Restraint Reduction Using a Decision Tool

Clinical Nurse Participation at Family Conferences

Family Navigator to Support Patients’ Surrogates

Identification of Posttraumatic Stress Symptoms

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Fatigue, Depression, and Hospitalization

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WE ARE A TEAM ... WITH ROOM FOR IMPROVEMENT

By Richard H. Savel, MD, and Cindy L. Munro, RN, PhD, ANP

In some of our previous editorials, we have emphasized the crucial nature of communication in the intensive care unit (ICU).1-3 We have pointed out the ways in which communication can become a highly complex and somewhat convoluted matrix in the ICU environment. Effective communication is required between nurses and patients, nurses and families, clinicians and patients, and clinicians and families, as well as between clinicians and nurses and clinicians and each other.

Several scholars have attempted to analyze some of these complex communication pathways and to define the very nature of the term ICU team in a more formal way. In one article from the University of Toronto, Alexanian et al4 sought to determine whether what we practice in the ICU qualifies as “teamwork.” In another article from the same university, Haas et al5 performed an analysis on communication between surgeons and intensivists. Is it possible that multidisciplinary, multiprofessional ICU health care workers really do not constitute a team? We hope to convince you that they do.

Defining a Team

In the study by Alexanian,4 a group of medical anthropologists carefully analyzed and interviewed ICU health care workers at multiple hospitals within a system. They concluded that, although they were able to describe the interactions as “multiprofessional,” they could not categorize the members of the ICU as a “team” per se. These authors referred to the work of Reeves et al4,6 who defined a team by using incorporated elements discussed in health care literature as “a cohesive group with shared team identity, clarity, interdependence, integration, and shared responsibility.”

Alexanian et al4 stated that the work they analyzed could best be described as “collaboration, coordination, and networking.” They concluded that health care providers in the ICU were professionals who happened to share the same workspace, but were not a team. This is where we, the coeditors, both of whom are experienced ICU practitioners, take issue with some of the authors’ points. Much of what we do all day (and night) in the ICU involves collaboration, coordination, and networking (communication)—a belief we assert with pride—but our work together goes far beyond those things, and absolutely can be defined as teamwork.

Like other leaders in critical care,7 we feel strongly that the clinical members of any ICU are, in fact, a team. We think the reason these investigators were unable to describe the work as “teamwork” is that they had not expanded their definition of team broadly enough. Of course, if one compares provision of care in the ICU to a relatively simple concept.
In any ICU, there is the most important team: the team of bedside nurses.

of a team—such as, for example, the members of a sports team—the ICU may not look much like a team. But the truth is that an ICU team is much more, not much less, than a sports team. It is a team of teams. And to add further complexity, the types of teams that come together to make up an ICU’s overall care team may differ from one another.

In any ICU, there is the most important team: the team of bedside nurses. But not all staff nurses for an ICU will be there every day. There are also teams of physicians, usually intensivists, who help to provide medical leadership for the ICU. Although the physician team typically consists of attending intensivists, at teaching hospitals the teams can include fellows (i.e., those who have completed residency training in a specialty such as internal medicine, surgery, anesthesiology, or emergency medicine) who are in the process of becoming intensivists, as well as resident physicians in their initial phase of training following medical school. Other team members include advanced practice providers, respiratory therapists, clinical pharmacists, registered dietitians, physical and occupational therapists, social workers, case managers, patient care technicians, and information specialists. To call this group of health care professionals anything but a team is confusing and borderline illogical.

To assert that we are not in fact a team is to trivialize what we do. Anyone who has worked in a highly functional ICU knows what a good team feels like. Such ICUs include extraordinary nurse leaders who work with talented bedside nurses in a united effort to provide high-quality, cutting-edge, evidence-based care to patients. In these kinds of units—better yet, let’s just call them teams—a high degree of organization and implementation of protocols exist to empower the bedside nursing teams to make important decisions within the confines of an agreed upon set of guidelines. Rest assured that great effort will have been exerted behind the scenes to create a rational, reasonable approach to important and complex disease entities such as severe sepsis syndrome, respiratory failure, and hyperglycemia. It probably goes without saying that getting buy-in before implementation of such protocols from representatives of each part of the ICU team is crucial for successful implementation.

So rather than suggesting that the work we do in the ICU somehow is not teamwork, perhaps we should reframe the issue. In our view, the fundamental question is not whether the ICU team exists, but whether it’s functioning well. How can the quality of the team be improved, for example? In our view there are 3 obvious areas for improvement: hierarchy, input to decision-making, and communication.

Unfortunately, as the authors point out, the classic hierarchy of medicine to some degree translates even to the ICU team. It’s true that the ICU team often consists of doctors and nurses working closely with each other, with doctors ultimately being responsible (even if purely from a legal standpoint) for the overall medical care plan for each patient. But just because a physician and a nurse are working together in the ICU does not necessarily negate the idea that those 2 people, or other groups of people, constitute a team.

In cases where nurses feel they lack the right kind of input into the patient's care plan, such a circumstance should be rectified swiftly. More meetings and formal feedback ought to occur at the level of local nursing leadership, and that feedback ought to be shared with nursing administration and physician leadership so they will take a hard look at what is actually happening at the bedside and make necessary improvements. The job of the bedside nurse is far too important to permit anything less.

Communication Between Intensivists and Surgeons

The team situation in surgical ICUs is different. In surgical ICUs, the role of the intensivist contrasts a bit with that of a purely medical ICU in which the medical intensivist often makes all medical decisions. For surgical patients, the role of the attending surgeon and attending intensivist is a complex and occasionally contentious one. The study by Haas et al describes a formal analysis of "good" and "bad" communication between the surgeon and the intensivist. A team can easily break down if roles and lines of communication are not well orchestrated.

About the Authors

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What we found appealing about the study by Haas and colleagues5 was that it accurately reflected our clinical experience, both good and bad. The authors emphasized that the attending surgeon has a special role to play with the patient, and that both intensivists and surgeons in some cases feel their expertise is not being respected or their voices are not being heard. Inflexibility on the part of the intensivist can lead to confusion and conflict.

One example of poor communication between intensivists and surgeons involved performance of procedures (such as dialysis) on surgical patients in the ICU without approval of the attending surgeon. Another crucial example was lack of involvement with the surgeon on end-of-life issues. Unilateral actions by intensivists can lead to poor relationships with surgeons, which in turn can result in suboptimal care for patients and poor overall unit function. By contrast, “good” communication is what one reasonably expects; that is, there should be frequent contact between intensivist and surgeon, with each sharing his or her perspective on the situation so a consensus plan can be built.

Conclusion

For decades now, the editorial leadership of this journal has consisted of critical care practitioners with backgrounds in nursing and medicine who have collaborated closely and proudly as a TEAM! Given such a legacy, we find it distressing that some recent contributions to the medical literature assert that members of our multiprofessional ICU workforce do not qualify as teams.

Our response is to stand up to this. Consider this a clarion call to our readers to stand up for our patients, our teams, and ourselves. If we feel that our voices are not heard, our input is not valued, or our communication is not of the highest caliber, it is our duty to make a change. For the good of our patients, we must reconcile the fact that even though various members of the multiprofessional team have different roles, we are very much a team working together with one common, unwavering goal: to deliver the best care possible.

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

Cl

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.

Posttraumatic Stress Symptoms in Patients After Intensive Care

Critically ill patients are at risk for posttraumatic stress syndrome (PTSS) after hospitalization. This can lead to development of posttraumatic stress disorder (PTSD) and other long-term medical and psychiatric disorders. Warlan and colleagues examined the use of a posttraumatic stress instrument to screen for high PTSS and identify factors related to higher levels. They found the following:

- Patients found the tool easy to use and understand.
- Of the study group, 17% had high scores for PTSS.
- High PTSS scores were associated with a history of depression, receiving moderate levels of sedation, and experiencing delirium while being treated in the intensive care unit (ICU).

None of the patients had received any formal education about the risk of ICU-related PTSD. Although further study is needed, the authors recommend identifying PTSS to provide early intervention services and possibly improve patient outcomes.

See Article, pp 509-515

Nurses and PICU Family Conferences

Family conferences in the pediatric intensive care unit (PICU) are used for a variety of reasons, which include providing updates, discussing prognosis, and determining treatment preferences. Multidisciplinary participation is promoted, but most family conferences are physician dominated with a transfer-of-knowledge focus. Watson and colleagues examined nurse participation and perceptions during PICU family conferences and found the following:

- Nurses attended only 50% of the conferences. The main attendance barriers were excessive workloads and inadequate staff coverage.
- Of the nurses who attended, 53% reported making a verbal contribution, generally to clarify patient information. Most of those who did not speak felt no desire to do so.
- All but one nurse stated bedside nurse participation was important.

Nurses spend more time with children and families than other clinicians and often have the most current knowledge on patient status and family preferences. Limiting barriers and including clinical nurses in conferences can improve provider-family communication.

See Article, pp 489-497

Delirium Rates After ABCDE Bundle Intervention

Delirium affects many adult ICU patients and places them at risk for negative outcomes such as prolonged mechanical ventilation, increased hospital stays, and increased mortality. An intervention called the ABCDE bundle (Awakening and Breathing Coordination, Delirium prevention and management, and Early physical mobility) has been used for the prevention and management of delirium. Bounds and colleagues studied the effectiveness of the ABCDE bundle with ICU patients in a rural hospital system and found the following results after ABCDE implementation:

- A significant decrease in overall delirium prevalence
- A significant decrease in delirium prevalence and duration, and significant increase in delirium-free days for patients using mechanical ventilation.
- A significant increase in number of patients assisted to sitting position, in bed or at edge of bed

The overall findings of this study were consistent with other research showing that the multidisciplinary ABCDE bundle is an effective intervention for reducing delirium in adult ICU patients.

See Article, pp 535-544

Restraint Reduction With a Decision Support Tool

Restrains are commonly used in ICUs to prevent removal of medical devices. However, restraints can contribute to adverse patient outcomes and do not always prevent accidental extubation and/or removal of invasive lines. Hevener and colleagues studied the effects of an online educational program instructing use of a decision support tool on restraint use with 32 bedside MSICU nurses. They found the following:

- A 32% reduction of postintervention restraint use
- A 26% decrease of accidental device removal in restrained patients
- Whereas 84% of the nurses stated the decision tool should be used and 62% found it useful, only 29% actually used it.

One-on-one education increased staff awareness of resources on alternate methods of safety management, including the use of mitts. The authors recommend comprehensive staff education on ICU restraint use to assure patient safety while still meeting the national accrediting standards of the Joint Commission.

See Article, pp 479-485

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Improving In-Hospital Cardiac Arrest Response

As a doctorally prepared, sole-provider nurse anesthetist in a rural critical access hospital, I provide continuing education for both physicians and nurses in our facility. As such, I read with great interest your recent article on improving in-hospital cardiac arrest response,1 and was taken by your statement:

Gilligan et al2 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.

Such a finding goes a long way to support my belief that nurses trained in advanced cardiac life support in intensive care units and emergency departments are well qualified to lead a code team. I then read Gilligan et al’s article myself. They reported that nurses did, in fact, score higher on knowledge of the HSs and Ts, but the differences in overall performance scores among the 3 groups were not statistically significant. Moreover, nurses were the slowest—not fastest—at initial defibrillation, though this, too, was not statistically significant.

I applaud your introduction of a leadership dyad, and will introduce this concept for discussion at our facility.

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FINANCIAL DISCLOSURES
None reported.

REFERENCES

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“Getting Used to It” Perpetuates a Clinical Hierarchy

The editorial “Getting Used to It,” left a sour taste in my mouth. There is an attitude that permeates critical care that says “we” are experts and “we” may be excused for any lack of emotional intelligence or sensitivity to others because of our role in critical care. Having emotional intelligence does not allow us to put the onus for understanding on others, it helps us recognize that misunderstandings and misperceptions are truly the way others perceived what we have communicated, regardless of our intent.

A composed, caring professional is expected to communicate empathy for others. He or she does not model professionalism by denying another’s expertise, albeit expertise in another area or specialty. Nor does a composed, caring professional retreat to his or her camp of like-minded colleagues with the attitude that the family members or other clinicians we encounter are simply stressed and therefore cannot contribute to the care of the patient, or worse, make it difficult for us to care for them.

I believe a composed, caring professional, does show emotion when it is appropriate. He or she also partners with the people who are the experts in a patient’s individuality (eg, a family member or a physician who has known the patient for some time) to create a team approach to caring for the patient. This professional encourages his or her peers when doing these things, recognizing that this is the hard work of critical care and it is not natural or easy, but it does make the difference.

I am not naive to the burdens placed on critical care professionals when families are constantly at the
bedside, or when the team providing care consists of many specialists with seemingly different priorities. I agree with the recommended strategies the authors propose to address these difficulties. However, I cannot agree with promoting the attitude that critical care professionals are somehow in a hierarchy above our peers in other specialties.

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None reported.

REFERENCES
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“Getting Used to It,” Helps Prevent Burnout and Distress
In this thought-provoking editorial, Drs Savel and Munro precisely expressed the essence of being a successful critical care nurse. I have witnessed and have personally experienced the results of “a lack of balance.” When we allow ourselves to be injured by the perception of others’ thinking that we don’t care, we fall victim to emotional distress and burnout. When we learn to accept the patient and family in their vulnerable state as not responsible for their reactions toward us, we are able to facilitate a healing milieu. Only with experience, personal self-control, and reflection can we achieve this desired balance.

As the authors point out, it is through self-reflection, personal recognition, and self-control that we find compassion and equilibrium. This equilibrium sustains our spirits where others become spent and unable to effectively provide professional critical care. I agree with their spot-on point, “that no matter what comes our way, we can handle it, we will handle it, and we will do so with composed, caring professionalism.”

If we succeed in this point, we will remain patient and family-centered. If we fail, then we join the many who have fallen to burn-out and are unable to effect healing.

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FINANCIAL DISCLOSURES
None reported.

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doi: http://dx.doi.org/10.4037/ajcc2016387

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Background
In critically ill patients, prevention of pressure ulcers is a challenge because of the high risk for multiple comorbid conditions, immobility, hemodynamic instability, and increased use of medical devices.

Objectives
To compare the difference in incidence rates of hospital-acquired pressure ulcers (HAPUs) in critically ill patients between those treated with usual preventive care and a 5-layered soft silicone foam dressing versus a control group receiving usual care. Secondary goals were to examine risk factors for HAPUs in critically ill patients and to explicate cost savings related to prevention of pressure ulcers.

Methods
A prospective, randomized controlled trial in the intensive care units at a 569-bed, level II trauma hospital. All 366 participants received standard pressure ulcer prevention; 184 were randomized to have a 5-layered soft silicone foam dressing applied to the sacrum (intervention group) and 182 to receive usual care (control group).

Results
The incidence rate of HAPUs was significantly less in patients treated with the foam dressing than in the control group (0.7% vs 5.9%, \( P = .01 \)). Time to injury survival analysis (Cox proportional hazard models) revealed the intervention group had 88% reduced risk of HAPU development (hazard ratio, 0.12 [95% CI, 0.02-0.98], \( P = .048 \)).

Conclusion
Use of a soft silicone foam dressing combined with preventive care yielded a statistically and clinically significant benefit in reducing the incidence rate and severity of HAPUs in intensive care patients. This novel, cost-effective method can reduce HAPU incidence in critically ill patients. (American Journal of Critical Care. 2016;25:e108-e119)

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Using a Decision Wheel to Reduce Use of Restraints in a Medical-Surgical Intensive Care Unit

By Stacy Hevener, RN, MSN, CCRN, Barbara Rickabaugh, RN, MSN, NE-BC, and Toby Marsh, RN, MSA, MSN, NEA-BC

Background  Little information is available on the use of tools in intensive care units to help nurses determine when to restrain a patient. Patients in medical-surgical intensive care units are often restrained for their safety to prevent them from removing therapeutic devices. Research indicates that restraints do not necessarily prevent injuries or removal of devices by patients.

Objectives  To decrease use of restraints in a medical-surgical intensive care unit and to determine if a decision support tool is useful in helping bedside nurses determine whether or not to restrain a patient.

