Engaging Patients in Managing Symptoms

Family Presence During Resuscitation

A Secure, Social Media–Based “Case of the Month”

Calorie and Protein Deficit in the SICU

Trauma Patients and Hospital Resources

Improving Cardiac Arrest Response

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During medical crises or the delivery of bad news, families of intensive care unit (ICU) patients sometimes look at caregivers with shock and misunderstanding. In their sadness and despair, naturally they seek professionals who know what they’re doing and who care about their loved ones, but they don’t always sense that caring in our expressions or responses during such stressful situations. It’s a paradox: as we become experienced clinicians and do this work day in and day out, we become increasingly competent and clinically adept, but we may lose the expected look of “shock” on our faces. How should families interpret this? Does it mean we lack compassion?

Although the surgeons or primary care providers (PCPs) with whom families come into contact may not have cared for a critically ill patient for some time, we in critical care may have treated such patients yesterday, even moments ago. When we make a rapid assessment that a patient has septic shock or acute respiratory distress syndrome, the fact that we make such an assessment quickly is a sign we are qualified and good at our jobs, not that we are giving the patient short shrift. On the contrary, we work this way because time is of the essence!

In effect, we want to say to these families, “Please don’t be upset with us if we don’t recoil in shock every time we must care for a critically ill patient. We care for such patients every day.” It is especially hurtful when loved ones and families imply that we do not care as much for a patient because a PCP or surgeon has known them longer. We are proud members of the international critical care community, and we care very much indeed. We have complex problems to deal with and some of our patients may have no recollection of us at all. Emotionally, some family members want to move quickly past the time they spent in the ICU, when things were on the edge, and that’s understandable.

The Problem of Misunderstanding

As we have asserted in previous editorials, being a member of the critical care team is truly a calling. Yet it’s not uncommon for those outside the circle of critical care practitioners to misunderstand and misinterpret us. In such circumstances we must rely on each other to ensure clearer communication about our clinical approach and why we do things the way we do. Interestingly, PCPs, surgeons, and patients’ families have at least one thing in common: none want their loved ones or patients in the ICU. Because families and other caregivers can be angry, distraught, and potentially mistrustful, as an ICU team we have
We must, as consummate intensive care unit professionals, rise above our emotions.

Remember What Is Important

We must, as consummate ICU professionals, rise above our emotions. Our care is focused always on patients and their families. We do not have the luxury of becoming agitated or unglued. We cannot internalize others’ angst or take it personally. Patients, families, and other caregivers rely on us to be calm, cool, collected, and caring during the crisis. Remembering such a thing is one of the greatest challenges to our profession.

Reconciling such tension is important. We are highly trained, highly skilled, and highly caring professionals, but critically ill patients, their families, and their physicians often can be anxious, agitated, upset, and angry (the list of potential negative emotions is long) with us. As a profession we need to shine a bright light on this fact and deal with it head on. It is in everyone’s best interest that we use our emotional intelligence to handle such tensions wisely while providing the high level of technical care required to treat the modern critically ill patient.

To ensure a brighter future in this area, we must focus on innovative ways to improve the system. We think it’s more than conflict management or dealing with moral distress, as important as those factors are: failure to deal adequately with the tensions and misunderstandings we’re talking about here can lead to burnout and loss of valuable members of the profession. One area for improvement is for us to better market our profession.

During the massive assemblies called Super-Sessions at the annual American Association of Critical-Care Nurses National Teaching Institute, the remarkable positive energy in the auditorium is electrifying and palpable. Capturing energy from whatever professional gatherings inspire us, putting it in a bottle, and bringing it back to our hospitals would be a step in the right direction. Furthermore, educating the marketing and communications departments in our hospitals about how vital what we do in critical care really is and how we contribute so significantly to the infrastructure of our hospitals is mission critical.

As a unified group of critical care specialists, we all must do our part to get the word out about what we do. We must shout from the highest rooftops that no matter what comes our way, we can handle it, we will handle it, and we will do so with composed, caring professionalism. When a family member, surgeon, or PCP comes to us with a look of discontent or a voice pitched high with distress, we can hold our heads up high and say—evenly, and with great compassion—something like this:

We are very sorry this has happened. We are sorry your loved one/patient has become critically ill. We did not cause this, but we will do everything in our power to make it better. Please know that this is all we do. We do not work anywhere else. All of our patients are critically ill. Please do not misinterpret our calm, confident caring as indifference simply because we do this work all the time. Please do not imply that we do not care as much as you do because we met your loved one/patient only just now. Caring for this patient will require a tremendous amount of hard work and coordinated effort. There will be ups and downs. We will update you every day (and more often if needed). Your loved one/patient is critically ill. We can promise you this: no matter what happens, our team will be with you every step of the way. We understand and we care.

About the Authors

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Solutions Exist at the Local Level

Each hospital and ICU must tackle this problem at the local level. For some readers, perhaps, these issues are not significant problems. For those of you who do have this problem, however, the more resources you have to deal with it, the easier it is to manage. Having a separate team member who is devoted to interfacing with families to coordinate and facilitate their medical and nonmedical questions could make all the difference. These special members of the team might have different titles at different institutions, of course: they could be social workers, members of the patient relations or patient representative department, even members of the clergy. A simple pamphlet explaining to families how care is organized in the ICU and describing some of the basic procedures that patients might encounter can enhance the family or caregiver experience.

Another idea is to consider the creation of a family orientation video that can be viewed on a computer in the family waiting room. Such a thing could provide a more structured and understandable approach for families and could help them see that the ICU team is proud of what they do and is committed to taking a deliberate and compassionate approach to care.

There are 2 important aspects to this problem and we should tackle them both at the same time. The first is that we must help other members of the critical care team deal with the challenge of a constant presence of families and other physicians who are under great stress themselves. The second is to make sure we really do care.

Conclusion: Finding Balance

Part of our job is to acknowledge that these stressors exist so we can nurture the best and most effective responses to them. We must use our positive energy and expertise to be there for families and other clinicians. We also must make sure we are able to find balance in our own lives to replenish our positive energy so we do not respond or get caught up in the stress-laden situations all around us. Unfortunately, there are no easy ways to find that life balance while remaining strong, caring, compassionate critical care clinicians. Seeking meaning with family and friends and in spirituality may be the best place to start.11-14

Although we may grow accustomed to caring for the critically ill, we must reach the appropriate balance, always reminding ourselves how incredibly difficult and stressful it is for the families of our patients in intensive care while never allowing ourselves to slide down the slippery slope of pessimism, cynicism, and burnout.

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

FINANCIAL DISCLOSURES
None reported.

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Clinical Pearls

Rhonda Board, RN, PhD, CCRN, 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.

Engaging Patients in Symptom Management

Treatment with mechanical ventilation causes stress and anxiety that typically requires sedative and analgesic medications. Distinguished Research Lecturer for the American Association of Critical-Care Nurses (AACN), Chlan, summarizes her research on music intervention as a nonpharmacological method to promote relaxation and reduce anxiety. Her team has found:

- Patient-directed music listening allows patients receiving mechanical ventilation (MVPs) to focus on something pleasant and not on the stressful experience.
- MVPs who received music intervention had lower anxiety levels, required less frequent sedative medications, and reported improved sleep and comfort.
- Chlan and colleagues also studied the feasibility of patient-controlled sedation. They found:
  - Self-administered dexmedetomidine was a feasible and safe intervention.
  - Many MVPs were comfortable with the procedure and attained relaxation without adverse effects.

Further study is needed, however these are promising and empowering alternatives to help adult MVPs to manage their own anxiety.

See Article, pp 293-300

Hospital Resource Use Across BMI Categories

Obesity is a major US health concern that is linked with serious medical diseases. Management of trauma can be challenging with obese patients and there are conflicts in the literature on whether obese patients use more resources during their hospitalization.

Lee and colleagues examined the relationship between patient/injury characteristics and hospital resource usage across 3 body mass index (BMI) categories. Looking at 9771 adult trauma patients they found:

- For all BMI groups (nonobese, obese, and morbidly obese), patients with greater injury severity and physiological complications used more resources due to a longer length of ICU stay and required more procedures.
- Lower Glasgow Coma Scale score was a significant factor associated with increased resource use only in the nonobese group.
- Although the authors state further examination is needed in the morbidly obese population, they do recommend that clinicians focus efforts on decreasing ICU lengths of stay in order to decrease resource use.

See Article, pp 327-339

Living With Dying in the Pediatric ICU

Most children who die in hospitals are in the pediatric intensive care unit (PICU). While PICU nurses are central to providing quality palliative care to these children and families, most receive little education on how to do so.

Stayer and colleagues interviewed 12 PICU nurses to describe their experiences in caring for a dying child. They found the following:

- The nurses’ ability to provide comfort and support within the circumstance of the family’s situation was a significant experience to them.
- It was often difficult to respect parental wishes for continuing aggressive treatments but the nurses tried to set realistic goals.
- Nurses felt emotionally exhausted and experienced their own grieving process with patient loss.

Although working with a dying child and the family can be stressful, many nurses found professional satisfaction in providing palliative care. The authors stress the importance of open and honest communication between the child, family, nurses, and physicians.

See Article, pp 350-356

Family Presence During Resuscitation

Family presence during resuscitation (FPDR) is supported by various professional organizations including AACN and the American College of Emergency Physicians. Despite numerous research findings showing positive outcomes for patients, families, and health care professionals; many nurses continue to cite perceived patient and family risks for not implementing FPDR. Powers and colleagues studied the effects of an online learning module about FPDR with 74 adult critical care nurses throughout the United States. They found:

- Nurses’ perception of family presence significantly improved after completing the online FPDR module.
- There was a significant increase in nurses’ self-confidence for implementation of FPDR.

Given the advocacy role bedside nurses have with patients and families, effective FPDR policies and education are necessary for successful implementation of family-centered care. The authors recommend online learning platforms as an alternative to face-to-face education due to their cost-effectiveness and the shorter time needed for both the educator and staff nurses.

See Article, pp 302-309
Background Mild therapeutic hypothermia is recommended for comatose patients resuscitated from cardiac arrest. However, the prevalence of delirium and its associated risk factors have not been assessed in survivors of cardiac arrest treated with therapeutic hypothermia.

Objective To determine the prevalence of and risk factors for delirium among survivors of cardiac arrest who were treated with therapeutic hypothermia.

Methods A retrospective observational study of patients treated with therapeutic hypothermia after cardiac arrest from 2007 through 2014. Baseline demographic data and daily delirium assessments throughout the intensive care unit stay were obtained. The association between duration of delirium and various risk factors was assessed.

Results Of 251 patients, 107 (43%) awoke from coma. Among the 107 survivors, all had at least 1 day of delirium during their intensive care unit stay. Median number of days of delirium was 4.0 (interquartile range, 2.0-7.5). Multivariable analysis revealed that age (odds ratio, 1.72; 95% CI, 1.0-2.95; \( P = .05 \)), time from cardiopulmonary resuscitation to return of spontaneous circulation (odds ratio 1.52; 95% CI, 1.11-2.07; \( P = .01 \)), and total dose of prewarming propofol (odds ratio, 0.02; 95% CI, 0.00-0.48; \( P = .02 \)) were associated with duration of delirium.

Conclusions All survivors of cardiac arrest treated with mild therapeutic hypothermia had at least 1 day of delirium. Age and time from initiation of cardiopulmonary resuscitation to return of spontaneous circulation were associated with prolonged delirium, whereas exposure to propofol was protective against delirium. These findings are limited to this unique cohort and may not be generalizable to different populations. (American Journal of Critical Care. 2016;25:e81-e89)©2016 American Association of Critical-Care Nurses doi: http://dx.doi.org/10.4037/ajcc2016581

Multidisciplinary Review of Code Events in a Heart Center

By Angela C. Blankenship, APN, Richard P. Fernandez, MD, Brian F. Joy, MD, Julie C. Miller, PharmD, Aymen Naguib, MD, Steven C. Cassidy, MD, Janet Simsic, MD, Christina Phelps, MD, Sheila Harrison, BSISE, CPHQ, Mark Galantowicz, MD, Andrew R. Yates, MD

Objective To identify a cause for clinical deterioration, examine resuscitation efforts, and identify and correct system issues (thus improving outcomes) via a multidisciplinary code-review process soon after cardiopulmonary arrest.

Methods Retrospective analysis of code events in a tertiary pediatric heart center from September 2010 to December 2013 and review of surgical-cardiac data from January 2010 to December 2013.

Results A multidisciplinary team reviewed 47 code events, 16 of which (34%) were deemed potentially preventable. At least 2 issues were identified during 66% (31/47) of cardiopulmonary arrests reviewed. Key issues identified were related to communication (62%), environment/culture/policy (47%), patient care (including resuscitation, 41%), and equipment (38%). About 60% of reviewed arrests resulted in educational initiatives (eg, mock code, in-service education) and 47% resulted in a new policy or modification of existing policy. Less common were changes in equipment (32%) or modification of staffing needs (11%). Changes most frequently occurred in the unit specific to the event (68%) but some changes occurred throughout the Heart Center (32%) or across the hospital system (13%). Survival to discharge after cardiopulmonary arrest has improved over time \( (P = .03) \) to 81% for cardiac surgical patients in our center.

Conclusion A multidisciplinary code-review committee can identify deficiencies and lead to educational initiatives and improvements in care. When coupled with a hospital- wide “code blue” review process, these changes may benefit the institution as a whole. (American Journal of Critical Care. 2016;25:e90-e97)

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Caring for critically ill patients receiving mechanical ventilation in the intensive care unit (ICU) is an immense challenge for clinicians. Interventions to maintain physiological stability and life itself can cause a number of adverse effects that have a marked impact on patients beyond the period of critical illness or injury. These ICU-acquired conditions include but are not limited to weakness, depression, and post–intensive care syndrome, all of which markedly affect patients' quality of life after they leave the unit. How best to manage the many symptoms experienced by patients undergoing mechanical ventilation without contributing to adverse ICU-acquired sequelae remains a daunting charge for clinicians and requires innovative “out of the box” approaches to address these complex issues. Systematic, cutting-edge research is needed to challenge the “usual” way of managing ICU patients in order to provide the best available evidence for practice integration that minimizes adverse, ICU-acquired sequelae and improves outcomes for the most vulnerable patients. This article highlights a program of research focused on interventions for managing symptoms in critically ill patients receiving mechanical ventilatory support, including the appropriate empowerment of symptom self-management by patients undergoing mechanical ventilation. Development and testing of innovative, nontraditional interventions specifically tailored for ICU patients receiving mechanical ventilatory support are presented. Music listening is highlighted as a nonpharmacological, adjunctive intervention to reduce anxiety associated with mechanical ventilation. Patient-controlled sedation is discussed as an alternative method to meet patients’ highly individual needs for sedative therapy to promote comfort. (American Journal of Critical Care. 2016;25:293-300)
Imagine you are exceedingly anxious and extremely fearful of your surroundings. You are quite sure that people are trying to harm you, maybe even kill you. You try to scream for help, but you are voiceless! You try to get up and run away but you can’t move your hands or arms; they feel like they are tied down. Speaking of being tied down, your old back injury is causing shooting pain down your leg; if only you could get out of bed and relieve the pressure on your back. . . . Why doesn’t anyone ask you about your anxiety and help you get out of bed?

Background and Significance of Anxiety in Critically Ill Patients Receiving Mechanical Ventilation

In the United States, more than 1 million persons admitted annually to intensive care units (ICUs) receive mechanical ventilation. The anxiety scenario just presented is exceedingly common among ICU patients. Critical illness and mechanical ventilation are potent sources of chronic stress for ICU patients. The physiological stress of the critical illness or injury and the psychological distress of undergoing mechanical ventilation lead to a heightened activation of the stress response. Burdensome symptoms arise from sustained stress. Anxiety, defined as a heightened state of arousal, is one of the most intense and burdensome symptoms experienced by critically ill patients receiving mechanical ventilatory support and is a frequent indication for sedative administration. Sustained anxiety causes increased work of breathing, cardiovascular stimulation, and increased oxygen consumption, which are undesirable responses in patients receiving mechanical ventilatory support.

In current clinical practice, patients frequently receive intravenous sedative and analgesic medications to promote tolerance and synchrony with mechanical breaths. Although these medications are intended to reduce stress, anxiety, and oxygen consumption, they often produce long periods of unconsciousness. Further, the efficacy of these medications for symptom management is questionable; patients still report persistent symptoms of anxiety and pain while receiving these medications, leading to increased doses for extended periods without any clear benefit. Anxiety requires ongoing symptom management throughout the course of mechanical ventilation because patients continue to report moderate anxiety regardless of the duration of mechanical ventilation and despite receiving sedative medications. Current research on ICU symptoms and sedation management focuses on pharmacological strategies only to manage patients’ symptoms despite the documented deleterious effects of sedative agents such as hypotension, delayed weaning, immobility, and delirium. However, it is recommended that symptoms of ICU patients receiving mechanical ventilation be managed without sedation or if necessary, with minimum use of sedative agents, giving the brain a chance to clear the medications acting on the central nervous system. Further, clinical practice guidelines suggest that if a patient requires sedation, the patient should be only “lightly sedated” and symptoms should be interactively assessed.

It is the responsibility of ICU nurses to provide safe, evidence-based care to patients in a technologically complex, fast-paced environment. The immense challenge remains, however, for these ICU clinicians to manage distressing symptoms effectively without inducing adverse side effects such as immobility linked to overreliance on sedative medications. Symptom management interventions are needed that target specific symptoms, are safe, do not induce adverse side effects, are acceptable to patients, and do not promote decrements in post-ICU outcomes. To meet this challenge, a carefully planned, systematic approach to designing and testing interventions that effectively manage the symptoms of patients receiving mechanical ventilation (MVPs) is presented here. Findings from key research studies examining both nonpharmacological and pharmacological interventions are discussed. Appropriate empowerment of patients themselves to engage in symptom self-management will be advanced as an innovative out-of-the-box strategy to ameliorate the distressing symptom of anxiety without causing adverse side effects.

Music: More Than Something Nice to Listen to

Music is more than something pleasant to listen to. In fact, music is a very complex stimulus with a
strong scientific basis for promoting relaxation, anxiety reduction, and distraction. Music can be described as sounds arranged in time to provide a continuous, unified, and evocative composition.14 Relaxing music (slow tempo of 60-80 beats/minute, pitch, and no lyrics15) dampens arousability of the central nervous system through release of inhibitory neurotransmitters and withdrawal of sympathetic activity via diminished norepinephrine release.16 Music initiates brainstem responses that regulate heart rate, blood pressure, skin conductance, and muscle tension through noradrenergic neurons that regulate cholinergic and dopaminergic neurotransmission.17 These effects are mediated by the tempo of the music; brainstem neurons tend to fire synchronously with music tempo, so slower-tempo music induces a relaxed state.17

Music listening also promotes relaxation via entrainment, which is a phenomenon whereby 2 objects vibrating at similar frequencies tend to cause a mutual sympathetic resonance and vibrate at the same frequency.18 Entrainment is achieved by using music to directly elicit relaxation.18 Musical components and physiological processes (heart rate, respiratory rate, blood pressure, temperature, adrenal hormones) are composed of vibrations that occur in a regular, periodic manner and consist of oscillations.19 Musical components, specifically rhythm and tempo, can be used as a synchronizer to influence changes in physiological responses (ie, heart rate, respiratory rate, blood pressure) through entrainment.19 When music is used to induce relaxation through entrainment, it should have a tempo at or below a resting heart rate (60-80 beats per minute), predictable dynamics, fluid melodic movement, pleasing harmonies, a regular rhythm without sudden changes, and the tonal qualities of strings, flute, piano, or specially synthesized tones.20

A substantial body of evidence indicates that music reduces anxiety.6,21-23 which is a common, distressful symptom for MVPs and a frequent indication for sedative administration.24-28 Music perceived as pleasant and relaxing enhances tension reduction because relaxation is incompatible with anxiety.29 Music decreases anxiety by occupying attention channels in the brain with meaningful, distractive auditory stimuli,30 directing attention away from negative thoughts or experiences.31 Music allows the listener to focus on a pleasant, comforting sound rather than stressful environmental stimuli or thoughts. Music with steady, slow, and repetitive rhythm exerts a hypnotic effect, contributing to relaxation and anxiety reduction.15,32,33 Familiarity with music influences the listener’s responses. Studies in non-ICU patients document that participants who listen to preferred, familiar music experience pleasant and positive feelings that correlate with activation of the limbic system.34,35 Likewise, in older persons with dementia, preferred music introduces a sense of familiarity in the environment that enhances functional abilities.36,37 These findings highlight the importance of assessing music preferences and of providing choice so that the listener may select what is perceived as “pleasant and familiar.”

Building the Scientific Base for Music as a Nonpharmacological Intervention for Critically Ill Patients

Music listening as an adjunctive, complementary intervention is ideal for critically ill MVPs who may be fatigued and/or have difficulty concentrating. Music listening does not require focused concentration or effort from patients to be beneficial. I have conducted a number of studies over the years testing the effects of music listening for anxiety reduction and relaxation promotion and to determine whether exposure to potent sedative medications can be reduced via nonpharmacological means throughout the duration of mechanical ventilatory support. This section highlights some of those key research findings.

Feasibility and Acceptability of Music Intervention in Patients Undergoing Mechanical Ventilation

The first study29 investigating music as a nonpharmacological intervention for patients receiving mechanical ventilatory support was conducted to determine the feasibility and acceptability of music and to obtain preliminary data on indicators of relaxation. A convenience sample of 20 alert patients not receiving continuous infusions of sedative medications were enrolled from 2 medical ICUs and 1 surgical ICU in the urban Midwest. To reduce selection bias, patients were randomly allocated to either (1) a single 30-minute period of music listening through soft headphones or (2) a single 30-minute period of resting quietly wearing soft headphones (no music). Patients selected their own music from an investigator-provided collection of relaxing classical music for the single intervention session.30 Blood pressure, heart rate, and respiratory rate were recorded every 5 minutes from the bedside monitor during both of the 30-minute conditions. The Profile of Mood States (POMS)39 was administered before and immediately after each 30-minute condition. A statistically significant generalized relaxation response was noted in patients randomized to music with decreases in heart rate (101.8/min to 92.9/min) and respiratory rate (24.3/min to 19.3/min); a less
distressed mood state was reported by the music patients (total POMS score decreased from 16.5 to 9.9) compared with those patients who rested quietly with headphones, who actually had an increase in total mood disturbance score (from 15 to 18.4).38 Patients were receptive to music listening, and there were no problems with implementing the study protocol on the participating ICUs; no adverse responses were noted. Although patients reported that they enjoyed listening to music, many requested more choices other than just classical music.

Effects of Music Listening on Anxiety

Given the significant anxiety experienced by MVPs, the goal of the next study was to examine this common symptom in response to music listening. A sample of 54 adult MVPs were enrolled from 4 ICUs (medical and surgical) in the urban Midwest.6 Patients were randomized to either (1) a single 30-minute period of music listening through headphones or (2) resting quietly for a 30-minute period. Patients chose preferred music from the investigator’s prepared collection of relaxing music (tempo, 60-80 beats per minute) that contained a variety of instrumental selections from classical to music with nature sounds. A 6-item version of the Spielberger State Anxiety Inventory40 was administered to all patients before and after the assigned condition. Heart rate, respiratory rate, and blood pressure were recorded from the bedside monitor every 5 minutes. Patients allocated to music intervention had a significant 7-point decrease in state anxiety levels (from 17.3 to 10.1) and demonstrated a generalized relaxation response (heart rate decreased from 90.6/min to 85.9/min and respiratory rate from 21.3/min to 16.4/min) compared with patients in the control/rest condition.6 As in the first pilot study, patients reported anecdotally that they enjoyed the music and the quiet time afforded to them. Many patients requested to keep the music at their bedside so that they could listen to the music whenever desired. In addition, patients also indicated that more music options would be preferable, depending on their mood and individual needs/preferences. These insightful comments from patients were used to develop a novel patient self-directed music-listening intervention, as described in the following section.

Patient-Directed Music Listening to Reduce Anxiety and Sedative Exposure

Previous studies testing music intervention had typically employed a discrete collection of music from which limited choices were offered to study participants. Based on patients’ requests for more choices to ensure alignment with their individual preferences, we sought to design a true tailored music-listening intervention based on individual preferences. We first developed a music preference assessment tool41 that was later refined with music therapist expertise42 to include more detail on musical genres and a yes/no checklist format to promote communication with nonvocal MVPs.

Although the previous studies all demonstrated a generalized relaxation response and anxiety reduction in response to an investigator-initiated, single 30-minute music intervention, the impact of music intervention over time on distressful symptoms such as anxiety and on ICU care processes was not known. Likewise, an active control condition to account for simple noise reduction from the placement of headphones themselves was needed. Further, whether MVPs would use music to self-manage their own anxiety was not known. We next designed a randomized clinical trial to test the efficacy of patient self-initiated music listening on anxiety and sedative exposure (sedation intensity and sedation frequency43) over the course of mechanical ventilatory support in critically ill patients.22 A total of 373 patients were enrolled from 12 participating ICUs in the urban Midwest. Patients were randomly assigned to 1 of 3 conditions: (1) patient-directed music (PDM), which consisted of patients self-initiating music listening whenever desired for as long as desired using noise-canceling headphones with relaxing music selections individually tailored by a music therapist, (2) active control condition of wearing noise-canceling headphones whenever desired to block out ICU noise, or (3) usual-care control condition. Patients remained in the study for up to 30 days, as long as they were receiving mechanical ventilatory support in the ICU, until they withdrew, were extubated or transferred from the ICU, or died. On average, patients self-initiated music listening for approximately 80 minutes each day they were enrolled in the study. PDM patients’ anxiety levels decreased significantly over time by 36% and those patients received 36% less intense sedative regimens with 38% less frequent sedative administration compared with the control group over the course of mechanical ventilatory support.22 That study was the first to show that music as a nonpharmacological intervention could reduce anxiety while also reducing exposure to potent sedative medications. Moreover, that study was the first to show that MVPs could self-manage their anxiety with the PDM intervention. The strength of these findings was due in part to the experimental PDM protocol consisting of music selections individually tailored to personal

Patients undergoing mechanical ventilation relax and enjoy listening to music.
preferences by a board-certified music therapist. The effectiveness of PDM on patients’ outcomes, including the post-ICU period, is not known and requires further investigation.

**Patients’ Music Preferences and Benefits of Research Study Participation**  
In addition to the results just noted that listening to preferred music can significantly reduce anxiety, promote relaxation, and reduce exposure to sedative medications, a number of important subsequent findings have been discovered. First, patients have a wide variety of musical preferences that require careful assessment and consideration for a successful intervention. Further, the important role and contributions of a board-certified music therapist cannot be overstated. Given the complexity of music as a powerful stimulus, it is imperative to carefully assess music preferences before intervention. An instrument specifically developed to determine the music preferences of patients receiving mechanical ventilation is available, as are general music preferences of patients undergoing mechanical ventilation who were enrolled in our parent study to guide establishing a music-listening collection.

Second, although ICU clinicians may believe that participating in a research study is too burdensome for critically ill patients, that is not so. Participation in a research protocol while in the ICU can actually be beneficial for patients and their family members. We carefully recorded anecdotal comments from study participants and their family members throughout our clinical trial. General themes derived from content analysis revealed that patients reported relaxation and improved sleep from less environmental noise, particularly at night. Patients also reported enjoyment and comfort from listening to preferred music while in the ICU. Family members reported that they had observed direct benefits for the patient, such as relaxation, and that they were proud of their loved one for participating in a research study. Future investigations of music-listening interventions are needed to determine if listening to familiar preferred music has any favorable impact on the occurrence, severity, and duration of delirium among patients receiving mechanical ventilatory support.  

**Innovation Outside the Box: Patient Self-Administration of Sedative Therapy**  
Sedative therapy is a common practice in the ICU. Sedative medications are administered to patients to promote tolerance and synchrony with mechanical breaths and to manage distressful symptoms such as anxiety and pain. These potent medications are administered to MVPs on the basis of the subjective judgment of the ICU nurse in concert with observed patient arousal and motor activity. In fact, the most frequently used scale to guide ICU sedative therapy is the Richmond Agitation-Sedation Scale (RASS), which is a motor arousal scale that does not specifically assess patients’ symptoms. Thus, current sedative practices are not targeted to specific patients’ symptoms and do not involve patients in medication administration decisions.

Although clinical practice guidelines recommend a reduction in exposure to potent sedative medications so that MVPs are awake or only “lightly” sedated, how best to achieve this outcome is a pervasive clinical challenge. Interestingly, when patients were queried about their sedation preferences after cessation of therapy, some patients wanted more drug, some wanted less, and some wanted the same amount. It is impossible for ICU nurses to meet these individual preferences with the current sedation administration practices because those practices do not involve patients in decisions or directly assess important symptoms such as anxiety. This significant, vexing clinical problem of how best to manage patients’ symptoms and sedative therapy appropriately requires innovative thinking and “outside the box” strategies.

A look at publications on pain management may provide some direction for managing patients’ challenging symptoms in critical care. Patient-controlled analgesia (PCA) has been used in clinical practice since the 1970s for pain management. A recent PubMed search with the key word patient-controlled analgesia revealed the first reference to PCA as early as 1954. Since those early days when PCA was considered a risky, radical concept, PCA has evolved into an established clinical practice offering superior patient satisfaction and pain control. Based on PCA concepts, patients’ self-administration of sedative therapy is advanced here as one novel method of tailoring sedative therapy to individual patients’ needs. Our team has conducted 2 studies examining whether patient self-administration of sedative therapy may be a practical alternative to clinician-administered sedative therapy.

**Patient-Controlled Sedation: Proof of Principle, Feasibility, and Safety**  
Published findings from our small, single-group descriptive study of dexmedetomidine for patient-controlled sedation (PCS) provided proof of principle that MVPs can and will self-manage their sedative therapy. We selected dexmedetomidine for PCS because of its light sedative properties, short half-life, and ability to be administered through a standard
Patients being treated with mechanical ventilation can and will self-manage their sedative therapy.

Infusion pump. A highly selective sample of 17 adult MVPs were enrolled from a medical and a surgical ICU; they provided their consent as required by the institutional review board and participated in the protocol for up to 24 hours. Patients received a basal infusion of dexmedetomidine and were instructed to self-medicate with a bolus of dexmedetomidine whenever feeling anxious; protocol details can be found elsewhere. No self-extubations occurred, and 25% of patients experienced mild hemodynamic alterations (persistent bradycardia or hypotension, which are known side effects of dexmedetomidine). A majority of participants rated PCS with dexmedetomidine favorably for self-management of anxiety and relaxation level attained and reported that they were comfortable in self-administration of a sedative agent. Patients enrolled in this study were willing and able to self-administer a sedative medication on the basis of their individual needs.

