the basis of a preestablished randomization table. Appropriate procedures were in place to ensure the blinding of all investigators, physicians, and nursing staff. In case of emergency, patients’ physicians could obtain the group assignment through the pharmacy. Syringes were labeled “MVAT study drug” along with the patient’s name and room number. Three syringes were dispensed 3 times a day with the appropriate contents based on the randomized group assignment. The intervention was delivered every 8 hours by intermittent

Most chronically critically ill patients in the United States require mechanical ventilation.

About the Authors

Kimberly P. Howe is corporate director of academic affairs, Northside Medical Center, Youngstown, Ohio. John M. Clochesy is a professor, University of South Florida College of Nursing, Tampa, Florida. Lawrence S. Goldstein is medical director of the medical intensive care unit, Northside Medical Center, and an associate professor at Northeastern Ohio Universities College of Medicine, Rootstown, Ohio. Hugh Owen is a pharmacist at Northside Medical Center.

Corresponding author: John M. Clochesy, RN, PhD, University of South Florida College of Nursing, 12901 Bruce B. Downs Blvd, MDC 22, Tampa FL 33612-4766 (e-mail: jcloches@health.usf.edu).
Duration of mechanical ventilation for patients receiving vitamin C plus vitamin E was a mean of 10 days.

Setting
This study was conducted in the medical intensive care unit (ICU), surgical ICU, and progressive care unit (a long-term ventilator unit) of a 450-bed university-affiliated community teaching hospital in Northeast Ohio. The ICUs are closed units and are staffed by full-time intensivists.

Sample
Following approval of the institutional review boards, the privacy board, and the patients’ physicians, potential participants, or their surrogates, were approached by unit personnel and the study was explained. If interest in getting more information was expressed, one of the investigators approached the potential participant, or the surrogate, and described the study in detail and obtained informed consent. Potential participants were eligible for the study if they were 21 years of age or older, required mechanical ventilation for 72 hours, and mechanical ventilation was initiated at the study site during the current hospital stay. Those excluded from participation were patients with brainstem infarcts/hemorrhage, global hypoxic encephalopathy, spinal cord injury/lesions, phrenic nerve injury/paralysis, myasthenia gravis, and Guillain-Barré syndrome who had impaired neuromuscular integrity. Children less than 21 years of age were not included in the study because they are transferred to 1 of 3 pediatric ICUs in the region. Patients with a history of allergy to any of the agents used were excluded. Further, because of the increased risk of bleeding related to large doses of vitamin E, patients receiving doses of heparin, low-molecular-weight heparin, or warfarin were excluded from this study. Those receiving aspirin, heparin, and low-molecular-weight heparin at doses intended to prevent venous thrombosis were allowed to participate. After informed consent was obtained, patients were randomized into 1 of 3 treatment groups.

Statistical Analysis
The trial used an independent data safety monitor comprising 3 critical care physicians who were not involved in the investigation to ensure the safety of patients enrolled in the study and to ensure the integrity of the clinical trial. F tests, χ² tests, and t tests were used for between-group comparisons. Survival analytic techniques were used for time-to-event data (duration of mechanical ventilation and length of stay). Any deviations in treatment protocol were handled by an intent-to-treat approach to data analysis. No protocol deviations occurred and all subjects completed the study, hence this technique was not used. Statistical analysis was performed by using IBM SPSS Statistics.

Results
Seventy-six potential participants, or their surrogates, consented to participate in this study. Four patients were excluded from the study: 1 extubated himself before receiving the intervention, 1 died before receiving the intervention, and 2 had hypoxic encephalopathy diagnosed. Thus a total of 72 patients, 37 men and 35 women, 22% from underrepresented minorities (primarily African American), ranging in age from 36 to 93 years were enrolled in and completed the study. The surrogates of 9 potential participants who met inclusion criteria refused consent to participate, resulting in a consent rate of 89%.

Characteristics of patients did not differ significantly among the 3 treatment groups (Table 1). No significant differences among the 3 groups were found in primary diagnosis (cardiovascular, pulmonary, hepatic, sepsis, and others; χ² = 1.9), in the presence of chronic obstructive pulmonary disease (χ² = 0.8), the inspired oxygen fraction (F = 2.9, P = .06) or the ratio of PaO₂ to fraction of inspired oxygen (F = 1.1, P = .35). The duration of mechanical ventilation for patients receiving vitamin C plus vitamin E was a mean of 10 days and median of 6 days. For those receiving vitamin C plus vitamin E plus N-acetylcysteine, the mean was 12 days and the median was 6 days. The duration for those receiving placebo was a mean of 19 days and a median of 15 days. Clinical and statistically significant differences were seen among the 3 groups (Mantel-Cox log rank statistic = 5.69, df = 1, P = .02). No difference was noted between the 2 antioxidant groups (Mantel-Cox log rank statistic = 0.11, df = 1, P = .74). All-cause mortality during hospitalization, ICU length of stay, and hospital length of stay did not differ significantly among the 3 groups (Table 2).