Methods  A quasi-experimental study design was used for this pilot study. Data were collected for each patient each shift indicating if therapeutic devices were removed and if restraints were used. An online educational activity supplemented by 1-on-1 discussion about proper use of restraints, alternatives, and use of a restraint decision tool was provided. Frequency of restraint use was determined. Descriptive statistics and thematic analysis were used to examine nurses’ perceptions of the decision support tool.

Results  Use of restraints was reduced 32%. No unplanned extubations or disruption of life-threatening therapeutic devices by unrestrained patients occurred.

Conclusions  With implementation of the decision support tool, nurses decreased their use of restraints yet maintained patients’ safety. A decision support tool may help nurses who are undecided or who need reassurance on their decision to restrain or not restrain a patient. (American Journal of Critical Care. 2016;25:479-486)
Because physical restraints can cause accidental injury or death, hospitals need to limit use of restraints to clinically appropriate and adequately justified situations.\textsuperscript{1} Reduction in the use of restraints in the intensive care unit (ICU) is vital to protect patients’ rights and reduces the risk of patient harm due to restraints.\textsuperscript{2} In addition, restraints do not always prevent removal of invasive catheters.\textsuperscript{3}

Restraints are commonly used in ICUs. Mion\textsuperscript{4} found that ICUs accounted for 56% of all restraint days despite having only 16% of all patient days. In ICUs, the primary reason for the use of restraints is to prevent removal of therapeutic devices. However, recent research\textsuperscript{5} indicates that self-extubations or unplanned extubations are occurring despite the presence of restraints. In multiple studies,\textsuperscript{6-7} the results indicated that 82% to 86% of patients were physically restrained at the time of unplanned extubations. The most common adverse effects of restraint use include strangulation of the patient, agitation, complications from immobilization, increases in nosocomial infections and pressure sores, incontinence, and increases in length of stay and mortality.\textsuperscript{8,9} Risks associated with unplanned extubations include bronchospasms, arrhythmias, aspiration, pneumonia, respiratory failure and cardiopulmonary arrest resulting in prolonged mechanical ventilation, longer ICU and hospital stays, and an increased need for long-term care for patients who do not tolerate an unplanned extubation.\textsuperscript{5}

Little information is available on the use of tools in ICUs to help nurses determine when to use restraints. Hurlock-Chorostecki and Kielb\textsuperscript{10} reported that a simplified clinical decision support tool helped critical care nurses make decisions about the use of restraints. However, Vance\textsuperscript{11} found that nurses will use a clinical decision support tool but will forgo the recommendation of the tool to prevent disruption of treatment devices. Researchers\textsuperscript{12,13} have described the effectiveness of tools that help nurses predict agitation or measure aggression. However, Khan et al\textsuperscript{14} implemented and evaluated computer-based alerts to determine if physicians would change prescribing patterns for restraints and found that the physicians did not.

In 2009, the Joint Commission adopted requirements based on the Centers for Medicare and Medicaid Services’ mandates for use of restraints. This adoption was the impetus to evaluate existing restraint policies and related practices, make appropriate changes as needed, and look for innovative ways to reduce restraint use. A major challenge for critical care nurses is trying to prevent patients from removing therapeutic devices such as central catheters, feeding tubes, and endotracheal tubes while maintaining compliance with federal regulations.\textsuperscript{3}

After reviewing the literature and considering the need to meet federal regulations, we decided to do a pilot test with the Restraint Decision Wheel (RDW) as a tool to help nurses make decisions about use of restraints as reported by Hurlock-Chorostecki and Kielb.\textsuperscript{10} After 1 year of use of the RDW by nurses, the decrease in restraint use was significant, specifically in preventing patients’ removal of intravenous and therapeutic devices.\textsuperscript{10}

**Methods**

We used a quasi-experimental design to determine if use of restraints in the medical-surgical ICU could be reduced without harm to patients and if a decision support tool was useful in helping bedside nurses determine whether or not to restrain a patient.

**Sample and Setting**

Only bedside nurses regularly assigned to the medical-surgical ICU were asked to participate in the study. After obtaining approval from the appropriate institutional review board, one of us (S.H.) who was not in a position of authority over the nurses on the unit obtained consent from each bedside nurse. Of the 32 bedside nurses on the unit, 100% voluntarily enrolled in this study.

The study was done at the University of California Davis Medical Center, an academic institution located in Sacramento, California. The medical...
center is the only level I trauma center in the northern California region; it is situated 80 miles inland from the San Francisco Bay area. The medical center is licensed for 645 beds and serves as a tertiary referral center for a 65,000-square-mile area and maintains a staff of specialists and researchers in more than 150 areas of health care. The Sacramento area is home to 6 million residents, many with diverse family origins, from approximately 33 countries.

This study took place in a critical care unit designed for adults that also serves as an overflow ICU for the pediatric ICU. The medical-surgical ICU contains 8 private patient rooms and serves a diverse population of patients with various diagnoses, ages, economic and social statuses, and ethnic or cultural backgrounds.

**Data Collection**

The study was conducted from September 15, 2012, to January 15, 2013. Participants completed a demographics questionnaire and, at the end of the study, were asked to complete a poststudy survey.

Using an investigator (S.H.)-developed check sheet titled Device Dislodgment Reporting Form, each participant per shift per patient indicated when a therapeutic device was dislodged, if the device was reinserted, and whether or not the patient was in restraints at the time. For this study, a therapeutic device was defined as a device used to monitor or treat dysfunction, disease, or injury (Table 1). The form was located at each workstation and included the date, time, a checkoff list of therapeutic devices, and an indication if the device was reinserted. The completed form was placed in a designated locked box on the unit after each shift. The first month provided baseline data that were used as the control.

The Performance Improvement Department supplied data on the overall restraint incidence in the ICU, with quarterly and monthly aggregate data for the day shift and for the night shift. These data indicated the frequency and trends of restraint use by nurses during the time of the study as indicated in each patient’s electronic medical record. Restraint incidence was defined as the number of patients restrained within a 12-hour shift and was located by a query of the nursing documentation in the electronic medical record for restraint use by documenting “restraint initiated” or “restraint continued” during the 12-hour shift.

Additionally, during month 1, each participant received instruction on use of the RDW and levels (see Figure) via an online learning module developed in collaboration with the Center for Professional Practice of Nursing educators and through 1-on-1 discussions with the principal investigator (S.H.). The module and discussions focused on use of the RDW, documentation of restraint use, patients’ rights, and the medical center’s current policy on appropriate use of restraints and alternative methods or interventions to minimize restraint use.

Each participant was asked to remain in compliance with the existing restraint policies of the hospital and the Centers for Medicare and Medicaid Services, which state that the use of restraints should be based on assessment of the patient to determine need. Physical restraints were defined as any manual method or physical or mechanical device, material, or equipment that immobilizes or reduces the ability of a patient to move his or her arms, legs, head, or body freely. In addition, the least restrictive method of restraint is to be used after alternative methods are attempted. For this study, if a nurse was to continue or initiate use of restraints, he or she was asked to use the RDW to assist...
Behavior level
Level I
• Pathophysiological or therapeutic unconsciousness
• Pathophysiological or therapeutic paralysis
• Alert and oriented x 3
• Constant observation by staff or significant other
Level II
• Confused
• Disoriented
• Simple agitation
Level III
Agitation
Combativeness

Device level
Level I Non-life-threatening
• Peripheral intravenous catheters
• Nasogastric tube
• Urinary drainage catheter
• Monitoring leads
• Oxygen mask/nasal cannula
• Simple drains
• Simple dressings
• Pulse oximeter
• Blood pressure cuff
• Rectal bag/tube
• Peg drain
• Arterial catheter
Level II Life-threatening
• Intracranial pressure monitor or ventriculostomy drain
• Pulmonary artery catheter
• Central catheter
• Intra-aortic balloon pump
• Mechanical ventilation
• Chest tube
• Temporary pacemaker
• Sengstaken-Blakemore tube
• Suprapubic catheter
• Intravenous hemodynamic stabilizing/treatment infusions

Independence level
Level I Independent
• Can sit in chair
• Can bear weight
• Can walk steadily
Level II Semi-dependent
• Slides when in chair
• Can bear weight
• Unsteady gait or unfamiliar with assistive device
• Bradycardic
• Lightheadedness/dizziness
Level III Dependent
• Unable to bear weight
• Unstable fracture
• Neuromuscular weakness
• Unstable vital signs

**Figure** Restraint Decision Wheel and levels.

Provided by Christina Hurlock-Chorostecki and the Canadian Association for Critical Care Nurses and used with permission.
Participants indicated if restraints were used and whether or not the Restraint Decision Wheel was used.
Among the participants, 81% strongly agreed that the RDW was used 28.6% of the time in deciding whether or not to use restraints or an alternative method. Our results support the findings of Hurlock-Chorostecki and Kielb10 on restraint reduction and the need for education in the management of therapeutic devices. We cannot say that the RDW helped in reducing the use of restraints, because 62% slightly agreed that the RDW was useful in making decisions about use of restraints (Table 3, question 8). However, only 62% slightly agreed that the RDW was useful in making decisions about use of restraints (Table 3, question 9).

Regarding the need for restraints (Table 3, questions 1-6), the most significant response was to question 2: a total of 85% of participants strongly agreed that the primary rationale for the use of restraints is to keep patients from pulling out endotracheal tubes. The majority of the participants (77% strongly agree) felt comfortable removing restraints from their patients without a physician order.

In response to the question, Do you think bedside nurses should use the Restraint Decision Wheel in the medical-surgical ICU on a regular basis in the future? (Yes or No and please explain), 84% responded yes. Many explained that an additional resource for making decisions is always beneficial but that they ultimately want to rely on their own clinical judgment when deciding whether or not to restrain a patient.

### Thematic Analysis

Thematic analysis was performed by coding and sorting verbatim qualitative data into like or similar terms and applying a description theme to those terms to determine the frequency of appearance of a theme or a type of data. Table 4 has statements from the participants to the open-ended question asking for comment on how they felt about the usefulness of the RDW in deciding when or when not to restrain a patient. These statements illustrate the overall general theme that the participants’ perceptions of the tool’s usefulness were related to their confidence in their expertise in clinical assessment.

### Discussion

The significant reduction in the use of restraints did not result in an increase in unplanned removal of therapeutic devices or harm to the patients. Perhaps the use of mitts resulted in fewer restraints being used, and also prevented unplanned removal of therapeutic devices. We cannot say that the RDW helped in reducing the use of restraints, because 62% of the participants were not in agreement that the RDW was useful in assisting in making decisions about restraint use and the tool was used only 29% of the time in deciding whether or not to use restraints or alternative methods.

Our results support the findings of Hurlock-Chorostecki and Kielb10 on restraint reduction and the need for education in the management of restraints. During the 1-on-1 education, we discovered

---

**Table 2**

<table>
<thead>
<tr>
<th>Variable</th>
<th>2Q11</th>
<th>3Q11</th>
<th>4Q11</th>
<th>1Q12</th>
<th>2Q12</th>
<th>3Q12</th>
<th>4Q12</th>
<th>1Q13</th>
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</thead>
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<tr>
<td>Use of restraints</td>
<td>Night</td>
<td>261</td>
<td>267</td>
<td>290</td>
<td>233</td>
<td>223</td>
<td>120</td>
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<td></td>
<td>Day</td>
<td>288</td>
<td>281</td>
<td>306</td>
<td>252</td>
<td>216</td>
<td>119</td>
<td>146</td>
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<td>Total</td>
<td>549</td>
<td>548</td>
<td>596</td>
<td>485</td>
<td>439</td>
<td>239</td>
<td>294</td>
<td>194</td>
<td></td>
</tr>
<tr>
<td>Patient census</td>
<td>673</td>
<td>707</td>
<td>721</td>
<td>714</td>
<td>710</td>
<td>683</td>
<td>680</td>
<td>713</td>
<td></td>
</tr>
<tr>
<td>Restraint rate (%)</td>
<td>81.6</td>
<td>77.5</td>
<td>82.7</td>
<td>67.9</td>
<td>61.8</td>
<td>35.0</td>
<td>43.2</td>
<td>27.2</td>
<td></td>
</tr>
</tbody>
</table>

* The study began during third quarter of 2012 (3Q12) and ended during first quarter of 2013 (1Q13).
* Rate of restraint use is calculated from total number of restraints in a 24-hour period (day plus night shift) and patient census.

**Table 3**

<table>
<thead>
<tr>
<th>Question</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I use restraints to keep my patient from falling.</td>
<td>2.83</td>
<td>1.01</td>
</tr>
<tr>
<td>2. I use restraints to keep my patient from pulling out endotracheal tubes.</td>
<td>3.88</td>
<td>0.33</td>
</tr>
<tr>
<td>3. I use restraints when observation is difficult.</td>
<td>2.88</td>
<td>0.88</td>
</tr>
<tr>
<td>4. I use restraints to protect the staff from physical combativeness.</td>
<td>3.54</td>
<td>0.90</td>
</tr>
<tr>
<td>5. I attempt alternative measures before using restraints.</td>
<td>3.62</td>
<td>0.80</td>
</tr>
<tr>
<td>6. I feel comfortable removing restraints from my patient without a physician’s order.</td>
<td>3.69</td>
<td>0.70</td>
</tr>
<tr>
<td>7. I find the Decision Wheel easy to use.</td>
<td>3.23</td>
<td>0.76</td>
</tr>
<tr>
<td>8. The Decision Wheel is readily accessible when needed.</td>
<td>3.73</td>
<td>0.67</td>
</tr>
<tr>
<td>9. The Decision Wheel is effective in assisting me in making decisions regarding restraint use.</td>
<td>2.96</td>
<td>0.72</td>
</tr>
<tr>
<td>10. The Bedside Binder is a convenient location for the Decision Wheel.</td>
<td>3.31</td>
<td>0.79</td>
</tr>
<tr>
<td>11. I document the rationale for restraint use for my patient.</td>
<td>3.77</td>
<td>0.51</td>
</tr>
<tr>
<td>12. I document alternatives used before restraining my patient.</td>
<td>3.50</td>
<td>0.65</td>
</tr>
<tr>
<td>13. I document the patient’s condition or symptoms that warranted the use of restraints.</td>
<td>3.69</td>
<td>0.47</td>
</tr>
<tr>
<td>14. I assess my restrained patient for trial of removal of restraints during my shift.</td>
<td>3.27</td>
<td>0.67</td>
</tr>
</tbody>
</table>

* For questions 1-10, the mean is calculated from a Likert scale with 1 = strongly disagree, 2 = slightly disagree, 3 = slightly agree, 4 = strongly agree. For questions 11-14, the mean is calculated from a Likert scale with 1 = never, 2 = some of the time, 3 = most of the time, 4 = always.
that our participants were not aware of all the resources available as alternatives to physical restraints. Mitts were used more often after the education. Unfortunately, promoting the use of mitts was not the original intent of this study, and therefore a method for tracking mitt use was not identified until the study was under way. Future studies are needed to evaluate if mitts are an appropriate alternative to restraints for prevention of unplanned removal of therapeutic devices and for overall patient safety in the ICU.

In our study, some participants found the RDW helpful and others did not. The participants in the study used the RDW in ambiguous clinical situations but preferred to rely on their own clinical judgment in nonambiguous situations. This finding might have occurred because all nurses on staff in the hospital are registered nurses who are accustomed to a substantial amount of autonomy in their practice.

Our study had some limitations. The nurses’ lack of knowledge of mitts as an alternative to physical restraints and the inability to document mitts as such in a discrete field in the electronic medical record were a major unforeseen discovery. Even though the use of mitts increased after the participants’ education, no process was in place for collecting that information until the study was almost complete.

We also relied on participants’ self-reported data or clinical documentation of removal of a device by a patient and for incidence of restraint use or removal. Because the self-reported forms for device removal were anonymous, we do not know if all participants submitted these forms. Device removal was counted only once per shift, even if a patient removed the same device numerous times during a shift. Future studies might determine if multiple device dislodgments occurred in a given shift with a given patient.

In addition, our sample size consisted of only a few nurses, and the study was conducted in a single ICU in a single academic medical center. Also, having the principal investigator work on the unit and provide daily surveillance and discussions could be a limitation. The presence of the investigator may have affected practices and participation in the study. Also, we did not address other factors that promote or inhibit device removal, such as activity level, level of sedation, or ICU delirium. Larger studies in other settings are needed.