Our next logical step was to study PCS for more than 24 hours against a usual sedation care comparator. We next conducted a small randomized pilot trial to study the feasibility and safety of PCS with dexmedetomidine for up to 5 days. To reduce selection bias, 37 adult patients were randomized to either PCS with dexmedetomidine (n = 17) or to usual care (n = 20), which was nurse-administered sedative therapy. Patients remained on protocol for up to 5 days, or until they withdrew, were extubated, transferred from the ICU, or died.

Feasibility was defined as our ability to enroll and maintain patients on protocol and patients’ ability to use the PCS push-button device. Of the 81 patients screened as eligible, we enrolled 37, including 2 by proxy, which reflects a 46% consent rate of those approached. The 2 patients enrolled by proxy had verbally agreed to participate but then experienced bedside procedures that required short-term heavier sedation. The main obstacles to enrollment consisted of medical contraindications to our strict inclusion criteria (aggressive ventilatory support, vasopressor therapy, chemical paralysis, acute stroke, or acute myocardial infarction) or patients not being alert or being delirious (Confusion Assessment Method for the ICU indicating that delirium was present), which was an exclusion criterion. Most patients (68%) were enrolled by day 6 of mechanical ventilation, with 43% enrolled by day 3 of mechanical ventilation, which established feasibility of identifying and getting consent from MVPs. Patients were on the protocol for a mean of 2.6 days (SD, 1.6 days; median, 4 days; range, 0–5 days). No statistically significant differences between groups were found in days of mechanical ventilation or length of ICU stay. No patients withdrew from the study. None of the patients using PCS with dexmedetomidine were unable to use the push-button device during the study. No patients died while enrolled in the protocol.

Safety was operationalized as protocol-related adverse events or unanticipated adverse events. One patient in the usual-care group removed the endotracheal tube and required reintubation. No patients using PCS with dexmedetomidine self-extubated themselves while enrolled in the protocol. Three patients using PCS with dexmedetomidine experienced arterial hypotension that warranted temporarily decreasing or suspending the dexmedetomidine infusion. No unanticipated adverse events occurred. No patients using PCS with dexmedetomidine were removed from the protocol for safety reasons.

Overall, findings from our team’s work demonstrate that self-administration of sedative therapy is feasible, safe for a select group of MVPs, and may be a practical alternative to clinician-administered sedative therapy to ameliorate distressing symptoms such as anxiety. Further investigation is needed to determine the effects of PCS on patients’ outcomes such as anxiety, duration of mechanical ventilatory support, sedative exposure, and post-ICU outcomes such as quality of life in a larger, representative sample.

Summary and Conclusions

Critical ill patients receiving mechanical ventilatory support will engage in self-management of anxiety symptoms with the nonpharmacological intervention of music listening. Further, appropriately empowering MVPs to self-administer sedative therapy may be a practical alternative to clinician-administered sedative therapy for a select group of patients. Given the opportunity, patients will engage in symptom assessment and can participate in self-management of distressful symptoms such as anxiety. Moreover, medications administered to patients should be driven by symptom assessment rather than motor activity. Likewise, critically ill patients should be afforded the opportunity to participate in ICU-based research studies. Challenging long-standing beliefs and practices by thinking outside the box and carefully designing research studies with a multidisciplinary-team perspective to develop and test innovative interventions can result in immediate benefits for critically ill patients receiving mechanical ventilatory support.

FINANCIAL DISCLOSURES

None reported.
REFERENCES


Notice to CE enrollees:

This article has been designated for CE contact hour(s). The evaluation tests your knowledge of the following objectives:

1. Identify intensive care unit factors that increase anxiety in patients being treated with mechanical ventilation.
2. Explain the conceptual basis of listening to music for relaxation.
3. Understand the importance of music preferences for successful music listening interventions.

To complete evaluation for CE contact hour(s) for test #A162504, visit www.ajcconline.org and click the “CE Articles” button. No CE test fee for AACN members. This test expires on January 1, 2019.

The American Association of Critical-Care Nurses is an accredited provider of continuing 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 Registered Nursing of California (#01036) and Louisiana (#LSBN12).
For many nurses, managing patients’ symptoms in the intensive care unit (ICU) presents a major dilemma. We want to control pain, anxiety, dyspnea, and ensure that our patients experience as little discomfort as possible. However, the medications used to treat these symptoms have side effects and overuse may result in unintended consequences that include increased number of ventilator days, increased risk of aspiration, and worsening delirium.

Veteran researcher, Linda Chlan, PhD, points to effective alternatives that include self-directed music listening and patient-controlled sedation. Using music to mitigate the unfamiliar and frightening sounds in the ICU is not a new idea, but having the patient select the music and control the timing of its use is novel. Similarly, allowing patients to control sedation dose timing addresses their anxiety and respects patient autonomy. Through interventions like these, nurses may find a much needed alternative in the sedation dilemma and patients may experience less discomfort and a greater sense of personal wholeness during their ICU experience.

Here’s what you can do:

- Target responses to the sources of discomfort, which may include procedure-related pain, intravenous pump and monitor alarms, bright lights, or being moved.
- Talk to patients or families about music preferences and suggest that loved ones bring in a device that the patient can use.
- Maintain a list of devices that are approved for use by your institution and provide this list to patients’ families and friends.
- Discuss the use of patient-controlled sedation with your interdisciplinary team and determine their opinions.

Other helpful resources:

- The National Center for Complementary and Integrative Health at https://nccih.nih.gov, offers a list of complementary therapies and research-based evidence of their efficacy.
- The ABCDEF Bundle, available at the ICU Delirium website, http://www.icudelirium.org, provides information for patients and providers and has resources to assess pain, prevent delirium, and manage sedation in the ICU.

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Background  Family presence during resuscitation (FPDR) is supported by patients and their family members. Nurses, however, including critical care nurses who frequently implement resuscitative care, have mixed views.

Objectives  To determine the impact of online learning on critical care nurses’ perception of and self-confidence with FPDR.

Methods  A 2-group, random assignment, pretest and posttest quasi-experimental study was conducted with critical care nurses recruited nationally. An online learning module on FPDR was developed and administered to the intervention group. Perceptions and self-confidence for FPDR were measured by using the Family Presence Risk-Benefit Scale (FPR-BS) and the Family Presence Self-confidence Scale (FPS-CS). Two-factor, mixed-model factorial analysis of variance was used to compare mean scores.

Results  A total of 74 critical care nurses participated in the study. Mean FPR-BS and FPS-CS scores were significantly greater in the intervention group than in the control group. For the intervention group, mean scores on the FPR-BS increased from 3.63 to 4.07 ($P<.001$) and on the FPS-CS increased from 4.24 to 4.57 ($P<.001$), signifying improved perception and self-confidence. Scores did not change significantly in the control group: mean FPR-BS score increased from 3.82 to 3.88 ($P=.23$) and the mean FPS-CS score of 4.40 did not change ($P>.99$).

Conclusions  Online learning is a feasible and effective method for educating large numbers of critical care nurses about FPDR. Online learning can improve perceptions and self-confidence related to FPDR, which may promote more widespread adoption of FPDR into practice.

Family presence during resuscitation (FPDR) refers to giving a patient’s family member (or members) the option to be present during the resuscitation of a loved one. It is a shift from the traditional practice norm of separating families during resuscitative care and aims to promote family-centered care during acute health crises. FPDR is supported by 94% to 100% of patients’ family members, and patients and their family members view FPDR as their right. FPDR is also supported by multiple professional nursing and interdisciplinary organizations. Support for this family-centered care practice has mounted because of research that has demonstrated positive outcomes for the patient, the patient’s family, and the health care team.

Research has shown that FPDR provides patients with a sense of comfort, support, and connectedness. FPDR also facilitates family members’ grieving and promotes professionalism among the members of the health care team. Yet, despite patient and family support and positive findings regarding its outcomes, FPDR remains controversial and far from the norm in clinical practice.

FPDR implementation in bedside care has been linked to nursing because patients and their family members are most likely to express their desires for FPDR to nurses. They view nurses as their advocates, and nurses are in a unique position to ensure that the needs of patients and their family members for FPDR are met. Ironically, the biggest threat to upholding family-centered care (and FPDR by extension) is nurses. Research has repeatedly shown that nurses are not uniformly supportive of FPDR with adult patients, and FPDR is not commonly implemented at the bedside. In fact, only approximately one-third of nurses from across practice settings implement FPDR in their bedside care.

Nurse support and implementation of FPDR are influenced by the risks that nurses perceive FPDR to have. Commonly cited risks include potential for interference with patient care, emotional distress and psychological trauma of the family, and increased risk for litigation. Research has disproven these perceived risks, yet nurses’ negative perceptions persist and are viewed as an obstacle to support and implementation of FPDR. Change theory supports the need for interventions to change nurses’ perceptions of the risks and benefits of FPDR. Education is essential to change perceptions so that traditional resuscitative care that excludes the patient’s family is no longer the norm. Additionally, perception and support are positively influenced by prior experience with FPDR, which may be because health care providers see the benefits of FPDR and the absence of perceived risks and increase their self-confidence for its implementation. Identification of interventions to improve self-confidence for FPDR is supported by social cognitive theory, and education that provides opportunities for FPDR practice can dispel fears, increase self-confidence, and foster a commitment to change. Research has shown that education can increase nurses’ support for FPDR.

However, to date few studies have been focused on educational interventions, and the impact of existing study findings is somewhat limited by methodological issues such as the use of 1-group designs, examination of variables not grounded in theory, and/or use of instruments without established reliability.

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Additionally, research has not been focused on critical care nurses even though a large percentage of cardiac arrest events occur in this setting, thus providing critical care nurses frequent opportunities to enact FPDR. Last, all prior research has used face-to-face educational interventions. Online learning, which may be a means of promoting more widespread FPDR education, has not been studied. Therefore, our aim was to determine the impact of online learning on critical care nurses’ perception of and self-confidence for FPDR.

**Methods**

**Study Design and Sample**

A 2-group, random assignment, pretest and posttest quasi-experimental design was used. A convenience sample of currently employed registered nurses working in adult critical care settings in the United States was obtained. Sample recruitment occurred at a national level through study advertisements posted on the American Association of Critical-Care Nurses’ (AACN) Critical Care eNewslines and Facebook and Twitter social media pages.

**Study Variables and Instruments**

The intervention group received a researcher-designed online learning module that was developed following a review of the FPDR literature. The control group received a researcher-developed online learning module based on literature regarding recent changes in resuscitative care guidelines produced by the American Heart Association, which did not include any information on FPDR. The content of the online learning modules is described in Table 1.

Measurement of the dependent variables, perception and self-confidence for FPDR, was accomplished by using scales previously shown to be valid and reliable. Permission to use the scales unmodified was obtained. The 22-item Family Presence Risk-Benefit Scale (FPR-BS) was used to measure perception, and the 17-item Family Presence Self-confidence Scale (FPS-CS) was used to measure self-confidence. Response options ranged from strongly disagree (1) to strongly agree (5) for the FPR-BS and from not at all confident (1) to very confident (5) for the FPS-CS using 5-point Likert scales. Mean composite scores were used to determine the overall perception and self-confidence of both groups in pretesting and posttesting.

**Procedure/Data Collection**

The study was conducted online in 2014 following approval from the appropriate institutional review board. Advertisements were posted by the AACN for 4 weeks and included a link to the online study site. Qualtrics (Qualtrics LLC) was used to conduct random assignment and to administer the online learning modules and measurement instruments. Participants were given 4 weeks to complete their participation, although expected time for study completion was approximately 45 minutes to read the study information, sign the informed consent form, complete the pretest and posttest, and view the assigned online learning module. The data collection process is illustrated in the Figure.

**Data Analysis**

Data were transferred from Qualtrics into SPSS version 21 for analysis. Incomplete data were screened out. Data were screened for extreme outliers and normality was determined. Descriptive statistics were used to present findings from the demographic and professional attribute form. Six scale items were reverse coded, and mean composite scores for the FPR-BS and FPS-CS were calculated. Two-factor, mixed-model factorial analysis of variance was used to detect mean differences in the within-subjects
and between-subjects factors on the FPR-BS and FPS-CS. The significance level was a $P$ of .05 or less.

**Results**

**Sample Demographics**

A total of 132 critical care nurses consented to participate in the study. Of these, 74 (56.1%) completed the pretest and posttest and the assigned online learning module and thus comprised the total study sample, with 40 in the intervention group and 34 in the control group. Demographic and professional attribute information was collected from all participants (Table 2), as was information related to prior experience with resuscitative care and FPDR (Table 3). Data revealed that the groups were similar with respect to demographic characteristics and professional attributes. Participants’ sex, ethnicity, and age were similar to national trends for the registered nursing workforce. A baccalaureate degree or higher was reported by 67.5% of the intervention group and 82.4% of the control group, which is higher than the national trend of 50%. Approximately three-fourths of the total sample reported that they provide bedside care; the remainder reported education, management, or advanced practice roles. All participants reported prior experience with resuscitative care, and all but 1 participant in each group had prior experience with FPDR, a level considerably higher than reported in other recent studies of critical care nurses.

**Perception Findings**

A total of 74 participants (40 in the intervention group and 34 in the control group) completed the FPR-BS pretest and posttest. FPR-BS mean composite scores were subjected to the 2-factor, mixed-model factorial analysis of variance. Relevant assumptions were met, and reliability of the FPR-BS was confirmed (Cronbach $\alpha = 0.94$). Results revealed a statistically significant increase in mean composite score on the FPR-BS from 3.63 on the pretest to 4.07 on the posttest for the intervention group ($F_{1,72} = 80.21$, $P<.001$, partial $\eta^2 = .53$). The control group’s FPR-BS mean composite score increased from 3.82 to 3.88, but this change was not significant ($P = .23$; Table 4). The difference in FPR-BS mean composite scores between the intervention and control groups was not statistically significant on the pretest ($P = .19$) or posttest ($P = .21$).

**Self-confidence Findings**

Data from a total of 72 nurses was used to analyze FPS-CS scores (38 in the intervention group and 34 in the control group). Mean composite scores on the FPS-CS were subjected to the 2-factor, mixed-model factorial analysis of variance. FPS-CS reliability was also confirmed (Cronbach $\alpha = 0.94$) and relevant assumptions were met. A statistically significant increase in self-confidence from pretesting to posttesting occurred in the intervention group ($F_{1,70} = 31.23$, $P<.001$, partial $\eta^2 = .31$), but not in the control group ($P > .99$; Table 4). FPS-CS mean composite scores increased from 4.24 to 4.57 for the intervention group and demonstrated no change for the control group. The difference in FPS-CS mean composite scores between the intervention and control groups was not statistically significant on the pretest ($P = .29$) or the posttest ($P = .26$).

**Discussion and Recommendations**

Our study was the first to investigate the impact of online learning in regard to FPDR. Prior research had demonstrated the positive impact that face-to-face
education can have on nurses’ support for FPDR; however, face-to-face education requires time availability for both the educator and staff nurses. Face-to-face education also is limited in its ability to reach out to and educate large numbers of nurses. Our findings revealed that online learning can improve critical care nurses’ perception of and self-confidence for FPDR. This important finding has implications for expanding FPDR education in order to educate larger numbers of nurses and promote more widespread adoption of FPDR into practice.

The FPDR online learning module we created for critical care nurses had a positive effect on both perception and self-confidence. Given the high level (97.5%) of prior FPDR experience among participants in the intervention group, the magnitude of impact on perception and self-confidence level that resulted was surprising. In early studies conducted when little had been published about FPDR and in studies involving participants with minimal resuscitative experience, the impact of education was quite pronounced, most likely because they had less exposure to the topic. For example, a 1999 study33 of the impact of classroom education on critical care and emergency department nurses’ beliefs showed an increase in FPDR support from 55.6% to 88.9% and an increase in intent to implement FPDR from 10.9% to 79.1%. More recently, a study16 using classroom and video simulation with nursing students resulted in significant increases in perception and self-confidence with large and medium effect sizes, respectively. Because more has been published on FPDR and critical care nurses are frequently exposed to resuscitative care, we anticipated a medium effect size during a priori sample size calculations.

Our findings related to perception exceeded these expectations, as mean composite scores among the intervention group increased significantly from 3.63 to 4.07 ($P < .001$) with a large effect size ($\eta^2 = .53$). For self-confidence, intervention group scores increased from 4.24 to 4.57 ($P < .001$), and a medium effect size ($\eta^2 = .31$) was noted.43 Online learning was effective among critical care nurses who had a vast amount of resuscitative care exposure and experience. Inclusion of evidence-based information and active learning through a case study in our FPDR online learning module resulted in significant increases in perception and self-confidence. Further, our use of a 2-group quasi-experimental design demonstrated that it is unlikely that our results were due to repeat testing, as the minimal change in perception scores and the zero change in self-confidence scores were not significant for the control group. Our findings demonstrate the potential that online learning has for improving perception of and self-confidence for FPDR.

Research has shown that patients and their families support FPDR as an option5,13 and that FPDR can be beneficial.14,15 Therefore, nursing support and implementation of FPDR are vital to the provision of family-centered care. Yet, recent research continues to demonstrate unfavorable or mixed views of FPDR.

### Table 2
Demographic information and professional attributes

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Intervention group (n = 40)</th>
<th>Control group (n = 34)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>38 (95)</td>
<td>31 (91)</td>
</tr>
<tr>
<td>Male</td>
<td>2 (5)</td>
<td>3 (9)</td>
</tr>
<tr>
<td>Ethnicity&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>34 (85)</td>
<td>32 (94)</td>
</tr>
<tr>
<td>African American</td>
<td>3 (8)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>2 (5)</td>
<td>1 (3)</td>
</tr>
<tr>
<td>Asian</td>
<td>1 (2)</td>
<td>2 (6)</td>
</tr>
<tr>
<td>Native American</td>
<td>0 (0)</td>
<td>1 (3)</td>
</tr>
<tr>
<td>Other</td>
<td>1 (2)</td>
<td>1 (3)</td>
</tr>
<tr>
<td>Age, y</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18–24</td>
<td>0 (0)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>25–34</td>
<td>8 (20)</td>
<td>12 (35)</td>
</tr>
<tr>
<td>35–44</td>
<td>9 (22)</td>
<td>6 (18)</td>
</tr>
<tr>
<td>45–54</td>
<td>11 (28)</td>
<td>8 (24)</td>
</tr>
<tr>
<td>55–64</td>
<td>11 (28)</td>
<td>7 (21)</td>
</tr>
<tr>
<td>≥ 65</td>
<td>1 (3)</td>
<td>1 (3)</td>
</tr>
<tr>
<td>Highest nursing degree</td>
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<td></td>
</tr>
<tr>
<td>Diploma</td>
<td>1 (2)</td>
<td>3 (9)</td>
</tr>
<tr>
<td>Associate</td>
<td>12 (30)</td>
<td>3 (9)</td>
</tr>
<tr>
<td>Baccalaureate</td>
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<td>18 (53)</td>
</tr>
<tr>
<td>Master’s</td>
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<td>9 (26)</td>
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<tr>
<td>Doctorate</td>
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<td>1 (3)</td>
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<tr>
<td>Years of nursing experience</td>
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<td></td>
</tr>
<tr>
<td>&lt;1</td>
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</tr>
<tr>
<td>11-15</td>
<td>5 (12)</td>
<td>4 (12)</td>
</tr>
<tr>
<td>16-20</td>
<td>6 (15)</td>
<td>3 (9)</td>
</tr>
<tr>
<td>≥ 20</td>
<td>17 (42)</td>
<td>12 (35)</td>
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<tr>
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<td>22 (65)</td>
</tr>
<tr>
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<td>11 (32)</td>
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<td>1 (3)</td>
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<tr>
<td>Member of professional organization</td>
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<td></td>
</tr>
<tr>
<td>Yes</td>
<td>37 (92)</td>
<td>32 (94)</td>
</tr>
<tr>
<td>No</td>
<td>2 (5)</td>
<td>2 (6)</td>
</tr>
<tr>
<td>No response</td>
<td>1 (2)</td>
<td>0 (0)</td>
</tr>
</tbody>
</table>

<sup>a</sup> Percentages may not total 100 because of rounding.

<sup>b</sup> Nurses could identify more than 1 ethnicity.
among nurses. Consequently, the need for creation of policies and programs and an increase in education to facilitate acceptance and implementation of FPDR continues to be emphasized. Yet, among our total sample of critical care nurses who are frequently exposed to resuscitative care, we found that only 29.7% worked in a facility or unit that had an FPDR policy and only 41.9% had received any prior education on FPDR.

FPDR education of critical care nurses should be a priority, and the results of our study demonstrate that online learning is an effective educational option. Hospital management and educators seeking to improve support and implementation of FPDR in critical care areas should consider the use of online learning and creation of facility and unit policies to guide and support nurses. Professional organizations should consider the value of adding online learning about FPDR to their current continuing education offerings to increase convenience and accessibility for learning. Providers of advanced cardiac life support (ACLS) certification courses should consider adding FPDR online learning to current ACLS certification renewal courses to increase exposure among interdisciplinary resuscitative care providers.

We recommend continued research on FPDR education. Researchers should consider using the FPR-BS and FPS-CS because those tools are applicable to various patient care settings, they are reliable and valid, and repeated use of the same scales will enable comparisons across studies. This study should be replicated with a more culturally diverse sample, as the impact of culture on FPDR support is unclear. Research should also be undertaken with nurses and health care providers from other acute care settings, as resuscitative care can occur hospital-wide and resuscitation is an interdisciplinary act. Study focused on nursing students is important to promote integration of FPDR into their future nursing practice. Researchers should also continue to explore other methods of FPDR education, and comparisons are vital to determine the best educational method or combination of methods. Last, the long-term effect of FPDR education on perception, self-confidence, and implementation rates must be studied.

Limitations

The measures of control instituted to determine the impact of the online learning module limit the ability to evaluate long-term or sustained changes in critical care nurses’ perception and self-confidence for FPDR. Evaluation of the long-term effect of FPDR education is vital, and further research must be done to determine the long-term impact of FPDR education on critical care nurses’ clinical practice. A second limitation lies in the small sample size; future research

| Table 3 | Resuscitation care attributes |
|-----------------|-----------------|-----------------|
| Attribute                    | No. (%) of nurses¹ |
|                             | Intervention group (n = 40) | Control group (n = 34) |
| Advanced cardiac life support (ACLS) certified | | |
| Yes                          | 37 (92) | 30 (88) |
| No                           | 3 (8)   | 4 (12)  |
| Member of code or rapid response teams | | |
| Yes                          | 38 (95) | 32 (94) |
| No                           | 2 (5)   | 2 (6)   |
| Amount of resuscitation or codes experienced | | |
| In entire career             | | |
| Never                        | 11 (28) | 11 (32) |
| 1-5 times                    | 16 (40) | 15 (44) |
| 6-10 times                   | 12 (32) | 16 (40) |
| 11-20 times                  | 9 (22)  | 9 (24)  |
| > 20 times                   | 22 (55) | 21 (61) |
| In past year                 | | |
| Never                        | 1 (2)   | 1 (3)   |
| 1-5 times                    | 18 (45) | 14 (41) |
| 6-10 times                   | 7 (18)  | 4 (12)  |
| 11-20 times                  | 9 (22)  | 9 (26)  |
| > 20 times                   | 5 (13)  | 6 (18)  |
| Facility or unit policy on family presence | | |
| Yes                          | 18 (45) | 13 (38) |
| No                           | 22 (55) | 21 (62) |
| Prior education about family presence | | |
| Yes                          | 11 (28) | 9 (26)  |
| No                           | 12 (32) | 14 (39) |
| Experience with family presence during resuscitation | | |
| In entire career             | | |
| Never                        | 1 (2)   | 3 (6)   |
| 1-5 times                    | 17 (45) | 12 (35) |
| 6-10 times                   | 6 (18)  | 8 (23)  |
| 11-20 times                  | 9 (22)  | 9 (26)  |
| > 20 times                   | 3 (8)   | 1 (2)   |
| In past year                 | | |
| Never                        | 11 (28) | 9 (26)  |
| 1-5 times                    | 23 (58) | 17 (50) |
| 6-10 times                   | 8 (21)  | 5 (17)  |
| 11-20 times                  | 8 (21)  | 6 (18)  |
| > 20 times                   | 1 (2)   | 3 (6)   |
| Facility or unit policy on family presence | | |
| Yes                          | 18 (45) | 13 (38) |
| No                           | 22 (55) | 21 (62) |
| Prior education about family presence | | |
| Yes                          | 11 (28) | 9 (26)  |
| No                           | 12 (32) | 16 (41) |
| Experience with family presence during resuscitation | | |
| In entire career             | | |
| Never                        | 1 (2)   | 3 (6)   |
| 1-5 times                    | 17 (45) | 12 (35) |
| 6-10 times                   | 6 (18)  | 8 (23)  |
| 11-20 times                  | 9 (22)  | 9 (26)  |
| > 20 times                   | 3 (8)   | 1 (2)   |
| In past year                 | | |
| Never                        | 11 (28) | 9 (26)  |
| 1-5 times                    | 23 (58) | 17 (50) |
| 6-10 times                   | 8 (21)  | 5 (17)  |
| 11-20 times                  | 8 (21)  | 6 (18)  |
| > 20 times                   | 1 (2)   | 3 (6)   |
| Facility or unit policy on family presence | | |
| Yes                          | 18 (45) | 13 (38) |
| No                           | 22 (55) | 21 (62) |
| Prior education about family presence | | |
| Yes                          | 11 (28) | 9 (26)  |
| No                           | 12 (32) | 16 (41) |
| Experience with family presence during resuscitation | | |
| In entire career | | |
| Never | 1 (2) | 3 (6) |
| 1-5 times | 17 (45) | 12 (35) |
| 6-10 times | 6 (18) | 8 (23) |
| 11-20 times | 9 (22) | 9 (26) |
| > 20 times | 3 (8) | 1 (2) |
| In past year | | |
| Never | 11 (28) | 9 (26) |
| 1-5 times | 23 (58) | 17 (50) |
| 6-10 times | 8 (21) | 5 (17) |
| 11-20 times | 8 (21) | 6 (18) |
| > 20 times | 1 (2) | 3 (6) |
| Facility or unit policy on family presence | | |
| Yes | 18 (45) | 13 (38) |
| No | 22 (55) | 21 (62) |
| Prior education about family presence | | |
| Yes | 11 (28) | 9 (26) |
| No | 12 (32) | 16 (41) |
| Experience with family presence during resuscitation | | |

| Table 4 | Mean composite scores for perception and self-confidence |
|-----------------|-----------------|-----------------|
| Characteristic/group | No. of nurses | Pretest | Posttest | Mean difference |
| Perception³ | Intervention group (n = 40) | 3.63 (0.68) | 4.07 (0.63) | 0.44⁴ |
| Control group (n = 34) | 3.82 (0.55) | 3.88 (0.59) | 0.06 |
| Self-confidence³ | Intervention group (n = 40) | 4.24 (0.68) | 4.57 (0.56) | 0.33⁴ |
| Control group (n = 34) | 4.40 (0.59) | 4.40 (0.70) | 0.00 |

a Measured with the Family Presence Risk-Benefit Scale.
b P < .001.
c Measured with the Family Presence Self-confidence Scale.

²²⁹,⁴⁴,⁴⁵
should seek to replicate the findings using a larger, more diverse sample. In addition, only 56.1% of nurses who consented to participate actually completed both pretesting and posttesting, most likely because of the length of the educational intervention and the 45 minutes of time estimated for study completion. Researchers replicating the study might seek to offer incentives for participation in order to obtain a larger sample size and a higher rate of study completion. Last, the method of recruiting participants may have resulted in study findings not representative of critical care nurses who do not maintain AACN membership or subscription to the AACN online sites used for study advertisement; this too warrants further study.

Conclusion

It is imperative that interventions capable of improving nurses’ support for FPDR be instituted so that implementation of FPDR in practice increases and family-centered care is upheld. Increasing support for FPDR is especially relevant to critical care nurses, who have frequent opportunities to enact FPDR in their bedside care. The results of our study demonstrate that online learning is a feasible and effective method for delivering FPDR education to critical care nurses. Online learning resulted in significant increases in both perception of and self-confidence for FPDR implementation with adult patients. Those in management and education roles should consider the use of online learning to promote critical care environments that are receptive to FPDR.

ACKNOWLEDGMENTS

The authors thank Dr Michele Clark, Dr Susan Kowalski, Dr Richard Tandy, and Dr Michael Moore for their guidance in the development of this study and the AACN for hosting the online study advertisements.

FINANCIAL DISCLOSURES

None reported.

eLetters

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SEE ALSO

For more about family presence during resuscitation, visit the Critical Care Nurse website, www.ccnonline.org, and read the AACN Practice Alert, “Family Presence During Resuscitation and Invasive Procedures” (February 2016).

REFERENCES


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A Secure, Social Media–Based “Case of the Month” Module in a Neurocritical Care Unit

By Briana Witherspoon, DNP, ACNP-BC, Kathryn Braunlin, RN, BSN, and Avinash B. Kumar, MD

Background Systems to meet the on-demand learning needs of nurses in intensive care units are not well studied beyond the traditional classroom models. Objective To study the feasibility and effect of implementing an online discussion forum for nurses in a busy neuroscience intensive care unit. Methods A baseline survey was done to highlight the areas of educational need in the unit. Freeform—a password-protected, online discussion forum supported by the university—was used for the pilot project. Freeform has functions similar to Facebook, with “likes,” “follow,” discussion/comment spaces, and the capacity for uploading images and files. A page called “All things NeuroCritical Care” was created. All nurses working in the intensive care unit were automatically enrolled. Clinical vignettes relevant to neurocritical care were posted once a month with 1 to 2 lead questions. All participation was voluntary, and topics were chosen on the basis of the needs survey. At the end of each case, a recent review article on the topic was posted for secure download. Results Eight sentinel diagnoses have been presented as clinical vignettes, and 34 of 76 members formally follow the page. The mean number of discussion strings per case is 8.3 posts. The number of unique visitors to the page during active case discussions exceeds 100. Conclusion A secure, online, problem-based learning discussion format is a feasible point-of-care learning opportunity that can help overcome some of the traditional barriers to ongoing nursing education needs in a busy intensive care unit. (American Journal of Critical Care. 2016;25:310-317)
It is widely acknowledged that a time lag exists between the bedside implementation of best practices and advances in medical knowledge gained through research. As early as 2001, the Institute of Medicine outlined in its report titled “Crossing the Quality Chasm: A New Health System for the 21st Century” that there is a relative disconnect between medical advances (what we know) and current medical care in the United States (what we do). In recent years, the amount of online content in various health care domains, including nursing, has exploded in an attempt to bridge this chasm.