Daily costs associated with the care of patients in this trial were as follows: antioxidants (and placebo)
### Table 1
**Characteristics of participants in the study by treatment group**

<table>
<thead>
<tr>
<th>Variable</th>
<th>No.</th>
<th>Mean (SD)</th>
<th>Median (IQR)</th>
<th>Test statistic</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, y</td>
<td>72</td>
<td></td>
<td>72 (19)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C+E+NAC</td>
<td>23</td>
<td>64.7 (15.1)</td>
<td>65 (16)</td>
<td>F = 2.6</td>
<td>.08</td>
</tr>
<tr>
<td>Placebo</td>
<td>22</td>
<td>72.9 (9.5)</td>
<td>73 (16)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C+E</td>
<td>27</td>
<td>66.6 (12.8)</td>
<td>72 (19)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td>$\chi^2 = 1.4$</td>
<td>.50</td>
</tr>
<tr>
<td>C+E+NAC</td>
<td>37</td>
<td>64.7 (15.1)</td>
<td>65 (16)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Placebo</td>
<td>13</td>
<td>72.9 (9.5)</td>
<td>73 (16)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C+E</td>
<td>15</td>
<td>66.6 (12.8)</td>
<td>72 (19)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Body mass index</td>
<td>70</td>
<td>28.8 (10.7)</td>
<td></td>
<td>F = 1.68</td>
<td>.20</td>
</tr>
<tr>
<td>C+E+NAC</td>
<td>21</td>
<td>33.5 (11.5)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Placebo</td>
<td>22</td>
<td>29.1 (7.5)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C+E</td>
<td>27</td>
<td>33.5 (11.5)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>APACHE III score</td>
<td>72</td>
<td>75.8 (18.8)</td>
<td></td>
<td>F = 2.26</td>
<td>.11</td>
</tr>
<tr>
<td>C+E+NAC</td>
<td>23</td>
<td>79.6 (19.4)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Placebo</td>
<td>22</td>
<td>79.6 (19.4)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C+E</td>
<td>27</td>
<td>88.6 (23.5)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fio2</td>
<td>72</td>
<td>0.38 (0.12)</td>
<td>0.35 (0.10)</td>
<td>F = 1.07</td>
<td>.35</td>
</tr>
<tr>
<td>C+E+NAC</td>
<td>23</td>
<td>0.51 (0.24)</td>
<td>0.40 (0.29)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Placebo</td>
<td>22</td>
<td>0.44 (0.17)</td>
<td>0.40 (0.15)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C+E</td>
<td>27</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pao2/Fio2</td>
<td>72</td>
<td>229 (72)</td>
<td>232.5 (78.9)</td>
<td>F = 2.88</td>
<td>.06</td>
</tr>
<tr>
<td>C+E+NAC</td>
<td>23</td>
<td>195 (92)</td>
<td>202.8 (137.4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Placebo</td>
<td>22</td>
<td>211 (70)</td>
<td>213.3 (85.0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C+E</td>
<td>27</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COPD history</td>
<td>32</td>
<td></td>
<td></td>
<td>$\chi^2 = 0.8$</td>
<td>.66</td>
</tr>
<tr>
<td>C+E+NAC</td>
<td>11</td>
<td>11 (48%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Placebo</td>
<td>8</td>
<td>8 (36%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C+E</td>
<td>13</td>
<td>13 (48%)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: APACHE, Acute Physiology and Chronic Health Evaluation; COPD, chronic obstructive pulmonary disease; Fio2, fraction of inspired oxygen; IQR, interquartile range.

* Treatment groups: C + E + NAC, vitamin C, vitamin E, and N-acetylcysteine; C + E, vitamin C and vitamin E.

### Table 2
**Outcomes by treatment group**

<table>
<thead>
<tr>
<th>Variable</th>
<th>No.</th>
<th>Mean (SD)</th>
<th>Test statistic</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>All-cause mortality</td>
<td>27</td>
<td></td>
<td>$\chi^2 = 0.6$</td>
<td>.52</td>
</tr>
<tr>
<td>C+E+NAC</td>
<td>8</td>
<td>14.8 (12.1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Placebo</td>
<td>10</td>
<td>19.1 (16.0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C+E</td>
<td>9</td>
<td>12.9 (9.0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Days in intensive care unit</td>
<td>72</td>
<td></td>
<td>F = 2.03</td>
<td>.14</td>
</tr>
<tr>
<td>C+E+NAC</td>
<td>23</td>
<td>13.0 (10.5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Placebo</td>
<td>22</td>
<td>19.1 (16.0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C+E</td>
<td>27</td>
<td>12.9 (9.0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Days in hospital</td>
<td>72</td>
<td></td>
<td>F = 0.12</td>
<td>.89</td>
</tr>
<tr>
<td>C+E+NAC</td>
<td>23</td>
<td>22.5 (20.8)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Placebo</td>
<td>22</td>
<td>22.6 (15.5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C+E</td>
<td>27</td>
<td>21.1 (13.7)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Treatment groups: C + E + NAC, vitamin C, vitamin E, and N-acetylcysteine; C + E, vitamin C and vitamin E.
prepared by the investigational pharmacy, $50; venti-
lator and associated care, $1553; and ICU "room" costs, $5685. Since ICU length of stay did not differ among the 3 groups, the cost benefit from enterally administered antioxidants was in decreased costs related to the need for the ventilator and associated care.

Discussion

When patients are being weaned from long-term mechanical ventilation, clinicians must consider both nonpulmonary and pulmonary factors. Critically ill patients have lower circulating levels of serum ascorbic acid21-24 and α-tocopherol.22,25,26 Antioxidant depletion occurs early in the course of critical illness and correlates with increasing levels of organ dysfunction.23,24,27,28 The importance of oxidative stress in critical illness is often overlooked.