Our findings support the need for education on restraint use.
Conclusion

Deciding when to restrain a patient in the ICU requires that a nurse take many factors into consideration. Traditionally, restraints have been used in the ICU to prevent patients from injuring themselves by removing therapeutic devices. In order to change this culture, nurses must receive comprehensive education on patients’ rights, the indications for restraints, appropriate alternatives to restraints, documentation, and a tool that might help in making decisions about the use of restraints.

Our study is an important step to improve the appropriateness of restraint use in an ICU. This study is one of the first conducted to evaluate the usefulness of the RDW in an ICU in the United States. Providing ICU nurses with the tool alone is not enough to create change. The key factor in creating change in reducing restraint use in our ICU was use of mitts as an alternative. More research is needed to evaluate clinical decision support tools to improve the appropriate use of restraints in ICUs.

ACKNOWLEDGMENTS

This study was performed at University of California, Davis Medical Center. We thank Christina Hurlock-Chorostecki, RN, BScN, MScN, ACNP, CNCC(C), nurse practitioner, and the Canadian Association for Critical Care Nurses for their permission to use the ICU Restraint Decision Wheel. Also, we thank Margi Crandall, RN, PhD, for her assistance in the thematic analysis of the data.

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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) 362-2049; e-mail, reprints@aacn.org.
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 integrating 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 479-486, consider the questions and discussion points outlined in the “Discussion Points” box.

Across hospital settings, the application of restraints is commonly intended to enhance a patient’s safety and prevent accidental injury. Despite the use of restraints to promote patient safety, they may predispose patients to significant reductions in their health status and expose restrained patients to potentially life-threatening adverse events. In multiple studies, researchers have shown that restrained patients being treated with mechanical ventilation are not any safer than those who are unrestrained.

Most critically ill patients who experienced an unplanned extubation were physically restrained at the time of the event. Moreover, the application of restraints can contribute to heightened states of agitation, complications from immobilization, strangulation, and increases in a patient’s length of stay. This evidence undermines the benefit of restraint use. Yet, acute and critical care nurses routinely apply restraints without evidence-based resources to inform their clinical decision making about the appropriateness of restraining a patient.

The authors of this study aimed to address a significant gap in clinical practice knowledge by evaluating the effects of a decision support tool to help guide critical care nurses’ regarding the application of restraints. The authors conducted a quasi-experimental study to describe the effects of a decision support tool on restraint use in the medical-surgical intensive care unit (MSICU) at the University of California Davis Medical Center. The authors recruited 35 critical care nurses from the MSICU and provided online and face-to-face educational sessions on the institutional policies about restraint use and a decision support tool, the Restraint Decision Wheel. Data were collected on patients (eg, occurrence of unplanned removal or dislodgement of devices and incidence of restraint use) and from critical care nurses (eg, perceptions of the usefulness of the Restraint Decision Wheel) for 4 months.

The authors established that implementation of education combined with the Restraint Decision Wheel helped the clinical decision making of critical care nurses regarding the appropriate use of restraints.

Investigator Spotlight

Stacy Hevener, MSN, RN, CCRN is a nurse manager for Patient Care Services Quality and Safety at the University of California Davis Medical Center in Sacramento, California. When this study was done, she was a critical care nurse in the medical-surgical intensive care unit.

Hevener describes several important lessons learned while conducting this study. First, she found that in order to ensure that the critical care nurses understood how to use the decision support tool, 1-on-1 education was effective but time intensive. Secondly, Hevener learned that the critical care nurses who participated in the study needed more education on restraint alternatives, such as hand mitts. Lastly, she says, “Choosing the right patient care unit was important and it was important to have critical care nurses willing to challenge current practice and implement a new tool.”

Before doing this study, Hevener was a critical care nurse with little experience in quality improvement. She reflects, “Undergoing the process of creating this study and conducting it, and then implementing a new policy based on the study results has provided me with a first-hand account of how quality improvement can impact patient outcomes.”

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After implementation of the decision support tool, the authors report a 32% reduction in the use of restraints and no adverse events, such as removal or dislodgement of central lines, endotracheal, gastrointestinal, thoracostomy, or ventriculostomy tubes.

Most nurses (84%) in the sample found the Restraint Decision Wheel to be useful and recommended that it be used regularly to inform their clinical judgment about the use of restraints for a critically ill patient. Thus, authors conclude that that restraint education coupled with the Restraint Decision Wheel is a usefulness strategy for that can improve the appropriate use of restraints among critically ill patients.

Information From the Authors
Stacy Hevener, MSN, RN, CCRN, lead author on this EBR article provides additional information about the study. Motivated by the support of her manager and the pressing need to reduce restraint use at her institution, Hevener and her coauthors sought to provide critical care nurses with a resource that would inform their clinical judgments on the use of restraints among the critically ill.

“As an institution, our restraint use was higher than the national average and our nurses were challenged with meeting regulatory compliance standards while balancing the need to keep their patients safe,” says Hevener. She adds, “When my nurse manager approached me with an article written by Hurlock-Chorostecki and Kielb4 and asked me if I was interested in piloting their decision support tool, I was immediately interested in the prospect of trying to create a culture change that I felt would benefit our patients.”

To help sustain the effects of the restraint education and decision support tool, Hevener makes use of quality and safety champions. She describes the quality and safety champions as clinical resource nurses who are assigned to patient care units to provide just-in-time coaching on restraint use as well as other quality and safety topics. Hevener believes that this model of ongoing education helps to sustain the integration of the Restraint Decision Wheel into the decision making processes of registered nurses at her institution.

Implications for Practice
Hevener encourages the readers of the American Journal of Critical Care to consider the use of evidence-based strategies to inform clinical judgments about the use of restraints with critically ill patients.

Understanding that restraints do not always prevent injury is a challenging concept for acute and critical care nurses. However, Hevener hopes that her article will motivate registered nurses to question their bedside practice and identify opportunities to enhance patient safety through the appropriate use of restraints. She adds, it is crucial that registered nurses have the necessary tools and education to reduce restraint use, and the Restraint Decision Wheel is a useful tool to inform nurses’ clinical judgments about restraint use in the intensive care unit.

REFERENCE

Discussion Points

A. Description of the Study
- Why is inappropriate use of restraints a significant clinical problem?
- What is the purpose of the study?

B. Literature Evaluation
- What are the benefits and risks associated with the application of restraints to an acutely or critically ill patient?
- What types of strategies have been evaluated to help reduce restraint use?

C. Sample
- Who was eligible to participate in this study?
- Who was excluded from this study and why?

D. Methods and Design
- Why do you suspect the authors used a quasi-experimental research design instead of an experimental research design?
- Describe the data collection procedures for this study.

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?
Background  Clinical nurses attend family conferences in the intensive care unit, but their role during these meetings is not yet fully understood.

Objectives  To assess perceived and observed contributions of the clinical nurse during family conferences.

Methods  Prospective cross-sectional survey and review of 40 audio-recorded family conferences conducted in the 44-bed pediatric intensive care unit of an urban pediatric hospital.

Results  Survey responses from 47 nurses were examined. Most nurses thought it important to attend family conferences, but identified workload as a barrier to attendance. They perceived their roles as gaining first-hand knowledge of the discussion and providing a unique perspective regarding patient care, emotional support, and advocacy. Audio recordings revealed that bedside nurses attended 20 (50%) of 40 family conferences and spoke in 5 (25%) of the 20. Nurses verbally contributed 4.6% to the overall speech at the family conference, mostly providing information on patient care.

Conclusions  The clinical nurse is often absent or silent during family conferences in the intensive care unit, despite the important roles they want to play in these settings. Strategies to improve both the physical and verbal participation of clinical nurses during the family conference are suggested, especially in the context of previous research demonstrating the need for more attention in family conferences to social-emotional support and patient advocacy. (American Journal of Critical Care. 2016;25:489-497)
Families of critically ill children meet with clinicians to receive medical updates on the patient's status and treatment options, discuss prognosis, and explore end-of-life care choices. Frequently, the format of these meetings in the pediatric intensive care unit (PICU) is the family conference. In an effort to meet the full range of needs of patients and their families, these family conferences are often interprofessional, including physicians, social workers, pastoral care, case management, and nurses. Despite participation of a range of professionals, recent data suggest that these meetings are often physician-dominated and heavily focused on the transfer of medical information from the physician to patients and their families.

In addition, a growing body of publications calls for the inclusion of early, regular exploration of values and goals and provision of emotional support to patients' families during family conferences. Some evidence indicates that these additional components of communication in formal family conferences occur infrequently. The role of other care providers, who have additional perspectives and information about the patient and the patient's family, is poorly understood and is of interest, given these findings.

The purpose of this study is to examine the role of the clinical nurse in family conferences, within the framework of an interprofessional approach to shared decision making that acknowledges the importance of collaboration between professionals in various disciplines over time, integrated and cohesive care, symmetrical power relationships, shared mental models, and a supportive institutional culture. Clinical nurses spend a significant amount of time with patients and patients' families, probably more time than any other clinician. The clinical nurse often has up-to-date information on the patient's status, has had the most opportunity to discuss patients' values and treatment preferences, and is experienced in using a clear, sensitive, and caring vocabulary about comfort, information, emotional, and advocacy needs. This uniquely intimate involvement with patients and their families can lead to deep relationships and a view into a family's values and goals. Clinical nurses report contributing to family conferences by sharing information with and about the patient and family, advocating for the patient and family, and providing support and comfort. Although nurses also perceive some uncertainty in their role, their potential to contribute is significant.

Current efforts in adult oncology, intensive care, and palliative care are aimed at defining and enhancing the role of the clinical nurse in discussions around prognosis and goals of care. The American College of Critical Care Medicine and the Society of Critical Care Medicine have also recommended that ICU nurses be active participants in family conferences. The purpose of the study reported here is to examine the verbal participation of clinical nurses during real-time PICU family conferences, and to explore pediatric clinical nurses' perception of their role in family conferences.

Methods
Setting and Design
A prospective, cross-sectional study in a PICU of a tertiary medical center was conducted to understand both the observed and perceived roles of clinical nurses during family conferences. In this PICU, family conferences to discuss critical treatment decisions are convened at the discretion of the attending physician on service or at the request of a family member. Critical treatment decisions are defined as a decision to initiate, escalate, or withdraw life-sustaining therapies involving an invasive procedure (eg, endotracheal tube placement), escalation or adjustment of a medical therapy (eg, continuous renal replacement), or end-of-life care (eg, resuscitation status).
Family conferences for medical updates, delivery of bad news, or discharge planning were excluded. This PICU has no automatic trigger mechanism for family conferences or guidelines providing a standardized structure for those conferences. All formal family conferences are conducted in a conference room within the PICU.

Two approaches were taken to directly evaluate the participation of clinical nurses in family conferences: (1) analysis of audio recordings of actual family conferences and (2) responses to a survey about family conference attendance and participation. Written consent was obtained from all participants in the family meeting. The study was approved by the hospital’s institutional review board.

**Observed Family Conference Participation: Audio Recordings**

Forty family conferences with English-speaking adults holding primary decision-making responsibilities for a critically ill child (biological parent, adopted or foster parent, or member of the extended family) were audio recorded from April 2012 to August 2014 (enrollment rate was 87%). Mandatory participants were the primary ICU physician and family member(s) of the critically ill child. The unit social worker arranges the family conference, coordinating schedules for the ICU physician, consultants, and the patient’s family. After the date and time are set, clinical nurses are notified of the family conference and encouraged to attend.

The audio-recorded conferences were coded by using the Roter Interaction Analysis System (RIAS). The RIAS is a valid and reliable quantitative tool for assessing medical communication in a variety of settings and has demonstrated high levels of reliability and predictive validity. The unit of analysis in RIAS is a statement conveying a complete thought, communicated as a single word, simple sentence, or a clause in complex sentence. Statements are coded directly from recordings and assigned to mutually exclusive and exhaustive code categories, identified by speaker. The codes are placed into 2 large categories: medical talk and psychosocial talk. Medical talk includes items such as medical information giving or counseling. Psychosocial talk includes elements regarding lifestyle and behavior, feelings, and emotions. As an example, a clinician’s statement, “She has to go downstairs for the CT scans. So she’s being moved around. That can increase swelling.” would be coded as medical talk. A statement from the clinician, “Some families say, ‘There’s still quality of life. I can provide joy to my child and my child can provide joy to me’” would be coded as psychosocial talk.

Structural measures of conference communication include: conference duration (minutes), the sum of all family and clinician statements as an indication of total dialogue, and a measure of clinician verbal dominance constructed as the ratio of all clinician-to-family statements. One coder, with 10 years of RIAS experience, coded all of the conference recordings. Intracoder reliability was calculated on 4 randomly selected, double-coded recordings. The mean reliability, based on Pearson correlation coefficients, was 0.97 for both clinician and family codes.

**Perceived Family Conference Participation: Survey**

All steady day-shift or rotating-shift clinical nurses working in the PICU during July and August 2014 were sent a survey on their perceived role in family conferences (N = 96). The survey questions reflect the framework of interdisciplinary shared decision making and were developed on the basis of published findings, followed by a focus group of 5 clinical nurses in our PICU who evaluated the survey for face validity. Changes were made to the ordering of items and reductions of items after review with the focus group. The 16-question survey included basic demographic data, such as full- or part-time status, shift, and years of practice. It also included items regarding how often, in the prior 6 months, the nurse received an invitation to attend a family conference, the number of conferences attended, and whether they verbally contributed during the conference. If the nurse had not spoken, we inquired about the desire to speak. Last, the survey included 3 open-ended questions asking participants to describe their perceived role in family conferences, factors that influenced their ability to attend family conferences, and elaboration on any verbal contributions made.

Each nurse received an information sheet and a link to complete an online survey through hospital electronic mail. The survey was created and distributed using the Research Electronic Data Capture (REDCap) application. REDCap is a free, secure, web-based program designed to support data capture and includes the capacity for branching logic in the sequencing of survey questions. A follow-up
e-mail was automatically sent 2 weeks later to those who had not completed the survey.

Descriptive statistics were used to examine demographic variables. Content analysis, the systematic extraction and description of the intended meaning of narrative content, was used to examine answers to open-ended questions. The codes that emerged from this analysis were described in terms of meaning and frequency. Two independent coders (A.W. and T.O.) evaluated the narrative survey results for recurrent themes and formulated definitions for these themes. Each individual quote from the clinical nurses’ responses was repeatedly compared with other responses for both overlapping and unique meaning, leading to reductions and merging of similar themes. Each response was then sorted by theme. After reduction of codes, 20% of the individual responses were analyzed for interrater reliability between the 2 coders, Cohen $\kappa$ was 0.89 ($P < .001$).

Results

Observed Family Conference Participation: Audio Recordings

A clinical nurse attended 20 (50%) of the family conferences that were audio recorded. No nurses declined consent to the audio recordings after informing the charge nurse they intended to attend. Additional attendees included a PICU physician (100%), consultant physicians (89%), social workers (86%), case managers (50%), and palliative care providers (33%). The mean duration of the family conference was 37 (SD, 15.9) minutes. When a clinical nurse was present, the conference length was 43 minutes, compared with 36 minutes when a clinical nurse was absent ($P = .28$).

The medical team spoke, on average, 73% of the time, compared with family speech of 27% on average. Physicians verbally dominated the interaction, encompassing 89% of medical team talk compared with contributions from other team members such as the social worker (7%), case manager (2%), and clinical nurse (2%). The content of the conference was mostly medical information (79%) compared with psychosocial talk (21%).

Of the 20 conferences a clinical nurse attended, the clinical nurse made a verbal contribution in 5 conferences (25%). The mean length of time the 5 clinical nurses spoke was 1.7 minutes (range, 2 seconds-3 minutes), representing 4.6% of the total conference. Because of the low verbal participation rate of clinical nurses, we were not able to perform a thematic analysis on their utterances. Three of the 5 clinical nurses who spoke added clarifying information (1 to give the room number for a patient transfer, 1 to explain the current schedule for urinary catheterizations of the patient, and 1 to state when eye drops would be placed for an upcoming eye examination). The 2 other verbal contributions included clinical nurses adding detailed clinical updates, such as progress of ventilator weaning, feeding tolerance, and a discussion about a pulmonary toilet regimen.