Few outcome studies have addressed the long-term effectiveness of educational initiatives that are based on the web or on mobile devices. A need remains for better understanding of the elements of online curricula and best practices, including instructional design, that have a long-term meaningful impact on participants’ knowledge or behavior, especially changes related to their professional practice. On a practical level, adding a layer of complexity to this issue, intensive care units (ICUs) nationwide are experiencing a high turnover of nurses for multiple reasons, resulting in additional strain on an already stretched health care system. Furthermore, time constraints and dynamically changing and challenging ICU staffing models only add to the complexity of developing and establishing a successful nurse education program.

Systems to meet the on-demand and point-of-care learning needs of nurses in critical care settings are not well studied outside the traditional classroom models. Blended learning and web-based programs offer the promise to bridge the current resource gap and have the added advantage of improving self-directed learning across disciplines, including academic nursing programs. In addition to exposure to content, online case-based discussions increase critical thinking among nursing students. The value of online learning was reinforced in a recent meta-analysis published by the US Department of Education, which concluded that student performance was enhanced with online instruction when compared with face-to-face instruction. The renewed emphasis on nursing education is timely because emerging data show that a better educated nursing workforce is associated with reduced mortality of patients in the ICU.

Little is known about the short- and long-term knowledge-based impact that online, case-based discussions have on learning and translated clinical outcomes in neurocritical care settings. We describe our pilot project experience in successfully implementing a case-based learning discussion centered on neurocritical care by using a password-protected, institution-specific online platform called Freeform (https://freeform.vanderbilt.edu). The focus of our study was 2-fold: to address the immediate educational needs of nurses in our ICU and to test and develop a novel platform for asynchronous learning using a case-based format.

**Methods**

**Needs Assessment**

As our starting point, an educational needs assessment survey was sent to all neuroscience ICU nurses at the medical center. The survey was created by using REDCap, a secure web application for building and managing online surveys and databases. Sending out the survey also allowed us to gauge the level of interest and to determine the subject areas that we would need to focus on during the implementation phase of the project. The anonymous educational needs survey was sent out in late 2013 to approximately 70 nurses, all of whom primarily work in the neuroscience ICU.

The survey was focused on questions including how long the responder had worked in the neuroscience ICU, the responder’s level of confidence in identifying and responding to urgent changes in the clinical conditions of ICU patients with acute respiratory failure, hemodynamic instability, acute neurological changes including changes in intracranial pressure, and seizures. The survey also included free-text options asking responders which areas of critical care they felt least comfortable with. Finally,
we also asked about the willingness of responders to participate in a monthly online learning experience.

We had 39 responses to the survey, although some respondents did not answer all of the questions. Nine of the 39 had worked in the neuroscience ICU for less than 1 year, 15 of the 39 had worked in the neuroscience ICU for 2 to 5 years, and 7 of the 39 had worked in the unit for more than 5 years. Nearly half (19 of 39) of the responding nurses responded no to the question “Did your nursing school training prepare you WELL for your work in the neuroscience ICU?” Those responses reemphasized the need to focus the case-based discussions on pathophysiology specific to neuroscience. In the survey section for free-text suggestions, advanced hemodynamic monitoring was the most frequently requested area of further education, followed by crisis scenario management (adult cardiovascular life support, code scenarios), bedside procedures done in the neuroscience ICU (eg, bronchoscopies, external ventricular drain placements), and understanding and management of neuromuscular disorders (eg, myasthenia gravis). The night nurses expressed a particular need to be involved with the educational program because they tended to miss additional educational opportunities during multidisciplinary rounds in the morning.

Virtual Learning Environment or Web-Based Platform

After evaluation of various social media platforms such as Twitter and Facebook, we decided to use Freeform—a password-protected, institution-specific online platform. Freeform is a web-based, mobile device-enabled, open collaboration platform that is based on social media functionality and architecture. The functionality and look of Freeform are loosely based on the user experiences of Facebook (https://www.facebook.com). Users can post answers or comments, as well as “like” and “follow” the discussion. Administrators can create pages and post content comprising images, text, and video (Figure 1). At the start of the project, sophisticated video capability was limited. Currently the forum is open only to faculty and staff members of our institution. We created the “All things NeuroCritical Care” page (Figure 2) to allow collaborative, asynchronous, and just-in-time learning experiences for the nursing team on all things related to neuroscience.

Educational Content

Content development was a collaborative effort between the core team of intensivists, acute care nurse practitioners, and registered nurses. A series of clinical vignettes and cases that incorporated audio, video, images, and text was developed. The goal was to develop a “case of the month” focused on core pathophysiology seen in the neuroscience ICU. The case launch included a clinical vignette with 1 to 3 questions following the case. Cases were always presented with visual data (computed tomography scans, electrocardiograms, magnetic resonance images, or electroencephalograms as relevant to the specific case).

Each month, 2 moderators (between a physician, an acute care nurse practitioner, and a registered nurse) posted a clinical vignette pertinent to neuroscience with 2 lead questions. The information is posted on a Monday and nursing staff had approximately 5 days to answer the questions and introduce discussion questions. At the conclusion of the case, a recent peer-reviewed review article on the topic was posted for secure download. The articles were made available for participants through the university’s medical library.

The neuroscience ICU at our medical center is a dedicated 22-bed ICU with 8 step-down beds that admits approximately 2400 patients each year. Intensivists board certified in neurocritical care with primary specialties in anesthesiology staff the ICU. The ICU team also includes 11 critical care acute care nurse practitioners and residents who are on monthly rotations. The neuroscience ICU has a core group of about 75 nurses to provide 24/7 coverage. We obtained consent from the institutional review board to retrospectively review the user data of those who participated in the Freeform discussion forum in 2013 and 2014 for our pilot study.

Results

Participation in this initiative was and continues to be voluntary. This forum is ongoing and has been active since inception. We are in the process of updating the clinical vignettes for the upcoming academic year. Eight sentinel diagnoses have been presented so far. Currently 39 of 72 nursing team members formally follow the page regularly. Some of the clinical vignettes discussed so far include complications after subarachnoid hemorrhage, burst suppression in the ICU, myasthenic crisis, posterior reversible encephalopathy syndrome, stunned neurogenic myocardium, polyuria in the ICU, and cerebral venous sinus thrombosis (see Table). We have had 84 answers to questions and discussions posted, and 70 comments have been posted to various scenarios. The mean number of discussion strings per case is 8.3. We have had 3 moderators of the page.
so far. The unique visitors to the page during active case discussions exceed 100 members. The unique visitors metric gives the web administrators a sense of the size of the target audience. The visitor count helps bridge the gap that is evident in all interactive online modules. In discussion forums, at any point in time, a larger number of passive viewers are present on the site than active members who are posting responses. Thus a module may seem less used if one counts only the responses to posts, especially when participants are not required to answer questions in a particular module to progress through it. Hence it is crucial to have webpage analytics to better understand traffic flow to the site and understand online user behavior. Analytics provide an objective method to customize and improve the visitor experience to the website or page.

The current version of the software includes web-based analytics similar to the reports available through Google analytics (Google Inc) for webpages. These analytics can help track the routes that people take to reach the page and the types of devices (eg, mobile phone, tablets, desktops) they use to get there. The number of website visits and the time spent on individual pages and posts also can be tracked. This information helps the content managers better customize future cases to the needs of the specific audience.
Feedback (eg, e-mails, nursing unit board discussions, informal feedback) to date has been extremely positive, and the nursing staff continues to request future topics for discussion.

Discussion

Increased clinical workloads, increased patient acuity, and time constraints continue to be challenges faced by most ICU nurses across the nation. These challenges are compounded by the shortage of registered nurses and an ever-increasing demand on their time to complete and update multiple mandated competencies each year. Thus the logistics of implementing any novel educational initiatives are challenging. In spite of baseline challenges in the work environment, our pilot project was successful in developing an online presence and attempted to fulfill an unmet curricular need via an innovative approach.

Problem-based learning or case-based learning has been successfully used in medical education since the 1960s. Focusing students’ learning on core information relevant to real patient scenarios is one of the primary advantages of problem-based learning in medical education. As early as 2002, the Institute of Medicine Committee on Health Professionals Education highlighted the need to use a multipronged approach including informatics to educate the current generation of health professionals.

![Figure 2 Screenshot of the Freeform—All things NeuroCritical Care page.](https://example.com/fig2.png)
These early recommendations were bolstered by the subsequent findings of a large meta-analysis of more than 200 studies, showing that web-based learning is associated with large positive effects across different types of learners and clinical topics. Furthermore, web-based curricula were at least as effective as traditional classroom teaching methods and web-based platforms allow asynchronous access to content, thus minimizing the constraints of geography and time. This flexibility was particularly useful for our unit, which has a dedicated staff for the night shift whose members cannot be present for daytime learning opportunities such as multidisciplinary rounds.

In order to ensure a successful case discussion, the chosen topic must allow demonstration of knowledge of key concepts, reflection, consensus building, and critical thinking. Using an educational forum such as Freeform to discuss key concepts allows nurses to learn from one another and share their expertise. Reflection on cases provides an opportunity to share how a clinical situation or an experience related to the chosen topic personally affected the nurses, while consensus building allows the staff to work together and come to an agreement on the chosen topic. Finally, through the use of

<table>
<thead>
<tr>
<th>Date</th>
<th>Description</th>
</tr>
</thead>
</table>
| December 2013 | Aneurysmal subarachnoid hemorrhage  
1. Grading of subarachnoid hemorrhage  
2. Common imaging studies  
3. What we do for monitoring during the vasospasm window in our unit |
| January 2014  | Burst suppression for status epilepticus  
1. Standard nomenclature and leads for electroencephalography  
2. What does status epilepticus look like?  
3. Hemodynamic changes during burst suppression  
4. Deployed the unit specific modified treatment algorithm for status epilepticus |
| February 2014 | Myasthenic crisis  
1. Clinical presentation  
2. Therapy choices between intravenous immunoglobulin and plasmapheresis  
3. Complications associated with each modality |
| March 2014    | Posterior reversible encephalopathy syndrome (PRES)  
1. Presentation and associated conditions  
2. Imaging examples in PRES  
3. Management of acute hypertensive urgency and strategy to reduce blood pressure  
4. Pharmacology of agents used in PRES |
| May 2014      | Stunned neurogenic myocardium and Takotsubo cardiomyopathy  
1. Clinical manifestation and presentation  
2. Comparing Takotsubo cardiomyopathy and stunned neurogenic myocardium  
3. Comparing and contrasting Takotsubo cardiomyopathy with acute myocardial infarction |
| June 2014     | High urine output states in the neurological intensive care unit  
1. Diabetes insipidus versus syndrome of inappropriate secretion of antidiuretic hormone (SIADH)  
2. Discussion of cerebral salt wasting (CSW)  
3. Comparing and contrasting mannitol versus hypertonic saline  
4. Discussion of intracranial pressure– versus cerebral perfusion pressure–guided therapy |
| July 2014     | Traumatic brain injury  
1. Imaging and clinical presentation  
2. Indications for hyperosmolar therapy  
3. Comparing and contrasting mannitol versus hypertonic saline  
4. Discussion of mannitol versus hypertonic saline |
| Oct 2014      | Dural venous sinus thrombosis  
1. Etiology and presentation  
2. Imaging and findings  
3. Management |
| Nov 2014      | Dural venous sinus thrombosis, part 2  
1. Discussion of a specific case seen in our unit  
2. Discussion of systemic anticoagulation  
3. Anticoagulation strategies: unfractionated heparin versus low-molecular-weight heparins |
As with a face-to-face curriculum, sound instructional design is essential to successful web-based learning. Higher order questioning, the education forum can be used to encourage critical thinking skills as well.

As with a face-to-face curriculum, sound instructional design that incorporates effective learning strategies is essential for a successful web-based learning module.\textsuperscript{19} The value that students find in learning modules determines the quality of participation.\textsuperscript{19} Education via interactive forums includes 2 main sorts of activities: passive reading of the forum content and active participation by writing posts. Social interaction among the nurses facilitates collaborative learning, which increases retention.\textsuperscript{20} A major criticism of online learning stems from "social isolation" factors for learners who are not accustomed to the lack of sustained human interaction in web only-based courses.\textsuperscript{21}

In our pilot project, despite the high-quality content being posted, we found that although most participants logged into the resource, a high percentage of online viewers did not post any comments. This finding reflects what has been observed in other investigations as well.\textsuperscript{22} The reasons varied from being self-conscious, apprehension of being wrong, and uncertainty about who else was online in the forum, including supervisors and attending physicians.

Limitations of the Project in Its Current State

This pilot project was done to evaluate the feasibility of wider implementation of an online, case-based learning discussion module. We recognize some inherent limitations of our project. We had limited data on nursing education specific to the neuroscience ICU before the project was implemented, thus lacking a well-defined control group. We cannot specifically compare the case-based discussion model with the prior traditional initiatives led by a nurse educator. Long-term retention of knowledge was not specifically tested in this study. The study was not designed to test long-term translation of knowledge into clinical practice.

Future Directions

Keeping some of the limitations in mind, we are currently fine-tuning the platform for the next year. We seek to broaden the scope of the case-based discussion for the upcoming year with an added focus on topics such as neurosurgical procedures, patient safety, stroke education, and general resuscitation. The ease of use of the currently available platform, the configurability of content, and the way it allows just-in-time learning (especially on mobile devices) speak to its tremendous potential. We seek to leverage these features to our advantage in our busy clinical program.

In this pilot project, we described the feasibility and value of an online case-based discussion forum using a social media-type platform. This pilot project can serve as a template for other institutions and ICUs seeking to implement similar projects. The forum can be easily adapted to other nonproprietary social media networks such as Facebook or Twitter.

Practical Challenges Faced During Implementation of the Program

Content is crucial to the long-term success of any information-weighted web delivery platform. Some of the challenges that we faced in generating content and creating a process for participation without disruption included the following:

1. Having a planned release of content at a fixed time each month was the most efficient use of resources and minimized time constraints of various content providers.

2. Although most of the staff was interested in the project from the start, "technostress" was an element that we needed to address. Not all participating staff members were facile with technology, and it is unrealistic to expect them to learn specific technologies that they may not otherwise use. The website and user interface was similar to other social media sites and made the user experience less stressful for novice users.

3. The frequency of the new cases can be a make-or-break element for the platform.\textsuperscript{23} Initially we optimistically planned to post once a week. However, it quickly became apparent that maintaining this schedule was not feasible in the face of regular clinical and more conventional workplace responsibilities. To make this a sustainable venture, we decided that posting a new case once a month was the most reasonable schedule at this point.

4. Using software that did not require a high degree of programming skills was key. Our choice of platform was dictated by this need as well. We believe that the familiar look and user interface were key to the success of the platform.

5. Engaging in work during off hours was viewed as undesirable by most participants, despite the value attached to enhancing practice and patient care. The nature and culture of critical care medicine with long shifts, unpredictable clinical volumes, and varying patient acuities reinforced the notion that time away from work is a precious commodity. Improving engagement when nurses were not present was a challenge as expressed in similar ventures in other specialties.\textsuperscript{24}
Conclusion

In this single-center pilot project, we were successful in creating an online, case-based learning discussion and just-in-time learning opportunity for our neuroscience ICU nurses that was based on their expressed need. We seek to develop this platform further by incorporating topics hosted by clinical experts and enhance engagement of nurses by incorporating continuing education credits into the platform in the upcoming academic year.

ACKNOWLEDGMENTS
The authors thank Martha W. Tanner for her help with manuscript review and preparation.

FINANCIAL DISCLOSURES
None reported.

REFERENCES

For more about technology and nursing education visit the Critical Care Nurse website, www.ccnnonline.org, and read the article by Curran, “Smartphone Applications: Potential Tools for Use in Preparing for CCRN Certification Examinations” (June 2014).


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.
Background Adequate nutritional therapy in critically ill patients is integral to optimal outcome.

Objective To evaluate the association between cumulative macronutrient deficit and overall morbidity in surgical intensive care unit patients.

Methods Adult patients receiving enteral nutrition for more than 72 hours were included if they had no previous admission to the surgical intensive care unit, had received no enteral feedings before admission, had no intestinal obstruction or ileus, and survived 72 hours or more after admission. Data on demographics, outcomes, and nutritional intake during the unit stay were collected for up to 14 days until oral intake began, discharge, or death. Outcome variables included lengths of stay in the hospital and intensive care unit, days with no mechanical ventilation, complications, and mortality.

Results Of 94 participants, 71% were men, mean age was 63 years, and mean score on the Acute Physiology and Chronic Health Evaluation II was 14. Patients with high cumulative calorie deficit (≥6000 cal) and high protein deficit (≥300 g) had significantly fewer days with no mechanical ventilation ($P<.001$), longer unit stays ($P<.001$), longer hospital stays ($P=.007$), more total complications ($P=.007$), and more infectious complications ($P=.009$) than other participants. These associations remained significant in multivariable models after adjustments for age, sex, reason for admission, and propensity score of deficit. In-hospital and 30-day mortality did not differ.

Conclusions Cumulative macronutrient deficits have important clinical outcomes in surgical intensive care patients. (American Journal of Critical Care. 2016;25:318-326)
Provision of adequate nutrition during critical illness is thought to be integral to achieving optimal health outcomes.1-3 Providing timely, sufficient calories and protein is thought to influence both short-term outcomes (eg, intensive care unit [ICU] length of stay, ICU-acquired infections, duration of mechanical ventilation) and long-term outcomes (eg, hospital length of stay, discharge disposition). Observational studies2,4 and randomized trials have indicated an inverse relationship between daily calories received and complication rates. In a large international observational study across 167 ICUs, Alberda et al2 found a stepwise decrease in mortality associated with each additional 1000 cal provided per day in underweight and overweight patients. Dvir et al5 also found a strong correlation between increases in energy deficit and increases in complications such as renal failure and sepsis. Accordingly, consensus statements5-7 from professional nutrition societies emphasize initiating enteral nutrition within 24 to 48 hours of ICU admission. Yet, despite strong recommendations and compelling supportive evidence, ICU patients receive only about one-half of prescribed nutrition in the first 2 weeks of critical illness.2,8

To date, medical ICU patients have been the focus of most research4,9,10 on cumulative calorie or protein deficit. The evidence on the association between malnutrition and outcomes in surgical ICU patients is less convincing.3,11 Yet, compared with medical patients, surgical patients are more likely to have delayed initiation of enteral nutrition and to receive a lower percentage of prescribed calories.12 The purpose of our study was to investigate the association between calorie and protein deficits and important clinical outcomes in surgical ICU patients.

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Methods

Patients and Setting
We performed a prospective, observational, cohort study of patients from 2 surgical ICUs in Massachusetts General Hospital, an academic hospital in Boston, Massachusetts. During the study period (March 2012-December 2012), both surgical ICUs received patients from the trauma and emergency surgery service as well as from transplant, vascular, urologic, orthopedic, colorectal, and surgical oncology services. Surgical patients with medical (nonsurgery related) indications such as sepsis or rapid atrial fibrillation admitted to the 2 ICUs were also considered for inclusion in the study. All patients 18 years and older who received enteral nutrition for more than 72 hours were eligible. If parenteral nutrition or propofol was given concomitantly with enteral feedings, the amount of calories and protein content received from these sources was determined and included in the daily nutritional assessments. Goal rates for enteral feedings were adjusted to avoid hyperalimentation in patients receiving concomitant intravenous nutrition. For patients with multiple surgical ICU admissions, nutritional data were collected solely for the index ICU admission. Exclusion criteria were ICU stay less than 72 hours, previous ICU stay within the same hospitalization, use of enteral feedings before ICU admission, and diagnosis of intestinal obstruction (mechanical or paralytic ileus). Because of the observational study design, Partners Human Research Committee (an institutional review board) waived the requirement to obtain informed consent.
Clinical Management

Initiation and advancement of enteral nutritional intake were based on the official enteral feeding protocol approved by all intensivists in the 2 surgical ICUs where the study was done. When no absolute contraindications were present, enteral feedings were started within 48 hours of ICU admission, initially at a rate of 10 mL/h and increased by 10 mL/h every 2 hours until the desired goal was reached. The goal rate in all surgical ICU patients was calculated by qualified dietitians and was based on the American Society of Parenteral and Enteral Nutrition (ASPEN) guidelines for the provision and assessment of nutritional support therapy in adult critically ill patients. For patients with body mass index (BMI; calculated as the weight in kilograms divided by height in meters squared) less than 30, the goal was 25 to 30 kcal per kilogram of actual weight and 1.5 to 2 g of protein per kilogram of actual weight. For BMI 30 to 40, the goal was 22 to 25 kcal per kilogram of ideal weight or 11 to 14 kcal per kilogram of actual weight and more than 2 g of protein per kilogram of ideal weight. For BMI greater than 40, the calorie goals were the same as those for as BMI 30 to 40 and more than 2.5 g of protein per kilogram of ideal weight.

Enteral feedings were administered via nasogastric, postpyloric, or gastrostomy tubes. Feeding tolerance was evaluated by measuring gastric residual volumes (GRVs) every 4 hours. If the GRV was less than 250 mL, the tube feedings that were sus- tioned out for measurement were returned to the patient, and feeding was continued according to protocol. If the GRV was 250 to 500 mL, the residual was infused again, feeding was continued according to protocol, and use of promotility agents (metoclopramide and/or erythromycin) was started. If the GRV was greater than 500 mL, the residual was infused again, enteral feeding was stopped, use of promotility agents was started, GRV was measured 4 hours later, and if the GRV was less than 500 mL, enteral feeding was resumed at the previous rate.

Clinical Data

Clinical data collected included age, sex, BMI, score on the Acute Physiology and Chronic Health Evaluation (APACHE) II, and admission diagnosis. Data on calorie and protein intake from enteral and parenteral sources were abstracted from the daily nursing flow sheet; collection began on the first day of ICU admission and continued for a maximum of 14 days after admission unless oral intake began, the patient was discharged from the ICU, or death occurred. The data were collected by a research fellow through daily review of the electronic medical record and bedside paper flow sheets. When clarification was required, the clinical team was contacted. Outcomes were determined from review of hospital administrative data and discharge summaries. Calories contained in propofol and the use of supplements (eg, whey powder) were accounted for when total calorie and protein delivery were calculated. Adequacy of calories and protein received was expressed as a percentage of the prescribed nutrition. In our practice, assessments of resting energy expenditure, nitrogen balance, and serum levels of prealbumin and C-reactive protein are obtained solely on selected patients who require long-term critical care and therefore were not routinely measured in the patients in our study during the first 2 weeks after surgical ICU admission.

Outcomes

The primary outcomes of interest were ICU length of stay, hospital length of stay, and 28-day ventilator-free days (VFD; number of days in a 28-day period that no mechanical ventilation was required). The secondary outcome of interest was the 30-day complication rate.

Gastrointestinal complications were abdominal distention that required withholding enteral feed- ings, diarrhea that involved a documented workup and required cessation of enteral feedings, persistent nausea and vomiting, and clinically important aspiration events with radiological evidence and detection of enteral feeding material in tracheal aspirate (on visual inspection).

Infectious complications included pneumonia (defined as radiological findings of new or progres- sive infiltrate, and at least 1 of the following: fever [temperature > 38°C], leukocytosis or leukopenia, purulent secretions, or temporally relevant con- firmed aspiration event); catheter-related infection, surgical site infections, urinary tract infection, and other nonspecified type of infection confirmed by microbiological culture data.


Statistical Analysis

Continuous variables were summarized by using means with standard deviations or medians with interquartile ranges (IQRs), whichever was more appropriate; categorical variables were summarized
by using frequencies. On the basis of the existing literature on nutritional deficits and outcomes in critical illness,13 patients were dichotomized into low- and high-deficit groups. For cumulative calorie deficit, patients were dichotomized to less than 6000 kcal and 6000 or more kcal and for cumulative protein deficit, to less than 300 g and 300 g or greater. Outcomes between the 2 groups were compared by using 2-sample t tests, Wilcoxon rank sum tests, or the Fisher exact test as appropriate.

In an attempt to reduce confounding effects, we controlled for age, sex, BMI, and “propensity score of nutritional deficits” in all multivariable regression analyses. The propensity score of nutritional deficits was constructed by using logistic regression models that included APACHE II score, reason for surgical ICU admission, timing of initiation of enteral feeding, and presence or absence of gastrointestinal surgery. Specifically, to investigate the association between nutritional deficits and length of stay, we compared deficit groups by using a linear regression model for the log-transformed length-of-stay outcomes, because length of stay in the analytic cohort was not normally distributed. To investigate the association between nutritional deficits and length of stay, we compared deficit groups by using a linear regression model, because VFD in the analytic cohort was almost normally distributed. To investigate the association between nutritional deficits and 30-day complication rate, we compared deficit groups by using a Poisson regression model, because complications in the ICU are discrete-count data variables. As a sensitivity analysis, reason for admission was added to all the multivariable models.

On the basis of preliminary data from our own patient cohorts,13 we assumed that 60% of patients in the low-deficit groups were at or below the median ICU length of stay, 30-day VFD, and hospital length of stay. We also assumed that 20% of patients in the high-deficit groups were at or below the median ICU length of stay, 30-day VFD, and hospital length of stay. To detect this difference with a power of 80% and assuming α equals 0.05, we would require a minimum of 23 patients in each group. All analyses were conducted by using SAS, version 9.3, software (SAS Institute). Two-sided P values less than .05 and 95% CIs that did not include 1 were considered statistically significant.

Results
The analytic cohort consisted of 94 surgical ICU patients who met inclusion and exclusion criteria (Table 1). The majority of the patients were male (71%), and they had a mean age of 63 years (SD, 17 years) and a mean APACHE II score of 14 (SD, 6).

A total of 10% of all patients received supplemental parenteral feedings, 28% received whey protein supplements, and 93% received calories from the administration of propofol. In more than two-thirds of the patients, enteral feedings were initiated within 48 hours of ICU admission (see Figure). Median duration of enteral feedings was 10 days (IQR, 6-15 days). Overall, patients received 68% (SD, 19%) of their calorie and 64% (SD, 20%) of their protein requirements. The mean daily calorie deficit was 524 kcal (SD, 436 kcal), and the mean daily protein deficit was 32 g (SD, 22 g). The mean total calorie deficit was 4950 kcal (SD, 4418 kcal), and mean total protein deficit was 298 g (SD, 233 g).

Median ICU length of stay in the analytic cohort was 15 days (IQR, 10-27 days), and hospital length of stay was 29 days (IQR, 19-43 days). The median 28-day VFD was 19 (IQR, 13-25). During hospitalization, a total of 15 patients (16%) died. Seven of those deaths (7%) occurred within 30 days after admission to the surgical ICU. A total of 235 complications occurred in the study cohort (Table 2), with a median of 2 (IQR, 1-3) complications per patient. More than half of the complications were due to infections; pneumonia was a leading causative factor.

Calorie Deficit
Multivariable regression analysis (Table 3) indicated that patients with a cumulative caloric deficit of 6000 kcal or more had almost a 2-fold risk for prolonged ICU length of stay (risk ratio in the log scale, 2.32; 95% CI, 1.62-3.32) and hospital length of stay (risk ratio in the log scale, 1.77; 95% CI, 1.25-2.49) compared with patients with a cumulative calorie deficit of less than 6000 kcal. Patients with a cumulative calorie deficit of 6000 kcal or greater also had approximately 7 fewer VFDs than did patients with a cumulative calorie deficit of 6000 kcal or less (β = -6.93; 95% CI, -11.2 to -2.65). And finally, patients with a cumulative calorie deficit of 6000 kcal or greater were more than 1.5 times more likely to experience complications during hospitalization (incident risk ratio, 1.66; 95% CI, 1.16-2.37) compared with patients with a cumulative caloric deficit of 6000 kcal or less. No difference in in-hospital or 30-day mortality was detected between low- and high-calorie deficit groups.