In an early study, Preiser et al29 provided enteral feedings enriched with vitamins A, C, and E for a 7-day period. Although these investigators found an increase in plasma concentrations of the vitamins and improved resistance to oxidation of low-density lipoproteins, clinical outcomes did not differ significantly between patients who received the antioxidant-enriched enteral feedings and patients who received a standard feeding solution.

The current study demonstrated that antioxidant supplementation every 8 hours reduced duration of mechanical ventilation, consistent with results of several other investigations, including both human and animal models. Nathens et al30 reported that supplementation with 1000 IU α-tocopherol administered every 8 hours enterally and 1000 mg ascorbic acid administered intravenously every 8 hours to critically ill surgical patients resulted in a lower likelihood of multiple organ failure developing compared with patients receiving standard care. Pontes-Arruda and colleagues31 reported that a continuously administered enteral diet enriched with omega-3 fatty acids and antioxidants was associated with a reduction in mortality as well as improved oxygenation status and more ventilator-free days.

Since this study was done, Miller et al31 conducted a meta-analysis of 19 studies and concluded that vitamin E administered at high doses (median dose, 400 IU per day) may increase all-cause mortality. Several limitations of this analysis were noted. First, most of the clinical trials included were conducted on healthy persons and on persons who had a chronic illness diagnosed. None of the studies in this meta-analysis were conducted on critically ill adults, a population shown to have significant antioxidant depletion. Last, unlike the patients in the current study, who received antioxidant supplementation for a short period (≤ 28 days), patients in the 19 studies included in Miller’s meta-analysis received vitamin E supplementation for a mean of 2.75 years (range, 1.4-8.2 years).

Although antioxidant administration may have adverse effects, for example, bleeding with large doses of vitamin E and metabolic acidosis, precipitation of kidney stones, and hemolytic anemia among patients with inadequate levels of glucose-6-phosphate dehydrogenase when large doses of vitamin C are administered. None of these adverse effects were observed in the current study. A recent Cochrane review reported no significant effect of intravenously administered N-acetylcysteine on duration of mechanical ventilation or length of stay.32 This is consistent with our findings that enterally administered N-acetylcysteine provided no additional benefit beyond the benefits provided by vitamins C and E.

Limitations of the study are the single site and the relatively small sample. The findings cannot be readily compared with results of trials in which ascorbic acid, N-acetylcysteine, or both were administered parenterally.

Implications for Research and Practice

Future research could focus on 2 main areas. First, is supplementation with vitamin C alone sufficient to achieve the results, as we found no difference between patients receiving vitamins C and E and patients who also received N-acetylcysteine. Further, it is not clear that most critically ill adults are deficient in vitamin E. Second, would starting antioxidant supplementation at the time of injury or surgery decrease the risk for prolonged mechanical ventilation?

Conclusions

Enterally administered antioxidants are a simple, safe, inexpensive, and effective intervention that decreases the duration of mechanical ventilation in critically ill adults. N-acetylcysteine does not appear to offer any benefit beyond that provided by vitamins C and E.

ACKNOWLEDGMENT

The authors acknowledge the contributions of John Politi, MD, to the conceptualization and design of the study as well as the analysis and interpretation of the findings.

FINANCIAL DISCLOSURES

Supported in part by a grant from the American Association of Critical-Care Nurses and Sigma Theta Tau International.
Common Symptoms in Patients Receiving Mechanical Ventilation, "Nonpharmacological Interventions to Manage Mechanical Ventilation, visit the web site, www.ccnonline.org, and read the article by Tracy and Chlan, “Nonpharmacological Interventions to Manage Common Symptoms in Patients Receiving Mechanical Ventilation” (June 2011).

REFERENCES


To purchase electronic or print reprints, contact American Association of Critical-Care Nurses, 101 Columbia, Aliso Viejo, CA 92656. Phone, (800) 899-1712 or (949) 362-2050; fax, (949) 362-2049; e-mail, reprints@aacn.org.
Benefit to Family Members of Delivering Hand Massage With Essential Oils to Critically Ill Patients

By Charlesea Prichard, RN, MSN, CCRN, CCAP, NE-BC, and Patricia Newcomb, RN, PhD, CPNP

Background In intensive care environments, patients’ families are often encouraged to participate in their loved one’s care; however, many family members feel anxious, depressed, and unsure about how to help patients.

Objectives To determine (1) the feasibility of teaching family members a simple intervention combining hand massage with essential oils in a trauma intensive care unit and (2) an effect size for use in designing a more powerful trial.

Method A quasi-experimental pilot study of the effect of a family-delivered touch treatment on anxiety and depression of family members of patients. Fifteen family members were assigned to a treatment group, and 15 family members were assigned to a control group. The treatment consisted of the application of hand massage with essential oils for 6 sessions. Each session lasted 5 minutes and was presented twice a day for 3 days.

Results The 5-minute intervention was associated with positive change in anxiety and depression scores on the Hospital Anxiety and Depression Scale (HADS) among family members visiting patients. The magnitude of change (improvement) in anxiety scores within the group of treated family members was significantly greater than within family members in the control group.

Conclusion Administering a brief hand massage using pleasant-smelling oils to patients in an intensive care unit may reduce anxiety of family members who administer the treatment. (American Journal of Critical Care. 2015;24:446-449)
Hospitalization can result in emotional distress for family members of patients. Highly stressed family members may adversely affect themselves, the patient, and hospital staff. It is important for nurses to recognize such stress and address the needs of patients’ family members. Institute of Medicine recommendations include the development of family interventions to reduce stress and promote mutually supportive family interactions. Teaching family members to provide care for an acutely ill patient promotes feelings of empowerment and closeness and may diminish family stress. Some evidence indicates that family members want to perform some patient care such as touching, encouraging, and assisting with daily living routines.