Perceived Family Conference Participation: Survey

Forty-seven (49%) of 96 day or rotating day/night shift nurses completed the survey. The majority of clinical nurses who responded worked full-time and held at least a bachelor of science degree in nursing. Thirty-four percent had been a clinical nurse for more than 7 years, and 28% had been a PICU clinical nurse for more than 7 years (Table 1).

Forty-six respondents (98%) agreed with the statement “it was important for the clinical nurse to attend family conferences” (Table 2). Forty-two clinical nurses (89%) reported that they had been invited to at least 1 family conference in the preceding 6 months. Of the 42 clinical nurses who reported being invited to at least 1 family conference, 7 (17%) were able to attend all of the time and 33 (78%) at least most or some of the time. Among the 40 clinical nurses who had attended a family conference in the past 6 months, 21 (53%) reported that they had

<table>
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<tr>
<th>Characteristic</th>
<th>Frequency, %</th>
</tr>
</thead>
<tbody>
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</tr>
<tr>
<td>Part-time</td>
<td>5 (11)</td>
</tr>
<tr>
<td>Full-time</td>
<td>42 (89)</td>
</tr>
<tr>
<td>Shift</td>
<td></td>
</tr>
<tr>
<td>Day</td>
<td>27 (57)</td>
</tr>
<tr>
<td>Rotating</td>
<td>20 (43)</td>
</tr>
<tr>
<td>Years of nursing experience</td>
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</tr>
<tr>
<td>&lt;1</td>
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<td>1-3</td>
<td>11 (23)</td>
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<td>3-5</td>
<td>7 (15)</td>
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<td>5-7</td>
<td>10 (21)</td>
</tr>
<tr>
<td>&gt;7</td>
<td>16 (34)</td>
</tr>
<tr>
<td>Years of nursing experience in pediatric intensive care unit</td>
<td></td>
</tr>
<tr>
<td>&lt;1</td>
<td>8 (17)</td>
</tr>
<tr>
<td>1-3</td>
<td>15 (32)</td>
</tr>
<tr>
<td>3-5</td>
<td>7 (15)</td>
</tr>
<tr>
<td>5-7</td>
<td>4 (9)</td>
</tr>
<tr>
<td>&gt;7</td>
<td>13 (28)</td>
</tr>
<tr>
<td>Education</td>
<td></td>
</tr>
<tr>
<td>Bachelor’s degree</td>
<td>36 (77)</td>
</tr>
<tr>
<td>&gt;Bachelor’s degree</td>
<td>10 (21)</td>
</tr>
<tr>
<td>Not reported</td>
<td>1 (2)</td>
</tr>
</tbody>
</table>
made a verbal contribution during the conference. Two-thirds (12/19, 63%) of those who said that they had not made a verbal contribution indicated that they had not had any desire to speak during the conference (1 clinical nurse did not respond to this question). However, 6 nurses reported that they had wanted to speak, and their reasons for not speaking included the following: (1) they were new to their position and uncomfortable speaking during the conference (n = 5), (2) a perception that the conference was physician-led and as a clinical nurse they either did not have a role or did not understand their role in the conference (n = 5), and (3) they did not want to influence the decisions being made at the conference (n = 2).

Qualitatively, we analyzed responses to 3 questions regarding attendance at family conferences. Question 1: What influenced your ability to accept or decline the invitation to the family conference? (This question was asked of all clinical nurses who had been invited to a conference, n = 42). We identified 5 themes after examination of 69 unique responses to this question (Table 3). Most frequently, clinical nurses made statements that intense clinical responsibilities (30/69, 43%) and inadequate staffing coverage of their patient assignment (19/69, 28%) precluded their ability to attend. Factors that facilitated or enabled clinical nurse attendance included the importance of the topic being discussed (16%), having a special relationship with the family (7%), or the clinical nurse perceiving it as a part of his or her duties (6%).

### Table 2
**Survey responses on nurse participation in family conferences**

<table>
<thead>
<tr>
<th>Survey question</th>
<th>No. (%) of responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you think it is important for the bedside nurse to attend family meetings? (n = 47)</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>46 (98)</td>
</tr>
<tr>
<td>No</td>
<td>1 (2)</td>
</tr>
<tr>
<td>How many family meetings were you invited to attend in the past 6 months? (n = 47)</td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>5 (11)</td>
</tr>
<tr>
<td>1-3</td>
<td>18 (38)</td>
</tr>
<tr>
<td>4-6</td>
<td>17 (36)</td>
</tr>
<tr>
<td>&gt;7</td>
<td>7 (15)</td>
</tr>
<tr>
<td>How many conferences were you able to attend in the past 6 months? (n = 42)²</td>
<td></td>
</tr>
<tr>
<td>All of them (100%)</td>
<td>7 (17)</td>
</tr>
<tr>
<td>Most of them (75%)</td>
<td>17 (40)</td>
</tr>
<tr>
<td>Some of them (25%)</td>
<td>16 (38)</td>
</tr>
<tr>
<td>None of them (0%)</td>
<td>2 (5)</td>
</tr>
<tr>
<td>Did you say anything during a family conference? (n = 40)³</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>21 (53)</td>
</tr>
<tr>
<td>No</td>
<td>19 (7)</td>
</tr>
<tr>
<td>Did you want to speak at the conference? (n = 19)⁵</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>6 (32)</td>
</tr>
<tr>
<td>No</td>
<td>12 (63)</td>
</tr>
<tr>
<td>Not reported</td>
<td>1 (5)</td>
</tr>
</tbody>
</table>

² Question asked only if respondent said they had been invited to a family conference.
³ Question asked only if respondent said they had attended a family conference.
⁵ Question asked only if respondent said they did not say anything at the family conference.

Question 2: What did you say and why? (This question was asked of all clinical nurses who reportedly spoke at a family conference, n = 21.) Five key themes

### Table 3
**Thematic responses on the nurse’s ability to attend family conferences (N = 69 responses)**

<table>
<thead>
<tr>
<th>Themes</th>
<th>Definition</th>
<th>No. (%) of responses</th>
<th>Sample quotes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intense clinical responsibilities</td>
<td>Nurse’s workload and/or patient’s acuity limits ability to leave the bedside</td>
<td>30 (43)</td>
<td>“It depends greatly on the needs of my patient assignment.”</td>
</tr>
<tr>
<td>Inadequate staffing coverage</td>
<td>Nurse reports insufficient availability of other nurses to offload duties during meeting</td>
<td>19 (28)</td>
<td>“Staffing ratios/patient assignments always play a role in if I can or cannot attend the meeting.”</td>
</tr>
<tr>
<td>Important issues were going to be discussed</td>
<td>Nurse values the information he/she acquires from the meeting that then improves his/her ability to support families and understand the treatment plan</td>
<td>11 (16)</td>
<td>“To gain clarification from and for parents on treatment of their child”</td>
</tr>
<tr>
<td>Relationship to patient and patient’s family</td>
<td>Degree of familiarity or a special relationship to the family</td>
<td>5 (7)</td>
<td>“Feel that an RN who is well-acquainted with the family is best suited to attend meeting”</td>
</tr>
<tr>
<td>My duty to attend</td>
<td>Nurse is an important member of the team and should participate in care decisions</td>
<td>4 (6)</td>
<td>“Important to have entire team at the meetings”</td>
</tr>
</tbody>
</table>

Abbreviation: RN, registered nurse.
Themes | Definition | No. (%) of responses | Sample quotes
--- | --- | --- | ---
Provide clarification | Nurse adds value by supplying unknown information or explanations from the nursing perspective | 16 (46) | “Providing information regarding bedside care”
Support for family | Expressed support and provided reassurances for family | 7 (20) | “I usually ask the family if there is anything nursing can provide”
Act as voice for family | Nurse asks questions on behalf of the family on the basis of previous interactions with them and intimate knowledge of the family’s wishes | 6 (17) | “I feel that sometimes parents say things to nurses that they wouldn’t feel comfortable saying to a physician or during a family meeting”
End-of-life perspective | I brought up issues related to end of life | 5 (14) | “I have commented on end-of-life meetings that nursing staff will continue to care for children as they have before”
Support for physician | Provided support for physician plan of care | 1 (3) | “Underlining importance of docs’ recs [physicians’ recommendations]”

Themes | Definition | No. (%) of responses | Sample quotes
--- | --- | --- | ---
Hearing firsthand parent-physician communication | Direct knowledge of family-provider conversation provides a consistent message and improves both future nurse-nurse and nurse-family communication | 35 (35) | “To listen to what is being said in the meeting in order to answer any questions the family may not ask or understand during the meeting”
Having a unique perspective | Nurse has the most contact with patient’s family, and therefore may provide information about the patient and family that is not available to other clinicians | 28 (28) | “She/he sees and experiences things with the patient and family that the rest of the team does not have the opportunity to view.”
Advocating for patient and family | Nurse serves as spokesperson for the patient’s family, helping to ensure that their concerns and questions are appropriately addressed | 18 (18) | “As an experienced [nurse] I can often contribute by . . . helping them ask questions”
Providing support for the family and physicians | Nurse acts as a comforting presence for patients’ families and can reinforce with families the plan of care laid out by physicians | 14 (14) | “I think having the nurse in the meeting would be a comfort for the family to know they have someone they can trust and lean on for support and guidance”
Decoding jargon | Clarifying and translating complex medical language for the family | 4 (4) | “A family in crisis needs the most basic language and simple explanations, until proven otherwise”

*Because of rounding, not all percentages total 100.

emerged from 35 responses (Table 4). Most commonly, clinical nurses stated that they spoke during a family conference to provide clarification or information from the clinical nurse’s perspective on patient care or patient status (46%). Second, clinical nurses reportedly provided support and reassurance for the family (20%) followed by helping the family by asking questions on their behalf (17%). Clinical nurses also reported that they brought up issues related to patient care at the end of life (14%).

Question 3: *In your opinion, what role, if any, does the clinical nurse play in family conferences?* (This question was answered by all clinical nurses, n = 47). Five key themes emerged from 99 responses (Table 5). Clinical nurses stated that hearing firsthand the content discussed during the family conference led to a consistent message between providers and improved both future nurse-nurse and nurse-family communication (35%). Clinical nurses also expressed that, because they had the most contact with patients’ families, they could provide information not available to other clinicians (28%). Advocating for the patient and the patient’s family (18%), providing support for families and clinicians (14%), and decoding medical jargon (4%) were also offered as roles of the clinical nurse in family conferences.
Discussion

Clinical nurses are important members of the critical care team and overwhelmingly believe that they should participate in family conferences. Their desire to attend was strongest when they believed that the topic of discussion was important or when they had a deep relationship with a particular family. Despite this desire to attend, only 19% of nurses reported being able to attend all of the time. Not surprisingly, the main barriers to nurse attendance were excessive workload demands, high acuity needs of their patient, and inadequate staffing, as reported in previous research. Increased attention to resource barriers by physician and nurse management is a first step toward improving clinical nurse involvement in formal family communication given these findings.

Clinical nurses in our study identified roles in family conferences that match what has been found in previous research. Clinical nurses reported that they provide a unique perspective of the patient’s care, can be an advocate for the patient and the patient’s family, and can support both the patient’s family and the physician. Importantly, clinical nurses reported that they are a critical conduit to pass information along to other clinicians and to deliver a consistent message when talking to patients’ families later.

Despite these potentially vital roles, clinical nurses rarely made verbal contributions during the family conferences. Additionally, when clinical nurses did speak, there was little discussion of psychosocial issues related to goals of care. If family conferences are not meeting all needs of patients’ families, increased verbal participation from all team members could help expand discussions around goals of care.

“Care and Communication Bundles,” modeled after other evidence-based, proactive care protocols, have been successfully designed and implemented in adult settings to standardize multidisciplinary planning, documentation, and discussions about goals of care. In 1 intervention study, clinical nurses in 5 adult Veterans Administration ICUs were trained by using role playing to help convene family conferences, ensure bidirectional communication and voicing of concerns, name emotional reactions and respond appropriately, and follow up after the family conferences. These protocols instantiate the key features of an expanded interprofessional team approach: “The team [which includes the patient and family] must provide integrated and cohesive care and share power among its members. The team members must be able to exercise their partnership and share their knowledge regularly and without interruptions, communicating information systematically throughout the therapeutic process and using well-designed information and communication technologies.”

A well-established conceptual framework, referred to as a “multiple goals theoretical perspective” and drawn from social psychology, communication studies, and discourse theory, has recently been used to analyze difficult medical conversations. This perspective provides a theoretical construct for incorporating the additional expertise and experience of clinical nurses and other members of the interprofessional team in family communication. Human communication necessarily involves 3 basic and often conflicting goals: task goals, relational goals, and identity goals. Patients and their families want information, support for their decisions, continuity of care, assurance that suffering will be avoided, and to participate in decision making. These are task goals, or the topics of the conversation. Relational and identity goals are more subtle and nuanced. They reflect the need for establishing, monitoring, altering, or reinforcing interpersonal connections (relational), maintaining autonomy and reciprocity in the interaction, and exploring roles (identity). It may be difficult for clinicians to address relational and identity goals when these conversations are often the first time they have met with patients’ families. Increased participation by other team members could help address these goals.

It is also important to consider that the clinical nurse may be silenced not by choice. Six of the 18 nurses who did not speak said that they had wanted to speak, and some of the reasons provided were that they were “uncomfortable speaking” or “were not asked” to speak and that the “physicians spoke through the duration of the meeting.” Differences in the perspectives on the timing and content of end-of-life discussions, the use of inappropriate interventions, lack of informed consent, and the degree of patient and family suffering between clinical nurses, clinicians, and other family conference participants have been reported. Clinical nurses have a responsibility to be proactive in expressing their desire to participate in family conferences, especially with respect to the degree to which professional hierarchies may contribute to their lack of verbal participation during these important conversations.
Clinical nurses have a responsibility to express their desire to participate in family conferences.

Several study limitations must be addressed. The survey was limited to formal family conferences, so information about other types of conversations occurring between clinical nurses and patients’ families, such as those at the bedside, were not evaluated and need additional examination. It has been reported that clinical nurses were often observed to remain in the room with patients and patients’ families after the conference had ended, or to accompany them back to the patient’s room and remain there. These important interactions were not captured, nor were the nonverbal behaviors of participants during the conferences. In addition, these results arise from a single center and may not be generalizable to other ICUs. Finally, selection bias must be considered. It is possible that clinical nurses who chose to participate may be different from those who declined participation.

Conclusions

Clinical nurses identified their participation in family conferences as important. However, multiple barriers to attendance were identified. When clinical nurses did attend, they rarely made verbal contributions. Continued efforts to improve both the physical and verbal participation of the clinical nurse during the family conference are needed, with special consideration given to expanding family and patient communication in the psychosocial realm.

FINANCIAL DISCLOSURES

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eLetters

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

REFERENCES


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  Communication problems between family surrogates and intensive care unit (ICU) clinicians have been documented, but few interventions are effective. Nurses have the potential to play an expanded role in ICU communication and decision making.

Objectives  To conduct a pilot randomized controlled trial of the family navigator (FN), a distinct nursing role to address family members’ unmet communication needs early in an ICU stay.

Methods  An interprofessional team developed the FN protocol. A randomized controlled pilot intervention trial of the FN was performed in a tertiary referral hospital’s ICU to test the feasibility and acceptability of the intervention. The intervention addressed informational and emotional communication needs through daily contact by using structured clinical updates, emotional and informational support modules, family meeting support, and follow-up phone calls.

Results  Twenty-six surrogate/patient pairs (13 per study arm) were enrolled. Surrogates randomized to the intervention had contact with the FN on 90% or more of eligible patient days. All surrogates agreed that they would recommend the FN to other families. Open-ended comments from both surrogates and clinicians were uniformly positive.