Protein Deficit
Multivariable regression analysis (Table 3) indicated that patients with a cumulative protein deficit of 300 g or greater had almost a 2-fold risk of prolonged ICU length of stay (risk ratio in the log scale,
Table 1
Baseline demographics, nutrition prescription and delivery, and clinical outcomes

<table>
<thead>
<tr>
<th></th>
<th>All (N=94)</th>
<th>Calorie deficit</th>
<th>Protein deficit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>&lt;6000 kcal (n=71)</td>
<td>≥6000 kcal (n=23)</td>
</tr>
<tr>
<td>Age, mean (SD), y</td>
<td>63 (17)</td>
<td>64 (18)</td>
<td>59 (15)</td>
</tr>
<tr>
<td>Male sex, No. (%)</td>
<td>67 (71)</td>
<td>46 (65)</td>
<td>21 (91)</td>
</tr>
<tr>
<td>Body mass index, mean (SD)</td>
<td>26.6 (6.1)</td>
<td>25.6 (5.6)</td>
<td>29.8 (6.6)</td>
</tr>
<tr>
<td>APACHE II score, mean (SD)</td>
<td>14.0 (6.3)</td>
<td>14.3 (6.6)</td>
<td>13.3 (5.3)</td>
</tr>
<tr>
<td>Admission category, %</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elective</td>
<td>33</td>
<td>28</td>
<td>48</td>
</tr>
<tr>
<td>Emergency surgery</td>
<td>17</td>
<td>18</td>
<td>13</td>
</tr>
<tr>
<td>Trauma</td>
<td>21</td>
<td>31</td>
<td>22</td>
</tr>
<tr>
<td>Nonoperative (medical)</td>
<td>29</td>
<td>23</td>
<td>17</td>
</tr>
<tr>
<td>Initiation of enteral nutrition, hours after admission, No. (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;48</td>
<td>63 (67)</td>
<td>45 (63)</td>
<td>18 (78)</td>
</tr>
<tr>
<td>48-72</td>
<td>10 (11)</td>
<td>8 (11)</td>
<td>2 (9)</td>
</tr>
<tr>
<td>72-96</td>
<td>7 (7)</td>
<td>6 (9)</td>
<td>1 (4)</td>
</tr>
<tr>
<td>≥96</td>
<td>14 (15)</td>
<td>12 (17)</td>
<td>2 (9)</td>
</tr>
<tr>
<td>Nutrition, No. (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parenteral</td>
<td>9 (10)</td>
<td>6 (9)</td>
<td>3 (13)</td>
</tr>
<tr>
<td>Protein supplements</td>
<td>26 (28)</td>
<td>20 (28)</td>
<td>6 (26)</td>
</tr>
<tr>
<td>Propofol</td>
<td>87 (93)</td>
<td>65 (92)</td>
<td>22 (96)</td>
</tr>
<tr>
<td>Baseline nutritional prescription, mean (SD)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calories, kcal/d</td>
<td>1708 (389)</td>
<td>1617 (323)</td>
<td>1989 (445)</td>
</tr>
<tr>
<td>Protein, g/d</td>
<td>87 (21)</td>
<td>84 (21)</td>
<td>95 (18)</td>
</tr>
<tr>
<td>Daily nutrition, mean (SD)</td>
<td></td>
<td></td>
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<tr>
<td>Calories, kcal/d</td>
<td>1184 (406)</td>
<td>1252 (352)</td>
<td>972 (491)</td>
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<tr>
<td>Protein, kcal/d</td>
<td>55 (22)</td>
<td>59 (21)</td>
<td>43 (22)</td>
</tr>
<tr>
<td>ICU nutrition deficit, mean (SD)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caloric, kcal/d</td>
<td>524 (436)</td>
<td>365 (237)</td>
<td>1017 (538)</td>
</tr>
<tr>
<td>Protein, g/d</td>
<td>32 (22)</td>
<td>25 (17)</td>
<td>52 (24)</td>
</tr>
<tr>
<td>Total calorie deficit, mean (SD)</td>
<td>4950 (4418)</td>
<td>2922 (1801)</td>
<td>11 211 (4234)</td>
</tr>
<tr>
<td>Total protein deficit, mean (SD)</td>
<td>298 (233)</td>
<td>203 (134)</td>
<td>591 (231)</td>
</tr>
<tr>
<td>Percentage of calories delivered, mean (SD)</td>
<td>68 (19)</td>
<td>74 (16)</td>
<td>49 (18)</td>
</tr>
<tr>
<td>Percentage of protein delivered, mean (SD)</td>
<td>64 (20)</td>
<td>70 (18)</td>
<td>48 (19)</td>
</tr>
<tr>
<td>Days of enteral nutrition, median (IQR)</td>
<td>10 (6-15)</td>
<td>8 (5-13)</td>
<td>15 (8-15)</td>
</tr>
<tr>
<td>Ventilator days, median (IQR)</td>
<td>10 (3-17)</td>
<td>7 (3-14)</td>
<td>14 (11-29)</td>
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<tr>
<td>ICU LOS, median (IQR), d</td>
<td>15 (10-27)</td>
<td>12 (9-23)</td>
<td>27 (16-42)</td>
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<tr>
<td>Hospital LOS, median (IQR), d</td>
<td>29 (19-43)</td>
<td>25 (18-42)</td>
<td>38 (33-53)</td>
</tr>
<tr>
<td>In-hospital mortality, No. (%)</td>
<td>15 (16)</td>
<td>10 (14)</td>
<td>5 (22)</td>
</tr>
<tr>
<td>30-day mortality, No. (%)</td>
<td>7 (7)</td>
<td>4 (6)</td>
<td>3 (13)</td>
</tr>
<tr>
<td>Total complications, median (IQR)</td>
<td>2 (1-3)</td>
<td>1 (1-3)</td>
<td>2 (2-4)</td>
</tr>
<tr>
<td>Gastrointestinal complications, median (IQR)</td>
<td>0 (0-0)</td>
<td>0 (0-1)</td>
<td>0 (0-1)</td>
</tr>
<tr>
<td>Infectious complications, median (IQR)</td>
<td>1 (0-2)</td>
<td>1 (0-1)</td>
<td>1 (1-2)</td>
</tr>
<tr>
<td>Cardiovascular complications, median (IQR)</td>
<td>0 (0-1)</td>
<td>0 (0-0)</td>
<td>0 (0-1)</td>
</tr>
<tr>
<td>Skin complications, median (IQR)</td>
<td>0 (0-0)</td>
<td>0 (0-0)</td>
<td>0 (0-1)</td>
</tr>
</tbody>
</table>

Abbreviations: APACHE, Acute Physiology and Chronic Health Evaluation; ICU, intensive care unit; IQR, interquartile range; LOS, length of stay; VFD, ventilator-free days.

*Because of rounding, not all percentages total 100.

Calculated as weight in kilograms divided by height in meters squared.
2.27; 95% CI, 1.71-3.02) and hospital length of stay (risk ratio in the log scale, 1.70; 95% CI, 1.28-2.25) compared with patients with a cumulative protein deficit less than 300 g. Patients with a cumulative protein deficit of 300 g or greater also had approximately 10 fewer VFDs compared with patients with a cumulative protein deficit less than 300 g (β = -9.47; 95% CI, -12.66 to -6.29). And finally, patients with a cumulative protein deficit of 300 g or more were approximately 1.5 times more likely to experience complications during hospitalization (incident risk ratio, 1.49; 95% CI, 1.10-2.03) than were patients with a cumulative protein deficit less than 300 g. No difference in hospital or 30-day mortality was detected between low- and high-protein deficit groups.

**Sensitivity Analysis**

Addition of reason for admission to the surgical ICU to the multivariable models to test the association of calorie and protein deficit with outcomes did not materially change the results of our primary analysis (data not shown). Moreover, because we observed a high correlation between cumulative calorie deficit and cumulative protein deficit (r = 0.82), we repeated each of our primary multivariable analyses for calorie deficit with protein deficit as an interaction term.

---

**Table 2**

<table>
<thead>
<tr>
<th>Complication</th>
<th>All (N=94)</th>
<th>Calorie deficit</th>
<th>Protein deficit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>&lt;6000 kcal (n=71)</td>
<td>≥6000 kcal (n=23)</td>
</tr>
<tr>
<td>Total number of complications</td>
<td>235</td>
<td>153</td>
<td>82</td>
</tr>
<tr>
<td>Number of complications per patient, median (IQR)</td>
<td>2 (1-3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gastrointestinal</td>
<td>45</td>
<td>31</td>
<td>14</td>
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<tr>
<td>Vomiting</td>
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<tr>
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<tr>
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<td>49</td>
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<tr>
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<td>7</td>
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<td>Heart failure</td>
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<td>1</td>
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<td>Wound healing</td>
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<td>1</td>
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<tr>
<td>Pressure wounds</td>
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<td>2</td>
<td>4</td>
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</tbody>
</table>

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**Discussion**

In this prospective, cohort study of patients admitted to the surgical ICU, we found that cumulative complications during hospital admission

![Figure](image-url) **Figure** Initiation of enteral nutrition after admission to surgical intensive care unit.

We found no interaction between calorie and protein deficit in any of the multivariable regression models (data not shown).
Patients with a cumulative caloric deficit of 6000 kcal or more had longer ICU and hospital lengths of stay. Calorie and protein deficit is associated with important clinical outcomes. Specifically, compared with the other patients, patients with an accumulated caloric deficit of 6000 kcal or greater or those with an accumulated protein deficit of 300 g or greater had longer ICU length of stay, longer hospital length of stay, fewer VFDs, and higher rate of complications. Although our results are compelling, a causal relationship cannot be inferred because of the observational nature of the study; nonetheless, our results provide evidence for a better understanding of how attention to nutritional status may promote desired outcomes in surgical ICU patients. For example, the concept of a cumulative nutritional deficit is analogous to using lactate as a biomarker for oxygen debt or cumulative fluid balance to account for crystalloid resuscitation. Serial measurements of lactate clearance are more prognostic of outcome than is initial serum level of lactate at the time of admission.14 Likewise, a patient with septic shock may require aggressive fluid replacement early in the hospital course, but later outcomes will depend on how aggressively that accumulated fluid can be removed through diuresis after the patient’s condition is stabilized.15 The same relationship may be true of nutritional deficits. Future investigations of calorie and protein deficit should elaborate on several questions: What is the interaction between time and calorie deficit? Is a calorie deficit of less than 6000 calories that develops during a 14-day period as deleterious as one that develops rapidly in the first 4 to 7 days? If a causal link exists, can patients’ outcomes be improved by “paying down” the deficit over time (ie, mild overfeeding to make up for prior deficits)?

Villet et al13 previously reported that in surgical ICU patients, a cumulative deficit of less than 10 000 kcal during the first week of care is associated with worse outcomes. Our threshold was much lower, and the deficit accumulated more insidiously during a 2-week period. In medical patients, Faisy and colleagues9,16 found that cumulative deficits were predictive of ventilator-associated pneumonia caused by Staphylococcus aureus and suggested a daily energy deficit of 5021 kJ (approximately 1199 cal) as a threshold for predicting ICU mortality. In our study, the daily calorie deficit threshold for predicting complications and increased length of stay in surgical patients was remarkably similar (1107 cal); however, differences in mortality in our study were not significant, most likely because of the small number of patients. Plausibly, accumulating a macronutrient deficit would result in worse clinical outcomes (eg, increased rate of infections, wound dehiscence, decubitus ulcers, and longer stays) due to decreased immunocompetence, skeletal muscle catabolism, and impaired wound healing. Indeed, our data revealed an association between energy (calorie) deficit and prolonged mechanical ventilation, ICU length of stay, and complications.

Other investigators have concluded opposite findings: that aggressive delivery of nutrients may be associated with harm.17,18 However, accounting for 2 confounding factors is important. First, patients who have short ICU stays and are generally healthy most likely will have good outcomes regardless of poor delivery of nutrients during the patients’ short stay. Second, days after permanent progression to oral intake may be misrepresented as 0% enteral intake because no tube feedings were delivered. Controlling for these confounding factors confirms our findings that improved nutrient delivery is correlated with improved clinical outcomes.19

None of our patients had an absolute contraindication to enteral feedings, and all study patients received enteral feedings within the first 2 weeks after ICU admission. Among patients with a calorie deficit greater than the 6000-calorie threshold, 78% had enteral feedings within 48 hours of ICU admission. Interestingly, the groups with high calorie and protein deficits were prescribed significantly more calories and protein and had enteral feeding started on similar ICU days compared with groups with low calorie and protein deficits. Yet, patients in the groups with high calorie and protein deficits rapidly accumulated a deficit within a median of 6 days. This finding implies that prescription and initiation of enteral feeding were not the responsible

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Calorie deficit ≤6000 kcal</th>
<th>Protein deficit ≥300 g</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimate</td>
<td>95% CI</td>
</tr>
<tr>
<td>Ventilator-free days, difference in days</td>
<td>-6.93</td>
<td>-11.20 to -2.65</td>
</tr>
<tr>
<td>Length of stay in surgical intensive care unit, risk ratio in the log scale</td>
<td>2.32</td>
<td>1.62 to 3.32</td>
</tr>
<tr>
<td>Length of stay in hospital, risk ratio in the log scale</td>
<td>1.77</td>
<td>1.25 to 2.49</td>
</tr>
<tr>
<td>Total number of complications, incident risk ratio</td>
<td>1.66</td>
<td>1.16 to 2.37</td>
</tr>
</tbody>
</table>

Table 3 Multivariable model estimates of calorie or protein deficit effect on outcomes.
Both calorie and protein deficits may affect outcomes in surgical intensive care unit patients.
deficits were more likely to experience longer ICU length of stay, prolonged hospital length of stay, fewer VFDs, and higher complication rates than were patients with low calorie and protein deficits. Randomized, controlled trials are needed to determine whether minimizing cumulative nutritional deficits in surgical ICU patients improves clinical outcomes.

ACKNOWLEDGMENTS

This research was performed at Massachusetts General Hospital. Material in this article was presented as a poster at the Society of Critical Care Medicine 43rd Critical Congress; January 9-13, 2014; San Francisco, California.

FINANCIAL DISCLOSURES

None reported.

eLetters

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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) 362-2048; e-mail, reprints@aacn.org.
Background Allocating resources appropriately requires knowing whether obese patients use more resources during a hospital stay than nonobese patients.

Objectives To determine if trauma patients with different body mass indexes differed in use of resources measured as a multifaceted outcome variable.

Methods A trauma registry was used for a retrospective study of adult patients admitted to a midwestern level I trauma center. Patients were stratified into 3 groups: nonobese (normal weight, overweight), obese, and morbidly obese. Three canonical correlation analyses were used to determine the relationship between patient/injury characteristics and hospital resource usage.

Results In a sample of 9771 patients, 71.2% were nonobese, 23.8% obese, and 5.0% morbidly obese. For patient/injury characteristics, Injury Severity Score and physiological complications were significant variables for all 3 groups. Scores on the Glasgow Coma Scale were significant for nonobese patients only. For resource usage, intensive care unit length of stay and procedures were significant variables for all 3 groups.

Conclusions Associations between body mass index and outcomes have been noted when assessed as independent variables. However, when resource usage was assessed as a multifaceted outcome variable, injury factors (higher Injury Severity Score, lower scores on the Glasgow Coma Scale, more physiological complications) were associated with resource usage (increased length of stay in the intensive care unit and increased number of procedures). These findings provide clinicians a new perspective for evaluating the complex relationship between patient/injury characteristics and hospital resource usage.

Trauma is the most common cause of mortality for persons 1 to 45 years old and is the third leading cause of death in the United States. Obesity is a national epidemic that affects all aspects of health care, including trauma care. According to the Centers for Disease Control and Prevention, 35.1% of US adults 20 years old and older are obese (body mass index [BMI], calculated as weight in kilograms divided by height in meters squared, > 30), and 69% are overweight (BMI > 25). Obesity is a major health concern because of its established relationship with serious medical diseases and increased likelihood of comorbid conditions (eg, diabetes mellitus, hyperlipidemia, heart disease, pulmonary disease). As the number of obese adults continues to increase, the potential number of obese trauma patients with severe injury and complications will also increase.

Management of prehospital and in-hospital trauma care, including complications associated with airway management, surgical procedures, and radiological imaging, of obese patients can be challenging. However, published reports on how obesity complicates hospital stays after trauma are conflicting. Several studies have indicated that obese trauma patients are more likely than nonobese patients to have longer stays in the intensive care unit (ICU) and hospital, more days of mechanical ventilation, more complications and comorbid conditions, and higher mortality. Other studies have indicated no differences between obese and nonobese patients in mortality, length of stay in the ICU, and the hospital, duration of mechanical ventilation, complications, or comorbid conditions.

Care of critically ill trauma patients is resource intensive, technically involved, and expensive because of the need for highly trained staff and modern equipment and the use of diagnostic tests, pharmaceutical agents, and interventions. Allocating resources appropriately requires knowledge of whether or not obese patients use more resources during their hospital stay than do nonobese patients. The ability to reliably predict or assess resource needs according to the population of patients is a starting point for good internal management of resources. Published reports conflict on the topic of whether obesity complicates hospital stays after trauma.

Published reports conflict on the topic of whether obesity complicates hospital stays after trauma.

Methods

Patients and Setting

The study was a retrospective review of data in a trauma registry of all adult trauma patients (≥ 18 years old) admitted between 2004 and 2012 at a midwestern level I trauma facility in a predominantly rural state. Exclusion criteria included patients with BMI less than 18.5 (underweight persons are physiologically distinct from persons of other weight classifications), patients who were dead on arrival, and patients with burns (physiological and clinical factors affecting outcomes differ between burn and nonburn patients). Additionally, patients transferred to another acute care facility before 1 week were...
excluded because their final outcomes were not indicated in the registry. Patients were also excluded if anthropometric data (height, weight, trauma registry–calculated BMI) were missing. Approval was obtained from all appropriate institutional review boards.

**Study Variables**

Demographic and clinical data were extracted from the trauma registry. Variables for univariate analysis included sex, race, BMI, mechanism of injury, mortality, and discharge destination. The selection of variables for multivariate analysis was exploratory and based on availability and on variables of interest. Variables representing patient/injury characteristics and hospital resource usage were grouped for statistical analysis. Patient/injury characteristic variables known to be associated with trauma outcomes included age,33-35 Injury Severity Score (ISS),16,36 and score on the Glasgow Coma Scale (GCS).35,37 Number of physiological complications (eg, cardiovascular, gastrointestinal, hematologic, hepatic/pancreatic/biliary/splenic, infectious, musculoskeletal/integumentary, neurological, pulmonary, renal/genitourinary, vascular), hypothesized to be related to resource usage because of increased complications for obese patients7,9,15-18,24 was also included as an injury factor. Hospital resource usage variables included ICU and hospital (non-ICU) lengths of stay.38,39 Number of medical consultations was considered a resource usage variable to assess “human” resources and included allergy/immunology, anesthesiology, cardiology, head and neck, emergency medicine, family practice, infectious disease, internal medicine, neurology, neurosurgery, obstetrics and gynecology, oral and maxillofacial surgery, ophthalmology, orthopedics, otolaryngology, psychiatry, pulmonary, radiology, renal service, surgery (general, hand-orthopedics, thoracic, trauma, vascular), urology, and other. Number of procedures was included to assess human and material resources; all procedures performed during the course of care were included (eg, surgical, diagnostic).40

ICU and hospital lengths of stay are 2 variables that often have skewed distributions.41 Because of the highly skewed nature of these variables in this data set (due to patient outliers who had shorter lengths of stay than did average patients), a logarithm transformation of data for multivariate analysis was performed. This type of transformation is used as a remedy for outliers and uses the logarithm of a set of numbers to reduce positive skewness in a data set.42

**BMI Groups**

The BMI classification recommended by the World Health Organization43 was used to stratify patients into 3 groups for analyses: nonobese (normal weight and overweight; BMI 18.50-24.99 and 25.00-29.99, respectively), obese (BMI 30.00-39.99), and morbidly obese (BMI > 40.00).

**Statistical Analysis**

The outcome was a composite variable of resource usage, including ICU and hospital lengths of stay, medical consultations, and procedures. Descriptive statistics were summarized by using frequencies (percentages) and means (standard deviations). Continuous variables were compared by using Kruskal-Wallis (nonparametric analysis of variance) and Mann-Whitney (nonparametric t test) tests with Bonferroni adjustments for multiple comparisons. Categorical variables were analyzed by using $\chi^2$ tests. BMI stratifications were grouped into 3 categories on the basis of previous research for multivariate analysis: nonobese, 3,8-10,12,15,19,22,26 obese, and morbidly obese.17,25,27,44 Analyses were completed on each weight classification. Statistical significance was set at $P < .05$. SPSS for Windows, version 20, software (IBM SPSS) was used for all analyses.

Canonical correlation analysis is an exploratory multivariate statistical analysis of the correlation between 2 separate and distinct sets of variables. Data are obtained on each patient for each set of variables (patient/injury characteristics and hospital resource usage) to determine the dimensions in which the variables are related (see Figure). The optimal linear combination of 1 set of variables (canonical variate) is combined to produce, on each side, a predicted value that has the highest correlations with the predicted value on the other side (forming a pair of canonical variates). Canonical loadings (correlation values) are produced to measure the relationship between every observed variable and its canonical variate (composite). This statistical analysis can be thought of as creating multiple composite variables. In the study reported here, the individual variables age, ISS, GCS score, and physiological complications represent the first composite variable (patient/injury characteristics) and the individual variables ICU length of stay, hospital length of stay, medical consultations, and procedures represent a second composite variable (hospital resource usage). The analysis indicates the relationship between the 2 composite variables. Canonical correlation analysis is a useful technique when the underlying dimensions representing the combinations of variables are unknown.42
The Glasgow Coma Scale score was a significant variable for non-obese patients only.

**Results**

Of the 9771 study patients in the final sample, 71.2% (n = 6958) were nonobese (3517 normal weight and 3441 overweight), 23.8% (n = 2329) were obese, and 5.0% (n = 484) were morbidly obese (Table 1). The majority, 61.9% (n = 6053) were men, and 89.1% (n = 8655) were white. The mean age was 45.88 years (SD, 21.5). The mean ISS was 10.77 (SD, 9.6). The most common mechanisms of injury were motor vehicle crash (33.8%), fall (33.1%), and other (33.1%; eg, sports injury, off-road vehicle). The majority of patients (77.3%) were discharged home, 19.3% were discharged to continued care, and 3.4% were discharged to nonhome sites (eg, mental health facility, other acute care hospital). Mean hospital length of stay was 3.12 days (SD, 4.9), and ICU length of stay was 1.47 days (SD, 3.6). The majority of the patients (95.3%) survived (Table 2).

**Canonical Correlation Analyses**

Canonical correlation analyses (Table 3) indicated the first canonical correlation pair was significant for the nonobese ($r = 0.76$; accounting for 58% of the variance), obese ($r = 0.77$; accounting for 59% of the variance), and morbidly obese ($r = 0.76$; accounting for 58% of the variance). This finding indicated that for each BMI classification, a significant linear association existed between patient/injury characteristics and resource utilization.

**Discussion**

In this exploratory study, we used canonical correlation analysis to examine the relationship between patient/injury characteristics and hospital resource usage across BMI categories. Statistically significant results from preliminary univariate tests (Tables 1 and 2) indicated differences between BMI populations and justified separate canonical correlation analyses. Injury factors (ISS, GCS score [only significant in nonobese population], and physiological complications) were related to hospital resource usage. As ISS and physiological complications increased, ICU length of stay increased and patients required more procedures. These findings were similar across the obese and morbidly obese populations. The only significant differences were apparent in the nonobese population; GCS was a significant factor associated with hospital resource utilization in this group.

Injury factors accounted for the most variance in hospital resource usage in these trauma patients, and similar associations have been observed by others. Vincent et al. assessed differences in hospital resource utilization in terms of acute care length of stay, units of blood transfused, number of days of mechanical ventilation, and hospital charges between non–morbidly obese and morbidly obese patients and found no differences. BMI was not related to hospital resource usage, and ISS was highly predictive of length of stay and hospital charges. They concluded that orthopedic trauma teams can expect similar outcomes regardless of BMI in patients with acetabular fractures. Dhungel et al. determined that hospital length of stay, ICU length of stay, and duration of mechanical ventilation did not differ significantly between normal weight, overweight, obese, and morbidly obese patients. In addition, studies have indicated that with adjustments for ISS, BMI is not a significant factor in determining mortality. Furthermore, in many studies, obese patients had more complications than did...
nonobese patients. However, we found that within all populations (nonobese, obese, and morbidly obese), the number of physiological complications influenced ICU length of stay and number of procedures. In contrast to many researchers who investigated hospital resource usage as a single outcome (eg, total hospital length of stay, ICU length of stay), we used canonical correlation analyses to examine the complex relationship between patient/injury characteristics and the multifaceted nature of hospital resources.

In our study, nonobese patients differed slightly from the obese and morbidly obese patients; the GCS score was significantly associated with resource utilization in the nonobese group. These results are not surprising, because obese patients sustain fewer head injuries than do lean trauma patients. We were unable to use GCS scores as a significant differentiating variable for the obese and morbidly obese patients because of the rarity of head injury within those populations.

### Clinical Implications

Although the morbidly obese patients in our study did not use more resources than did the other groups, this population potentially requires different resources than do the nonobese and obese. Morbidly obese patients require changes in practice that entail increased individual cost for care (eg, nursing equipment such as beds, toilets, and lifting devices). Further, because of airway complications, some procedures, such as percutaneous placement of a tracheostomy tube, typically done at the bedside are moved to the operating room for the patient’s safety.

From the perspective of hospital management, identifying populations of patients who use more resources than do other populations is essential. Appropriate planning and identification of at-risk populations contribute to reduced cost for patients, hospitals, and health care systems by decreasing ICU and hospital lengths of stay. Length of stay is a useful indicator of resource usage in trauma patients, and because the trauma system is a dynamic one,

---

### Table 1

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Total</th>
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<th>Obese</th>
<th>Morbidly obese</th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>9771 (100)</td>
<td>6958 (71.2)</td>
<td>2329 (23.8)</td>
<td>484 (5.0)</td>
<td></td>
</tr>
<tr>
<td>Age, mean (SD), y</td>
<td>45.88 (21.5)</td>
<td>45.80 (22.5)</td>
<td>46.27 (19.1)</td>
<td>45.23 (17.1)</td>
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<tr>
<td>Injury Severity Score, mean (SD)</td>
<td>10.77 (9.6)</td>
<td>10.95 (9.5)</td>
<td>10.49 (9.7)</td>
<td>9.53 (9.7)</td>
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</tr>
<tr>
<td>Score on Glasgow Coma Scale, mean (SD)</td>
<td>13.60 (9.5)</td>
<td>13.52 (3.6)</td>
<td>13.75 (3.4)</td>
<td>13.92 (3.2)</td>
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<tr>
<td>Physiological complications, mean (SD)</td>
<td>0.36 (1.1)</td>
<td>0.33 (1.1)</td>
<td>0.42 (1.2)</td>
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<td>6053 (61.9)</td>
<td>4468 (64.2)</td>
<td>1382 (59.3)</td>
<td>203 (41.9)</td>
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<td>3718 (38.1)</td>
<td>2490 (35.8)</td>
<td>947 (40.7)</td>
<td>281 (58.1)</td>
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<td>2080 (90.0)</td>
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<td>769 (11.1)</td>
<td>232 (10.0)</td>
<td>55 (11.4)</td>
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<tr>
<td>Score on Glasgow Coma Scale</td>
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<td></td>
<td></td>
<td></td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Severe (3-8)</td>
<td>1000 (10.2)</td>
<td>740 (10.6)</td>
<td>218 (9.4)</td>
<td>42 (8.7)</td>
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<td>Moderate (9-13)</td>
<td>453 (4.6)</td>
<td>368 (5.3)</td>
<td>77 (3.3)</td>
<td>8 (1.7)</td>
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<td>Mild (14-15)</td>
<td>8312 (85.1)</td>
<td>5845 (84.1)</td>
<td>2033 (87.3)</td>
<td>434 (89.7)</td>
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<td>6438 (92.8)</td>
<td>2168 (93.3)</td>
<td>458 (95.0)</td>
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<td>Penetrating</td>
<td>683 (7.0)</td>
<td>503 (7.2)</td>
<td>156 (6.7)</td>
<td>24 (5.0)</td>
<td></td>
</tr>
<tr>
<td>Mechanism of injury</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Motor vehicle crash</td>
<td>3289 (33.8)</td>
<td>2193 (31.7)</td>
<td>879 (37.9)</td>
<td>217 (45.0)</td>
<td></td>
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<tr>
<td>Fall</td>
<td>3221 (33.1)</td>
<td>2375 (34.3)</td>
<td>702 (30.3)</td>
<td>144 (29.9)</td>
<td></td>
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<tr>
<td>Other</td>
<td>3214 (33.1)</td>
<td>2355 (34.0)</td>
<td>738 (31.8)</td>
<td>121 (25.1)</td>
<td></td>
</tr>
</tbody>
</table>

a Data are presented as number (percentage) unless otherwise specified. Percentages may not total 100 because of incomplete data, missing data, or rounding. Kruskal-Wallis and Mann-Whitney tests completed for means testing. \( \chi^2 \) test completed for frequency analysis.

b Nonobese: normal weight, body mass index (BMI, calculated as weight in kilograms divided by height in meters squared) 18. 50-24.99 and overweight, BMI 25.00-29.99; morbidly obese: BMI ≥ 40.00.

c Physiological complications include but are not limited to pulmonary, cardiovascular, gastrointestinal, hepatic/pancreatic/biliary/splenic, hematologic, infections, renal/gentourinary, musculoskeletal/integumentary, neurological, and vascular.

d Other: animal, assault, bicycle crash, drowning, electrical injury, fall, farm/heavy equipment, gunshot wound, motorcycle crash, off-road vehicle, other mechanism, pedestrian injury, plane crash, power equipment/machinery, railway injury, sports injury, stab wound, unspecified, watercraft injury.
knowledge of demographic data contributes to the ability to plan resources.40 In addition, resources must be used effectively and efficiently to promote maximal opportunity for optimal recovery.46

According to our results, the burden of resource usage falls on the critical care team because ICU length of stay, not hospital length of stay, was affected by injury factors in terms of ISS, GCS scores, and physiological complications regardless of BMI classification. Although only 3% to 5% of beds are located within the ICU, up to 30% of hospital budgets are spent on ICU resources.47,48 The reduction in ICU length of stay is an important aim of the critical care unit because longer stays increase risk for infection and are associated with a higher risk for in-hospital death.50

### Strengths and Limitations

Strengths of our study include use of a large sample size reflective of US trends in overweight, obese, and morbidly obese patients: 64% of the patients cared for at our facility and 69% of the US population, respectively.4 The trauma registry is a clinical database that provides an in-depth collection of patient information. However, because the trauma registry was not designed specifically for research purposes, incomplete and missing data might have led to a potential bias in our study sample. Facility-specific guidelines and protocols for procedures and consultations also limit the generalizability of our findings.

---

**Table 2**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Total (n = 9771)</th>
<th>Nonobese (n = 6958)</th>
<th>Obese (n = 2329)</th>
<th>Morbidly obese (n = 484)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Procedures, mean (SD)</td>
<td>4.72 (5.0)</td>
<td>4.54 (4.7)</td>
<td>5.12 (5.5)</td>
<td>5.37 (5.9)</td>
<td>.01</td>
</tr>
<tr>
<td>Medical consultations, mean (SD)</td>
<td>1.07 (0.8)</td>
<td>1.06 (0.9)</td>
<td>1.09 (0.9)</td>
<td>1.13 (0.9)</td>
<td>.20</td>
</tr>
<tr>
<td>Days in intensive care unit, mean (SD)</td>
<td>1.47 (3.6)</td>
<td>1.4 (3.3)</td>
<td>1.7 (4.1)</td>
<td>1.9 (4.4)</td>
<td>.34</td>
</tr>
<tr>
<td>Days in hospital, mean (SD)</td>
<td>3.12 (4.9)</td>
<td>3.08 (4.9)</td>
<td>3.14 (4.4)</td>
<td>3.7 (7.1)</td>
<td>.73</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Injury location</th>
<th>Head and neck</th>
<th>Face</th>
<th>Chest</th>
<th>Abdomen or pelvic</th>
<th>Extremity or pelvic girdle</th>
<th>External</th>
</tr>
</thead>
<tbody>
<tr>
<td>3652 (55.7)</td>
<td>2698 (58.3)</td>
<td>807 (50.7)</td>
<td>147 (43.2)</td>
<td>&lt;.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2698 (14.9)</td>
<td>1131 (24.4)</td>
<td>397 (24.9)</td>
<td>82 (21.4)</td>
<td>.90</td>
<td></td>
<td></td>
</tr>
<tr>
<td>969 (14.8)</td>
<td>640 (13.8)</td>
<td>272 (17.1)</td>
<td>57 (16.8)</td>
<td>.004</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2467 (37.6)</td>
<td>1646 (35.6)</td>
<td>652 (41.0)</td>
<td>169 (49.7)</td>
<td>&lt;.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3498 (53.3)</td>
<td>2462 (53.2)</td>
<td>848 (53.3)</td>
<td>188 (55.3)</td>
<td>.75</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hospital disposition (nondeceased)</th>
<th>&lt;.001</th>
</tr>
</thead>
<tbody>
<tr>
<td>Home</td>
<td>7173 (77.3)</td>
</tr>
<tr>
<td>Continued care</td>
<td>1788 (19.3)</td>
</tr>
<tr>
<td>Nonhome</td>
<td>314 (3.4)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mortality</th>
<th>Survived</th>
<th>Died</th>
</tr>
</thead>
<tbody>
<tr>
<td>9314 (95.3)</td>
<td>91 (3.9)</td>
<td>2238 (96.1)</td>
</tr>
<tr>
<td>457 (4.7)</td>
<td>344 (4.9)</td>
<td>9771 (100)</td>
</tr>
</tbody>
</table>

**Table 3**

<table>
<thead>
<tr>
<th>Canonical function 1</th>
<th>Nonobese (n = 6958)</th>
<th>Obese (n = 2329)</th>
<th>Morbidly obese (n = 484)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>-0.13</td>
<td>-0.11</td>
<td>-0.12</td>
</tr>
<tr>
<td>Injury Severity Score</td>
<td>0.61&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.37&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.30&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Score on Glasgow Coma Scale</td>
<td>-0.45&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-0.2</td>
<td>0.21</td>
</tr>
<tr>
<td>Physiological complications</td>
<td>0.94&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.70&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.74&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Hospital resource use</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Days in intensive care unit</td>
<td>0.50&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.56&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.35&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Days in hospital</td>
<td>0.06</td>
<td>-0.05</td>
<td>0.09</td>
</tr>
<tr>
<td>Medical consultations</td>
<td>0.07</td>
<td>0.03</td>
<td>0.06</td>
</tr>
<tr>
<td>Procedures</td>
<td>0.54&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.55&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.67&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Canonical correlation</td>
<td>0.76&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.77</td>
<td>0.76</td>
</tr>
</tbody>
</table>

<sup>a</sup> Denotes significant factor.<sup>42</sup>
<sup>b</sup> Squared canonical correlation.
In addition, comorbid conditions could not be accounted for in our analysis because of the incomplete data in the registry.