Purpose
The purpose of this pilot study was to assess the feasibility of teaching a simple intervention to family members of patients in a trauma intensive care unit (ICU). A secondary aim was to determine effect size of the intervention as a means of calculating power and sample size for future studies.

Background
Family-centered care (FCC) is an approach to delivering health care that emphasizes establishing and sustaining mutually beneficial partnerships between patients, their families, and health care providers. From the perspective of the FCC model, the patient and the patient’s family members are the unit of care. Nurses practicing within an FCC framework deliver emotional care to patients’ family members, and family members may participate in the care of patients. Complementary therapies delivered by family members may provide reasonable and efficient interventions for the emotional care of family members while simultaneously comforting patients.

Aromatherapy and massage are common complementary therapies. Aromatherapy involves the topical application of essential oils, and it is thought that people may derive emotional benefit from aromatherapy. For instance, Citrus bergamia, or bergamot oil, is thought to relieve symptoms of anxiety and depression. Massage involves manipulating muscle, joints, or skin by stroking or kneading and is frequently conducted by using oils. The combination of aromatherapy and light hand massage improves comfort and mood. The finding that many people are comforted when another gently strokes their skin with pleasant-smelling oil constitutes the rationale for asking family members to apply massage to patients’ hands. Scientific evidence of the effectiveness of aromatherapy and/or massage is scarce and typically weak, but interest in providing such therapy is growing among critical care nurses; therefore, research on these complementary therapies is important.

Methods
This quasi-experimental pilot study was approved by the institutional review board at Texas Health Resources and complied with ethical standards set forth in the Helsinki Declaration of 1975. During the process of obtaining written consent, conducted by the principal investigator (C.P.), potential participants (family members) were informed that the purpose of the study was to evaluate the effect of a massage intervention on their own feelings and that the intervention might help the patient feel better, too.

Sample
The convenience sample consisted of 30 persons. The first 15 persons who enrolled were assigned to a control group, and the second set of 15 participants were assigned to a treatment group. English-speaking, literate, adult family members of patients admitted to the trauma ICU were eligible to participate with the following exceptions. Bergamot oil is citrus based and the carrier oil is nut based; therefore, potential participants were excluded from the study if they or the patient were sensitive to citrus or nuts. Pregnant family members or family members of patients with injuries to both hands or catheters placed in both hands also were excluded.

About the Authors
Charlsea Prichard is manager of the trauma intensive care unit at Texas Health Harris Methodist Hospital, Fort Worth, Texas. Patricia Newcomb is a nurse scientist at Texas Health Resources, Fort Worth, Texas.

Corresponding author: Patricia Newcomb, RN, PhD, CPNP, Texas Health Resources, 701 5th Avenue, Fort Worth, TX 76104 (e-mail: PatriciaNewcomb@texashealth.org).
Table 1
Sample attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Total sample (N = 30)</th>
<th>Treatment group (n = 15)</th>
<th>Control group (n = 15)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age, y</td>
<td>51</td>
<td>51</td>
<td>51</td>
</tr>
<tr>
<td>Female sex, %</td>
<td>80</td>
<td>87</td>
<td>73</td>
</tr>
<tr>
<td>White race, %</td>
<td>80</td>
<td>93</td>
<td>67</td>
</tr>
<tr>
<td>Identified as anxious on screening at enrollment, %</td>
<td>80</td>
<td>67</td>
<td>93</td>
</tr>
<tr>
<td>Identified as depressed on screening at enrollment, %</td>
<td>67</td>
<td>60</td>
<td>73</td>
</tr>
</tbody>
</table>

Measures
The Hospital Anxiety and Depression Scale (HADS) was administered to each participant. The HADS is a 14-item self-report screening that contains 2 subscales of 7 items each. One subscale (HADS-A) purports to measure anxiety and the other subscale (HADS-D) measures “depression.” The aspect of depression measured in the HADS is anhedonia, the loss of pleasure response. HADS items are answered on a 4-point response scale from 0 to 3, indicating frequency (eg, “seldom” to “very often”) or agreement (eg, “definitely” to “not at all”). The HADS takes about 2 to 5 minutes to complete, and instructions on the version used in this study were to report on how items “currently” describe participants’ feelings.

In a 2002 review of the literature regarding validity of the HADS, Bjelland et al reported that more than 700 papers had described HADS sensitivity, specificity, factor structure, discriminant validity, internal consistency, and agreement with other self-report measures for anxiety and depression. As a screening instrument, HADS has shown good sensitivity and specificity in samples of inpatients, primary care patients, and community members, and good evidence for validity and reliability has been documented. For instance, across 22 studies that reported internal consistency, Cronbach α’s ranged from 0.68 to 0.93 for the HADS-A and 0.67 to 0.90 for the HADS-D. In studies that were large enough to appropriately use factor analysis, factors ranged from 2 to 3 and were theoretically consistent.

Procedure
Nursing staff in the trauma ICU encouraged participants to provide usual family care, such as caressing and talking to the patient. Participants were asked to visit their patient twice a day, for 3 consecutive days. The control group received no further instructions. The HADS tool was administered to all participants on the day of enrollment and again on the last study day (4 days later).