Conclusions  Having a fully integrated nurse empowered to facilitate decision making is a feasible intervention in an ICU and is well-received by ICU families and staff. A larger randomized controlled trial is needed to demonstrate impact on important outcomes, such as surrogates’ well-being and decision quality. (American Journal of Critical Care. 2016;25:498-507)
In the intensive care unit (ICU), patients’ family members are thrust into a highly stressful and often bewildering environment. Although good communication is essential to decision making, up to one-third of family members of seriously ill patients report problems communicating with clinicians and clinician/family conflict. Fragmented relationships and unmet needs for communication and emotional support are common. Family surrogate decision makers (SDMs) often experience high levels of posttraumatic stress, decisional conflict, and regret. Thus, interventions to improve communication are needed to support family members of critically ill patients in the ICU.

Intervention studies have had limited success in improving communication with SDMs. In a systematic review of 16 ICU interventions, researchers found that printed information, palliative and ethics consultations, and structured communication by the ICU team affected patient care and family distress. However, most of these approaches require either resource-intensive consulting teams with expertise in ethics or palliative care, or changing physicians’ behavior (e.g., early family meetings for patients who are expected to die).

We believe that nurses have high potential to improve communication through early intervention with SDMs if they are fully integrated into the interprofessional ICU team and empowered to facilitate decisions. This strategy is consistent with the Institute of Medicine’s recommendations for expanding nurses’ roles in patient care. A major prior effort to develop nursing-led intervention, the SUPPORT study, did not show an impact on patient-centered outcomes such as time to do-not-resuscitate (DNR) orders, life-sustaining interventions, or pain. The SUPPORT nurses often provided extensive communication, education, and emotional support to patients and patients’ families, the impact of which may not have been measured by the planned outcomes. Failure to fully integrate into systems of care may have also reduced the impact of the intervention.

In recent years, several nurse-focused ICU interventions have shown potential in single-arm, retrospective analysis, or quasi-experimental (baseline/intervention) studies. One randomized controlled trial of a family meeting facilitator showed improvements in some measures of SDM well-being and decreased length of stay, providing early evidence that nurse interventions can influence outcomes.

We describe the development and randomized pilot testing of the family navigator (FN), a distinct nursing role to address family members’ unmet communication needs early in ICU hospitalization. The goals of this pilot study were to develop the intervention on the basis of our conceptual model, demonstrate feasibility and acceptability, and provide evidence for the feasibility of a future randomized controlled trial to assess impact on family distress.

Conceptual Model

On the basis of a review of the literature and our prior empirical research, we have developed a conceptual model proposing that communication quality affects decision making, which in turn affects outcomes for patients and SDMs (Figure 1). Consistent with prior theoretical work in communication, ours...
The family navigator participated in daily ICU rounds and helped guide daily family communication.

The family navigator participated in daily ICU rounds and helped guide daily family communication.

we proposed that surrogate/clinician communication has 2 core dimensions: (1) an informational dimension and (2) an emotional dimension. Just as most patients desire to be fully informed about their own medical conditions and decisions in order to make decisions and know what to expect, SDMs also describe a preference for early and frequent provision of information. Researchers in other studies have found that emotional support through empathic statements, respect, and spiritual support are important.

Cognitive and emotional processing theories of posttraumatic stress disorder (PTSD) propose that when experiencing a trauma, some individuals develop negative appraisals about the situation and about their own capacity to cope with it. In the ICU setting, family decision makers are often overwhelmed by a family member’s critical illness. Fear reactions may further reduce the individual’s ability to process information. Specific goals of early intervention include improving functional capacity, encouraging supportive coping mechanisms, and optimizing social support. We theorize that the FN intervention will help individuals cope with the trauma of critical illness by supporting understanding of complex information, providing emotional support, and supporting the surrogate’s coping mechanisms, leading to higher quality decisions and better SDM outcomes.

Methods

The study was approved by the institutional review board at Indiana University.

Intervention Development

The interdisciplinary team, including research staff (nurse researcher, principal investigator, research coordinator, and research assistant) and ICU staff (physician director, nurse manager, social worker), met weekly for 3 months to develop the FN intervention. The full investigator team met monthly to oversee implementation. The study was presented at nursing and physician ICU staff meetings early in development to obtain buy-in and input on study design.

Setting and Participants

The study was conducted in an 18-bed ICU located in a tertiary referral hospital. We chose to focus the intervention on patients with severe cognitive impairment because their family members would need to be entirely responsible for decision making, a situation associated with high distress. Eligibility criteria for patients to be included in the study were (1) age 21 years and older; (2) admitted to the medical ICU; (3) severe cognitive impairment determined by chart review (sedated or comatose) or a score of 8 or more errors on the Short Portable Mental Status Questionnaire, indicating severe impairment; and (4) ability to contact the patient’s SDM within 3 days of ICU admission. Patients were excluded if they were imminently dying or were expected to be transferred out of the ICU within 24 hours of admission. SDMs were eligible if they were the legally authorized decision makers according to a health care power of attorney document or Indiana surrogate decision-making law and could complete oral or written surveys in English.

Recruitment and Randomization

Eligible patients were identified Monday through Friday, between October 2013 and March 2014. The research assistant identified the legally authorized SDM from the medical record or calls to the physician or bedside nurse and contacted the SDM to describe the study, obtain informed consent, and conduct a baseline interview. The research coordinator then randomized each participant by using sequentially numbered opaque envelopes that contained the randomly generated group assignment and contacted each SDM to inform him or her of group assignment.

FN Interventionist Training

The FN interventionist was an experienced ICU registered nurse who underwent a 2-week training period. This training included shadowing staff members (nurse manager, clinical director, social worker, and chaplain) to learn how their roles would complement one another and review of the research protocol, study materials, and related literature. The FN also met regularly with the principal investigator and nurse researcher to review materials and
refine the FN role and underwent a half-day training session based on the VitalTalk\textsuperscript{45} method, led by a trained facilitator (G.T.B.).

The Intervention

We mapped the 2 core communication elements of our conceptual model into the specific interventions performed by the FN (Figure 2). The study involved preset meetings and modules to ensure reproducibility, but at all times, the FN was encouraged to tailor responses to individual informational and emotional needs.

\textit{FN/SDM Introductory Meeting}. The FN met with the SDM within 24 hours of enrollment, either at the hospital or by phone, to establish a relationship and to assess the SDM’s needs that would trigger study protocols for informational and emotional support.

\textit{Structured Daily Contact}. The FN contacted the SDM 5 days per week. The FN participated in daily ICU rounds and completed a structured form to guide daily family communication, including the patient’s status, the goals of care, and the clinical plan for the day. We established a goal of communication with family SDMs on 90% of weekdays. The physician, social worker, or other clinicians were encouraged to maintain their usual level of contact with patients’ families.

\textit{Informational/Emotional Support Modules}. On the basis of our group’s prior family care management research,\textsuperscript{46,47} we developed 13 support modules involving an oral script delivered by the FN and a handout that was left with SDMs. Modules were triggered by clinical findings or SDM needs and addressed the primary domains of SDM knowledge and emotional support.

\textit{Family Meetings}. The FN identified the need for family meetings on the basis of a major decline in the patient’s condition, a clinician’s concern that the patient would not survive the ICU stay, assessment of family/SDM need, or a recommendation from a physician, a social worker, or a patient’s family member. Family meetings were also requested by physicians and the social worker, consistent with standard practice in this ICU. The role of the FN at the meeting was (1) to monitor and facilitate understanding of clinical information and (2) to provide emotional support using the VALUE framework, an approach to guide ICU conversations that includes the following 5 communication behaviors: value, acknowledge, listen, understand, elicit.\textsuperscript{48}

\textit{Postdischarge Phone Calls}. The FN contacted the SDM at 3 days and at 2 weeks after ICU discharge to assess for any unmet informational or emotional needs and responded to unmet needs with referrals to appropriate hospital resources.

Control Group

The control group received usual care. All enrolled patients were eligible to receive support resources available in this ICU. The ICU social worker provided ongoing, in-depth psychosocial support to all patients’ families and coordinated most family meetings, and board-certified chaplains provided spiritual care.

Data Collection and Outcomes

We defined feasibility to include the successful implementation of the intervention with high treatment fidelity.\textsuperscript{49} Treatment fidelity measures were selected on the basis of the recommendations of the National Institutes of Health Treatment Fidelity Working Group.\textsuperscript{50} Fidelity of provider training was addressed by monitoring the FN’s completion of the 80-hour training program, ensuring skill acquisition by observing the FN in standardized role plays, and
monitoring drift in provider skill through direct observation by the nurse researcher. We assessed fidelity to treatment delivery by measuring the percentage of eligible participants completing enrollment interviews, the percentage of days with medical team contact and SDM contact, the number of educational/support modules delivered, and the percentage of follow-up calls completed. The FN also kept a daily online journal. These were reviewed at weekly team meetings. We used REDCap databases to track treatment delivery data.

We operationalized acceptability of recruitment, randomization, and the intervention on the basis of successful participant enrollment, high rates of completion of study measures, low rates of dropout and loss to follow-up, and acceptance by SDMs and ICU clinicians based on semistructured interviews.

At baseline, we computed a measure of illness severity, the mean score on the Sequential Organ Failure Assessment, for each patient on the basis of a chart review. Our primary measure of SDM well-being was assessment of posttraumatic stress symptoms, measured by the Impact of Events Scale-Revised 6 to 8 weeks after ICU discharge (internal consistency: coefficient $\alpha = 0.96$). Decision quality was measured with the Decisional Conflict Scale ($\alpha = 0.78$). Because SDMs face a variety of potentially stressful decisions, we administered the scale during weekly interviews for up to 3 decisions experienced by each SDM. We analyzed the highest decision conflict score for each SDM.

Depression and anxiety were measured at 6- to 8-week follow-up by using the Patient Health Questionnaire ($\alpha = 0.86$) and the Generalized Anxiety Disorder 7-item scale ($\alpha = 0.92$). These measures have been used in multiple prior studies of SDMs.

Data collection interviews were conducted by phone or in-person with the SDM weekly during the ICU stay and 2 to 7 days after ICU discharge to identify major decisions and measure decision conflict. At 6 to 8 weeks after ICU discharge, SDM posttraumatic distress, anxiety, depression, and decision regret were assessed. The 6- to 8-week interview included open- and closed-ended questions about the FN for those in the intervention arm. At the conclusion of the study, we conducted semistructured interviews with 2 clinicians to assess acceptability to clinicians.

Data Analysis

Markers of adherence to the treatment protocol are shown as the proportion of successful contacts over the number of potential contact days or opportunities. We dichotomized scores on the Impact of Events Scale-Revised ($\geq 22$ and < 22; scores $\geq 22$ indicate a high risk of clinically important posttraumatic stress). Scores on the Sequential Organ Failure Assessment also were dichotomized (as < 11 or $\geq 11$), as scores of 11 or greater confer a mortality of more than 80%. We compared categorical variables by using the Fisher exact test, because of low cell counts, and Student $t$ tests or Wilcoxon rank-sum tests were used to compare continuous variables, depending on the data distribution. Analyses were performed.

Interviews with surrogate decision makers were conducted by phone or in-person weekly during the intensive care unit stay.
# Characteristics of Patients and Their Surrogates

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Overall (N=26)</th>
<th>Family navigator (n=13)</th>
<th>Control (n=13)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Patient</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age, mean (SD), y</td>
<td>55.35 (12.62)</td>
<td>53.27 (14.18)</td>
<td>57.42 (11.03)</td>
<td>.41</td>
</tr>
<tr>
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<td>15 (58)</td>
<td>9 (69)</td>
<td>6 (46)</td>
<td>.43</td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
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<td>&gt;.99</td>
</tr>
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<td>African American</td>
<td>7 (27)</td>
<td>3 (23)</td>
<td>4 (31)</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>19 (73)</td>
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<td></td>
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<tr>
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<td>11.5 (1.6)</td>
<td>13.5 (3.1)</td>
</tr>
<tr>
<td></td>
<td>Median</td>
<td>12</td>
<td>12</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>Range</td>
<td>6-20</td>
<td>8-14</td>
<td>6-20</td>
</tr>
<tr>
<td>Score on Sequential Organ Failure Assessment ≥ 11</td>
<td>21 (81)</td>
<td>9 (69)</td>
<td>12 (92)</td>
<td>.32</td>
</tr>
<tr>
<td><strong>Surrogate</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Age, mean (SD)</td>
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<td>50.93 (12.01)</td>
<td>46.16 (17.36)</td>
<td>.42</td>
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<tr>
<td>Relationship to patient</td>
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<td></td>
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<td>.86</td>
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<td>14 (54)</td>
<td>8 (62)</td>
<td>6 (46)</td>
<td></td>
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<td>3 (23)</td>
<td>5 (39)</td>
<td></td>
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<tr>
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<td>0 (0)</td>
<td>0 (0)</td>
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<td>14 (54)</td>
<td>4 (31)</td>
<td>10 (77)</td>
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<td>Race</td>
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<td></td>
<td></td>
<td>&gt;.99</td>
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<td>3 (23)</td>
<td>3 (23)</td>
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<td>White</td>
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<td>10 (77)</td>
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<td>1 (8)</td>
<td>3 (23)</td>
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<td>1 (8)</td>
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<td>Education, y</td>
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<td>Median</td>
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<td>Range</td>
<td>10-21</td>
<td>10-16</td>
<td>12-21</td>
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<td>Annual household income, $</td>
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<td>.57</td>
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<td>≤ 24999</td>
<td>11 (44)</td>
<td>6 (46)</td>
<td>5 (42)</td>
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<td>25000-49999</td>
<td>7 (28)</td>
<td>5 (38)</td>
<td>2 (17)</td>
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<td>50000-74999</td>
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<td>1 (8)</td>
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<td>2 (8)</td>
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<td>Not answered (not determined, refused, don’t know)</td>
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<tr>
<td>Depression score (PHQ-9)</td>
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<td>7.2 (5.5)</td>
<td>9.1 (5.1)</td>
<td>5.2 (5.3)</td>
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<td></td>
<td>Median</td>
<td>7</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Range</td>
<td>0-18</td>
<td>1-18</td>
<td>0-17</td>
</tr>
<tr>
<td>Anxiety score (GAD-7)</td>
<td>Mean (SD)</td>
<td>6.2 (5.6)</td>
<td>8.1 (5.6)</td>
<td>4.3 (5.2)</td>
</tr>
<tr>
<td></td>
<td>Median</td>
<td>4.5</td>
<td>5</td>
<td>2</td>
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<tr>
<td></td>
<td>Range</td>
<td>0-19</td>
<td>3-19</td>
<td>0-19</td>
</tr>
<tr>
<td>Health literacy, No. correct on REALM-SF</td>
<td>Mean (SD)</td>
<td>7.3 (0.6)</td>
<td>7.4 (0.7)</td>
<td>7.2 (0.4)</td>
</tr>
<tr>
<td></td>
<td>Median</td>
<td>7</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Range</td>
<td>7-9</td>
<td>7-9</td>
<td>7-8</td>
</tr>
</tbody>
</table>

Abbreviations: NA, not applicable; PHQ-9, Patient Health Questionnaire-9; GAD-7, Generalized Anxiety Disorder 7-item scale; REALM-SF, Rapid Estimate of Adult Literacy in Medicine-Short Form.

- Values in second through fourth columns are number (percentage) of patients or surrogates unless otherwise indicated in this column.
- Wilcoxon rank sum test.
by using SAS (version 9.3, SAS Institute). Semistruc-
tured interviews were analyzed by thematic analysis.62

Results

Participants

We enrolled 26 participants (13 control and 13 intervention), 59% of eligible participants (Figure 3). The most common reasons for refusal were lack of interest and feeling it was a bad time because of the patient’s condition or family members’ emotions. Enrolled patients were 58% female and 27% African American (Table 1). At baseline, intervention patients had lower education (11.5 vs 13.5 years, \(P= .05\)) but were otherwise similar. Intervention SDMs also had lower education (12.3 vs 15.5 years, \(P= .001\)) and were less likely to be female (31% vs 77%; \(P= .05\)). No significant differences in severity of depression (mean [SD] score on Patient Health Questionnaire-9, 9.1 [5.1] vs 5.2 [5.3], \(P= .07\)) or anxiety (mean [SD] score on Generalized Anxiety Disorder 7-item scale, 8.1 [5.6] vs 4.3 [5.2], \(P= .07\)) were observed between the groups.