The statistical analysis we used has some limitations. Canonical correlation maximizes the correlation between sets of variables; however, the combination may not make sense theoretically.42 Findings must be interpreted with caution; both statistical and clinical significance should be taken into account. Canonical correlation is also especially sensitive to data involved in analysis. Outliers and which variables are included in analysis can dramatically affect results. Variables included in our analysis are frequently noted in trauma literature.

Future Research

Future research should include assessment of additional resources “consumed” in the hospital and after discharge, including care provided by caregivers, rehabilitation, and medicinal needs. In addition, further exploration of the multivariate approach to understanding hospital resource usage in terms of length of stay, procedures, complications, comorbid conditions, days of mechanical ventilation, hospital equipment/materials, and human resources is needed. Development of a composite weighted variable for assessing and standardizing hospital resource utilization would be ideal to accurately gauge hospital resource usage for a critically ill trauma population. Moreover, the inclusion of injury patterns, injury type (blunt vs penetrating), mechanism of injury (eg, falls vs motor vehicle crash), and measures of injury severity (Abbreviated Injury Scale, trauma activation) in the patient/injury characteristics variable set may potentially produce different results when hospital resources are reviewed as a composite variable. Cost should also be included in future analysis, to take into account financial resource utilization.

Conclusions

Our review of a level I trauma registry in a predominantly rural area revealed that injury factors, as assessed in terms of ISS and physiological complications, were associated with hospital resource usage across BMI categories, specifically an increase in ICU length of stay and number of procedures. Results for the nonobese population differed slightly from those for the other 2 groups in the study. Among nonobese patients, GCS score was also associated with outcomes. In the evolving health care environment, rather than assessing patient/injury characteristics and hospital resource usage independently, a composite approach should be used to accurately assess patient resource needs. Our findings provide a new perspective for evaluating the complex relationship between patient/injury characteristics and hospital resource usage.

ACKNOWLEDGMENTS

This research was performed at University of Kansas School of Medicine–Wichita and Wesley Medical Center.

FINANCIAL DISCLOSURES

None reported.

eLetters

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1. Describe the relationship between patient/injury characteristics and hospital resource usage.
2. Examine the use of multivariable analysis when assessing the relationship between 2 composite variables (patient/injury characteristics and resource usage).
3. Explain the implications of findings as they relate to hospital management and resource allocation and planning.

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IMPROVING PROVIDERS’ ROLE DEFINITIONS TO DECREASE OVERCROWDING AND IMPROVE IN-HOSPITAL CARDIAC ARREST RESPONSE

By Marion Leary, RN, MPH, MSN, William Schweickert, MD, Stacie Neefe, RN, BSN, Boris Tsypenyuk, MSPT, MHA, CPHQ, Scott Austin Falk, MD, and Daniel N. Holena, MD

Background How nontechnical factors such as inadequate role definition and overcrowding affect outcomes of in-hospital cardiac arrest (IHCA) is unknown. Using a bundled intervention, we sought to improve providers’ role definitions and decrease overcrowding during IHCA events.

Objectives To determine if a bundled intervention consisting of a nurse/physician leadership dyad, visual cues for provider roles, and a “role check” would lead to reductions in crowding and improve perceptions of communication and team leadership.

Methods Baseline data on the number and type of IHCA providers were collected. Providers were asked to complete a postevent survey rating communication and leadership. A bundled intervention was then introduced. Data were then obtained for the subsequent IHCA events.

Results Twenty IHCA events were captured before and 34 after the intervention. The number of physicians present at pulse checks 2 (median [interquartile range]: 6 [5-8] before vs 5 [3-6] after, \( P = .02 \)) and 3 (7 [5-9] vs 4 [4-5], \( P = .004 \)) decreased significantly after the intervention. The overall number of providers at the third pulse check (18 [14-22] before vs 14 [12-16] after, \( P = .04 \)) also decreased after the intervention. On a 10-point Likert scale, ratings of communication (8 [7-8]) and physician leadership (8 [7-9]) did not differ significantly from before to after the intervention. Both the physician leads (90%) and patients’ primary nurses (97%) were able to identify clear nurse leaders.

Conclusion A bundled intervention targeted at improving IHCA response led to a decrease in overcrowding at IHCA events without substantial changes in the perceptions of communication or physician leadership. (American Journal of Critical Care. 2016;25:335-339)
Approximately 200,000 in-hospital cardiac arrests (IHCAEs) occur annually in the United States, resulting in a mortality of about 80%. Technical aspects such as quality cardiopulmonary resuscitation (CPR) and adherence to advanced cardiovascular life support protocols have been linked to better outcomes, but less is known about how nontechnical factors such as team leadership and communication may improve survival. Evidence from cardiac arrest simulation literature suggests that the absence of leadership and of clearly defined roles is associated with negative outcomes.

As part of a performance improvement project, we deconstructed code-team activations at our center and revised our process to include specific interventions targeted at providing clear roles for providers and improving our leadership structure.

**Methods**

The study hospital, the Hospital of the University of Pennsylvania, is a 663-bed urban tertiary academic medical center with approximately 70 adult IHCAE events outside of the intensive care unit (ICU). The response team to IHCAE consists of resident and attending physicians, a nurse clinical coordinator, bedside nurses, respiratory therapists, pharmacy staff, and anesthesiologists. Upon recognition of a cardiac arrest event, the clinical emergency system is activated by phone, and a “code call” is announced overhead throughout the hospital and via a paging system.

Although activation through both systems ensures that IHCAE events are seldom underresourced, it was known that IHCAE events are seldom underresourced, it was recognized that in some cases the activation resulted in overcrowding by providers at these events. The recurring observation of overcrowding and concerns that this might decrease the quality of care that patients received prompted review of this process as part of a performance improvement project.

Before the intervention, control group data were collected from April 2013 to June 2013, and after the intervention, data from non-ICU IHCAE events were collected from July 2013 to April 2014. Data collected included the number and type of personnel (physicians, nurses, respiratory therapists, nurse clinical coordinators, anesthesiologists, patients’ family members, or other providers) present at each pulse check performed after a round of chest compressions until return of spontaneous circulation or the termination of the resuscitation. After the resuscitation, a survey to assess noise level, team communication, and leadership during the IHCAE event on a 10-point Likert scale was administered. Data from these surveys were deidentified and stored in an online REDCap database.

During the same period, a multidisciplinary team of health care providers (1 medical critical care physician, 1 anesthesiologist, 1 surgical critical care physician, 2 clinical nurse coordinators, 1 general care area nurse, 1 resuscitation nurse researcher, 1 pharmacist, 1 respiratory therapist, 1 security officer, and 1 quality improvement officer) collaborated in an effort to understand the source of the perceived problem. As a first step, a high-level process map and a detailed process map were created to determine the areas of highest concern related to overcrowding during cardiac arrest events. A cross-functional detailed process map (also called swim lane diagram) was used to identify areas of weakness in the existing process.

Additionally, a root-cause analysis was performed by the members of the Penn Medicine Leadership Forum—Performance Improvement in Action to determine the principal component leading to room overcrowding during IHCAE events. The results of these analyses suggested that inadequate role definition was responsible for much of the provider overcrowding observed at IHCAE events. Dialog with

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Corresponding author: Marion Leary, RN, MPH, MSN, University of Pennsylvania, 3400 Spruce Street, Philadelphia, PA 19104 (e-mail: Marion.leary@uphs.upenn.edu).
Stakeholders in the IHCA process and expert opinion were used to arrive at “optimal” numbers of each provider type based on what was considered the smallest safe number of each that would permit efficient conduct of the resuscitation. Specific roles were scripted for each of the 13 providers in the room. These roles described which health care provider would fill the role, where that provider would stand in the room, and the tasks that the provider would be responsible for during the resuscitation event.

To clarify role definitions, a code improvement bundle consisting of 3 interventions was implemented. First, a physician/nurse code leadership dyad was introduced. Under this paradigm, the physician ran the medical conduct of the code while the nurse leader organized the room. Second, a visual representation of providers’ roles consisting of color-coded identification stickers in prescribed numbers by provider type was introduced. Third, a “role check” was performed at the third pulse check by the nurse leader, in which the role of providers identified by stickers was confirmed and providers without clear roles were excused from the event.

The primary outcome measurement was the number of providers present after the role check. Secondary outcome measurements consisted of surveyed values of noise level, communication, and leadership.

Statistical testing was performed by using the Mann-Whitney test for nonparametrically distributed continuous variables, whereas a χ² or Fisher exact test was used to compare categorical variables. Two-tailed statistical significance was set at \( P = .05 \). Statistical testing was performed by using Stata v13.0.

This research was conducted in accordance with the guidelines provided by the University of Pennsylvania institutional review board, aligning with the ethical standards set forth in the Helsinki Declaration of 1975.

**Results**

Data for 54 non-ICU IHCA events (20 before the intervention and 34 after the intervention) were captured. During both periods, physicians and nurses comprised the majority of the personnel present (see Table). After the intervention, no differences were seen in the numbers of providers at the first pulse check, but by the second pulse check, the number of physicians present had decreased significantly (median [interquartile range]: 6 [5-8] before vs 5 [3-6] after, \( P = .02 \); see Table). At the third pulse check, the median number of physicians present was lower after the intervention than before (7 [5-9] before vs 4 [4-5] after, \( P = .004 \)) as was the number of total providers overall (18 [14-22] before vs 14 [12-16] after, \( P = .04 \)).

Survey response rates were 75% before the intervention and 94% after the intervention. Communication and physician leadership at resuscitations were perceived to be good, with median (interquartile range) values of 8 (7-8) for communication and 8 (7-9) for physician leadership. However, perceptions of noise levels, communications, or physician leadership did not differ significantly from before to after the intervention.

A clear nurse leader was identified in the postintervention survey by most of the physician code leaders (90%) and patients’ primary nurses (97%). Ratings of nurse leadership were consistently high (median score of 9/10).

**Discussion**

The American Heart Association Consensus Statement on the quality of cardiopulmonary resuscitation emphasized team management as a way to improve the quality of resuscitation care.14

---

*Table*

<table>
<thead>
<tr>
<th>Provider</th>
<th>No. of providers, median (interquartile range)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before intervention (n = 20)</td>
</tr>
<tr>
<td><strong>Pulse check 1</strong></td>
<td></td>
</tr>
<tr>
<td>MDs</td>
<td>5 (4-7)</td>
</tr>
<tr>
<td>RNs</td>
<td>4 (3-6)</td>
</tr>
<tr>
<td>RTs</td>
<td>2 (1-3)</td>
</tr>
<tr>
<td>NCC</td>
<td>1.5 (1-2)</td>
</tr>
<tr>
<td>Anesthesiologists</td>
<td>1 (0-2)</td>
</tr>
<tr>
<td>Family members</td>
<td>0 (0-0)</td>
</tr>
<tr>
<td>Other</td>
<td>0 (0-1)</td>
</tr>
<tr>
<td><strong>Total providers</strong></td>
<td>16.5 (13-18.5)</td>
</tr>
<tr>
<td><strong>Pulse check 2</strong></td>
<td></td>
</tr>
<tr>
<td>MDs</td>
<td>6 (5-8)</td>
</tr>
<tr>
<td>RNs</td>
<td>4 (3-6)</td>
</tr>
<tr>
<td>RTs</td>
<td>2 (2-3)</td>
</tr>
<tr>
<td>NCC</td>
<td>2 (1-2)</td>
</tr>
<tr>
<td>Anesthesiologists</td>
<td>2 (1-2)</td>
</tr>
<tr>
<td>Family members</td>
<td>0 (0-0)</td>
</tr>
<tr>
<td>Other</td>
<td>1 (0-2)</td>
</tr>
<tr>
<td><strong>Total providers</strong></td>
<td>18 (15-20)</td>
</tr>
<tr>
<td><strong>Pulse check 3</strong></td>
<td></td>
</tr>
<tr>
<td>MDs</td>
<td>7 (5-9)</td>
</tr>
<tr>
<td>RNs</td>
<td>4 (3-6)</td>
</tr>
<tr>
<td>RTs</td>
<td>2 (2-3)</td>
</tr>
<tr>
<td>NCC</td>
<td>2 (1-2)</td>
</tr>
<tr>
<td>Anesthesiologists</td>
<td>2 (0-2)</td>
</tr>
<tr>
<td>Family members</td>
<td>0 (0-0)</td>
</tr>
<tr>
<td>Other</td>
<td>1 (0-2)</td>
</tr>
<tr>
<td><strong>Total providers</strong></td>
<td>18 (14-22)</td>
</tr>
</tbody>
</table>

Abbreviations: MD, medical doctor; NCC, nurse clinical coordinator; RN, registered nurse; RT, respiratory therapist.

* Mann-Whitney test; significance was defined as \( P < .05 \).
Our bundle consisting of dual nurse/physician leadership, distribution of preprinted identification stickers, and the institution of a formal role check led to significant reductions in the number of personnel being present at pulse checks 2 and 3 during IHCA events. Additionally, a clear nurse leader was identified by IHCA providers in the postintervention period. Whether this bundled intervention would improve outcomes will require further examination.

Our findings suggest that providing clear role identification during IHCA can lead to reduction in the number of providers responding.

Nurse leadership of code teams is not a novel concept, having been described in published reports nearly 10 years ago. In a prospective simulation study of cardiac arrest, Gilligan et al reported that nurses trained in advanced life support performed better than senior house staff with or without training in advanced life support performed. Additionally, nurses with advanced life support training found these events less stressful and initiated defibrillation sooner than senior house staff did. Our work differs from that study in that here we describe the role of nurse leader in actual clinical practice. The paradigm of dual physician/nurse leadership in code situations presented here is a logical extension of the multidisciplinary care provided to critically ill patients in other settings, which has been strongly endorsed by international organizations such as the Society of Critical Care Medicine.

Limitations

Although we were able to demonstrate a significant reduction in total provider numbers at codes, the pre/post design of our study leaves open the possibility that this decline is due to other temporal factors unrelated to our intervention. Additionally, the success of any quality improvement project is heavily influenced by the culture of the institution; whether this intervention will be generalizable to other institutions is unknown.

Three interventions, including a physician/nurse leadership dyad, were implemented.

The American Heart Association published new resuscitation guidelines in October 2015, and health care providers are focusing on training and educating their cardiac arrest response teams in these areas. Therefore, more emphasis should be placed on interventions such as those used in this study that improve code team leadership and reduce overcrowding.

Nurse leadership of code teams is not a novel concept, having been described in published reports nearly 10 years ago. In a prospective simulation study of cardiac arrest, Gilligan et al reported that nurses trained in advanced life support performed better than senior house staff with or without training in advanced life support performed. Additionally, nurses with advanced life support training found these events less stressful and initiated defibrillation sooner than senior house staff did. Our work differs from that study in that here we describe the role of nurse leader in actual clinical practice. The paradigm of dual physician/nurse leadership in code situations presented here is a logical extension of the multidisciplinary care provided to critically ill patients in other settings, which has been strongly endorsed by international organizations such as the Society of Critical Care Medicine.

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Conclusion

Introduction of a bundled intervention targeted at improving role definitions and decreasing overcrowding led to a decrease in overcrowding at ICHA events without substantial changes in the perceptions of noise, physician leadership, or communication at these events. The addition of a nurse leader was positively received by providers.

ACKNOWLEDGMENTS

We thank all members of our Penn Medicine Leadership Forum—Performance Improvement in Action, including Leah Davis, Joseph Forte, Ameenah Shaheed, Michael Daly, and Felicia Gooden, for their help with this project. Additionally, we thank all of the health care providers who respond to ICHA events at our institution and who work tirelessly to improve patient care and survival.

FINANCIAL DISCLOSURES

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For more bundled interventions, visit the Critical Care Nurse website, www.ccnnonline.org, and read the article by Williams, et al, “From Door to Recovery: A Collaborative Approach to the Development of a Post–Cardiac Arrest Center” (October 2013).

REFERENCES


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Background  Web-based electronic patient-reported outcomes (ePRO) measures are increasingly used to facilitate patient-centered health assessments. However, it is unknown if ePRO completion is feasible for recently ill intensive care unit (ICU) survivors and their families.

Objective  To develop and evaluate the usability of a novel ePRO system (ePRO to Support People and Enhance Recovery [ePROSPER]) among ICU survivors and their families within an ongoing clinical trial.

Methods  Paper-based PROs were iteratively adapted to electronic forms (ePROs). Then, the usability of ePROSPER was assessed among 60 patients, their family members, and PRO and programming experts via questionnaires (eg, Systems Usability Scale), “think aloud” open-ended feedback, task completion times, and error rates.

Results  Input from patients and their families was used to incorporate user-experience modifications into ePROSPER. This feedback also led to inclusion of automated reminders for questionnaire completion and real-time alerts for staff triggered by high symptom levels. Median usability scores increased over testing cycles from 40 to 73 to 95, nearing the maximum score and showing excellent usability. All users completed ePROSPER within 20 minutes; 87% preferred it to a written version. ePROSPER was then implemented in a clinical trial without data errors.

Conclusions  Automated ePRO systems can be successfully integrated in a post-ICU clinical trial setting. The value of integrating such systems in direct clinical care should be assessed in future studies. (American Journal of Critical Care. 2016;25:340-349)
Critical illness can affect areas of emotional, physical, and social functioning in important ways. These health outcomes are typically assessed in clinical research settings by administering standardized patient-reported outcomes (PRO) questionnaires in person, by telephone, or by mail. This approach, however, presents challenges related to patient-centeredness as well as research efficiency and accuracy. Collecting potentially sensitive data such as data on psychological distress in personal interviews may result in discomfort, filtering, or bias.

Also, survivors of critical illness and their families often have characteristics that pose particular challenges to interviewers, including residence in time zones and area codes that differ from those of the research staff (leading to call screening), unpredictable schedules, frequent changes of residence through the process of recovery, and physical and cognitive disabilities. As a result of these data collection barriers, intensive care unit (ICU) outcomes studies sometimes suffer from more than 30% to 50% of data being missing, necessitating trial extension or acceptance of lower statistical power. The multiple telephone calls, letters, and e-mails required to complete study interviews can also increase staff strain and cost.

The convenience and ubiquity of smartphone and Internet access, combined with the use of electronic patient-reported outcomes (ePROs) could help to overcome many of the logistical challenges associated with clinical trial follow-up. However, many clinical research database systems are designed to allow data entry from study staff only, without incorporating users’ experience. This limitation makes data collection directly from patients in a way that is efficient, secure, and compliant with the Health Insurance Portability and Accountability Act (HIPAA) challenging. Furthermore, many off-the-shelf ePROs do not include content tailored for critical illness survivors or lack the capability for complicated self-administered assessments (eg, cognitive evaluation). Also, usability of ePROs administered through existing database systems (eg, REDCap) cannot be generally assumed for critically ill patients, who are often disabled and elderly. Regardless of the underlying digital platform used, developing a multidomain battery of ePROs and a system through which to administer them to critical illness survivors is novel.

To address these challenges and to accommodate evolving patient preferences for online questionnaires versus telephone interviews, we developed and performed usability testing of ePROSPER (ePRO to Support People and to Enhance Recovery)—a data collection system tailored to the needs of ICU survivors and their families—in a clinical trial setting. As usability is a critical antecedent of implementation outside of research settings, understanding the usability of an ePRO system in ICU survivors also could be relevant to future clinical practice in critical care.

**Methods**

**Overview of the Parent Clinical Trial**

This study was performed within a recently initiated randomized clinical trial that compares the effect on psychological distress of 2 postdischarge behavioral and informational interventions among ICU survivors and their family members (NCT01983254). In this trial, patient and family participants complete an in-person interview while hospitalized, followed by 3 telephone interviews in the first 6 months after discharge. This article describes the development, performance evaluation, and implementation of an ePRO system for ICU patients and their family members (ePROSPER, Figure 1).
Rationale for the Development of ePROSPER

Many of the first participants enrolled in the parent clinical trial stated that they would prefer online questionnaires to telephone-based interviews for convenience, added privacy, and to reduce the time required for completion. We could not find an off-the-shelf solution that addressed the study’s complex data collection needs, its requirement for sophisticated security checks, or had evidence of usability in the target population.

Therefore, we aimed to develop an ePRO system that was usable as well as the following features: (1) highly secure, HIPAA compliant, and met site regulatory policies; (2) could allow direct data entry via smartphone, tablet computer, or desktop computer into a study database with safeguards to prevent missing items; (3) could control different users’ views (eg, research coordinators vs patients), (4) could accommodate users with limited technological understanding and reading literacy; and (5) could send automated e-mails to study staff if psychological distress ePRO scores exceeded prespecified “alert” values.

Study Sites, Participants, and Settings

ePROSPER was intended for use in a medical and surgical ICU population. Therefore, to develop it and evaluate its usability, we included ICU survivors who received mechanical ventilation for more than 48 hours and their informal caregivers, ICU physicians and nurses, research coordinators, patient advocacy group representatives, as well as content experts in computer programming, user interface design, ePRO development, and usability testing. Patients and caregivers with characteristics that might affect their technological abilities (elderly, disabled, rural) were purposefully sampled from ICU discharges at Duke University Medical Center and a community hospital in central North Carolina. All participants were fluent and literate in English. We pilot tested ePROSPER at Duke University Medical Center, an academic medical center in the parent clinical trial among participants who provided written informed consent (Duke Institutional Review Board Protocol #0004371). All study activities were performed between January and June 2014.
Development of ePROSPER

We developed a preliminary version of a web-based ePRO system by using an iterative process with the assistance of patients, their families, and content experts in which we transformed PROs to ePROs and then incorporated the ePROs into a delivery system.15 The patient-facing ICU ePRO system is an extension of the parent trial’s study staff–directed interface for the data entry and management system (DEMS). The DEMS is a web-based, touch-screen–friendly system designed for study staff to enter clinical and sociodemographic data (Figure 1). The DEMS, its security features, and its build process are described more extensively in Supplement 1 (available online only, at www.ajccconline.org). We used the DEMS foundation and the recommendations of the International Society for Pharmacoeconomics and Outcomes Research task force to then transform written PROs to electronic questionnaires (ie, ePROs).16 The resultant electronic clinical research form contained 76 items for assessing depression and anxiety symptoms, posttraumatic stress symptoms, quality of life, cognitive ability, and various other factors derived from standard questionnaires (Supplement 2—available online only).17,21 In an iterative process, study programmers, investigators, data technicians, web designers, and statistical analysts made revisions including font resizing, pagination cut points, color schemes, navigation mechanics, mode of answer responses allowed (radio buttons vs boxes), and screen responsiveness optimization for electronic devices with different screen sizes.

This final version of ePROSPER possesses some key conceptual differences from our standard study staff–directed data collection processes that are shown in Figure 2. First, ePROSPER allows participants to enter data directly into the study database without the need for a telephone interview. Second, we tailored the instructions and cues to a novice user who is not one of the study staff and reformatted the question layout, formatting, and response types for clarity. Third, we built a highly secure function that links the user to the ePRO interface by means of a personal e-mail message that is free of health information that is generated by the appropriate timing of the required interview (eg, 3 months after randomization).

Evaluation of ePROSPER Performance and Implementation in a Clinical Trial Setting

After consensus among developers was reached on the design features of the ICU ePROSPER system, we evaluated its usability, acceptability, and feasibility. Usability Testing. Usability is a measure of the extent to which a person can use a system for its goal effectively, efficiently, and satisfactorily.22 Using guidelines from the website Usability.gov and our past experience in usability testing among ICU survivors,23 we evaluated usability among ICU survivors and their family members by using online questionnaires, by telephone, or in person as was most convenient.9,24,25 The study questionnaire included quantitative and qualitative assessments of the following usability characteristics of ePROSPER: ease of use and completion, presence of mistakes or problems, user satisfaction with the system, likes and dislikes (with open-ended feedback framed by Nielsen characteristics),26 and efficiency (ie, time required to complete tasks).9 Participants also completed the System Usability Scale (SUS), a validated 10-item scale with Likert-scaled responses ranging from “strongly agree” to “strongly disagree” and a summary score that ranges from 0 (worst possible usability) to 100 (best possible usability).24 A priori, we defined success in usability

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1. Standard system data flow
2. ePROSPER data flow
3. Data flow within DEMS system
4. Data flow from DEMS system

Figure 2 Comparison of ePROSPER (electronic Patient-Reported Outcomes to Support People and Enhance Recovery) with standard processes of questionnaire-based data collection conducted by study staff. This figure shows how data collection can occur using either standard processes (telephone or in-person interviews conducted by study staff) or ePROSPER. Solid lines show the ePROSPER pathways of data prompting and entry by patients and families. Dashed lines show the standard data entry processes. Dotted lines show unique functionalities of the ePROSPER data system. Different user types (study staff vs study participants) are limited to specific “views” of the system depending on their role.
when SUS scores appeared to reach a ceiling effect, with a minimum score of 70—the general accepted cutoff for a usability rating of “good.”²²,²⁷ In final evaluation cycles, participants also evaluated the ePROSPER in a think-aloud approach with study staff to provide feedback in their own words as they were navigating the system.²⁸

Usability testing of ePROSPER comprised 2 phases: (1) development and heuristic testing by developers and experts in PROs, user interfaces, programming, and visual display and (2) formal usability testing among patients and families within informal and clinical settings. Participants were sent electronic links to the ePROSPER demo system (see Supplement 1—available online only). In phase 1, evaluators were instructed to consider the system from the perspective of a recently discharged ICU survivor, to view it on either a tablet or laptop/desktop computers, and to provide feedback using a framework of Nielsen’s 10 usability and user interface heuristics (Table 1).²⁸ In phase 2, ICU survivors and their family members, ICU physicians, and ICU nurses completed usability questionnaires and provided feedback. Cycles of heuristic evaluation and responsive revisions were performed from March through May 2014 (phase 1) and in June and July 2014 (phase 2).

Acceptability and Feasibility Testing. Acceptability was assessed among all participants by Likert-scaled measures of satisfaction and preference in comparison to an identical, but written, questionnaire adapted from the Client Satisfaction Questionnaire.²⁹ Feasibility was measured by rates of task completion (open e-mail, login to system, complete questionnaire), time to complete the questionnaire, comprehensibility (5-point Likert scale), and rates of errors after implementation in the DEMS system.

Results

Participants

It took 6 months to adapt the written questionnaires to electronic versions, develop and evaluate ePROSPER, and then implement it in a clinical trial. In the 2-month development phase, a total of 30 participants included 5 patients, 5 caregivers, 5 programmers, 6 study investigators, 3 ePRO experts (3 had PRO expertise, 2 had user interface expertise, and 1 had programming expertise), and 6 study staff. A total of 30 participants evaluated the performance of the 4-month ePRO system, including 10 patients, 13 family members, 2 physicians, 2 nurses, and 3 content experts. Altogether, the 60 participants’ age groups were as follows: 27 (45%) were less than 45 years old, 22 (37%) were 46 to 64 years old, and 11 (18%) were at least 65 years old; 28 (47%) were female. Primary ICU admission diagnoses for patients included acute respiratory distress syndrome (76%), sepsis without acute respiratory distress syndrome (8%), and trauma (16%); all received mechanical ventilation, and all had illness severity scores consistent with 50% or greater risk of hospital mortality.³⁰

Usability Testing of ePROSPER and System Revisions in Response to Feedback

In phase 1, expert participants were able to complete study tasks within 15 minutes and reported a median SUS score of 83. In response to their critiques, instructions were clarified, small radio button responses were replaced with larger touch boxes, font size was increased, screen responsiveness to device type was enabled, real-time response upload was added to prevent data loss and user frustration, and the login procedure was simplified. These results are displayed in the context of Nielsen usability heuristics in Table 1.

In phase 2, testing involved 3 cycles of 6 to 8 persons each. The major issues identified by users in early cycles involved login validation processes, instruction clarity, and the cumbersome nature of documenting postdischarge disposition over time (Table 1; see also Supplement 3—available online only). In response, we enhanced language clarity, visual appeal, user-friendliness of the response buttons, and personalization of the discharge disposition page by prepopulation of the user’s discharge date and most recent postdischarge disposition location (eg, home, nursing home). Think-aloud exercises identified issues related to screen placement of answer choices and instructions. Examples of selected final ePRO items with various possible response types are shown in Figure 3. Median SUS scores increased with progressive revision cycles from 40 to 73 to 95—a final score considered “exceptional” (Table 2).³¹ We then implemented the final version of ePROSPER within the parent clinical trial. Data from 5 patients and 5 caregivers were cross-checked by hand and showed no errors or missing variables.

Acceptability and Feasibility

All but 1 user from the first evaluation cycle were either “very satisfied” or “satisfied” with ePROSPER. Twenty-six (87%) of all study participants (and 100% of usability testing participants) said that they preferred the online questionnaire to a written
questionnaire, primarily because of its convenience. All users in the final 3 cycles were able open the e-mail link, log in to the system, and complete the questionnaire within 20 minutes (~5-10 minutes faster than a telephone-based interview).