Treatment group participants were screened for nut or citrus sensitivity, and a patch test of the essential oil was performed on the patient and the participant. Each treatment participant received written instructions for hand massage and a bottle of 5% bergamot oil mixed in almond oil. Participants were taught to administer hand massage in compliance with the M Technique, a registered method of simple, structured touch that has been used on critically ill patients with positive effects. The M Technique uses repetitive stroking movements in a structured sequence. For this study, the technique was used on hands. Participants applied the intervention twice daily for 5 minutes per session for 3 consecutive days.

Results
Fifteen participants were assigned to the control group and 15 to the intervention group. All participants completed the study. Characteristics of the sample are described in Table 1, which shows the groups were nonequivalent in regard to anxiety scores before treatment (Mann-Whitney test result: P = .03). The HADS-A demonstrated acceptable test-retest reliability (Spearman-Brown coefficient = 0.90) and internal consistency (Cronbach α, 0.87-0.91). The HADS-D also showed acceptable test-retest reliability (Spearman-Brown coefficient = 0.83) and internal consistency (Cronbach α, 0.85-0.89).

Before the intervention, HADS-A scores ranged from 4 to 20 (mean, 12.73), and after the intervention, HADS-A scores ranged from 1 to 21 (mean, 10.6). Before the intervention, HADS-D scores ranged from 0 to 19 (mean, 9.47), and after the intervention, HADS-D scores ranged from 0 to 20 (mean, 8.03).

Mean change in scores was approximately normally distributed and raw scores were not normally distributed; therefore, the magnitudes of the mean changes in score rather than mean raw scores for anxiety and depression were compared between groups by means of a t test.

As shown in Table 2, the mean change in anxiety scores was significantly greater for the treatment group than for the control group, and the change was in a positive direction. The effect of the intervention on this outcome was large (d = 1.3), that is, the mean change size in the treatment group was at the 90th percentile of the control group. The groups did not differ significantly with respect to change in HADS-D scores. Age was inversely related to the magnitude of change in anxiety scores (r = -0.36, P < .05); that is, younger participants were more likely than older participants to experience relief from anxiety.
Discussion  
This study demonstrated that a brief, inexpensive, family-delivered touch/aroma intervention is feasible in an ICU. It is striking that even in this poorly powered pilot study, gentle hand massage with essential oils substantially influenced the anxiety level of the family member delivering the massage. Effects on depression (anhedonia) were not statistically significant, but attained a moderate effect size.

Many families were unable to visit daily, and the research team observed that males tended to be less interested in the intervention; therefore, research to discover acceptability of complementary therapies to different groups and to test such interventions with unrelated, but available persons such as volunteers would be of interest. Lack of randomization precludes strong claims regarding cause, but the large effect size of the intervention on anxiety scores indicates that a genuine randomized, controlled trial could be informative with a relatively small sample size. Larger quasi-experimental studies employing valid control strategies could also be useful.

FINANCIAL DISCLOSURES  
None reported.

eLetters  
Now that you’ve read the article, create or contribute to an online discussion on this topic. Visit www.ajcconline.org and click “Submit a response” in either the full-text or PDF view of the article.

REFERENCES  
Most patients discharged from critical care, particularly after septic shock, experience problems with physical, psychosocial, and emotional functioning. We report on bilateral blindness and unilateral sensorineural hearing loss as rare but severely disabling complications in a young survivor of septic shock.

Case Report

A 42-year-old man with a history of psoriatic arthritis, for which he used methotrexate (2.5 mg once a week), came to the emergency department with abdominal pain 2 days after endoscopic repair of an inguinal hernia. Laboratory examination revealed an elevated level of C-reactive protein (51 mg/L; reference value < 10 mg/L; to convert to nanomoles per liter, multiply by 9.524) and leukocytosis (13.9 x 10^9/L; reference value, 4.0-10.0 x 10^9/L), with an elevated level of neutrophils (12.6 x 10^9/L; reference value, 1.3-5.7 x 10^9/L) among others. Ultrasound showed a fluid collection in the abdominal wall, thought to indicate a rectus hematoma.

The patient was admitted to the surgical care area for observation and analgesia, but clinical deterioration occurred and septic shock developed within 12 hours of admission. The patient was admitted to the intensive care unit (ICU) and resuscitated with fluids and vasopressors. Antibiotics (ceftriaxone and metronidazole) were administered to treat...
a suspected abdominal infection and an emergency laparotomy was performed, which showed turbid fluid but no perforation or abscess. The mesh was removed and culture samples were taken. When cultures revealed hemolytic group A streptococcus, antibiotic treatment was switched to penicillin and clindamycin. Intravenous immunoglobulin was added for treatment of toxic shock syndrome.