Feasibility

All intervention SDMs had the initial FN/SDM meeting (Table 2). All SDMs had contact with the FN on 90% or more of eligible weekdays. “Communicating with your family member” (92%) and “coping with stress” (77%) were the 2 most frequently used support modules (Table 2). Twelve subjects (92%) had at least 1 in-person contact, and 6 (46%) had at least 1 phone contact.

On the basis of the nurse researcher’s observations of 2 selected cases, the FN demonstrated expert communication skills as outlined in the VALUE framework. The FN was observed to translate complex medical concepts into layman’s terms, assess the SDM’s understanding of the medical situation, correct misconceptions, and explain key elements of information.

All baseline data collection interviews were completed. We completed 81% of 6- to 8-week follow-up interviews. We were unable to complete 4 of the first 12 follow-up interviews early in the pilot project. After modifying our study protocol to allow evening interviews, we missed only 1 of a remaining 14 possible interviews.

All SDMs agreed or strongly agreed that they would recommend the FN to other families. No SDM agreed that the FN contacted them too often or took up too much time. Semistructured interviews described benefits of the intervention, “The support and the overall counseling was comforting and gave optimism and relief. She talked to my kids, which helped them relax.” Feedback from clinicians during the semistructured interviews was highly positive. One physician said, “For family members, it helped them understand better what was going on with the (patient). It helped us to establish the goals of care much faster. For staff, it decreased our frustration.”

Outcome Measures

There were no significant differences in post-
traumatic stress, anxiety, depression, decision conflict, or decision regret between the FN and control groups (Table 3). We repeated the analyses for anxiety and depression, controlling for baseline levels, and also found no significant differences.

Discussion

We developed a novel intervention to improve family communication in the ICU that was based on theoretical and empirical communication literature and input from an interdisciplinary team of
researchers and ICU clinicians. We delivered the intervention to 13 SDMs with high treatment fidelity. Similar to other nurse-led interventions, this pilot study was well-received by SDMs. Our pilot study also demonstrated the feasibility of randomizing patients within the ICU setting, which has been done in few other studies. 

We learned several lessons in this feasibility study that will inform future work. First, data collection strategies were successful because they included phone as well as in-person approaches, which enhanced the successful completion of our 6- to 8-week follow-up interviews. Engagement with ICU staff early in the project with weekly meetings addressed ongoing concerns, encouraged buy-in from clinicians, and allowed us to troubleshoot problems in real time. Randomization within the ICU was acceptable to SDMs. We minimized contamination by avoiding FN contact with control families and maintaining careful control of printed study materials, although a larger study demonstrating differences between the groups will be needed to determine if this concern was adequately addressed.

Our model incorporates several innovations that are important for success in the ICU setting. Rather than simply adding a new resource, the FN is (1) fully integrated into the ICU clinical team; (2) provided with the authority, responsibility, and resources to facilitate communication; and (3) empowered to deliver interventions directly to the SDM that are jointly agreed upon with physicians.

Limitations of this work include the small sample size, which prevented the evaluation of between-group differences with adequate power. Although our outcome measures have been validated in patients, there is no validation data from family surrogates. Although decisions occurred throughout the intervention, a detailed analysis of decision conflict and regret that examined changes over time was not feasible given the small sample size in this pilot study as it would require controlling for decision type. With a larger sample size, a linear mixed model that would allow separation of intervention from treatment decision effects would be more appropriate.

We note that although depressive symptoms and anxiety did not differ significantly between groups at baseline, the FN group had baseline scores at least half a standard deviation higher than scores in the control group. This potential imbalance could also have affected group comparisons. In future work, we will stratify study randomization by baseline measures in order to reduce potential imbalances between the groups. Our refusal rate was 41%, which is similar to refusal rates reported for other ICU interventions but may have introduced bias. Loss to follow-up was higher in the intervention group (4 vs 1 SDM). Although it is possible that this effect was due to the intervention, we note that no SDM withdrew from the intervention itself. Additionally, this intervention was implemented in a single, Midwestern tertiary ICU with moderately high health literacy, and thus the results may not generalize to other settings.

Demonstrating feasibility of this intervention is only the first step. Further work is now needed to show that this highly integrated, novel intervention has an impact on outcomes for patients and SDMs. Although several small demonstration projects have relied on nurses to enhance communication, only 1 prior randomized controlled study provides evidence that a nurse intervention improves SDM outcomes. Additional research is needed to demonstrate the impact of nursing interventions in this setting. Additionally, this intervention may have an impact on a broader range of patients than

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**Table 3: Outcomes for patients and their families**

<table>
<thead>
<tr>
<th>Variable</th>
<th>All</th>
<th>Family navigator</th>
<th>Control</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. (%) with completed interviews</td>
<td>21 (81)</td>
<td>9 (69)</td>
<td>12 (92)</td>
<td></td>
</tr>
<tr>
<td>No. (%) with IES-R score</td>
<td>&gt;.99</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-21</td>
<td>12 (57)</td>
<td>5 (56)</td>
<td>7 (58)</td>
<td></td>
</tr>
<tr>
<td>≥ 22</td>
<td>9 (43)</td>
<td>4 (44)</td>
<td>5 (42)</td>
<td></td>
</tr>
<tr>
<td>Patient’s highest score on Decision Conflict Scale</td>
<td>.15</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean (SD)</td>
<td>31.7 (5.5)</td>
<td>29.5 (6.0)</td>
<td>34.4 (3.6)</td>
<td></td>
</tr>
<tr>
<td>Median</td>
<td>32</td>
<td>31.5</td>
<td>33</td>
<td></td>
</tr>
<tr>
<td>Range</td>
<td>20-40</td>
<td>20-37</td>
<td>31-40</td>
<td></td>
</tr>
<tr>
<td>Patient’s highest score on Decision Regret Scale</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean (SD)</td>
<td>9.7 (5.4)</td>
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<td></td>
</tr>
<tr>
<td>Median</td>
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<td>6</td>
<td>9.5</td>
<td></td>
</tr>
<tr>
<td>Range</td>
<td>5-24</td>
<td>5-24</td>
<td>5-20</td>
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<tr>
<td>PHQ-9 total score</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Mean (SD)</td>
<td>5.4 (6.0)</td>
<td>7.1 (7.4)</td>
<td>4.2 (4.6)</td>
<td></td>
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<td>Median</td>
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<td>6</td>
<td>2.5</td>
<td></td>
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<tr>
<td>Range</td>
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<td>0 – 24</td>
<td>0 – 11</td>
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<tr>
<td>GAD-7 total score</td>
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<td></td>
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<tr>
<td>Mean (SD)</td>
<td>4.7 (5.3)</td>
<td>5.7 (5.7)</td>
<td>3.9 (5.0)</td>
<td></td>
</tr>
<tr>
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<td>0.5</td>
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<tr>
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<td>0-18</td>
<td>0-12</td>
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</tr>
</tbody>
</table>

*Abbreviations: IES-R, Impact of Events Scale–Revised; PHQ-9, Patient Health Questionnaire-9; GAD-7, Generalized Anxiety Disorder 7-item scale.*

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**Engagement with ICU staff early in the project helped troubleshoot problems in real time.**
the group included in the present study. Future work will be needed to demonstrate this.

ACKNOWLEDGMENTS
We acknowledge Susan Elpers, RN, BSN, CNML, Joy Dyer, MSW, Wanda Keith, RN, and Kenneth Covinsky, MD, for their contributions to intervention development and Mary Austrom, PhD, for guidance on family education. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institute on Aging or the National Institutes of Health.

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Communicating to Help Patients and Families

By Linda Bell, RN, MSN

S
killed communication with patients and their families regarding patients’ care, trajectory, and expected outcomes is an advocacy role for nurses at the bedside. Being able to bridge the gap between what is said by members of the interprofessional team and what patients and their families understand is an opportunity for nurses to lead the way in patient-centered care. This is true during patient rounds, family conferences, or bedside communication. Do not assume that someone else will facilitate these difficult conversations with patients and families. It is important for all nurses to become excellent communicators in order to help patients and their families.

Here’s what you can do:

• Identify a colleague (this can be anyone on the interprofessional team) who demonstrates skilled communication with patients and families.

• Observe your colleague’s interactions to identify how they listen and respond to questions.

• Note how your colleague learns what the patient and family understand about care and patient trajectory.

• Ask to observe a family conference to identify family behaviors that indicate understanding or lack of understanding about the care and treatment plan.

• Develop a script you can use to clarify knowledge and understanding when approaching the patient and family. You can always start with “tell me what you understand about . . . .”

• Question your own assumptions. For example, do not assume that the 80-year-old man is ready for end-of-life care because of his stage in life.

• Debrief your communication experiences with a mentor to find ways to improve your communication skills.

Other helpful resources:


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Background Despite emphasis on identifying personal and clinical characteristics that place patients at higher risk for posttraumatic stress syndrome after intensive care, the extent of screening for the syndrome in intensive care patients is unknown.

Objectives To examine the feasibility and acceptability of a screening tool to detect posttraumatic stress syndrome, screen for the syndrome soon after discharge from intensive care to identify patients at risk for posttraumatic stress disorder, and determine personal and clinical factors related to higher scores on the screening instrument.

Methods A single-center, cross-sectional design was used. At 2 to 4 weeks after hospital discharge, 41 patients treated in an intensive care unit completed the screening instrument and the Screening Experience Questionnaire via telephone. Associations between participants’ characteristics and scores were examined, and screening experiences were described.

Results Participants reported that the screening instrument was easy to understand, caused little distress, and could be completed in an acceptable time frame. Participants reported that they had not been screened via a formal process or received education during or after their stay in the unit. Among the participants, 44% preferred screening in the outpatient setting. Higher scores on the screening tool were associated with history of depression, moderate levels of sedation, and intensive care unit delirium.

Conclusions The majority of intensive care patients most likely are not being screened for posttraumatic stress syndrome despite a higher risk for the syndrome in these patients than in the general population. (American Journal of Critical Care. 2016;25:509-515)
Receiving life-saving interventions in an intensive care unit (ICU) can increase a patient's risk for posttraumatic stress disorder (PTSD). According to a systematic review of 9 studies from 2008 to 2012, the estimated prevalence of PTSD in patients after an ICU stay is 9% to 27%. PTSD is a cluster of symptoms that can include intrusive symptoms, such as reexperiencing the event via nightmares or flashbacks, avoidance of people or places associated with the event, depressed mood, trouble concentrating, irritability, and hypervigilance. In order to meet the diagnostic criteria for PTSD of the Diagnostic and Statistical Manual of Mental Disorders (Fifth Edition), symptoms must persist for at least 1 month and cause distress or dysfunction in social or occupational domains.

Posttraumatic stress syndrome (PTSS) is a commonly used term in PTSD literature. Patients with PTSS manifest many of the symptoms of PTSD but do not meet the full diagnostic criteria. Indeed, the illness of patients who meet all the criteria of the Diagnostic and Statistical Manual of Mental Disorders (Fifth Edition) sooner than 30 days after the traumatic event cannot be formally diagnosed as PTSD; however, eventually PTSS may progress to PTSD. Early identification of patients at risk for PTSD after an ICU stay may improve the patients' long-term psychological outcomes. The purpose of this study was to evaluate a screening tool for PTSS and to describe patients who exhibit symptoms of PTSD earlier than 30 days after a traumatic event.

Factors associated with development of PTSS include patients' characteristics (psychiatric history, age, sex) before the traumatic event, clinical care variables (medications and interventions used in the ICU), and factors after discharge from intensive care, such as social support. In a review of 54 studies, Ratzer et al found that psychopathology before admission to an ICU was an important risk factor for PTSD after ICU care. Ratzer et al also found that younger age, female sex, and lower education level were associated with ICU-induced PTSD.

Evidence increasingly indicates that specific medications given in the ICU to keep patients alive and comfortable increase the risk for PTSD. In a study of 157 ICU patients, longer duration of sedation was the strongest clinical risk factor for PTSD. Additionally, vaspressors and inotropes were associated with higher rates of anxiety. In a systematic review of 26 studies, mechanical ventilation was a consistent risk factor for PTSD after ICU care.

Patients who experienced more traumatic memories (nightmares, hallucinations, panic, memories of pain, and respiratory distress) after an ICU stay reported a higher incidence and intensity of PTSD symptoms than did patients who did not report traumatic memories of an ICU stay. Unfortunately, symptoms may persist long after a patient's ICU experience. In a 2-year prospective study of 56 patients who survived acute lung injury, 62% still had PTSS 24 months after discharge from the ICU. After discharge from an ICU, patients have reported unsettling delusional memories of their hospitalizations interwoven with real events and experienced as intrusive recollections and have experienced flashbacks or nightmares. Delusional memories are more likely to be retained over time than are factual memories and are correlated with development of PTSD in patients who have delusional memories after an ICU stay. Results of research on the relationship between PTSD and clinical characteristics such as length of stay in the ICU and severity of illness are inconclusive.

Patients with PTSS and PTSD have high rates of other medical and psychiatric disorders. In a meta-analysis of 6 studies, PTSD was associated with increased risk for coronary heart disease and autoimmune disorders such as arthritis, rheumatoid arthritis, and psoriasis. In a subsample (5877 adults) of the National Comorbidity Survey, PTSD was a strong comorbid factor with other psychiatric disorders (eg, affective, anxiety, and substance abuse disorders). Myhren et al found that patients with

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**About the Authors**

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Corresponding author: Heather Warlan, UC San Diego Health, 200 West Arbor Dr, MC8949, San Diego, CA 92103-8949 (e-mail: hwarlan@gmail.com).
PTSD after ICU care had a decreased quality of life and that only half had returned to work after 1 year.

Patients with symptoms of PTSD who are identified and treated early may have improved health outcomes. Peris et al.\(^\text{14}\) found that incorporating an intervention including counseling, education, and psychological support for ICU patients before ICU discharge resulted in a lower incidence of PTSD in the group who received the intervention (21\%) than in a control group (57\%). Use of a screening instrument, such as the Post-Traumatic Stress Syndrome 10-Item Inventory (PTSS-10), can be an efficient way to identify patients with PTSD so they can be referred to treatment.\(^\text{15}\) Although we limited our focus to PTSD, the overall psychological health of ICU patients should be assessed. Longitudinal studies\(^\text{16,17}\) on the psychological health of patients after ICU care have indicated that many of the patients continue to experience depressive symptoms and PTSD 1 year after discharge from the unit.

Research is limited on the feasibility and effectiveness of screening patients for PTSD and on the personal and clinical care factors that increase the risk for PTSD. Because of the need to improve detection of early symptoms of PTSD and provide timely treatment, the aims of our study were to examine the feasibility and acceptability of a screening regimen among patients after ICU care, screen for high levels of PTSD soon after ICU discharge to identify patients at higher risk for PTSD, and identify personal and clinical factors related to higher scores on the Post-Traumatic Stress Syndrome 14 (PTSS-14) screening tool.\(^\text{18}\)

### Methods

**Theoretical Framework**

We were guided in the study by the Transactional Theory of Stress and Coping developed by Lazarus and Folkman\(^\text{19}\) that emphasizes the interaction between a person and environmental factors that influence a person’s threat appraisal and coping capacity. The variables in our study were important personal and environmental factors that previous research\(^\text{1,3,5,8-12}\) suggested were linked with the development of PTSD in patients after discharge from the ICU.

**Study Design**

A single-center cross-sectional design was used for the study. All study procedures, including protocols for recruiting participants and obtaining informed consent, were reviewed and approved by appropriate institutional review boards. We recruited a convenience sample of 47 men and women who received care in a 13-bed medical ICU, a 20-bed surgical ICU, or both at a tertiary level academic medical center in San Diego, California. Patients were included if they were 18 years or older, able to read and understand English, had no history of PTSD, and were cared for in the ICU for 24 hours or longer. Patients were excluded if they had a history of traumatic brain injury, currently had altered mental status or delirium (as indicated by the score on the Confusion Assessment Method for the Intensive Care Unit [CAM-ICU] and verification by the primary nurse), were in state custody, or were unable to participate in a telephone interview.