### Table 1

Results in heuristic usability categories

<table>
<thead>
<tr>
<th>Usability categories</th>
<th>Phase 1 Experts and investigators</th>
<th>Phase 2 Patients, patients’ families, clinicians</th>
<th>Developmental solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visibility of system status</td>
<td>Password-driven linkage to website not clear in e-mail; Password linkage to a date picker that required typing a date of birth was confusing</td>
<td>Users did not know progress status as they completed pages**; Date picker was confusing**</td>
<td>Confusing login procedure*; Better instructions quantifying the length of questionnaire; progress bar in development; E-mail improved with a very large button specifying hotlink to ePRO added; New date picker added that did not require typing</td>
</tr>
<tr>
<td>Match between system and the real world</td>
<td>Thematic flow problems between questionnaires identified</td>
<td>Users senses repetition of items when multiple questionnaires were combined**</td>
<td>Formal language identified as problematic*; Component questionnaires rearranged in thematic groups; Scale language “Americanized” Reduced redundant items removed</td>
</tr>
<tr>
<td>User control and freedom</td>
<td>Need for automated saving of work completed without requiring redo by user</td>
<td>Instructions unclear*</td>
<td>Auto-save function added</td>
</tr>
<tr>
<td>Consistency and standards</td>
<td>Cognitive status form too short*</td>
<td>Numerals before items on different scales distracting**</td>
<td>Standardized formatting; Numerals (scoring) removed</td>
</tr>
<tr>
<td>Error prevention</td>
<td>Instructions not carried over to new pages*</td>
<td>Instructions unclear*</td>
<td>Simpler, directed instructions</td>
</tr>
<tr>
<td>Recognition rather than recall</td>
<td>Timeouts relaxed</td>
<td>Instructions carried forward</td>
<td></td>
</tr>
<tr>
<td>Flexibility and efficiency of use</td>
<td>Repetition of answers on subsequent questionnaires (longitudinal)**</td>
<td>Method of completing visual analogue scale (VAS) items was unclear*</td>
<td>Full browser testing and troubleshooting; VAS items simplified; Item answers carried forward for issues less likely to change in a short period of time (e.g., medications)</td>
</tr>
<tr>
<td>Aesthetic and minimalist design</td>
<td>Font too small**; Too many questions per page**; Date picker tool required typing*</td>
<td>Font too small*</td>
<td>Large font; Large response buttons ideal for computer or touch screens; Simple date picker with click function</td>
</tr>
<tr>
<td>Help users with errors</td>
<td>Help function hard to see**; Missed items hard to see**</td>
<td></td>
<td>Provide information about avoiding errors due to missed items; Help function increased in size Missed items highlighted in red</td>
</tr>
<tr>
<td>Help and documentation</td>
<td>No contact information for help provided**</td>
<td>Contact info (text, e-mail) provided for assistance on every page</td>
<td></td>
</tr>
</tbody>
</table>

*Single asterisk refers to comments in cycle 1; double asterisk refers to comments in cycle 2.

---

### Discussion

ePROs measure the concepts that are most personally significant and relevant to a patient’s condition and treatment. We developed ePROSPER, a novel web-based ePRO system that shows evidence of...
usability, acceptability, and feasibility among ICU survivors and their family members. The ePROSPER system represents an acceptable method by which to completely automate data collection and storage in a research setting. Although an ePRO system in itself is not particularly novel in concept in 2015, ePROSPER is one of the first automated mobile data collection tools to be successfully implemented in a clinical research setting among survivors of critical illness—and built with their help. The extremely high level of usability that we achieved reflects the quality of this partnership. The fact that ICU survivors and their families can complete online questionnaires successfully is a key observation relevant to future studies in critical illness that involve long-term follow-up.

**What Are the Research Implications of This Study?**

It Provides Proof of Concept That ePROs Could Enhance Research Efficiency in Critical Illness. First,
ePROSPER is a patient-centered solution that applies the efficiencies of mobile information technology to a specific problem in a special environment, incorporating complex questionnaires—some of which, to our knowledge, have not previously been adapted to a self-directed electronic format (eg, the Modified Telephone Interview for Cognitive Status)—with different response types and user demands,25 displaying them in an understandable manner, and ordering them to optimize the user experience. Second, ePROs can address many serious logistical challenges associated with collecting patient-centered outcomes from ICU survivors and their families. Some groups have reported low rates of dropout and missing data,21 which may be related to the use of both repeated contacts and different methods of contact (eg, telephone calls, mailed surveys).7 To this end, ePROSPER could provide a method of automating contacts and introducing a digital modality of data collection that is increasingly used by all age groups. Third, ePRO systems meet a need, since a number of patients prefer online to written surveys as did our participants.10-12 Last, an important lesson we learned in ePROSPER’s evolution was that the revisions most important to enhanced usability were related to general user interface issues rather than condition-specific elements.

It Provides Information on the Value Proposition of ePRO Systems. ePROSPER required 3 weeks (~120 hours) of programmer, developer, and web designer time—a cost of roughly $10 000. However, after ePROSPER implementation in the parent clinical trial, 120 of a possible 212 interviews (57%) have been completed by using smartphones, tablets, and laptop/desktop computers to date. This accomplishment has saved approximately 3 weeks of scheduling and interview time for our research team. It is important to emphasize that for smaller projects or straightforward data collection needs, off-the-shelf questionnaires could be adequate. However, for more complex data use scenarios, data-base integration, graphics-heavy interface design, or site-specific security demands, a home-grown ePRO system could add value by gains in efficiency that offset the upfront investment required. More importantly, though, by enhancing clinical trial participants’ research experiences like this, ePRO systems could increase response rates, improve engagement of participants, reduce staff effort, and improve data accuracy.13,14

What Are the Clinical Applications of ePRO Systems Like This?

Monitoring Health of Individuals Within Populations. Data obtained from ePROs can be automatically translated to a variety of tasks beyond generating reports.13 As an example, ePROs enabled our data system to generate automated, real-time, e-mails that were free of protected health information (ie, no name, birthdate, phone number) to the study investigators when any participant’s psychological distress scores exceeded predefined cutoffs (Supplement 4—available online only). Although these systems may present methodological questions for clinical researchers, such as biasing results by intervening on the basis of questionnaire scores of unclear significance during a trial,15 they could present a feasible way for clinicians to manage populations of patients more responsively and efficiently in the moment. Further, ePRO systems may foster relationship building between study participants, allowing crowdsourcing of important issues or research questions from the point of view of patients and caregivers, integration with decision-support capabilities, and engagement in self-management techniques.

Contributing to Decision Making in a Future Digital Health System for ICU Survivors and Their Families. Although patients and families want answers to basic questions such as “What happens to people like me long-term?”, our current ability to model the relevant trajectories of long-term outcomes is constrained by the financial and logistical infeasibility of the data collection required.36 ePRO-enabled systems could capture these data, which could then be used to inform decision tools and individualize prediction models.37,38 If patients could see their ePRO data applied to such useful tasks, it could reinforce their buy-in for such data systems—while also serving to improve data quality for clinical applications and research alike.

ePROSPER as Part of a Learning Health Care System. Developing multiple uses for patient-centered data is a foundational principle in developing learning health systems—ideal environments in which real-time health care data such as patient-level ePRO input are continuously aggregated, analyzed, and applied to the continual improvement of patient care, quality, and research.37 Although ePROSPER was designed for research, a future direction might be to simplify it to include only the most practical items for direct clinical care, such as triggering supportive services for those with high symptom burdens, monitoring the quality of survivorship care, and, when linked to other health care data, contributing to our currently immature understanding of modifiable predictors of survivorship outcome.39

ePROSPER is usable, acceptable, and feasible for collecting data from recently ill patients.
Study Limitations

This study has a number of limitations. First, it is relatively small and uncontrolled. Although we purposely sampled from different age groups, our results may not be applicable to all ICU survivors. Similarly, ePROSPER was developed and tested entirely in English, in North America, and thus would not necessarily generalize to other languages and cultures without further specific user testing. Second, this study did not test the equivalence of written and electronic questionnaires; however, such testing is generally unnecessary when minimal changes are made to items as was done in this study. In fact, meta-analyses have shown that the differences in scores between written and electronic modes is 0.2 points on a 10-point scale. Third, the Pew Research Internet Project estimates that although 87% of all US adults overall have Internet access, only 77% in the lowest socioeconomic stratum are online. Therefore, digital equality is an important topic of future research. Last, a general risk of using ePRO systems is uncertainty about whether a patient or a caregiver is completing questionnaires. However, it seems unlikely that systematic falsification of responses would be common.

Conclusion

In summary, we developed ePROSPER, a web-based ePRO system. ePROSPER shows evidence of usability, acceptability, and feasibility in a clinical trial setting that included recently ill patients. ePRO systems such as this may help to address some of the challenges associated with longitudinal data collection in studies of ICU patients and their families. Future research is warranted to determine if such systems may also provide benefits in a routine clinical setting.

ACKNOWLEDGMENTS

Thanks to Matthew Harker, MBA, MPH, for his guidance and to Mary Hoffa, MD, for performing participant interviews.

FINANCIAL DISCLOSURES

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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.
**Background** Despite reported challenges encountered by nurses who provide palliative care to children, few researchers have examined this phenomenon from the perspective of nurses who care for children with life-threatening illnesses in pediatric intensive care units. **Objectives** To describe and interpret the essence of the experiences of nurses in pediatric intensive care units who provide palliative care to children with life-threatening illnesses and the children's families. **Methods** A hermeneutic phenomenological study was conducted with 12 pediatric intensive care unit nurses in the northeastern United States. Face-to-face interviews and field notes were used to illuminate the experiences. **Results** Five major themes were detected: journey to death; a lifelong burden; and challenges delivering care, maintaining self, and crossing boundaries. These themes were illuminated by 12 subthemes: the emotional impact of the dying child, the emotional impact of the child’s death, concurrent grieving, creating a peaceful ending, parental burden of care, maintaining hope for the family, pain, unclear communication by physicians, need to hear the voice of the child, remaining respectful of parental wishes, collegial camaraderie and support, and personal support. **Conclusion** Providing palliative care to children with life-threatening illnesses was complex for the nurses. Findings revealed sometimes challenging intricacies involved in caring for dying children and the children’s families. However, the nurses voiced professional satisfaction in providing palliative care and in support from colleagues. Although the nurses reported collegial camaraderie, future research is needed to identify additional supportive resources that may help staff process and cope with death and dying. (*American Journal of Critical Care*. 2016;25:350-356)
Despite advances in health care, thousands of children die annually from life-threatening illnesses. Caring for critically ill children whose conditions progressively worsen or who die quickly is often overwhelming for health care providers. Nurses in the pediatric intensive care unit (PICU) face unique challenges in providing care to such children and the children’s families.

PICU nurses often spend considerable time attempting to identify and manage the palliative care needs of children and the children’s families. Parents and health care providers frequently want to continue aggressive treatment to the absolute end of the child’s life: in the United States, 80% of children who die in hospitals do so in PICUs.

PICU nurses may be challenged when a child’s focus of care shifts from cure to death. Also, many nurses have received little formal education on palliative care and may feel uncomfortable or unprepared to care for children with life-threatening illnesses that may result in death. Caring for critically ill children on a regular basis in which life-prolonging treatments are offered may elicit emotions of helplessness, anger, and stress in nurses and impede the quality care the nurses provide.

Few publications describe the experience of providing palliative care to children with life-threatening illnesses from the perspective of PICU nurses. Our aim was to understand the perspectives of PICU nurses who provide palliative care to these children and the children’s families and to understand the contextual factors associated with the nurses’ experience.

**Methods**

**Design**

Hermeneutic phenomenology, a descriptive and interpretative method, allowed for understanding how PICU nurses interpreted and made meaning of their experiences in caring for children with life-threatening illness and the children’s families.

**Study Participants**

A purposive sample of 9 female and 3 male nurses from a nonfreestanding children’s hospital in the northeastern United States participated in the study. Nurses were included if they were a registered nurse, had worked in the PICU for at least 18 months, and were willing to describe their experiences and provide informed consent. Permission to conduct the study was obtained from the setting and university where the researchers were affiliated. Participation was voluntary, and participants could withdraw at any time. Privacy was ensured by removing identifiers in the interviews and using pseudonyms.

**Data Collection**

After interviews had been conducted with 10 participants, repetition of salient points was evident. Two additional interviews revealed no new findings. Saturation of data was achieved with 12 interviews. Data collection involved a 9-item demographic form, an audio-recorded interview, a follow-up session to clarify responses, and field notes for nonverbal observations. Interviews began with open-ended questions: “What is it like to care for children diagnosed with a life-threatening illness and their families? Tell me what this experience has meant for you?” Interview probes encouraged and clarified responses. Participants received $25 gift cards after follow-up. All interviews were conducted by the same person (D.S.).

**Analysis**

Data were analyzed by using the hermeneutic phenomenological process described by Cohen et al and NVivo 9 (QSR International) computer software. Interviews were transcribed verbatim, with accuracy verified by the principal investigator (D.S.). Analysis began with immersion into the data to identify essential characteristics of the phenomenon (Table 1) and gain an initial interpretation of the data. The iterative process of the hermeneutic circle and reflective awareness (see Figure) were used and offered a more in-depth analysis of the data by examining the smaller parts within the context of the whole experience. Interpretations were continuously reviewed and scrutinized within and between transcripts.

**Trustworthiness**

Member checking, reflective journaling, and bracketing enhance credibility of a study’s findings. Peer debriefing was conducted by the second
investigator (J.S.L.), who is experienced in qualitative research. Both investigators reviewed transcripts independently to identify themes and discussed their findings until consensus was reached. An audit trail was created to address study dependability and confirmability.12

Results

The mean age of participants was 35.4 (range, 23-49) years. Most (42%) reported having 5 or fewer years of nursing experience, and slightly more than half (58%) reported receiving no formal preparation on death and dying (Table 2).

A total of 5 major themes with 12 subthemes were identified (Table 3).

Journey to Death

In the theme “journey to death,” nurses talked about their role and responsibilities in providing palliative care to children in the PICU during the entire dying process. Caring for a dying child was viewed as “part of my job” but was often emotionally demanding.

Table 1

<table>
<thead>
<tr>
<th>Essential characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elephant in the room/communication</td>
</tr>
<tr>
<td>Nursing staff support and relationships developed between patients’ families and nursing staff</td>
</tr>
<tr>
<td>Pain/torture</td>
</tr>
<tr>
<td>Real hope vs false hope</td>
</tr>
<tr>
<td>Relating to situation on a personal level</td>
</tr>
<tr>
<td>Children’s dying is part of the job</td>
</tr>
<tr>
<td>The time after/the final visit</td>
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<tr>
<td>Where in the dying process is the child’s family</td>
</tr>
<tr>
<td>Interdisciplinary relationships</td>
</tr>
<tr>
<td>Lens of the nurse</td>
</tr>
<tr>
<td>Nurse-physician relationship</td>
</tr>
<tr>
<td>The children</td>
</tr>
<tr>
<td>Stress of job/support for nurses</td>
</tr>
</tbody>
</table>

Figure Iterative process of the hermeneutic circle.

Experience (Define)

Integration (Define)

Contextualization (Illuminate)

Whole

Parts

Experience

The Emotional Impact of the Dying Child. The study participants described the emotional impact that providing physical care to a dying child and psychosocial care to the child’s family had on the nurses while working in the PICU. Although most of the nurses expressed feelings of sadness, frustration, anger, and helplessness, others conveyed a more positive experience.

Mixed emotions were evident in 2 nurses’ experiences of the same night shift when they dealt with 2 critically ill children who experienced cardiac arrest on the unit almost simultaneously. One nurse, upset and frustrated, described the situation as follows:

We basically had 2 kids die in 1 shift, that’s a lot when 1 child passes and you move to the next child—their heart stops and you haven’t had time to, to grasp the death of the first child, you have to move on to try and stop the second child from dying. I didn’t have a chance to say good-bye to the parents. I didn’t feel closure with this family.

The other nurse stated in an angry voice, “There wasn’t enough time to do the things we’d normally do for families because the other child kept coding. I felt as though I failed this family.”

On the other end of the spectrum, another nurse expressed feeling content with his experience in caring for a dying child and the child’s family. He recalled the following:

I had a difficult conversation with a family regarding the prognosis of their child. Their child had suffered a traumatic brain injury . . . wasn’t likely to recover. The child did end up dying; the family sent me a thank-you note later for being kind and honest in explaining how dismal the situation was.

The Emotional Impact of the Child’s Death. The nurses expressed how overwhelming it was for them to watch families see children die. Several nurses shared their feelings about experiencing the time of death: “It never gets easier,” and “It’s always gut wrenching to see the families go through it.” Some nurses voiced how difficult it was to watch children as the children took the last few breaths and how the situation considerably affected the nurses, knowing the situation could be reversed at any time. Participants stated, “I was overcome by my emotions,” “I had to step out of the room to regain my composure,” and “I cried with the family!”

Concurrent Grieving. The nurses tried to meet the needs of patients’ families during this difficult time by recognizing where the families were in the grieving process. One of the nurses shared the following:
I need to be patient and recognize denial is a powerful emotion! I found myself on one kid . . . I realized I was getting upset with the family for not being as far along in the grieving process as I was. I was to acceptance, this kid has been through awfulness, and someone needs to let him go. And they [the family] were still back denying there was a problem.

Creating a Peaceful Ending. Many nurses remarked how dealing with a child’s death was difficult for them. They described their need to try and make some “good” from a bad situation for the children’s families, such as providing simple comfort measures for the child. One nurse described her attempt to create a peaceful ending stating, “It is important to me to make that last time for the family as personal as possible . . . the baby’s own clothes . . . a pretty blanket . . . some lotion to smell good.”

Additionally, all the nurses said delivering effective pain management at a child’s end of life was particularly important to them. One nurse remarked as follows:

When I give that morphine I want to know this baby is going to lie there with her eyes closed peacefully and just go to sleep. I’ve never seen any child struggle . . . never . . . and I don’t want to because they shouldn’t!

A Lifelong Burden
The theme “a lifelong burden” was discussed by the nurses in relation to children who had experienced an acute injury and were left devastated or children who had a progressive chronic illness that required extensive lifelong care.

Parental Burden of Care. Parental burden of care was viewed by many nurses as being emotionally and physically exhausting for the children’s families, but particularly for mothers, who were often the primary caregivers of these children. One nurse commented: “It was a downward spiral; no matter what we did for her [the child], nothing seemed to help . . . you almost had to turn your back. I felt terrible. Her mother sat at the bedside by herself staring at her daughter in [a] pentobarb [pentobarbital] coma.”

Challenges Delivering Care
For the theme “challenges delivering care,” the nurses described situations encountered with the children, the children’s families, or physicians that made it difficult to deliver nursing care.

Maintaining Hope for the Family. Many nurses described feeling “guilty” taking away the last bit of hope from children’s families. One nurse expressed her guilt by saying, “There are times when there isn’t Major themes and subthemes

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>No. (%)a</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, y</td>
<td></td>
</tr>
<tr>
<td>20-25</td>
<td>2 (17)</td>
</tr>
<tr>
<td>26-30</td>
<td>3 (25)</td>
</tr>
<tr>
<td>31-40</td>
<td>2 (17)</td>
</tr>
<tr>
<td>≥41 years</td>
<td>5 (42)</td>
</tr>
<tr>
<td>Race/ethnicity</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>12 (100)</td>
</tr>
<tr>
<td>Years of nursing experience</td>
<td></td>
</tr>
<tr>
<td>0-5</td>
<td>5 (42)</td>
</tr>
<tr>
<td>6-10</td>
<td>3 (25)</td>
</tr>
<tr>
<td>11-20</td>
<td>2 (17)</td>
</tr>
<tr>
<td>&gt;20</td>
<td>2 (17)</td>
</tr>
<tr>
<td>Years of practicing in the pediatric intensive care unit</td>
<td></td>
</tr>
<tr>
<td>0-5</td>
<td>6 (50)</td>
</tr>
<tr>
<td>6-10</td>
<td>3 (25)</td>
</tr>
<tr>
<td>11-20</td>
<td>1 (8)</td>
</tr>
<tr>
<td>&gt;20</td>
<td>2 (17)</td>
</tr>
<tr>
<td>Highest nursing degree</td>
<td></td>
</tr>
<tr>
<td>Associate</td>
<td>6 (50)</td>
</tr>
<tr>
<td>Baccalaureate</td>
<td>6 (50)</td>
</tr>
<tr>
<td>Formal education on death and dying</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>5 (42)</td>
</tr>
<tr>
<td>No</td>
<td>7 (58)</td>
</tr>
</tbody>
</table>

Table 2
Demographic data for the 12 participants

a Because of rounding, not all percentages total 100.

Table 3
Meanings of the themes and subthemes

<table>
<thead>
<tr>
<th>Major themes and subthemes</th>
<th>Essential meanings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Journey to death</td>
<td>Children’s dying is part of their job</td>
</tr>
<tr>
<td>The emotional impact of the</td>
<td>Difficult watching patients’ families experience sadness</td>
</tr>
<tr>
<td>dying child</td>
<td>Making sense of a senseless situation</td>
</tr>
<tr>
<td>The emotional impact of the</td>
<td>Creating a “positive” for the patient’s family</td>
</tr>
<tr>
<td>child’s death</td>
<td></td>
</tr>
<tr>
<td>Concurrent grieving</td>
<td></td>
</tr>
<tr>
<td>Peaceful ending</td>
<td></td>
</tr>
<tr>
<td>A lifelong burden</td>
<td>Not accepting reality of child’s condition</td>
</tr>
<tr>
<td>Parental burden of care</td>
<td></td>
</tr>
<tr>
<td>Challenges delivering care</td>
<td></td>
</tr>
<tr>
<td>Maintaining hope for the child’s family</td>
<td>Hope and disease progression imbalance</td>
</tr>
<tr>
<td>Pain</td>
<td>No child should suffer</td>
</tr>
<tr>
<td>Unclear communication</td>
<td>Family misunderstandings</td>
</tr>
<tr>
<td>Need to hear the voice of the child</td>
<td>Child should have a say in decision-making</td>
</tr>
<tr>
<td>Remaining respectful of parental wishes</td>
<td>Being mindful when not in agreement</td>
</tr>
<tr>
<td>Maintaining self</td>
<td>Experience good and bad, ups and downs with patients’ families; developed relationships with the families</td>
</tr>
<tr>
<td>Collegial camaraderie and support</td>
<td></td>
</tr>
<tr>
<td>Personal support</td>
<td></td>
</tr>
</tbody>
</table>
Disciplines provided a way to decompress. Discussing feelings with colleagues gave nurses a sense of purpose, closure, and a way to decompress.

**Maintaining Self**

The focus of the theme “maintaining self” was the nurses’ validation of their feelings about the unpleasant happenings in the unit. Discussing their feelings with colleagues gave them a sense of purpose, closure, an opportunity to decompress, and the ability to safeguard themselves in order to continue working in the unit.

Collegial Camaraderie and Support, Personal Support. Most of the nurses talked about how “being supportive during times of crisis,” and “knowing others had experienced the same thing,” helped them continue working in the unit. They also spoke of trying not to “take work home,” but noted that taking work home happened many times.

One nurse exclaimed, “It goes back to my awesome coworkers, because the second you leave that room [child’s room] they’re [the nurses] trying to cheer you up some way.” Personal support was also important to the nurses. Another nurse said, “I try not to take it home, but I do! There are many times I talk to my husband about a horrible case.”

**Crossing Boundaries**

The final theme, “crossing boundaries,” reflected the nurses’ experiences in developing relationships with children’s families and showing families that they respected their child as a person. Many nurses admitted they had often “crossed the line” by allowing themselves to become “friends” with many of the children and the children’s families. One of the nurses described such a relationship:

“I was attached to the child and his mom. She [his mom] was there with him; she stayed with him especially as he got closer to death. It amazed me that his mom was saying to me, “thank you” after he passed. I never get that! I never understand how a family can thank you after their child has passed away.”

Discussion

In this study, we collected the day-to-day accounts of PICU nurses who provided palliative care to children with life-threatening illnesses and the children’s families. The nurses viewed their ability to provide comfort and support to the families during the dying process as a significant experience. Being dedicated to the context of the child and family’s situation was essential for these nurses and afforded them opportunities to be hopeful, be honest,
appreciate what was happening, and assess how they could best provide families with a peaceful ending. This finding was consistent with the results of earlier research,13 which cited the importance for a child’s parents to receive support from health care providers and have adequate time with the child after death.

Remaining respectful of parental wishes to continue aggressive treatment for the parents’ children was often difficult and challenged the nurses’ personal values. However, as a child’s death approached, the nurses, not wanting to take away the last bit of hope, attempted to discuss and set realistic goals with the child’s parents for the child’s care.

Many of the nurses addressed the emotional exhaustion experienced by families of children devastated by an acute injury or children with a progressive chronic illness. The nurses sensed that many of the parents had not been able to reach acceptance concerning the “loss” of their child. Parents had learned to cope and provide a sense of normalcy for their family the best way possible. The nurses thought it “wasn’t their place” to initiate a discussion with the families about the option of stopping treatment. This finding is consistent with the results of a study14 in which participants viewed families’ caring for children with palliative care needs as a major undertaking. In addition, Harrison et al15 reported that long-term adverse effects when families could not cope with the loss of the families’ once-normal children often led to destruction of the family. The nurses, who were also parents, stated they themselves would not give up on their own child until the very end. The nurses struggled when these situations arose, because the situations created a personal and professional dilemma for them.

The importance of maintaining open and honest communication with the child and the child’s family and physicians could not be overstated by the nurses. This finding was consistent with previous indications15 that communication was an essential element of quality palliative care. The nurses also thought that including the child in treatment decisions was essential. Finally, the nurses adamantly noted that informed decision making would be compromised unless physicians consistently promoted understanding by the child and the child’s family by communicating at an appropriate level.

The emotional impact of a child’s dying and death markedly affected nurses and often triggered a grief response in them that became more pronounced at an appropriate level.

...
REFERENCES


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CREDENTIALING AND PRIVILEGING OF ACUTE CARE NURSE PRACTITIONERS TO DO INVASIVE PROCEDURES: A STATEWIDE SURVEY

By Fatmata Jalloh, MSN, ACNP-BC, CNS, CCRN, Matthew D. Tadlock, MD, Stacy Cantwell, MSN, ACNP-BC, Timothy Rausch, RN, MSN, Hande Aksoy, MD, and Heidi Frankel, MD

Background

Acute care nurse practitioners have been successfully integrated into inpatient settings. They perform invasive procedures in the intensive care unit and other acute care settings. Although their general scope of practice is regulated at the state level, local and regional scope of practice is governed by hospitals.

Objective

To determine if credentialing and privileging of these nurses for invasive procedures varies depending on the institution.

Methods

Personnel in medical staff offices of 329 hospitals were surveyed by telephone with 6 questions. Data collected included acute care nurse practitioner and hospital demographics, frequency and type of procedures performed, proctoring and credentialing process, and the presence of residents and fellows at the institution.

Results

The response rate was 74.8% (246 hospitals). Among these, 48% (118) employed acute care nurse practitioners, of which 43.2% performed invasive procedures. Three hospitals were excluded from the final analysis. Of the hospitals that credentialed and granted privileges to the nurse practitioners for invasive procedures, 60.4% were teaching hospitals. A supervising physician was the proctor in 94% of the nonteaching hospitals and 100% of the teaching hospitals. The most common number of cases proctored was 4 to 7.

Conclusion

The majority of hospitals employ acute care nurse practitioners. The most common method of privileging for invasive procedures is proctoring by a supervising physician. However, the amount of proctoring required before privileges and independent practice are granted varies by procedure and institution. (American Journal of Critical Care. 2016;25:357-361)
Acute care nurse practitioners (ACNPs) are advanced practice registered nurses whose education, training, and certification involve caring for critically ill, complex, acute and chronically ill patients.1,2 In order to practice in the inpatient setting, ACNPs must be credentialed and privileged through their individual institutions. Credentialing refers to the process by which a provider’s license, certificate, and education are authenticated by an institution. Privileging is the process of authorizing a provider to perform specific clinical duties, including diagnostic testing, treatment, invasive testing, and invasive procedures.3

The Joint Commission and the individual states in which ACNPs practice set the general credentialing and privileging requirements and regulations.3-6 For example, in California the code of regulation, Title 22, requires health care facilities to have a system in place for review of credentials and delineation of clinical privileges for independent providers, including nurse practitioners.7 The state mandates that providers be credentialed and privileged every 2 years after the original appointment. For privileging, an organization must adopt its own policy that outlines the specifics.7

The number of ACNPs practicing in the inpatient setting continues to increase as the number of hours that residents work has been regulated and decreased.1,4,8-10 In inpatient settings, ACNPs are efficacious in improving patients’ outcomes and satisfaction, shortening length of stay, and decreasing cost of care.11,12 Furthermore, ACNPs routinely perform invasive procedures in the hospital.3,4,10,13,14 Research on the processes of credentialing, privileging, and proctoring ACNPs for the performance of invasive procedures is limited. One challenge of effective privileging of ACNPs on the basis of procedural competency is the lack of validated metrics to evaluate providers’ performance of procedures.9 The ideal method for granting ACNPs the privilege to perform invasive inpatient procedures has not been defined. We hypothesize that the process is highly variable. We conducted a telephone survey of California hospitals to determine what invasive procedures ACNPs perform and what proctoring, privileging, and credentialing processes are used before the ACNPs can practice independently at the hospitals.

Methods

A list of hospitals was obtained from the California Health Care Foundation. California has 394 general acute care hospitals; most are in Los Angeles County (24%) and the Greater Bay area (20%).15 Most ACNPs are credentialed and privileged through a hospital’s medical staff offices.1 Thus, all questions were directed to the credentialing coordinators. A telephone survey was conducted of personnel in the medical staff offices of 329 hospitals. Some institutions had sister hospitals with 1 facility handling credentialing; thus, the 329 hospitals called represented all 394 general acute care hospitals in California.15

A survey consisting of 5 closed-ended questions was written and developed for this study. During creation of the survey, state regulations were considered, specifically the California requirement for a collaborative agreement for ACNPs to diagnose, treat, and prescribe.16 Data collected included ACNP and hospital demographics, the presence of trainees at the institution, frequency and type of procedures performed by ACNPs, and the specific proctoring and credentialing process (see Appendix). Three attempts were made to call each hospital. For comparisons, \( \chi^2 \) analysis was performed; \( P < .05 \) was defined as significant. Three centers were excluded from the final analysis because of inadequate information and no return of follow-up calls. SPSS 20 for Mac (SPSS Inc) software was used for statistical analysis.