The patient had severe septic shock with multiorgan failure, including diffuse intravascular coagulation and acute respiratory distress syndrome (ratio of Pao₂ to fraction of inspired oxygen <20 kPa). Massive fluid replacement (maximal cumulative fluid balance was 50 L positive) and high-dose vasopressor therapy were needed (for 8 days; norepinephrine maximum dose 2.7 μg/kg per minute and epinephrine maximum 0.08 μg/kg per minute). He was initially ventilated with high pressures (maximal positive end-expiratory pressure, 14 cm H₂O) and high inspiratory oxygen, but he was not ventilated in prone position. After recovery from septic shock and extubation, he reported blindness in both eyes. His pupils were dilated and unresponsive to light. Ophthalmological evaluation revealed minimal papillary retinal hemorrhages without signs of papillary edema. Magnetic resonance imaging was performed but did not yield an explanation for his blindness. Visually evoked potentials were negative. The patient had bilateral ischemic optic neuropathy diagnosed. A course of steroids was considered to treat optic nerve edema but was found unsafe at that time because he still had an ongoing infection. Two weeks later, he unfortunately also experienced sudden unilateral deafness on the left side. No sound was perceived at 100 dB for frequencies from 250 to 8000 Hz on the left side, whereas no loss was observed for those frequencies in the right ear. At that time, a course of dexamethasone (4 mg 3 times a day for 1 week) was started, but neither vision nor hearing improved after steroid therapy. Follow-up ophthalmological examination showed regression of retinal hemorrhages, but 4 months after diagnosis there was still no light perception or pupillary reaction to light and fundoscopy revealed bilateral optic nerve pallor. In the meantime, more than 15 months after the ICU admission, his complete vision loss without any light sensation and unilateral hearing loss are unfortunately still unchanged.

**Discussion**

Ischemic optic neuropathy is a rare but serious complication of critical illness\(^1\) that has an anterior and a posterior type, each of which has several subtypes.\(^4\) Anterior ischemic optic neuropathy has 2 types: arteritic (due to giant cell arteritis) and nonarteritic (due to other causes and much more common).\(^5,6\) Posterior ischemic optic neuropathy has 3 subtypes: arteritic (due to giant cell arteritis); nonarteritic (the most common type); and surgical, postoperative, or perioperative (associated with various extraocular surgical procedures).\(^7-9\)

Blood supply to the posterior optic nerve is almost entirely dependent on the pial vasculature, which is very susceptible to ischemia.

The pathogenesis of ischemic optic neuropathy seems complex and is still not completely understood. Multiple factors seem to play a role, including arterial hypotension, blood loss and anemia, venous congestion, use of vasopressors, prone position, preexisting vaso-occlusive disease, and periocular edema.\(^10,12\)

A course of high-dose systemic steroids can decrease optic nerve edema and thereby improve outcome.\(^13\) Spontaneous recovery from or improvement of ischemic optic neuropathy is unlikely.

The exact cause of ischemic optic neuropathy in this case remains unclear. The patient had severe septic shock with multiorgan failure including diffuse intravascular coagulation, and aggressive resuscitation was needed. Multiple conditions that may have predisposed him to the development of ischemic optic neuropathy can be identified, including the hypotension, the massive fluid resuscitation and high-dose vasopressor therapy, venous congestion, the high levels of positive end-expiratory pressure and hypoxemia. The consequence of the administration of large amounts of crystalloids in his condition with capillary leakage is edema formation. Epinephrine is postulated to cause severe vasospasm of the ocular vessels.\(^11\) The presence of retinal bleeding on the initial ophthalmological examination may suggest a contributing role for diffuse intravascular coagulation. Although he had acute respiratory distress syndrome, he never received mechanical ventilation while prone. He did not have excessive blood loss or severe anemia and was not known to have vaso-occlusive disease. We found several other cases with visual damage acquired during ICU admission, but only 1 case of blindness after sepsis.\(^14\) Known causes for hearing loss in critical ill patients are combined aminoglycoside antibiotic and loop diuretic therapy. This patient received only 1 dose of aminoglycosides on the first day and was not treated with loop diuretics while in the ICU. The dogma of gentamicin ototoxicity theorizes that the toxic effects of the drug are cumulative, dose dependent, and

**About the Authors**

L. E. M. Haas is an internist-intensivist, R. S. van der Ploeg is an ophthalmologist, J. J. Quak is an internist-intensivist, J. P. J. Burgmans is a surgeon, and M. Otten is an anesthesiologist-intensivist at Diakonessenhuis, Utrecht, the Netherlands.

Corresponding author: L. E. M. Haas, Department of Intensive care, Diakonessenhuis Utrecht, Postbus 80250, 3508 TG Utrecht, the Netherlands (e-mail: lvlelyveld@diakhuis.nl).

www.ajcconline.org
irreversible and generally affect only high frequencies. However, clinical observations showed ototoxicity after single doses, and clinical improvement in hearing over time have been observed. In mice, it was indeed demonstrated that a single large dose of gentamicin may have ototoxic effects similar to those of multiple doses and that there is a potential for hearing recovery over time.\textsuperscript{15} So gentamicin ototoxicity cannot be completely excluded. However, we think that since the hearing loss is unilateral and not only the higher tones, gentamicin ototoxicity is less likely.

It seems likely that the same factors that can cause ischemic optic neuropathy also can affect the vestibulocochlear nerve. The relative contribution of each of the mentioned causal factors is speculative. Besides, the complication seems unpreventable, because these measures were needed in the initial phase of resuscitation.

Conclusion

A young man survived a septic shock but at the cost of bilateral irreversible complete vision loss due to ischemic optic neuropathy combined with unilateral sensorineural hearing loss.

FINANCIAL DISCLOSURES
None reported.

REFERENCES


To purchase electronic or print reprints, contact American Association of Critical-Care Nurses, 101 Columbia, Aliso Viejo, CA 92656. Phone, (800) 899-1712 or (949) 362-2050 (ext 532); fax, (949) 362-2049; e-mail, reprints@aacn.org.
Scenario: This 12-lead electrocardiogram (ECG) was obtained in the emergency department (ED) from a previously healthy 56-year-old female found unresponsive at home. During transport she had a seizure followed by a cardiac arrest, but was successfully resuscitated. While in the ED, she had another seizure and became bradycardic with agonal respirations and was consequently intubated.