Patients discharged or transferred from the ICU were approached once they had been extubated and off sedation for a minimum of 24 hours. Eligible patients reviewed and signed an informed consent form. Clinical and other demographic data were extracted from medical records. A diagnosis of PTSD cannot be made until 4 weeks after the traumatic event. Therefore, screening was done 2 to 4 weeks after discharge from the hospital to identify participants who might be experiencing PTSD to evaluate the process of screening patients while they are still either in the hospital or at an outpatient clinic. Participants were called 2 to 4 weeks after hospital discharge to complete the PTSS-14 and Screening Experience Questionnaire via telephone interview. All participants experiencing stress symptoms at the time of the telephone call were offered referral to treatment.

**Measures**

**Personal and Clinical Characteristics.** Personal characteristics measured were age, sex, marital status, level of education, racial background, and income. Clinical characteristics included psychiatric history, ICU type, total ICU days, total hospital days, sedative dosage range, days sedated, number of vasopressors and days on vasopressors, use of \(\beta\)-blockers, days in restraints, and days of mechanical ventilation. Delirium was measured by using the CAM-ICU score, a valid and reliable measure with high interrater reliability (\(\kappa = 0.96\)).\(^\text{20}\) At this academic medical center, the CAM-ICU is administered at least twice in a 24-hour period by the patient’s primary nurse. The CAM-ICU scores were collected retrospectively from the medical record by the study team.
Participants said that the PTSS-14 instrument was “very easy to understand.”

No formal screening was done for PTSD symptoms in the inpatient or outpatient setting.

**Instruments.** We used the PTSS-14 to identify PTSS. This instrument is a 14-item, 7-level self-report scale based on the Diagnostic and Statistical Manual of Mental Disorders (Fourth Edition). Total scores range from 14 to 98; higher scores indicate a greater level of PTSS; scores of 45 or greater are associated with a PTSD diagnosis. The PTSS-14 has been validated in ICU patients and has a high concurrent validity ($r = 0.86$) when compared with the PTSD Diagnostic Scale. A receiver operating characteristic curve indicated high sensitivity (86%) and specificity (97%); internal consistency at 4 to 14 days after discharge was high at a Cronbach $\alpha$ of 0.89. In our study sample, the Cronbach $\alpha$ for internal consistency reliability was 0.90. Scores on the PTSS-14 were analyzed as a categorical variable. We used a standardized cutoff point in which scores of 45 or higher indicate that a patient most likely meets criteria for PTSD (high) and scores less than 45 indicate that a patient most likely does not meet criteria for PTSD (low).

We used the Screening Experience Questionnaire to collect demographic data not available in the medical record (level of education, race or ethnicity, socioeconomic status, and marital status) and determine the acceptability of administering the PTSS-14. A total of 3 questions and a 5-item Likert scale were used to determine acceptability. The questions were how easily the participant understood the questions, if the questionnaire was completed in an acceptable time frame, and if the participant had experienced any distress in answering the questions. Participants were also asked if they would prefer to fill out the PTSS-14 as an inpatient or outpatient or had no preference. Last, to gain a preliminary understanding of the participant’s experiences in both the inpatient and outpatient setting related to anticipatory guidance, screening, and education for ICU-related PTSS, we asked participants the following questions: Did a nurse or physician talk to you about the risk for stress symptoms as a result of your ICU stay or critical illness? Did a nurse or physician provide any teaching about stress symptoms associated with the ICU?

**Statistical Analysis**

We used descriptive statistics to summarize participants’ characteristics. For the following analyses, scores on the PTSS-14 were dichotomized: 0 for a score less than 45 (low PTSS) and 1 for a score of 45 or greater (high PTSS). We used 1-way analysis of variance to examine whether patients with high PTSS differed significantly from those with low PTSS. The continuous variables and $\chi^2$ tests were used to evaluate relationships between categorical variables. SPSS, version 21, software (IBM SPSS) was used to analyze the data.

**Results**

A total of 47 participants were enrolled in the study from August 2013 to January 2014. Of these, 41 completed the study, 3 died before receiving the study telephone call, and 3 were lost to follow-up. Participants ranged in age from 20 to 91 (mean, 49; SD, 16.3) years. Slightly less than half were married and more than two-thirds were men. The sample was economically, educationally, and racially and ethnically diverse (see Table). A total of 93% of the participants had no history of psychiatric illness; 7% had a history of depression. Among the participants, 59% were treated in the trauma/surgical ICU, 35% in the medical ICU, and 7% in both ICUs. Total ICU days ranged from 1 to 14 (mean, 3.6; SD, 2.6), total hospital days ranged from 2 to 63 (mean, 12; SD, 10.6).

PTSS-14 scores ranged from 15 to 76 (mean, 29.17; SD, 14.59); when the scores were dichotomized, 17% of the sample most likely would meet diagnostic criteria for PTSD. Risk of PTSS was associated with a history of depression ($\chi^2 = 5.6; P = .02$), moderate levels of sedation ($\chi^2 = 9.9; P = .02$), and delirium ($\chi^2 = 7.4; P = .02$; see Table). Participants said that the PTSS-14 instrument was “very easy to understand” (98%), could be “completed in an acceptable period of time” (98%), and caused little (7%) to no (88%) distress. A total of 44% preferred to be screened in the outpatient setting, 32% preferred the inpatient setting, and 24% had no preference. Of the 4 participants who reported being spoken to about PTSD by a nurse or physician, 3 were asked if they were experiencing stress due to their hospital stay. The other participant received anticipatory guidance; a nurse mentioned that this time was stressful and that feeling stress was normal, but to seek help if needed. Despite these 4 reports, no formal screening was done for PTSD symptoms in the inpatient or outpatient setting. None of the 41 participants received education about PTSD after ICU discharge. Additional information obtained during the telephone call interview revealed that patients who preferred to be screened as inpatients thought that being screened once they...
were in stable condition, not experiencing pain, or were being discharged home would be better.

Discussion

Participants in this study reported that the PTSS-14 was easy to complete, caused little distress, and was completed within an acceptable time frame. Peris et al. compared critically ill patients who received psychological treatment (counseling, education, stress management, and coping strategies) during the ICU stay with a control group who received no psychological intervention. The results indicated that the intervention played a role in reducing the likelihood of PTSD and in reducing the need for psychiatric medications at 12 months after discharge from the hospital. Future research is needed to address optimal and cost-effective strategies to provide screening and treatment for patients after an ICU experience. Perhaps the PTSS-14 could be included as part of the hospital discharge process. However, the risk of incurring unnecessary costs associated with referral to mental health specialists too soon for patients who may recover naturally with time must be considered. Potential for unnecessary referral notwithstanding, creating a standard protocol to ensure proper follow-up after hospital discharge for patients who report PTSS symptoms during in-hospital screening is recommended. Some literature exists on ICU discharge clinics, however, no standard practice, protocol, or training is defined or used by the clinics. Patient outcomes associated with the clinics are unknown. Only a handful of these clinics exist in the United States, and only 30% of ICUs in the United Kingdom are associated with a discharge clinic. During the follow-up telephone call, none of our participants reported being formally screened, and none received education about the risk of PTSD after their critical illness. The lack of screening, education, and anticipatory guidance for patients after an ICU stay is concerning because PTSD is associated with a higher risk for physical and psychological comorbid conditions, including cardiovascular disease, autoimmune disorders, and depression, and an increased risk for suicide.

In our study, 7 participants (17%) were in the high category for PTSS, indicating they most likely would meet diagnostic criteria for PTSD. This prevalence rate is similar to the PTSD prevalence rate in larger studies in which either a structured clinical interview or the PTSS-14 was used. Although the majority of participants in our study had scores less than the PTSS-14 cutoff point, indicating no PTSD, several had scores close to the cutoff point, indicating

Table

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>No. (%) of patients</th>
<th>Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High PTSS scorea</td>
<td>Low PTSS scoreb</td>
</tr>
<tr>
<td></td>
<td>(n = 7)</td>
<td>(n = 34)</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>4 (57)</td>
<td>24 (71)</td>
</tr>
<tr>
<td>Female</td>
<td>3 (43)</td>
<td>10 (29)</td>
</tr>
<tr>
<td>Stated racial background</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>5 (71)</td>
<td>17 (50)</td>
</tr>
<tr>
<td>Black</td>
<td>0 (0)</td>
<td>4 (12)</td>
</tr>
<tr>
<td>Latino</td>
<td>1 (14)</td>
<td>9 (26)</td>
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<tr>
<td>East Asian</td>
<td>1 (14)</td>
<td>1 (3)</td>
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<tr>
<td>Middle Eastern or Arab</td>
<td>0 (0)</td>
<td>1 (3)</td>
</tr>
<tr>
<td>Other</td>
<td>0 (0)</td>
<td>2 (6)</td>
</tr>
<tr>
<td>Education level</td>
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<td></td>
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<tr>
<td>Some high school</td>
<td>1 (14)</td>
<td>4 (12)</td>
</tr>
<tr>
<td>High school</td>
<td>2 (29)</td>
<td>10 (29)</td>
</tr>
<tr>
<td>College</td>
<td>3 (43)</td>
<td>13 (38)</td>
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<tr>
<td>Graduate school</td>
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<tr>
<td>Income, $1000</td>
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<td>&lt;20</td>
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<tr>
<td>20-40</td>
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<td>41-60</td>
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<tr>
<td>76-100</td>
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<tr>
<td>&gt;100</td>
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<tr>
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<td></td>
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<tr>
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<td>5 (71)</td>
<td>33 (97)</td>
</tr>
<tr>
<td>Depression</td>
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<td>1 (3)</td>
</tr>
<tr>
<td>Sedative dosage</td>
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<td></td>
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<tr>
<td>No sedation</td>
<td>3 (43)</td>
<td>28 (82)</td>
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<tr>
<td>Light</td>
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<tr>
<td>Moderate</td>
<td>3 (43)</td>
<td>2 (6)</td>
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<tr>
<td>As needed</td>
<td>1 (14)</td>
<td>1 (3)</td>
</tr>
<tr>
<td>Number of vasopressors</td>
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<td></td>
</tr>
<tr>
<td>0</td>
<td>6 (86)</td>
<td>27 (79)</td>
</tr>
<tr>
<td>1</td>
<td>1 (14)</td>
<td>4 (12)</td>
</tr>
<tr>
<td>≥2</td>
<td>0 (0)</td>
<td>3 (9)</td>
</tr>
<tr>
<td>CAM-ICU</td>
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<td></td>
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<tr>
<td>Test not performed</td>
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<tr>
<td>Positive</td>
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<td>7 (21)</td>
</tr>
<tr>
<td>Negative</td>
<td>2 (29)</td>
<td>23 (68)</td>
</tr>
<tr>
<td>β-Blocker used (infusion)d</td>
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<td></td>
</tr>
<tr>
<td>Yes</td>
<td>1 (14)</td>
<td>12 (38)</td>
</tr>
<tr>
<td>No</td>
<td>4 (57)</td>
<td>18 (56)</td>
</tr>
<tr>
<td>As needed for hypertension</td>
<td>2 (29)</td>
<td>2 (6)</td>
</tr>
</tbody>
</table>

In our study, 7 participants (17%) were in the high category for PTSS, indicating they most likely would meet diagnostic criteria for PTSD. This prevalence rate is similar to the PTSD prevalence rate in larger studies in which either a structured clinical interview or the PTSS-14 was used. Although the majority of participants in our study had scores less than the PTSS-14 cutoff point, indicating no PTSD, several had scores close to the cutoff point, indicating
a higher level of stress symptoms, and might benefit from psychological treatment.

Careful screening and detection of PTSS are critical for prevention and early intervention services necessary to prevent a potential mental health disorder in patients at high risk for PTSD after an ICU stay. In our study, participants who had depression before their ICU admission had higher PTSS-14 scores than did participants without depression and were in the high symptoms group. This finding is consistent with previous research\textsuperscript{1} in which a history of depression, as well as a history of other psychiatric illness, was associated with higher rates of PTSD after an ICU stay.

We found no association between PTSS-14 scores and type of ICU to which patients were admitted, number of ICU days, or number of hospital days. These findings support the results of previous research that indicated no association between length of stay and PTSD\textsuperscript{1,27} and that ICU-related PTSD is experienced by patients in both surgical and medical ICUs.\textsuperscript{28} The personal characteristics of age and sex had no association with PTSS in our sample.

We found that delirium was moderately associated with the highest risk for PTSS. Although the causal linkage between delirium and PTSS is unclear, most likely the association is due to disease process, lack of restful sleep, or sedatives used in the ICU.\textsuperscript{1,29} Patients in our sample who received continuous moderate levels of sedatives were at significantly higher risk for PTSS than were patients who had no sedation or light sedation. Our findings are congruent with those of previous studies\textsuperscript{27,30} in which lower rates of PTSS were associated with lower levels of sedation.

Limitations

Our results must be viewed in the context of their limitations. The sample was a purposive convenience sample from a single clinical site. In addition, it was relatively homogenous and not randomly selected or matched, resulting in the potential for selection bias. The small number of participants in the sample precludes use of multivariate analyses that would adjust for the potential confounding effects of history of depression, sedation levels, days of treatment with vasopressors, use of restraints, and intubation on occurrence of PTSS. Patients who remained confused during their hospitalization had to be excluded from the study, and medical records of psychiatric history may not have been complete, leading to a higher percentage than expected of the sample (93%) without a psychiatric history. The cross-sectional design does not allow for effects of change over time and cannot adequately reflect the complex phenomenon under study. Despite these limitations, our study indicated that the use of the PTSS-14 was both a feasible and an acceptable approach to screening patients at high risk for PTSS after an ICU stay. Our results contribute to an understanding of the need to increase the emphasis on screening for PTSS among patients who survive the intensive care experience.

Conclusion

Participants reported that the PTSS-14 was an acceptable screening instrument. Approximately 17% of the participants had high levels of PTSS. We found that high PTSS-14 scores were associated with history of depression, level of sedation, and episodes of delirium. Many variables had positive correlations with higher PTSS scores, but were not statistically significant; risk factors need to be examined further with a larger sample size before changes in clinical practice can be recommended.

PTSS associated with physical and psychiatric comorbid conditions might be prevented if the symptoms are identified early. Further research is needed to address effective strategies in implementing early screening for PTSS, as well as other psychiatric disorders that commonly occur in patients after an ICU stay (eg, depression), and to determine if early identification and referral of at-risk patients can reduce the incidence of PTSD in ICU patients.

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FINANCIAL DISCLOSURES

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Background
Poor sleep quality is common and is associated with poor quality of life and health status in patients with heart failure. However, few investigators have focused on the impact of impaired sleep quality on survival in heart failure.

Objective
To examine whether self-reported sleep quality is associated with prognosis in patients with heart failure.

Methods
The study sample consisted of 204 patients with heart failure. Sleep quality was measured with the Pittsburgh Sleep Quality Index. Poor sleepers were defined as patients with scores greater than 5 on the index. Patients were followed up for a median of 364 days to determine cardiac events (a composite of cardiac death, hospitalizations, or emergency department visits for cardiac reasons). Multivariable Cox proportional hazard regression was used to examine whether poor sleepers were at a higher risk than good sleepers for shorter cardiac event–free survival after covariates were adjusted for.

Results
Of 204 patients, 129 (63%) reported poor sleep quality. Poor sleepers were 2.5 times more likely to have a shorter cardiac event–free survival (95% CI, 1.164-5.556) than were good sleepers after covariates were controlled for.

Conclusions
Impaired sleep quality was prevalent in patients with heart failure and was associated with poor cardiac event–free survival. Clinicians should assess and manage sleep quality in patients with heart failure to improve outcomes. (American Journal of Critical Care. 2016;25:516-525)
More than 5 million adults in the United States have heart failure and experience frequent hospitalizations, poor quality of life, and multiple signs and symptoms. Sleep disturbance is a common finding among patients with heart failure, and up to 94% of patients with heart failure experienced sleep disturbance, from occasionally to almost constantly. In a study in which patients with heart failure were followed up for 1 year after discharge from the hospital, Johansson et al found that sleep disturbance was persistent in 30% of the patients who reported sleep problems at discharge and that sleep disturbance newly occurred in 14% of patients who did not report sleep problems at discharge. Several factors contributing to sleep disturbance in patients with heart failure have been identified, including nocturnal dyspnea, comorbid conditions (eg, chronic obstructive pulmonary disease), sleep-disordered breathing, and medications (eg, β-blockers).