Results

A total of 246 hospitals participated in the survey, for a response rate of 74.8%. All of the hospitals surveyed credential and privilege their ACNPs via
the hospital’s medical staff office. Of the responding hospitals, 48% (118) employed ACNPs, and 43.2% of the hospitals privilege their ACNPs to perform invasive procedures. Of the hospitals that credentialed and granted privileges to ACNPs for invasive procedures, 60.4% were teaching hospitals. Table 1 shows the procedures performed by ACNPs at teaching and nonteaching hospitals. Compared with ACNPs at nonteaching hospitals, ACNPs at teaching hospitals were significantly more likely to perform chest tube insertion (58.6% vs 26.3%; *P* = .03), chest tube removal (82.8% vs 36.8%; *P* = .001), and insertion of arterial catheters (79.3% vs 47.4%; *P* = .02). Teaching hospital ACNPs were also more likely to insert central catheters (79.3% vs 63.2%; *P* = .22) and perform thoracentesis (41.4% vs 36.8%; *P* = .75), but not significantly so. Differences between ACNPs in teaching hospitals and those in nonteaching hospitals also were not significant for endotracheal intubations (63.2% vs 62.1%; *P* = .94) or lumbar punctures (68.4% vs 69%; *P* = .97). ACNPs at nonteaching hospitals (31.6%) were more likely to perform paracentesis than were ACNPs at teaching hospitals (27.6%).

A supervising physician was the proctor in 100% of the teaching hospitals and in 94.7% of the nonteaching hospitals (*P* = .21). The number of proctored cases required before privileges were granted varied according to the procedure being performed. Performance of lumbar puncture, chest tube removal, and paracentesis required 0 to 3 proctored cases; arterial catheterization for hemodynamic monitoring and thoracentesis required 4 to 7 cases; insertion of a central venous catheter required 8 to 11 cases; endotracheal intubation required 12 to 15 cases. Insertion of a chest tube required 0 to 3 or 4 to 7 proctored cases, depending on the hospital surveyed. Not every hospital reported the number of proctored procedures required according to the individual procedure; therefore, no other comparisons between teaching and nonteaching hospitals could be made. Teaching and nonteaching hospitals did not differ significantly in the mean number of overall cases to be performed before privileges were granted (Table 2). The most common range was 4 to 7 (52.6% vs 41.4%; *P* = .44). Only 3 teaching hospitals used cadaver or simulation laboratories for credentialing ACNPs.

**Discussion**

In this survey of a large sample of hospitals from the most populated state in the United States, we found that ACNP privileging varies among institutions. The only commonality is that the medical staff offices oversee the credentialing and privileging process. Although an attending physician provided supervision and proctoring of ACNPs in the majority of hospitals, the number of proctored procedures before the ACNPs could practice independently was not standardized and varied by institution and the procedure performed.

The use of ACNPs has increased because of the decrease in the number of hours that residents can work (as mandated by the Accreditation Council for Graduate Medical Education) and the proven efficacy of the ACNPs in reducing length of stay and cost of care and in increasing patient satisfaction.6-11,17 Although previous studies5,10,15 have indicated which procedures are performed by ACNPs, our study is the first on how ACNPs are credentialled and privileged.

![Table 1](image1)

<table>
<thead>
<tr>
<th>Procedure</th>
<th>% (No. of facilities)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Placement of arterial catheter</td>
<td>47.4 (9)</td>
<td>.02</td>
</tr>
<tr>
<td>Placement of central catheter</td>
<td>63.2 (12)</td>
<td>.22</td>
</tr>
<tr>
<td>Intubation</td>
<td>63.2 (12)</td>
<td>.94</td>
</tr>
<tr>
<td>Chest tube insertion</td>
<td>26.3 (5)</td>
<td>.03</td>
</tr>
<tr>
<td>Chest tube removal</td>
<td>36.8 (7)</td>
<td>.001</td>
</tr>
<tr>
<td>Lumbar puncture</td>
<td>68.4 (13)</td>
<td>.97</td>
</tr>
<tr>
<td>Paracentesis</td>
<td>31.6 (6)</td>
<td>.77</td>
</tr>
<tr>
<td>Thoracentesis</td>
<td>36.8 (7)</td>
<td>.75</td>
</tr>
<tr>
<td>Placement of pulmonary artery catheter</td>
<td>5.3 (1)</td>
<td>.82</td>
</tr>
<tr>
<td>Peripherally inserted central catheter</td>
<td>10.5 (2)</td>
<td>.07</td>
</tr>
<tr>
<td>Othera</td>
<td>31.6 (6)</td>
<td>.25</td>
</tr>
</tbody>
</table>

a Bone marrow biopsy, ventricular tap, removal of intracranial pressure monitor, thoracostomy, bronchoscopy, placement of extraventricular drain.

![Table 2](image2)

<table>
<thead>
<tr>
<th>No. of cases</th>
<th>Nonteaching (n = 19)</th>
<th>Teachingb (n = 29)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 3</td>
<td>31.6 (6)</td>
<td>10.3 (3)</td>
<td>.06</td>
</tr>
<tr>
<td>4-7</td>
<td>52.6 (10)</td>
<td>41.4 (12)</td>
<td>.44</td>
</tr>
<tr>
<td>8-11</td>
<td>5.3 (1)</td>
<td>27.6 (8)</td>
<td>.05</td>
</tr>
<tr>
<td>12-15</td>
<td>5.3 (1)</td>
<td>10.3 (3)</td>
<td>.53</td>
</tr>
<tr>
<td>Satisfactoryb</td>
<td>5.3 (1)</td>
<td>3.4 (1)</td>
<td>.76</td>
</tr>
</tbody>
</table>

a One teaching facility had 3 campuses but 1 credentialing office that granted privileges, so the total number of facilities listed is only 27.
b ACNPs had to do procedures until they were deemed satisfactory, rather than perform a particular number of procedures.
Further research is needed to assess issues of credentialing and privileging on a national basis. Teaching hospitals had the highest use of acute care nurse practitioners who perform invasive procedures.

Further research is needed to assess issues of credentialing and privileging on a national basis.
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 acute care nurse practitioners, visit the Critical Care Nurse website, www.ccnnonline.org, and read the article by Haut and Madden, “Hiring Appropriate Providers for Different Populations: Acute Care Nurse Practitioners” (June 2015).

REFERENCES

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Evidence-Based Review and Discussion Points

By Ronald L. Hickman, RN, PhD, ACNP-BC

Evidence-Based Review (EBR) is the journal club feature in the American Journal of Critical Care. In a journal club, attendees review and critique published research articles: an important first step toward incorporating evidence-based practice into patient care. General and specific questions such as those outlined in the “Discussion Points” box aid journal club participants in probing the quality of the research study, the appropriateness of the study design and methods, the validity of the conclusions, and the implications of the article for clinical practice. When critically appraising this issue’s EBR article, found on pp 357-361, consider the questions and discussion points outlined in the “Discussion Points” box.

Across acute care settings, acute care nurse practitioners (ACNPs) provide care to acutely and critically ill patients. In accordance with reductions in residency hours for physicians, there has been a proportional growth in the numbers of ACNPs who are needed to provide health care to high acuity patients. Despite the prevalence of ACNPs, there has been limited exploration into how this cohort of advanced practice nurses are credentialed or privileged to perform invasive procedures.

To gain insight on how credentialing and privileging of ACNPs occur across hospitals statewide, the authors contacted all of the hospitals in California. Medical credentialing coordinators were interviewed by telephone and asked 7 questions that included hospital and ACNP demographic characteristics, a description of the credentialing and privileging processes, as well as details on the invasive procedures performed by ACNPs.

In total, the authors were able to gather data from 74% (n = 246) of all the hospitals in California. Of these participating hospitals, fewer than half (48%) employed ACNPs and the majority (60%) of hospitals that privileged ACNPs for invasive procedures were teaching hospitals. The results of this study highlight that credentialing and privileging of ACNPs for invasive procedures typically involves proctored observations by a supervising physician and the number of proctored observations varies by hospital and procedure.

Information From the Authors

Fatmata Jalloh, ACNP-BC, CNS, CCRN, lead author on this EBR article provides additional information about the study. She says that the study was designed to answer the prevailing question, “How are ACNPs credentialed and privileged...”
to perform invasive procedures across hospitals in California?"

According to Jalloh, this study grew out of need to understand the best practices for credentialing and privileging ACNPs who are expected to perform invasive procedures on acutely or critically ill patients. “We were the first group of nurse practitioners at our hospital that requested the privilege of performing invasive procedures and the medical credentialing coordinator had difficulty deciding on what was needed to privilege an ACNP to independently perform these procedures,” she says.

Jalloh points out that initially calls were made to affiliate hospitals about the credentialing and privileging processes for ACNPs. However, the lack of standardization among these hospitals prompted her and coauthors to conduct a statewide investigation to gain insight on variations in the credentialing and privileging process among hospitals across California.

Implications for Practice
Jalloh encourages readers of the American Journal of Critical Care to consider the quality and safety implications that result from a lack of standardization of the credentialing and privileging processes. She hopes that her research sheds light on the inconsistencies in the credentialing and privileging processes for ACNPs and highlights the urgency for an evidence-based framework to standardize these processes, which may enhance the quality of patient outcomes.

The study findings confirm that credentialing and privileging ACNPs to perform invasive procedures varies by hospital and type of invasive procedure. Jalloh explains that it is important for standardization of credentialing and privileging process for ACNPs and other advanced practice nurses performing invasive procedures. “Doing an invasive procedure a couple of times does not necessarily make an ACNP proficient at performing the procedure,” she adds.

Discussion Points

A. Description of the Study
- What is the purpose of the study?
- What is the difference between the processes of credentialing and privileging an advanced practice nurse?

B. Literature Evaluation
- What are the regulatory bodies that influence the credentialing and privileging processes?
- Why do credentialing and privileging processes vary by hospital?

C. Sample
- How were eligible hospitals identified?
- Whom did the study investigators interview?

D. Methods and Design
- Discuss how the study procedures influenced the number of hospitals represented in this study.
- Why were 3 hospitals excluded from the final statistical analyses?

E. Results
- What were the major findings of this project?
- How can you use the findings of this project to positively impact the quality of nursing care at your hospital?
LONG-TERM ACUTE CARE: WHERE DOES IT FIT IN THE HEALTH CARE CONTINUUM?

By Taryn Miller, RN, DNP, NEA-BC, Christina Canfield, RN, MSN, ACNS-BC, CCRN-E, Thomas Buckingham, RN, BSN, MBA, Gary Johnston, RN, MSN, FNP-C, CCRN-K, Samuel Hammerman, MD, MMM, CPE, Gloria Skinner, RN, MSN, and John Tote, RN, MSN, CCRN

As technological advancements have been introduced into the intensive care environment, the volume of patients surviving the acute illness or trauma phase has increased. Many of these patients become chronically critically ill. Chronic critical illness, a term first used in 1985, refers to the subset of patients requiring prolonged mechanical ventilation, those who experience multisystem organ failure, and those patients referred to as the “damaged survivors of critical care.” In addition to their multiple organ system failures, these patients experience profound muscle weakness, debilitation and require periods of prolonged recovery. Recovery of the chronically critically ill has been described as slow; occurring over weeks or months.

Care of this population requires a skill set that blends critical care expertise with rehabilitation. The need for acute nursing and medical care extends significantly beyond the expected length of stay as seen in a traditional hospital environment. Extended acute care may be provided in specialized hospitals called long-term acute care hospitals (LTACHs). Long-term acute care hospitals specialize in the care of high acuity patients who become chronically critically ill and require medical treatment beyond the normal length of stay in a short-stay acute care hospital and beyond the scope of practice of inpatient rehabilitation or skilled nursing facilities.

Background

Long-term acute care hospitals were formally established in the 1980s, and are defined by the US Centers for Medicare and Medicaid Services as acute care hospitals with an average length of stay greater than 25 days. The Centers for Medicare and Medicaid Services also requires patients transitioning to LTACHs to have spent 3 or more days in an intensive care unit (ICU) immediately preceding their admission or to have required mechanical ventilation for more than 96 hours. These hospitals may be located within the walls of a short-term acute care hospital or they can be a free-standing facility. An LTACH is a fully functioning acute care hospital, not a skilled nursing facility or an inpatient rehabilitation facility. Categorized as a postacute care facility, an LTACH provides care for patients with higher acuity needs than an inpatient rehabilitation facility or skilled nursing facility. Within the postacute care provider category, LTACHs provide the highest level of clinical expertise and require the greatest use of human and equipment resources in the provision of care to this fragile patient population. Improved outcomes may be related to the LTACHs’ multidisciplinary approach to care, which includes physicians, nurses, respiratory therapists, physical therapists, pharmacists, dieticians, and case managers.

Care provided at an LTACH focuses on continued medical stabilization, management of critical infusions, optimizing respiratory status, and facilitation of functional recovery. Consideration for transfer to an LTACH should occur early in a critically ill patient’s ICU stay to afford the patient the optimal chance for recovery. Of note, access to many of the same services as a short-term acute care hospital, such as hemodialysis, radiology, and laboratory services, allows for the continued intense level of care these patients require. A smoother
The ultimate goal in caring for these patients is the restoration of normal function.

transition of care, avoidance of delays in discharge, and enhanced utilization of ICU resources are advantages of early LTACH identification. More than one-third of the 5 million patients admitted to ICUs every year will require mechanical ventilation and up to 25% of these patients will require ventilation beyond 7 days with subsequent tracheostomy placement. LTACHs provide highly specialized evidence-based care intended to improve long-term outcomes for these patients and offer the ideal environment for development and implementation of specialized strategies for liberation from prolonged mechanical ventilation. Collaboration among the interdisciplinary team focuses on decreasing the potential for ventilator-associated events, improving progressive mobility, preventing infection, maintaining adequate nutrition, and enhancing communication and strategic weaning strategies.

Identification of Patients
Patients are identified for transfer to an LTACH through a comprehensive referral process. Although patients are frequently referred directly out of the ICU, they may also transfer from a step-down or complex medical-surgical setting. Physicians and case managers identify patients who will benefit from an LTACH stay before transitioning them to a lower level of care. Patients requiring acute dialysis, liberation from mechanical ventilation, complex wound management, management of 1 or more infectious disease processes, and those who require frequent administration or adjustment of intravenous medications may all be eligible for admission to an LTACH. Clinical liaisons, skilled in the assessment of chronically critically ill patients, work with the short-term acute care hospital’s case management team to coordinate the admission and assurance of care between settings. Handoff occurs between physicians, advanced practice nurses, bedside nurses, and respiratory therapists prior to patient transfer.

Patients requiring intense or frequent nursing care and assessments may be placed in a high observation or special care unit within the facility, and lower acuity patients may be placed in a medical-surgical unit. The clinical team is geared toward the management and clinical resolution of the chronically critically ill patient’s complex medical issues. Interventions are carefully considered for possible unintended negative consequences. The LTACH environment provides adequate technology to assess and sustain care (eg, ventilators, electrocardiogram monitors, intravenous equipment). This is coupled with careful, coordinated attention and intervention by clinicians with specialized skills. The ultimate goal in caring for these patients is the restoration of normal function with an emphasis on mobility and weight bearing, effective nutrition, management of current organ dysfunction, and prevention of additional complications.

Interventions Provided
Interventions such as central venous catheter insertion, percutaneous endoscopic gastrostomy tube insertion, bronchoscopy, or colonoscopy may also be performed in an LTACH. Additionally, LTACHs are equipped to manage acute physiologic decompensation such as respiratory failure, sepsis, and acute pulmonary edema. Patients experiencing an acute decompensation may be transferred to a higher level of care within the facility for more intense management. Clinicians at LTACHs are skilled at endotracheal intubation and management of rapid response calls and cardiopulmonary arrest. LTACHs do not provide therapies such as percutaneous coronary intervention or extracorporeal membrane oxygenation. Patients requiring these therapies are transferred back to a short-term acute care hospital.

Many LTACHs maintain an affiliation or connection with providers at short-term acute care hospitals. This affiliation allows for continuity of care and exchange of key patient information. The relationship may be maintained via dual privileging of physicians and midlevel providers or through a shared medical record. Physicians assess the patients’ progress daily and adjust their treatment plan accordingly.
Consultations for specialty physicians, such as, but not limited to, pulmonologists, infectious disease experts, nephrologists, gastroenterologists, urologists, cardiologists, and neurologists are also available. Advancements in telemedicine further connect providers at referring hospitals to their patients and allow for virtual consults and, at times, assessment and management of care.

**The Long-Term Acute Care Hospital Team**

A care environment and clinical team geared to the management and clinical resolution of these issues as a group, such as that provided in an LTACH, is essential for returning the patient to true recovery. This patient population is very fragile, so every intervention must be carefully considered for possible unintended negative consequences. The environment must provide adequate technology to sustain care and carefully coordinated attention and intervention by clinicians with specialized skills. To reiterate, the goal in caring for these patients must be the restoration of normal function with emphasis on mobility and weight bearing, effective nutrition, management of current organ dysfunction and prevention of additional complications. This is difficult to achieve in the modern ICU, which is geared toward technology and interventions that limit mobility, and which does not have clinicians with specialized knowledge of this phase of critical illness. Once more, transfer to a more specialized environment such as an LTACH, can decrease anxiety and delirium, promote sleep, and possibly ameliorate future cognitive impairment and posttraumatic stress disorder.

Nurses who work at LTACHs must demonstrate a high degree of competence in caring for patients with multiple complex medical problems. Nurses maintain Acute Cardiac Life Support certification and many also hold certification as Critical Care Registered Nurses. Advanced training in the immediate management and stabilization of critically ill patients may be provided; Fundamentals of Critical Care Support training may be offered to nurses, as well. The nurse is an integral member of the interdisciplinary team and actively participates in developing, implementing and evaluating the individualized and continuing care plan for each patient.

Caring for patients and their families who have experienced an unexpected prolonged hospital stay presents its own unique set of challenges and nursing care of the patient admitted to an LTACH involves skillful therapeutic communication. Patients and their families are often hesitant to leave the ICU environment and require much reassurance that their needs will be met during the LTACH stay. Goals of care are set with patients and their families during care conferences held with the interdisciplinary team at the beginning of their stay. Care conferences allow the clinical team, the patient, and the family to collaborate on care delivery and also allow the patient and their family to express their preference and desire for a discharge plan. The goals of LTACH must frequently be reinforced. Physical therapy, occupational therapy, and speech therapy contribute significantly in the LTACH setting to the patient’s progression, however there is no defined amount of time that they must be able to participate in therapy sessions. Therapy interventions are fluid and dependent upon close collaboration with the medical, nursing, and respiratory teams. The therapy plan is decided based upon the daily assessment and the patient’s medical condition. Collaboration, cooperation, and communication are intrinsic to the patient’s outcome in the LTACH space.

The interdisciplinary team continuously evaluates patient progress and develops a plan for the next transition in care. This plan for transition is generated collaboratively with patients and their families while considering the available and/or required resources. Whereas some patients may be discharged home from an LTACH, many will transition to inpatient rehabilitation, skilled nursing, or hospice care. The decision to transfer to the next level of care is based on the patient’s medical stability and potential for rehabilitation. In contrast to LTACHs, inpatient rehabilitation facilities have a therapy driven model in which the patients must be able to tolerate 3 hours of therapy at a minimum.

**Focused on Return to Normalcy**

The successful recovery of a critically ill patient is defined by the entire episode of care and thus the transition of patients who are chronically critically ill out of the intensive care environment to an LTACH once they have reached the end of the acute phase of their illness is an important step in their healing. The LTACH environment, with a focus on the patient’s return to normalcy through the implementation of evidence-based protocols, has produced positive patient outcomes. Highly skilled clinicians, who comprise the interdisciplinary team, work closely together on a treatment
plan that encompasses the patients’ and families’ goals for healing. Unlike inpatient rehabilitation facilities and skilled nursing facilities, the care provided at an LTACH is driven by their continued acute medical needs. LTACHs provide high quality care to the chronically critically ill patient population and will continue to partner with ICUs to assure these patients are transitioning seamlessly to the best level of care possible, helping to ensure successful clinical outcomes.

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.
Burnout syndrome (BOS) occurs in all types of health care professionals and is especially common in individuals who care for critically ill patients. The development of BOS is related to an imbalance of personal characteristics of the employee and work-related issues or other organizational factors. BOS is associated with many deleterious consequences, including increased rates of job turnover, reduced patient satisfaction, and decreased quality of care. BOS also directly affects the mental health and physical well-being of the many critical care physicians, nurses, and other health care professionals who practice worldwide. Until recently, BOS and other psychological disorders in critical care health care professionals remained relatively unrecognized. To raise awareness of BOS, the Critical Care Societies Collaborative (CCSC) developed this call to action. The present article reviews the diagnostic criteria, prevalence, causative factors, and consequences of BOS. It also discusses potential interventions that may be used to prevent and treat BOS. Finally, we urge multiple stakeholders to help mitigate the development of BOS in critical care health care professionals and diminish the harmful consequences of BOS, both for critical care health care professionals and for patients. (American Journal of Critical Care. 2016;25:368-376)
Psychological stress develops when individuals’ external demands exceed their adaptive abilities. Although stress may help an individual become more focused, chronic and excessive stress has deleterious effects such as feeling pressured and being overwhelmed. Extreme stress can result in insomnia, fatigue, irritability, anxiety, and depression. For many adults, the demands from their work environment are a major contributor to feeling stressed. Owing to increasing expectations, longer hours, and a relative lack of community support in the workplace, the amount of work-related stress has increased in the past few decades. As a result, burnout syndrome (BOS) has become a common worldwide phenomenon, especially among members of high-stress professions: firefighters, police officers, teachers, and all types of health care professionals. Compared with all high school graduates, physicians were 36% more likely to have BOS develop. Among physicians, those at the front line of care (family medicine, emergency medicine, and general internal medicine) report the highest rates of BOS (ie, >40%).

Working in an intensive care unit (ICU) can be especially stressful because of the high patient morbidity and mortality, challenging daily work routines, and regular encounters with traumatic and ethical issues. This level of nearly continuous and excessive stress can rapidly accelerate when caregivers perceive that there is insufficient time or limited resources to properly care for patients. Until recently, the critical care community was relatively unaware of the harmful effects of working in a stressful ICU environment, including the development of BOS and other psychological disorders. Unfortunately, critical care health care professionals have one of the highest rates of BOS (ie, >50%), and development of this disorder may adversely affect the ability to care for patients properly.

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This document was jointly developed by members of the Critical Care Societies Collaborative, which consists of the American Association of Critical-Care Nurses, the American College of Chest Physicians (CHEST), the American Thoracic Society, and the Society of Critical Care Medicine. The CCSC convened a working group to acknowledge the importance of BOS and other psychological disorders in critical care health care professionals and to publish a document in the societies’ 4 major journals that would focus attention on this issue. The primary objectives of the present commentary were to (1) summarize the available literature regarding the diagnostic criteria, prevalence, causative factors, and consequences of BOS and related conditions, (2) raise awareness of BOS within the critical care community, and (3) inform multiple stakeholders of their potential roles in reducing BOS and its deleterious consequences in health care professionals and their critically ill patients.

We searched the Cochrane Library and Medline by using PubMed for published research relevant to BOS. A variety of search terms were entered, including (but not limited to) the following: “burnout syndrome,” “critical care,” “nursing,” “posttraumatic stress disorder,” “moral distress,” “resiliency,” and “mindfulness.” Search terms were grouped together and individually cross-matched. Pertinent review articles, editorials, books, and references from identified articles were also reviewed. We preferentially selected publications from the past 10 years but also included commonly referenced or highly regarded older publications.

What Is BOS?
First described in the 1970s, BOS is a work-related constellation of symptoms and signs that usually occurs in individuals with no history of psychological or psychiatric disorders. BOS is triggered by a
discrepancy between the expectations and ideals of the employee and the actual requirements of his or her position. Symptoms of BOS typically develop gradually and are usually absent when entering a new type of employment. In the initial stages of BOS, individuals feel emotional stress and increasing job-related disillusionment. They subsequently lose the ability to adapt to the work environment and display negative attitudes toward their job, their coworkers, and their patients. Eventually, the 3 classic symptoms of BOS develop: exhaustion, depersonalization, and reduced personal accomplishment. Exhaustion is generalized fatigue that can be related to devoting excessive time and effort to a task or project that is not perceived to be beneficial. For example, a feeling of exhaustion, particularly emotional exhaustion, may be caused by continuing to care for a patient who has a very poor chance of recovery. Depersonalization is a distant or indifferent attitude toward work. It manifests as negative, callous, and cynical behaviors or interaction with colleagues or patients in an impersonal manner. Depersonalization may be expressed as unprofessional comments directed toward coworkers, blaming patients for their medical problems, or the inability to express empathy or grief when a patient dies. Reduced personal accomplishment is the tendency to negatively evaluate the worth of one’s work, feeling insufficient regarding the ability to perform one’s job, and a generalized poor professional self-esteem.

Individuals with BOS may also develop non-specific symptoms such as feeling frustrated, angry, fearful, or anxious (Table 1). They may also express an inability to feel happiness, joy, pleasure, or contentment. BOS can be associated with physical symptoms, including insomnia, muscle tension, headaches, and gastrointestinal problems. BOS is most commonly diagnosed by using the Maslach Burnout Inventory (MBI). The MBI is a 22-item, self-report questionnaire that asks respondents to indicate on a 7-point Likert scale the frequency with which they experience certain feelings related to their job. The MBI is scored according to the presence and severity of emotional exhaustion, depersonalization, and reduced sense of personal accomplishment. Individuals are diagnosed with BOS if they exceed a cutoff value on the MBI. However, accurate cutoff values for critical care health care providers have not been determined. As a result, the diagnostic criteria for BOS vary across studies, making comparisons difficult from one study to another. Other conditions may overlap with BOS, including moral distress, perceived delivery of inappropriate care, and compassion fatigue (also called secondary traumatic stress). Moral distress occurs when an individual knows the ethical and appropriate action to take but feels constrained from enacting the specific action. Moral distress may be related to internal constraints such as self-doubt, anxiety about creating a conflict, and a lack of confidence. Moral distress may also be related to external constraints such as imbalances in perceived power (eg, between a nurse and a physician), inadequate communication strategies, and pressure to reduce costs or avoid legal ramifications. Clinicians consider care to be inappropriate when it is not aligned with their personal beliefs or professional knowledge. Examples of perceived inappropriate care include (1) differences in the amount of care given and the expected prognosis (either too much or too little care), (2) caring for patients who are persistently noncompliant, (3) holding the belief that other patients would benefit more from ICU care, (4) delivering inaccurate information to a patient or family, (5) not respecting the expressed wishes of a patient, and (6) delivering medical or nursing care believed to be of inadequate quality. Compassion fatigue is characterized by a gradual reduction in compassion over time that results from a cumulative and persistent desire to help suffering patients; it is sometimes referred to as “the cost of caring.” Moral distress, delivery of inappropriate care, and compassion fatigue occur in critical care health care professionals. For example, the perception of inappropriate care occurs in 25% of critical care nurses and 32% of critical care physicians.

**Prevalence of BOS in Critical Care Health Care Professionals**

Based upon multiple studies, approximately 25% to 33% of critical care nurses manifest symptoms of severe BOS, and up to 86% have at least 1 of the 3 classic symptoms. Other conditions may overlap with BOS if they exceed a cutoff value on the MBI. However, accurate cutoff values for critical care health care providers have not been determined. As a result, the diagnostic criteria for BOS vary across studies, making comparisons difficult from one study to another. Other conditions may overlap with BOS, including moral distress, perceived delivery of inappropriate care, and compassion fatigue (also called secondary traumatic stress). Moral distress occurs when an individual knows the ethical and appropriate action to take but feels constrained from enacting the specific action. Moral distress may be related to internal constraints such as self-doubt, anxiety about creating a conflict, and a lack of confidence. Moral distress may also be related to external constraints such as imbalances in perceived power (eg, between a nurse and a physician), inadequate communication strategies, and pressure to reduce costs or avoid legal ramifications. Clinicians consider care to be inappropriate when it is not aligned with their personal beliefs or professional knowledge. Examples of perceived inappropriate care include (1) differences in the amount of care given and the expected prognosis (either too much or too little care), (2) caring for patients who are persistently noncompliant, (3) holding the belief that other patients would benefit more from ICU care, (4) delivering inaccurate information to a patient or family, (5) not respecting the expressed wishes of a patient, and (6) delivering medical or nursing care believed to be of inadequate quality. Compassion fatigue is characterized by a gradual reduction in compassion over time that results from a cumulative and persistent desire to help suffering patients; it is sometimes referred to as “the cost of caring.” Moral distress, delivery of inappropriate care, and compassion fatigue occur in critical care health care professionals. For example, the perception of inappropriate care occurs in 25% of critical care nurses and 32% of critical care physicians.