ECG Changes During Neurologic Injury

By Salah S. Al-Zaiti, RN, PhD, CRNP, Elizabeth A. Crago, RN, PhD, Marilyn Hravnak, RN, PhD, ACNP, Teri M. Kozik, RN, PhD, CNS, CCRN, Michele M. Pelter, RN, PhD, and Mary G. Carey, RN, PhD

ECG Puzzler

A regular feature of the American Journal of Critical Care, the ECG Puzzler addresses electrocardiogram (ECG) interpretation for clinical practice. To send an eLetter or to contribute to an online discussion about this article, visit www.ajcconline.org and click “Respond to This Article” on either the full-text or PDF view of the article. We welcome letters regarding this feature.

ECG CHANGES DURING NEUROLOGIC INJURY

By Salah S. Al-Zaiti, RN, PhD, CRNP, Elizabeth A. Crago, RN, PhD, Marilyn Hravnak, RN, PhD, ACNP, Teri M. Kozik, RN, PhD, CNS, CCRN, Michele M. Pelter, RN, PhD, and Mary G. Carey, RN, PhD

Scenario: This 12-lead electrocardiogram (ECG) was obtained in the emergency department (ED) from a previously healthy 56-year-old female found unresponsive at home. During transport she had a seizure followed by a cardiac arrest, but was successfully resuscitated. While in the ED, she had another seizure and became bradycardic with agonal respirations and was consequently intubated.

Interpretation Questions:

1. Is the ECG properly calibrated (10 mm) and are leads properly placed? ❑ Yes ❑ No ❑ NA
   If no, interpret cautiously.

2. Is this a sinus rhythm (one P wave preceding every QRS complex)? ❑ Yes ❑ No ❑ NA
   If no, check for number of P waves in relation to QRS complexes.

3. Is the heart rate (R-R interval) normal (60–100 beats/min)? ❑ Yes ❑ No ❑ NA
   If no, check for supra-ventricular or ventricular arrhythmias.

4. Is the QRS complex narrow (duration < 110 milliseconds [ms] in V1)? ❑ Yes ❑ No ❑ NA
   If no, check for bundle branch blocks (BBBs), pacing, or ventricular arrhythmia.

5. Is the ST segment deviated (> 2 mm in V2–V3, or > 1 mm in other leads)? ❑ Yes ❑ No ❑ NA
   If yes, check for similar deviations in contiguous cardiac territories.

6. Is the T wave inverted in relation to the QRS (> 0.5 mV)? ❑ Yes ❑ No ❑ NA
   If yes, check for ST deviation or conduction abnormalities.

7. Is the QT interval lengthened (> 450 ms [women] or > 470 ms [men])? ❑ Yes ❑ No ❑ NA
   If yes, check for ventricular arrhythmias or left ventricular hypertrophy.

8. Is R- or S-wave amplitude enlarged (S wave V1 + R wave V5 > 35 mm)? ❑ Yes ❑ No ❑ NA
   If yes, check for axis deviation or other chamber hypertrophy criteria.

Salah S. Al-Zaiti is an assistant professor at the Department of Acute and Tertiary Care Nursing, University of Pittsburgh, Pennsylvania. Elizabeth A. Crago is a research assistant professor at the Department of Acute and Tertiary Care Nursing, University of Pittsburgh, Pennsylvania. Marilyn Hravnak is a professor of Acute and Tertiary Care Nursing, University of Pittsburgh, Pennsylvania. Teri M. Kozik is a nurse researcher at St. Joseph’s Medical Center, Stockton, California. Michele M. Pelter is a nurse researcher at St. Joseph’s Medical Center, Stockton, California. Mary G. Carey is associate director for clinical nursing research, Strong Memorial Hospital, Rochester, New York.
Interpretation

Sinus tachycardia, QTc prolongation, diffuse ST segment elevation and other nonspecific repolarization abnormalities (J waves in V5 and camel-hump pattern in lead I). These ECG abnormalities, combined with the clinical presentation, are suggestive of the profound repolarization abnormalities seen in brain injury or hypothermia patients. An urgent head computed tomography (CT) scan showed a diffuse subarachnoid hemorrhage (SAH) with intraventricular extension. Clinicians should interpret the above ECG patterns with caution so not to confuse ST-segment changes during neurologic injury with acute myocardial infarction.

Rationale and Mechanism

ECG changes following SAH can be mediated by intense central nervous system stimulation and catecholamine release in the myocardial sympathetic nerve distribution, which can precipitate cardiac contraction band necrosis. The result can be a diffusely stunned myocardium manifested by elevated cardiac troponin, abnormal cardiac wall motion and hypokinesis. Such cardiac dysfunction can develop in the initial hours to days following neurologic injury and can progress to pulmonary edema. ECG changes can help identify this neuro-cardiac dysfunction; the magnitude of QT changes is specifically associated with increased arrhythmias (both ventricular and supraventricular) and worsened neurologic outcome.

Management

This patient is an exemplar of the cardiac sequelae that can follow SAH, exhibiting QT prolongation, diffuse ischemic-like ST changes, elevated troponin (peak 10.08 ng/ml), abnormal echo (diffuse hypokinesis with poor ejection fraction <25%) and pulmonary edema. Although the myocardial injury typically reverses over time, these patients frequently display subtle to severe impairment in systemic perfusion during the acute phase, which may require vasoactive therapy.