**Table 1**

<table>
<thead>
<tr>
<th>Psychological symptoms</th>
<th>Physical symptoms</th>
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<tbody>
<tr>
<td>Frustration</td>
<td>Exhaustion/fatigue</td>
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<tr>
<td>Anger</td>
<td>Insomnia</td>
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<tr>
<td>Fear</td>
<td>Muscle tension</td>
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<tr>
<td>Anxiety</td>
<td>Headache</td>
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<tr>
<td>Inability to feel happy</td>
<td>Gastrointestinal problems</td>
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<tr>
<td>Being unprofessional</td>
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<tr>
<td>Feeling overwhelmed</td>
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<tr>
<td>Disillusionment</td>
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<tr>
<td>Hopelessness</td>
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<tr>
<td>Lack of empathy</td>
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<tr>
<td>Feeling insufficient at work</td>
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prevalence of BOS among their colleagues were also more likely to have BOS themselves. Therefore, units with a negative working culture might harbor a “contagion effect” among its employees.\textsuperscript{33} The relative shortage of critical care physicians and the demands for overnight ICU coverage have increased the awareness and recognition of BOS among physicians.\textsuperscript{3} BOS is common in critical care physicians as well.\textsuperscript{7,26–30} Up to 45% of critical care physicians reported symptoms of severe BOS.\textsuperscript{7,24} In pediatric critical care physicians, the prevalence of BOS is 71%, more than twice the rate in general pediatricians. Compared with other types of physicians, critical care physicians have the highest prevalence of BOS, followed closely by emergency medicine physicians.\textsuperscript{31} There is a paucity of data on the prevalence of BOS in other critical care health care professionals, such as social workers, and respiratory, physical, occupational, or speech therapy health care professionals.\textsuperscript{31} In one study, nursing assistants were more likely to have BOS compared with other types of critical care health care professionals.\textsuperscript{8}

**Risk Factors for BOS**

The ability to determine the temporal relationship between the majority of risk factors and the development of BOS is hampered by the cross-sectional design of most previous studies. Risk factors associated with BOS can be divided into 4 categories: (1) personal characteristics, (2) organizational factors, (3) quality of working relationships, and (4) exposure to end-of-life issues (see Figure).\textsuperscript{10} Personal characteristics associated with BOS include being self-critical, engaging in unhelpful coping strategies, sleep deprivation, and a work-life imbalance.\textsuperscript{32} Other personal risk factors associated with BOS are idealism, perfectionism, and overcommitment; these qualities often occur in the best and most productive employees. Certain personality types, such as neurotic individuals, also reportedly have higher rates of BOS; extraverted, conscientious, and agreeable individuals, conversely, are less likely to demonstrate symptoms of BOS.\textsuperscript{33} Burnout was once thought to be a late-career phenomenon, but studies suggest that younger physicians have nearly twice the prevalence of BOS compared with older colleagues and that onset may occur as early as residency training.\textsuperscript{34} Similarly, younger age is an independent risk factor for BOS among ICU nurses.\textsuperscript{10} However, older health care professionals who have not developed BOS may be those who remained in the work force and are therefore overrepresented in cross-sectional studies. Having an inadequate support system outside of the work environment (eg, having no spouse, partner, or children) has also been associated with high rates of BOS.\textsuperscript{8,20,35}

In general, organizational factors associated with BOS include (1) increasing workload, (2) lack of control over the work environment, (3) insufficient rewards, and (4) a general breakdown in the work community.\textsuperscript{35} Organizational factors that are associated with BOS seem to differ between critical care nurses and physicians. For critical care nurses, the inability to choose days off, rapid patient turnover, and the lack of participation in an ICU working group are all factors associated with BOS.\textsuperscript{5,30} For critical care physicians, the amount of work (defined as number of night shifts per month and time since the last nonworking week) was associated with the presence of BOS.\textsuperscript{7} For example, weekend coverage schedules affect the risk of BOS. Compared with having weekend coverage by another physician, working a continuous 14-day period of direct patient care was associated with increased symptoms of BOS.\textsuperscript{36} Having to make ethical decisions was also associated with higher rates of BOS for physicians. In contrast to nurses, physicians may less frequently experience moral distress, most likely because physicians are responsible for making the patient care decisions. In both nurses and physicians, problems with the quality of working relationships were common risk factors for BOS, including conflicts and poor working relationships with colleagues.\textsuperscript{34} This issue is an important and potentially modifiable risk factor because measures to improve communication and reduce conflict among critical care health care professionals can enhance relationships. Another significant source of stress is the strained relationships between health care professionals and patients and their families.

Finally, factors related to end-of-life issues are commonly reported risk factors in nurses, including caring for a dying patient and participating in or witnessing decisions to forgo life-sustaining treatments. As a result, higher unit-specific mortality
Consequences of BOS

BOS in critical care health care professionals may result in posttraumatic stress disorder (PTSD), alcohol abuse, and even suicidal ideation.29 Although alcohol and substance abuse were not specifically studied in critical care providers, physicians have higher rates of these problems compared with the general adult US population.11,20 PTSD is manifest by intrusion, avoidance, negative alterations in cognitions and mood, and marked alterations in arousal and reactivity. PTSD can occur in response to one catastrophic event or after chronic or repetitive exposure to traumatic episodes. Between 22% and 29% of critical care nurses have symptoms of PTSD, and up to 18% of critical care nurses meet the diagnostic criteria for PTSD.20,21,40 In addition, almost all of the nurses (98%) with PTSD will also have symptoms consistent with BOS.20 ICU work-related triggers associated with PTSD include participation in end-of-life issues, feeling overextended, caring for combative patients or family members, visualizing open wounds or massive bleeding, and providing postmortem care.40-42

Many factors influence the decision of a health care professional to leave his or her current position. For example, working in a pediatric unit, a government-owned hospital, or a hospital in a metropolitan area is favorably associated with lower rates of nursing turnover.43 However, the presence of BOS affects a health care professional’s decision to leave the profession.44 Excessive turnover rates increase health care costs, decrease productivity, lower staff morale, and reduce the overall quality of care because experienced professionals who leave the ICU must be replaced.45-47 Turnover occurs frequently in ICU nurses, with reported annual rates ranging between 13% and 20% (the 2013 US average annual turnover rate for all types of employees was 10.4%).55,48 In one survey, 41% of all nurses were not satisfied with their job, and 22% planned to leave their profession. When asked why they were considering leaving the nursing profession, 56% desired a less stressful position.49 Based on national survey data, the total cost of replacing 1 critical care nurse is estimated to be more than $65,000.50 Therefore, at a medium-sized hospital with 40 ICU beds employing 100 ICU nurses with an annual turnover rate of 17%, the hospital’s cost related to ICU nursing turnover would be approximately $1,105,000 per year. In general, physicians with BOS are more likely to leave their practice and therefore potentially decrease access and continuity of care for patients. Recently, the total cost of burnout among Canadian physicians was estimated to be more than $200 million.51 In the United States, replacement costs have been estimated to be at least $250,000 for each primary care physician, an amount that may be even higher for critical care physicians.52

BOS also results in decreased effectiveness and poor work performance, which have a direct impact on patient care. BOS in nurses is associated with reduced quality of care, lower patient satisfaction, increased number of medical errors, higher rates of health care–associated infections, and higher 30-day mortality rates.53,54 A national study reported that 9% of physicians had made a major medical error in the past 3 months.55 In studies of primarily physicians, there were strong dose-response relationships between burnout scores and medical errors. These errors appear to occur in a bidirectional manner: errors lead to distress, and distress leads to errors.34,56 After a medical error, physicians may experience significant job-related stress, including anxiety about future errors, loss of confidence, sleeping difficulties, reduced job satisfaction, and perceived harm to their reputation.57 Therefore, strategies that reduce medical errors may also decrease moral distress and BOS in health care providers. Additionally identifying strategies that reduce BOS and turnover in critical care professionals would likely have important effects on quality of care and health care costs.

Interventions to Prevent or Treat BOS

Currently, there are no large randomized controlled trials that have examined strategies to prevent or treat BOS in critical care health care professionals. Potential strategies that may prevent and treat critical care–related BOS can be divided into 2 categories: (1) interventions focused on enhancing the ICU environment, and (2) interventions focused on helping individuals cope with their environment. It is unlikely that any single intervention will be effective in preventing and treating BOS in critical care health care professionals; rather, multidimensional interventions that address the ICU environmental culture and individual practitioner level are more likely to successfully prevent and treat BOS. The benefit of any potential BOS intervention needs
to be weighed against the costs associated with its implementation and maintenance.

Establishing and sustaining a healthy work environment that fosters respect may be one key strategy to combat stress and BOS in the ICU working environment. Based on a report from the American Association of Critical-Care Nurses, 6 standards are needed to establish and sustain a healthy work environment: (1) skilled communication, (2) true collaboration, (3) effective decision-making, (4) appropriate staffing, (5) meaningful recognition, and (6) authentic leadership. Additional commonly recognized tenets of a healthy ICU environment include “avoiding or managing conflicts” and “improving end-of-life care.” Communication, collaboration, and effective decision-making during times when emotions are elevated are critical in engaging the team to decrease stress and BOS. A healthy work environment may be enhanced by utilizing team debriefings, structured communication, and collaborating with team members on critical decisions.

Critical care health care professionals should be taught how to recognize the risk factors for BOS and how to seek assistance when needed. Health care professionals should consider taking individual accountability for maintaining their own emotional and physical health, and for building resiliency. Resiliency is a multidimensional characteristic that allows an individual to thrive when faced with complexity and high rates of change. Building resilience requires a variety of interventions based on individual preferences. The foundation for resilience is adequate self-care, ensuring adequate rest, spiritual practices, exercise, meditation, and hobbies outside of the work environment. Additional strategies such as setting limits, establishing a work-life balance, and employing time management skills and stress reduction measures may also be beneficial in mitigating the risk of BOS. Among critical care physicians and nurses, interdisciplinary discussions that encourage ethical team deliberations may be useful in preventing BOS. Other potentially beneficial strategies that have been effectively used to prevent BOS and PTSD in other settings include support groups, cognitive-behavioral therapy, and mindfulness-based stress reduction programs (Table 2).

<p>| Table 2 |</p>
<table>
<thead>
<tr>
<th>Potential interventions to prevent and treat burnout syndrome in the intensive care unit (ICU)</th>
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<tbody>
<tr>
<td><strong>Environmental interventions</strong></td>
</tr>
<tr>
<td>Promoting healthy work environment</td>
</tr>
<tr>
<td>Communication training; appropriate staffing; meaningful recognition</td>
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<tr>
<td>ICU self-scheduling/time off</td>
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<tr>
<td>Limit the maximum number of days worked consecutively</td>
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<tr>
<td>Support groups</td>
</tr>
<tr>
<td>Cognitive-behavioral therapy</td>
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<tr>
<td><strong>Team-based interventions</strong></td>
</tr>
<tr>
<td>Team debriefings</td>
</tr>
<tr>
<td>Use of structured communication tools</td>
</tr>
<tr>
<td>Team-building and interpersonal skills training</td>
</tr>
<tr>
<td><strong>Practitioner-focused interventions</strong></td>
</tr>
<tr>
<td>Stress reduction training</td>
</tr>
<tr>
<td>Relaxation techniques</td>
</tr>
<tr>
<td>Time management</td>
</tr>
<tr>
<td>Assertiveness training</td>
</tr>
<tr>
<td>Meditation</td>
</tr>
<tr>
<td><strong>Work-life balance measures:</strong> hobbies, family, and social activities</td>
</tr>
<tr>
<td>Self-care measures: ensuring adequate rest, exercise, healthy eating habits</td>
</tr>
<tr>
<td>Interventions to mitigate risk factors</td>
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<tr>
<td>Palliative care consultations</td>
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<tr>
<td>Ethics consultations</td>
</tr>
<tr>
<td>Establishing goals of care for every ICU patient</td>
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<tr>
<td>Family care conferencing within 72 h of ICU admission</td>
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Promoting family care conferencing within 72 hours of ICU admission to enable discussion of prognosis and treatment goals is now advocated for critically ill patients, including those with severe sepsis and multiple organ system failure. These measures, as well as use of palliative care and ethics consultations, may mitigate moral distress in ICU clinicians, a potential mediator in the development of BOS. More research is needed to identify specific interventions that prevent and treat BOS and other psychological disorders in critical care health care professionals.

A Call for Action

There are more than 10 000 critical care physicians and 500 000 critical care nurses who practice in the United States. Much of the previous BOS-related literature has focused on the disorder’s negative consequences as they correspond to patient-centric outcome measures, including patient safety, satisfaction, and quality of care. However, promoting wellness in health care providers is also essential. Protecting the mental and physical health of health care professionals who are at risk for BOS should also be vitally important to the same group of stakeholders. This section provides advice for these stakeholder groups; suggestions are also included regarding ways to mitigate the development of BOS in critical care health care professionals and diminish the harmful consequences of BOS, both for critical care health care professionals and for patients.

Critical Care Health Care Professionals and Their Friends and Family

Critical care health care professionals have an important voice and should be involved in promoting their own wellness. Critical care health care professionals should be personally responsible for managing their own BOS symptoms and related consequences. They should be able to recognize the features of BOS...
and to access currently available resources. Similarly, friends and family members of critical care health care professionals should also become aware of early symptoms and understand BOS and its consequences.

ICU Unit-Based Leaders

ICU nurse managers, medical directors, and other unit-based administrators need to be aware of the high prevalence of BOS and other psychological disorders in their employees. ICU nurse managers and medical directors can empower their colleagues to participate in the oversight of the unit, recognize exemplary efforts, and strive to create a healthy work environment. In addition, managers should develop innovative staffing models that promote effective time away from the critical care environment. Collectively, ICU teams should improve their ability to function as a group, respect each other, and reduce triggers of BOS. Similarly, ICU leaders should implement programs that identify and manage employees with BOS. Measures of BOS or potential other surrogate outcomes should be benchmarked and compared across ICUs and medical centers. Based on a 2011 Joint Commission Sentinel Event Alert report, “The link between health care worker fatigue and adverse events is well documented, with a substantial number of studies indicating that the practice of extended work hours contributes to high levels of sleep deprivation and reduced productivity.” Consequently, nap opportunities strategically timed among high-intensity and potentially fatigued teams may provide unique reductions in BOS risk.

Hospital Administrators

Owing to financial implications and effects on patient-centered outcomes, hospital administrators have prioritized reducing turnover rates. More information is needed regarding the cost of BOS that occurs in all critical care health care professionals (nurses, physicians, and others members of the multidisciplinary team). Hospital administrators should consider the reduction in turnover rates as an important quality metric of providing a successful work environment; they should also monitor job satisfaction and rates of BOS in their employees. Hospitals should provide assistance programs for employees with (or at risk for) BOS and other psychological disorders such as PTSD. Finally, hospitals or clinical practices should consider limiting the number of consecutive days that a critical care health care professional works, while promoting healthy sleep habits and the importance of sleep recovery.

Funding Agencies

Despite the impact of BOS on health care professionals and their patients, research in this area is grossly underfunded. Based on a 2015 NIH RePORTER search, only 2 grants are currently funded to study BOS in health care professionals, and neither is focused on the critical care setting. The ICU is a unique environment to study BOS because of the high prevalence of symptomatic health care professionals and the unique work-related triggers. Funding agencies such as the National Institutes of Health are encouraged to develop requests for applications that will enhance critical care health care professionals’ understanding of the following: the epidemiology of BOS, BOS criteria, and cutoff values that accurately diagnose this disorder; preventative and therapeutic interventions; and appropriate and measurable outcome variables. In addition, research is needed to understand the relationship between moral distress, the delivery of inappropriate care, compassion fatigue, and BOS.

Professional Societies

One key function of professional societies is to educate and inform their members. These educational initiatives typically focus on disseminating new medical knowledge, updating health care policies, and teaching new practice strategies. Professional societies should educate members about BOS and other psychological disorders that impair the mental and physical health of their members, reduce the quality of care of their patients, and may deter trainees from entering their specific field. Similarly, accreditation and Maintenance of Certification groups should develop educational materials to raise awareness of BOS and its consequences.

Academic Institutions Training the Next Generation of Health Care Professionals

Academic institutions play an important role in career counseling. Students and postgraduate trainees should pursue positions and specialties in which they are most likely to be successful. However, the recruitment of students and postgraduate trainees into specialties perceived to have high levels of stress is declining. Career counselors could improve the preparation of trainees for their career choices and create more fulfilling and lasting careers. Therefore, academic institutions are encouraged to develop or expand their direct counseling or didactic education sessions so that students and postgraduate trainees are better prepared for the stresses inherent to their profession. In addition, academic institutions should educate students and postgraduate trainees on effective coping mechanisms to ensure more successful careers. Furthermore, critical care fellowships should include in their curriculum education regarding the recognition, prevention, and treatment of BOS and associated psychological disorders.
Patient Advocacy Groups

The focus of patient advocacy groups is on raising awareness, influencing policy, stimulating research, and improving the care of patients with specific disorders. Because of the negative effects of BOS on patient-centered outcomes, patient advocacy groups should be interested in improving the ability of health care professionals to effectively care for patients. These groups should develop educational programs for critically ill patients and their families to inform them about BOS in health care professionals. They may also develop patient and family educational programs to teach individuals how to effectively interact with critical care health care professionals and reduce the patient and family triggers associated with BOS. In addition, patient advocacy groups could help raise awareness about BOS and advocate for increased funding that may ultimately improve patient and family satisfaction, as well as the outcomes of critically ill patients.

Policy Makers

Owing to the increasing budgetary pressures on health care, government officials and other policy makers have prioritized the discovery of novel methods to produce better health outcomes at lower costs. Because of the deleterious impact of BOS on the job satisfaction of critical care health care professionals, health care costs, and quality of care, international and national policy makers should work with a variety of stakeholders to shape the laws and regulations that will reduce BOS in critical care health care professionals, improve the quality of patient care, and decrease health care costs (eg, those associated with turnover).

Conclusions

On behalf of the CCSC, this call to action hopefully enhances the critical care community’s interest in reducing the prevalence of BOS and other psychological disorders in health care professionals. Our colleagues are encouraged to be more vocal on this important issue and strive to create a healthy work environment in the ICU. The CCSC will continue to working diligently to increase awareness, educate our community, enhance research opportunities, implement strategies that enhance job satisfaction, and improve the mental health of critical care health care professionals. Collectively, healthy ICU work environments need to be created that ultimately and, most importantly, improve patients’ quality of care.

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None reported.

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Differential Diagnoses for Suspected ACS

By Michele M. Pelter, RN, PhD, Teri M. Kozik, RN, PhD, CNS, CCRN, Salah S. Al-Zaiti, RN, PhD, CRNP, and Mary G. Carey, RN, PhD

Scenario: This 12-lead electrocardiogram (ECG) is from a 75-year-old woman who came to the emergency department with complaints of chest pain. The patient is an active, healthy, retired grandmother whose only medical history is “mild” hypertension diagnosed 7 years ago, for which she takes metoprolol. The patient has had chest pain “off and on” for the past week, but decided to go to the emergency department because the pain lasted for more than 1 hour, which is longer than usual. Her blood pressure is 110/70 mm Hg, and the intensity of her chest pain currently is a 1 out of 10, but was 5 out of 10 two hours previously. Her initial troponin I is 0.045 ng/ml (>0.04 = positive).

Interpretation Questions:

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

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

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

4. Is the QRS complex narrow (duration <110 milliseconds [ms] in V1)? 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)? If yes, check for similar deviations in contiguous cardiac territories.

6. Is the T wave inverted in relation to the QRS (>0.5 mV)? If yes, check for ST deviation or conduction abnormalities.

7. Is the QT interval lengthened (>450 ms [men] or >470 ms [women])? 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)? If yes, check for axis deviation or other chamber hypertrophy criteria.

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Interpretation

Sinus tachycardia, first degree AV block, premature atrial contraction (7th beat), nonspecific ST, T-wave abnormality in the anterolateral leads V_2, I, and aVL, which may suggest possible ischemia, isolated Q-waves in lead V_1 indicate prior septal myocardial infarction (MI), right ventricular strain pattern is present (S wave in lead I and isolated Q wave in lead III) suggesting possible pulmonary embolism (PE).

Rationale

There are 2 main differential diagnoses to consider for this patient. First, non-ST elevation acute coronary syndrome (NSTE-ACS) should be considered based on this patient’s symptoms, positive troponin, and initial ECG features. The ECG features that support this diagnosis include nonspecific ST, T-wave changes. Whereas this feature is not confirmatory, this feature along with positive troponins can occur in NSTE-ACS. Another ECG feature supporting NSTE-ACS are Q waves in lead V_1. Normally, there is an initial R wave in lead V_1; here, a QS pattern is present. This indicates prior septal wall MI. Pathologic Q waves of prior MI include; any Q wave in leads V_1-V_3; Q wave >20 ms in V_1; Q wave >30 ms leads V5-V6, I, II, aVF, aVL. Q waves typically develop hours to days after acute MI and remain thereafter. Isolated Q waves in lead III are not considered an indication of prior MI, unless there are Q waves in at least 1 of its contiguous leads (ie, II or aVF). In this example, there is a Q wave in lead aVF; but its duration does not exceed 30 ms; hence previous MI is not present. However, the Q wave in lead III, the S wave in lead I, tachycardia and nonspecific ST, T wave changes suggest PE, which is the second possible diagnosis to consider for this patient.

Management

Given this patient’s initial symptoms, the intermittent nature of symptoms over the past week, slightly elevated troponin, and observed ECG abnormalities, she should be admitted to rule out NSTE-ACS or PE. Guideline recommendations to rule out NSTE-ACS include; continuous cardiac monitoring, serial cardiac troponins at 3 and 6 hours after symptom onset. If this patient’s pain persists, serial 12-lead ECGs (eg, 15-30 minute intervals) for the first hour, and continuous ST segment monitoring when the initial ECG is nondiagnostic is recommended. Testing for PE includes laboratory testing (ie, D-dimer, troponin), and an imaging study (ie, computed tomography angiography, V/Q scan). Importantly, troponin can be positive in both of these conditions; hence, this patient should be monitored carefully with testing performed promptly so that the appropriate treatment can be initiated.
A Fatal Case of Eczema Herpeticum With Septic Shock Due to Methicillin-Resistant Staphylococcus aureus

By Christina L. Tupe, MD, Bethany A. Weiler, MD, Avelino C. Verceles, MD, and Michael T. McCurdy, MD

Abstract A 62-year-old woman treated with several courses of corticosteroids for an undifferentiated rash came to the emergency department with progressively worsening cutaneous signs and symptoms and generalized weakness. She had scabies, and despite treatment continued to decompensate. Repeat skin biopsies revealed disseminated herpes simplex virus infection, and results of blood cultures were consistent with infection by methicillin-resistant Staphylococcus aureus. Despite antiviral and antimicrobial therapy, sepsis and multiorgan failure developed, and the patient died. This case illustrates the complications of the rare entity eczema herpeticum, which occurs most often in immunocompromised patients and is associated with a high mortality. Maintaining a high index of suspicion for this disease in decompensating patients with an unidentified rash is essential to avoid catastrophic outcomes. (American Journal of Critical Care. 2016;25:379-382)

Any life-threatening diseases initially have seemingly innocuous dermatological findings, and subtle abnormalities may only be evident to an astute clinician considering a broad range of potential diagnoses. Although chronic skin conditions, such as atopic dermatitis, are common and are relatively benign, severe complications can occur. For example, eczema herpeticum is a cutaneous dissemination of herpes simplex virus (HSV) in patients with a chronic skin condition, most commonly atopic dermatitis. Because of the rare occurrence and difficult diagnosis, the true incidence and prevalence of eczema herpeticum are unknown, although the condition is thought to affect 3% to 6% of patients with atopic dermatitis. Even though eczema herpeticum is exceedingly rare, 6% to 10% of immunocompetent hosts and up to 50% of immunocompromised patients can die of the viremia, multiorgan involvement, and bacterial superinfection potentially associated with it.

In this case report, we discuss an immunocompromised patient with an undiagnosed skin rash complicated by disseminated scabies, HSV infection, and subsequent superinfection with methicillin-resistant Staphylococcus aureus (MRSA). This case
highlights an important condition to consider in both critical care and primary care assessment of a patient with an undiagnosed rash.

A 62-year-old woman with a history of mild mental retardation, diabetes, hypertension, and hypothyroidism who was living in a group home came to the emergency department with a rash and generalized weakness. She had intermittently experienced a pruritic, generalized rash for approximately 1 year before she came to the hospital. Her caregivers at the group home had taken her to the primary care doctor for the workup of this rash throughout the year. The results of an outpatient skin biopsy were consistent with a drug eruption, thus prompting her primary care physician to have her stop taking hydrochlorothiazide and sitagliptin. Despite this step, the rash did not resolve.

The patient had an empiric trial of prednisone, which resulted in temporary resolution of the rash. However, whenever prednisone was discontinued, the rash would promptly reappear. The patient received repeated short courses of steroids (<7 days each) throughout the year. Despite the prednisone therapy, during the week before she came to the hospital, the rash started to evolve into white scaly plaques, and she had difficulty sleeping because of the marked pruritus. In the days before she came to the emergency department, the rash spread to her face and was accompanied by scleral injection and ophthalmalgia, prompting her primary care doctor to refer her to the hospital. She was promptly transferred to a tertiary care center because of the possibility of Stevens-Johnson syndrome.

On initial examination, the patient had normal vital signs. She had a diffuse erythematous, excoriated rash covering approximately 80% of her skin (Figure 1). Areas of denuded skin were concentrated over the anterior part of her chest and were draining serous fluid. Neither the Nikolsky sign nor mucosal involvement was present. Bilaterally her eyes had injected sclerae, crusting, and occasional yellowish discharge.

Collateral information from her group home and information from hospital social workers who evaluated her home environment indicated that other residents had similar rashes. Because of this information and the findings of the physical examination, a skin biopsy was performed, and empiric treatment with ivermectin and permethrin was started for suspected scabies. The biopsy results later confirmed the diagnosis of scabies. Additionally, the ophthalmology team identified bilateral ocular deep epithelialization and corneal abrasions, so ophthalmic erythromycin ointment was added to her treatment.

On hospital day 6, the patient became increasingly somnolent, hypoglycemic, tachycardic, and tachypneic. Her health care providers suspected septic shock with multiorgan injury, and she was transferred to the intensive care unit for intubation for airway protection, treatment with vasopressors and steroids for fluid-unresponsive shock, and empiric treatment with vancomycin, cefepime, and fluconazole. Chest computed tomography at that time revealed increases in bilateral pleural effusions and multifocal consolidation. Laboratory data revealed hyperlactatemia, acute kidney injury, and thrombocytopenia; continuous renal replacement therapy was started.

Because of the evolving skin changes, another skin biopsy was performed, which revealed viral inclusions and multinucleated cells consistent with a viral cytopathic effect (Figure 2). Because immunostaining for HSV-1/2 was positive for the virus, acyclovir was started for treatment of disseminated HSV infection. Despite therapeutic levels of vancomycin, subsequent blood cultures were positive for methicillin-resistant Staphylococcus aureus.
MRSA, so clindamycin was added to the treatment regimen. Vancomycin eye drops were also added because an ocular culture was positive for MRSA.

The patient further decompensated despite maximum multiorgan support. After a meeting with her group home coordinators on hospital day 11 to discuss her poor prognosis, the patient’s care was redirected to comfort measures. She was pronounced dead later that day.

An autopsy revealed extensive skin ulceration from disseminated HSV, persistent scabies, and an abscess on the anterior part of the chest wall. She had large bilateral pleural effusions, scattered septic emboli in both the lungs and the heart, and a serous pericardial effusion. No evidence of an HSV-induced cytopathic effect was detected in the visceral organs. The final cause of death was multiorgan failure due to a MRSA superinfection.

Discussion

This novel case of *S. aureus* septic shock due to eczema herpeticum occurred secondary to scabies. The scabies triggered chronic atopic dermatitis, which, in combination with chronic doses of steroids, predisposed the patient to disseminated HSV infection, or eczema herpeticum. The resultant cutaneous lesions made her susceptible to secondary infection by skin pathogens, such as MRSA.

Scabies has diverse manifestations. It is classically described as a wavy line in the finger webs, wrists, elbows, axillae, buttocks, and genitalia. The lesions are often described as papules, nodules, and vesicles. Secondary manifestations include excoriations, eczematous eruptions, crusting, and infections. Care providers should maintain a particularly high index of suspicion in patients with a pruritic skin eruption that is worse at night and involves the trunk and extremities, although the eruption can have diverse signs and symptoms. Skin scrapings taken from acral areas, skin-colored ridges, vesicles, or nonexcoriated papules generally yield the greatest probability of visualizing the mite and therefore diagnosing scabies. A highly inflamed, excoriated area is unlikely to contain the mite that causes the scabies. Microscopic examination of skin scrapings can show no evidence of scabies because of a low mite burden or a sampling error. Treatment can be unsuccessful because of misdiagnosis, poor application of topical treatments, inadequate dosing, and drug resistance.3

Eczema herpeticum, also known as Kaposi varicelliform eruption, is a rare skin complication of atopic dermatitis that often results from taking immunosuppressive agents to treat the primary skin condition. Eczema herpeticum, which is typically a challenging diagnostic dilemma for nondermatologists, is characterized by cutaneous pain with new skin lesions. The rapid spread of these virally mediated lesions (usually from HSV-1) can rapidly lead to severe morbidity and mortality.

HSV is a ubiquitous human pathogen in adults; the primary infection most often occurs in childhood.4 Despite the prevalence of HSV infection and atopic dermatitis (approximately 17% of children worldwide), eczema herpeticum is surprisingly rare: it occurs in less than 3% of patients with atopic dermatitis. This low percentage is thought to be due to a complex interplay of environmental factors and host genetic characteristics, such as defects in the generation and expression of interferon-γ (IFN-γ), which result in uncontained viral reactivation.5

The pathogenesis of eczema herpeticum is linked to the balance of CD4+ regulatory T cells and CD8+ effector T cells. CD8+ T cells are cytotoxic and inhibit HSV through the production of several cytokines such as IFN-γ and other chemical mediators, but, if unregulated, these effector T cells may also indiscriminately damage healthy tissue. In a normal immune system, a proper balance of CD4+ cells can suppress an excessive immune response to HSV by mitigating the cytotoxic effects of CD8+ T cells.6

In our patient’s situation, the short courses of steroids may have initially suppressed CD4+ regulatory T cells. However, when the steroids were discontinued, the number and activity of CD4+ cells most likely increased, leading to excessively suppressed effector CD8+ T cells,
decreases in IFN-γ, and, ultimately, HSV reactivation. A similar phenomenon of HSV reactivation occurs in patients with genetic defects in synthesis and expression of IFN-α. The direct correlation between an increased presence of functional CD4+ regulatory T cells in lesion biopsies and the clinical disease activity of eczema herpeticum further support the pathogenic role of CD4+ cells in eczema herpeticum.7

Eczema herpeticum is mostly a clinical diagnosis. The infection is characterized by the acute appearance of vesicles mainly on the trunk and extremities, and particularly over eczematous skin. Increases in the titer of antibodies to HSV support the diagnosis of eczema herpeticum, and pathological evidence of viral inclusions and multinucleated cells on biopsy of the skin lesions, as well as immunostains for HSV-1/2, can confirm the diagnosis.7 Before the advent of antiviral therapies, mortality in patients with eczema herpeticum was 10% to 50%. Most deaths are due to viremia-induced multiorgan failure, including meningitis and encephalitis.8,9 The consequences of untreated disease highlight the importance of prompt initiation of systemic antiviral therapy for effective treatment.

The most commonly isolated organism from swabs of eczema herpeticum lesions is S aureus. In one study,9 this microorganism was found in the lesions of 8 of 24 patients (33%). However, the microbes isolated from the lesion are often nonpathogenic and rarely cause marked morbidity or mortality. Although secondary infections with skin pathogens, such as S aureus and Streptococcus pyogenes, can occur in eczema herpeticum, our case is the first reported case of death due to secondary MRSA infection and bacteremia. Physicians, nursing staff, and patient care providers should always consider eczema herpeticum in the differential diagnosis in any acutely decompensating patient with an unidentified rash, because the consequences of improper or delayed diagnosis can be devastating.

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FINANCIAL DISCLOSURES
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