This patient underwent a cardiac catheterization revealing patent coronary arteries, which is not uncommon in this patient group. Careful triage would identify ECG changes attributed to neurologic injury. Unfortunately, the cerebral aneurysm repair and recovery period was prolonged due to impaired cardiac contractility. Early identification of ECG abnormalities associated with SAH can help in the prompt detection of cardiac dysfunction and evaluation of arrhythmias and need for systemic perfusion support. Diligent monitoring and early diagnostic testing (ie, echocardiography and cardiology consultation) are likely to improve neurologic outcomes and lower mortality.

RECOMMENDED READINGS

CALIFORNIA

Ontario
Annual Symposium: Falling for Critical Care
Date: September 22, 2015. Place: DoubleTree by Hilton Hotel Ontario Airport. Address: 222 N Vineyard Ave, Ontario, CA 91764. Sponsor: Inland Empire Chapter of AACN. Keynote Speakers: Dr Thomas Ahrens, Kathleena Vollman. Contact: Laura Reese. E-mail: Laura.M.Reese@kp.org. Fee: $100/Members; $110/nonmembers, local membership and conference. Credits: 8 CEUs.

Sacramento
CCRN/PCCN Review
Date: September 15-16, 2015. Place: University of California Davis, Education Building. Address: 416 X St, Sacramento, CA. Sponsor: Sacramento Area Chapter of AACN. Keynote Speaker: Carol Rauen. Contact: Laura Tobin. Phone: (916) 781-1651. E-mail: Tobs4@hotmail.com. Fee: TBD. 2-day course. Reduced parking $6.

COLORADO

Denver
CCRN and PCCN Certification Review Course
Date: November 18-20, 2015. Place: University of Colorado Hospital, Bruce Schroffel Auditorium, Denver, CO. Sponsor: Denver Chapter of AACN. Keynote Speaker: Carol Rauen. Contact: Shannon Johnson Bortolotto. E-mail: shannon.bortolotto@uchealth.org. Fee: Early bird $195 through 9/1/15; $225 after 9/2/15; $125 per day.

FLORIDA

Fort Lauderdale
2-Day CCRN/PCCN Review
Date: September 29, 2015. Place: Holy Cross Hospital Sister Innocent Conference Center Auditorium. Address: 4725 North Federal Highway, Fort Lauderdale, FL 33308. Sponsor: Broward County Chapter of AACN. Keynote Speaker: Cammy House-Fancher. Contact: Janis Smith-Love. E-mail: jlove@browardhealth.org. Fee: Early bird $175/member; $195/nonmember; single day rate available. Credits: 13 CEUs.

KENTUCKY

Louisville
Annual Symposium
Date: October 30, 2015. Place: Baptist Hospital East Education Center. Address: 4000 Kresge Way, Louisville, KY 40207. Sponsor: Greater Louisville Chapter of AACN. Keynote Speaker: Michael Ackerman. Contact: Marlot Wigginton. E-mail: mawigg@gmail.com. Fee: Members $60; nonmembers $75; student/prelicensure $25; manager’s special (local hospitals only) $50. Credits: 7 CEUs.

NEVADA

Las Vegas
Certification in Legal Nurse Consulting (5-day seminar and online)

Pennsylvania

King of Prussia
2015 TRENDS in Critical Care Nursing Conference
Date: October 6-9, 2015. Place: Valley Forge Event Center. Address: 1160 First Ave, King of Prussia, PA 19406. Keynote Speakers: Clareen Wiencek, Tracy Carlino, Charles Kunkle, Al Rundio. Sponsor: South-eastern Pennsylvania (SePA) Chapter. Contact: Patricia Nichols. E-mail: sepaeducation@sepa-aacn.org. Fee: Varies. Credits: Up to 34.5 CEUs.

Texas

Dallas
Advanced Critical Care and Emergency Nursing

For AJCC Education Directory submission information phone (800) 809-2273, ext 532; or e-mail, ajcc@aacc.org.
Your ticket to a great job offer.

Post your CV or résumé today.

You’re admitted to AACN’s Official Career Center. Designed as a comprehensive career resource for nurses of all levels, the Career Center enables you to explore job postings by specialty area, location, and hospital/facility.

- Search daily job postings on the homepage.
- Choose from the best career opportunities in nursing.
- Start now. The perfect job may be waiting for you.

AACNCareerCenter.org
Concise yet thorough guidance on how to safely and competently care for adult critically ill and progressive care patients

Endorsed by the American Association of Critical-Care Nurses (AACN) and written by top experts in the field, these authoritative textbooks cover all the must-know details on how to care for these types of patients and their families.

NEW EDITIONS!

AVAILABLE AT:
www.aacn.org/essentialsbooks
Be a Hero.
Make a Difference

Restore your patient’s voice and ability to participate in their care, recovery, and life.

To find out how the Passy-Muir® Valve can help restore your patient’s voice, enhance swallowing, reduce aspiration, expedite weaning and decannulation, and significantly reduce the costs associated with tracheostomy, visit www.passy-muir.com/hero

Be a Hero. Give your patient a voice.

Passy-Muir®

Millions of Voices, ONE VALVE™

Download the FREE TRACHTOOLS™ communication app at the app store or www.passy-muir.com/app