Sleep is a basic human need and has profound effects on brain development, restoration of body and brain function, cognitive function, and psychological status. Poor sleep is adversely related to psychological states, physical functioning, and quality of life. Sleep disturbance, such as chronic sleep deprivation and deviant sleep patterns, contributes to the development and progression of cardiovascular disease by changing immune and inflammatory responses and increasing unhealthy behaviors (eg, overeating). Patients with heart failure report that they experience poor physical and psychological functioning due to sleep problems. Because poor sleep contributes to excessive daytime sleepiness and cognitive dysfunction, poor sleepers are unable to effectively perform self-care. Therefore, sleep problems commonly experienced by patients with heart failure should receive attention to prevent poor outcomes.

Although the duration of sleep is important, the self-reported quality of sleep, a subjective appraisal by individuals of several aspects of sleep (eg, restfulness and depth), is also vital. Among patients with heart failure, as many as 96% have impaired quality of sleep as indicated by self-reports. Heart failure patients with poor quality of sleep have impaired quality of life and higher levels of depressive symptoms. Aside from the marked impact of sleep quality on quality of life and emotional states in patients with heart failure, its effect on prognosis has not been well described, although the relationship between the quality of sleep and prognosis has been reported in other populations of patients.

Therefore, the purpose of this study was to examine whether self-reported sleep quality is associated with prognosis in patients with heart failure. The specific aims were to describe components of self-reported sleep quality and to examine the relationship between self-reported sleep quality and cardiac event–free survival among patients with heart failure.

Methods

Design

We conducted a secondary analysis of data from a longitudinal, observational study to examine the relationship between self-reported sleep quality and prognosis in patients with heart failure. A total of 204 patients who had data on the variables of interest, such as self-reported sleep quality and cardiac events, were included in this analysis.

Sample

Patients with heart failure were recruited from heart failure clinics affiliated with a university-based
The outcome of this study was the composite end point of “time to first cardiac event.”

**Measurements of Variables**

**Sleep Quality.** The Pittsburgh Sleep Quality Index (PSQI) was used to assess self-reported sleep quality. The PSQI is a 19-item, self-reported measure of sleep quality during the preceding month that consists of 7 components: (1) sleep quality, (2) sleep onset latency, (3) sleep duration, (4) habitual sleep efficiency (ratio of hours spent asleep to hours spent in bed), (5) overall sleep disturbances (eg, nocturia, orthopnea, and pain), (6) use of sleeping medications, and (7) daytime dysfunction (“trouble staying awake while engaging in social activity” and “problem of keeping up enough enthusiasm to get things done”). Each subscale is weighted equally on a 0 to 3 scale. Global scores of the PSQI are obtained by summing the scores of the 7 components (ranges, 0-21); higher scores indicate worse sleep quality. A PSQI global score of greater than 5 was used to define a poor sleeper.

**Depressive Symptoms.** The Beck Depression Inventory-II was used to assess depressive symptoms. The inventory consists of 21 items to measure intensity of depressive symptoms indicated by self-report. Each item is rated with a 4-point Likert scale (0-3), and total scores can range from 0 to 63, with higher scores indicating more severe depressive symptoms. Depressive symptoms were categorized as absent (0-12), mild (13-19), moderate (20-28), or severe (≥29).

**Demographic and Clinical Variables.** Information on age, sex, living arrangement, cause of heart failure, New York Heart Association (NYHA) functional class, left ventricular ejection fraction, and prescribed medications were collected via interviews with patients and review of medical records by trained research nurses. A structured interview was used by research nurses to determine NYHA functional class. Height and weight were measured by using professional grade stadiometers and calibrated scales. Body mass index was calculated as weight in kilograms divided by height in meters squared.

**Statistical Analyses**

Sample characteristics of good and poor sleepers were compared by using independent t tests or χ² analysis as appropriate. Cox proportional hazards regression was used to determine the prognostic effect of self-reported sleep quality on length of cardiac event–free survival. Sleep quality was entered as a continuous variable and as a dichotomous variable (good vs poor sleepers) in Cox proportional hazards regression models. Covariates included in multivariable Cox proportional hazards regression models were age, sex, ethnic background, depressive symptoms, and NYHA class, which are associated with self-reported sleep quality and survival. Kaplan-Meier curves with log-rank tests were constructed. All statistical analyses were done by using SPSS, version 20.0, software (IBM SPSS).
Results

Sample Characteristics
The sample of 204 patients was predominately male and white, and most lived with someone (Table 1). The mean age of the sample was 62 years (range, 35-97 years). The majority of the patients were NYHA functional class I/II and obese class I (mean body mass index, 30.5). One-fourth of the patients were currently smoking or had quit within 1 year before the study enrollment. About 6% of the patients were heavy drinkers.

Among the 204 patients, 129 (63%) reported poor sleep quality (PSQI > 5). Compared with poor sleepers, good sleepers were more likely to be nonwhite, less depressed, and NYHA class I/II (Table 1).

Description of Sleep Quality
Each component of sleep quality is illustrated in Figure 1. Approximately 29% of the patients reported their overall sleep quality as fairly bad to very bad in response to the question “How would you rate your sleep quality overall during the past month?” Of 71 patients who needed more than 30 minutes to get to sleep, 53 (75%) had experienced difficulty falling asleep 3 or more times a week during the previous month. The majority of patients...
Figure 1 Components of sleep quality (N = 204).
(53%) had habitual sleep efficiency (i.e., the proportion of time for actual sleep over the total time spent in bed) of less than 85%. The most common reasons for disturbed sleep, in order, were waking for urination (91%), waking in the middle of the night or early in the morning (90%), snoring or coughing (56%), pain (53%), and breathing problems (44%). A little less than 30% of the patients had taken sleeping medications during the preceding week; of those taking sleeping medications, 70% took them at least 3 times a week. Differences in all components of sleep quality between good and poor sleepers were significant (all \( P < .05 \)) (Table 2).

### Cardiac Event–Free Survival

During the follow-up period (a median of 364 days) 2 patients died because of cardiac reasons, and 51 patients had at least 1 of the following cardiac events: cardiac-related visits to the emergency department and cardiac-related hospitalizations.

**Sleep Quality as a Continuous Variable.** The global scores of the PSQI were independently predictive of cardiac event–free survival after adjustments were made for age, sex, ethnic background, depressive symptoms, and NYHA functional class (hazard ratio, 1.074; 95% CI, 1.001-1.152) (Table 3, Model I). Among covariates entered, female sex (vs male) and NYHA class I/II (vs NYHA III/IV) were associated with a decrease in risk for a cardiac event.

**Sleep Quality as a Categorical Variable.** When patients were grouped as good and poor sleepers on the basis of PSQI scores, survival time differed significantly between good and poor sleepers (log-rank \( \chi^2 P = .01 \); Figure 2). In the Cox regression model, after adjustments were made for covariates, poor sleepers were 2.5 times more likely to have a shorter length of cardiac event–free survival than were good sleepers (hazard ratio, 2.545; 95% CI, 1.164-5.556; Table 3, Model II). Among covariates included in the Cox regression model, age, female sex, and NYHA functional class were predictive of cardiac event–free survival. Older age was associated

### Table 2
Comparison of components of sleep quality between good and poor sleepers (N = 204)

<table>
<thead>
<tr>
<th>Component</th>
<th>No. (%) of patients</th>
<th>( P )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good sleeper ( (n = 75) )</td>
<td>Poor sleeper ( (n = 129) )</td>
<td></td>
</tr>
<tr>
<td><strong>Sleep quality</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Very to fairly good (vs fairly to very bad)</td>
<td>74 (99)</td>
<td>.001</td>
</tr>
<tr>
<td>Sleep onset latency I: time to take to fall asleep ( \leq 30 ) min (vs &gt; 30 min)</td>
<td>69 (92)</td>
<td>.001</td>
</tr>
<tr>
<td>Sleep onset latency II: unable to fall asleep within 30 min during the past month ( \leq ) Once per week (vs &gt; once per week)</td>
<td>70 (93)</td>
<td>.001</td>
</tr>
<tr>
<td>Sleep duration ( \geq 6 ) h (vs &lt; 6 h)</td>
<td>72 (96)</td>
<td>.001</td>
</tr>
<tr>
<td><strong>Habitual sleep efficiency</strong></td>
<td>62 (83)</td>
<td>.001</td>
</tr>
<tr>
<td><strong>Overall sleep disturbances</strong></td>
<td>60 (80)</td>
<td>.001</td>
</tr>
<tr>
<td>Use of sleeping medications</td>
<td>73 (97)</td>
<td>.001</td>
</tr>
<tr>
<td>Not during the past month</td>
<td>72 (97)</td>
<td>.001</td>
</tr>
<tr>
<td><strong>Daytime dysfunction I: trouble staying awake</strong></td>
<td>73 (97)</td>
<td>.01</td>
</tr>
<tr>
<td>Not during the past month</td>
<td>68 (91)</td>
<td>.001</td>
</tr>
<tr>
<td><strong>Daytime dysfunction II: trouble keeping up enough enthusiasm</strong></td>
<td>73 (97)</td>
<td>.001</td>
</tr>
<tr>
<td>Not problem at all (vs only a very slight to very big problem)</td>
<td>68 (91)</td>
<td>.001</td>
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### Table 3
Multivariable Cox regression analysis (N = 204)

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<tr>
<th>Variable</th>
<th>Hazard ratio</th>
<th>( P )</th>
<th>95% CI</th>
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<tr>
<td>Model I</td>
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<td></td>
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<tr>
<td>Age</td>
<td>1.026</td>
<td>.001</td>
<td>1.001-1.052</td>
</tr>
<tr>
<td>Female</td>
<td>0.363</td>
<td>.005</td>
<td>0.180-0.733</td>
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<tr>
<td>White (vs nonwhite)</td>
<td>0.604</td>
<td>.11</td>
<td>0.324-1.126</td>
</tr>
<tr>
<td>Depressive symptoms</td>
<td>1.010</td>
<td>.58</td>
<td>0.974-1.048</td>
</tr>
<tr>
<td>NYHA class III/IV (vs I/II)</td>
<td>2.008</td>
<td>.02</td>
<td>1.117-3.607</td>
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<tr>
<td>Global scores on the PSQI</td>
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<td>.05</td>
<td>1.001-1.152</td>
</tr>
<tr>
<td>Model II</td>
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<td>&lt;.001</td>
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<tr>
<td>Age</td>
<td>1.028</td>
<td>.03</td>
<td>1.002-1.055</td>
</tr>
<tr>
<td>Female</td>
<td>0.352</td>
<td>.004</td>
<td>0.175-0.711</td>
</tr>
<tr>
<td>White (vs nonwhite)</td>
<td>0.539</td>
<td>.06</td>
<td>0.285-1.019</td>
</tr>
<tr>
<td>Depressive symptoms</td>
<td>1.012</td>
<td>.51</td>
<td>0.978-1.046</td>
</tr>
<tr>
<td>NYHA class III/IV (vs I/II)</td>
<td>1.903</td>
<td>.03</td>
<td>1.064-3.404</td>
</tr>
<tr>
<td>Poor sleeper (vs good sleeper)(^a)</td>
<td>2.545</td>
<td>.02</td>
<td>1.164-5.556</td>
</tr>
</tbody>
</table>

Abbreviations: NYHA, New York Heart Association functional class; PSQI, the Pittsburgh Sleep Quality Index.

\(^a\) Poor sleepers had global scores >5 on the PSQI.
with an increased risk for a cardiac event, and female sex and NYHA class I/II were associated with a decreased risk for the cardiac event.

**Discussion**

The major finding of this study was that self-reported quality of sleep was a significant independent predictor of cardiac event–free survival in patients with heart failure. This result calls clinicians’ attention to subjectively reported sleep problems, because more than half of the patients in our study had poor quality of sleep and might be at risk for recurrent visits to the emergency department, hospitalizations, or death.

After controlling for factors associated with survival in heart failure, we found that poor sleepers were 2.5 times more likely to have a cardiac event than were good sleepers. Similar findings were observed in 2 previous studies\(^5\)\(^,\)\(^20\) in which self-reported sleep measures were used to examine the relationship between sleep states and prognosis in patients with heart failure. However, these 2 studies\(^5\)\(^,\)\(^20\) had some methodological issues. Johansson et al\(^1\) used 1 item of the Center for Epidemiological Studies Depression Scale to assess sleep states (ie, Was your sleep restless?). Because that item is designed to provide data on sleep disturbances in the context of depression, its validity for measuring sleep problems in general is questionable, and the result of the study\(^1\) (significant relationship between sleep problems and mortality) should be interpreted cautiously. Although Wang et al\(^20\) found a significant relationship between poor sleep quality and increased number of hospitalizations, the method used to collect the hospitalization data and the length of time patients were followed up is unclear. Thus, our finding that self-reported sleep quality assessed by using a valid measure and a median follow-up of 364 days adds strong evidence of the adverse effect of poor sleep quality on outcomes in heart failure.

The adverse effect of poor quality of sleep on prognosis has been reported not only for patients with heart failure but also for other populations of patients, such as nonfragile older adults and patients with chronic illness.\(^8\)\(^,\)\(^22\)\(^,\)\(^23\)\(^,\)\(^27\) However, the reason sleep quality is associated with prognosis remains unclear. One potential mechanism is the impact of sleep quality on the engagement of patients with heart failure in self-care.\(^6\)\(^,\)\(^28\) Sufficient sleep is important in memory consolidation, so the finding that patients with poor sleep quality experience decreased cognitive function, including decreased memory and attention, is not surprising.\(^17\) Self-care is a complex decision-making process requiring sufficient knowledge and skill,\(^29\) and patients who have sleep deprivation or fragmentation may not be able to obtain and process self-care knowledge learned, interpret changes in symptom status, and make a decision to seek care in a timely manner.\(^6\)\(^,\)\(^28\)\(^,\)\(^30\) As a result of poor self-care performance, patients’ heart failure status may become worse, and hospitalization may be required.\(^6\)

The other potential reason for the relationship between sleep quality and poor prognosis is related to an increase in physiological perturbations such as chronic inflammation and a shift in sympathovagal balance. According to Motivala,\(^10\) impaired sleep contributes to chronic inflammation involved in systemic circulation of inflammatory markers (eg, C-reactive protein and interleukin 6) and sympathetic activation, which results in activation of cytokines and inflammatory markers.\(^10\) Empirical evidence in patients with chronic illness including heart failure supports the relationship between sleep disturbance and the physiological responses just mentioned (eg, sympathovagal imbalance).\(^31\)\(^,\)\(^32\) Among patients with sleep problems due to sleep-disordered breathing, nocturnal intermittent hypoxia is associated with elevated sympathetic activity and hypertension,

![Figure 2](image-url)
endothelial dysfunction via oxidative stress, and adverse cardiac remodeling.14,35 Thus, the physiological consequences of poor sleep may adversely affect prognosis in heart failure.

Of note, 63% of patients in our study were considered poor sleepers (PSQI scores > 5), which is slightly lower than the percentages (65.3%-96.0%) in other studies of patients with heart failure.17-20 Because sleep problems, which result in poor sleep quality, increase with age,36 this difference may be related to the differences in the mean age of the patients in the studies: 62 years in our study and 69 to 74 years in other studies.17-20 However, the prevalence of poor sleepers among patients with heart failure, including the patients in our study, is higher than the prevalence among healthy persons (10%)37 and persons with other chronic illnesses (49%-65%).23,38 The larger number of poor sleepers among patients with heart failure highlights the importance of sleep problems in patients with this illness.

In our study, 51% of the patients had experienced sleep disturbance at least once per week during the preceding month, and 53% had habitual sleep efficiency of less than 85%, indicating that those patients were awake more than 15% of the time spent in bed during the night despite an attempt to sleep. Among reasons for sleep disturbance, urination during the night, waking up in the middle of the night or early in the morning, snoring or coughing, and pain were cited by more than half of the patients in our study. Nocturia has consistently reported as the most prevalent reason for interference with sleep during the night.17-20 Its prevalence can be as high as 86.5% in patients with heart failure.13,38 Patients who often woke up more than twice per night for urination were more likely than other patients to have impaired sleep efficiency and to experience severe daytime sleepiness.39 Because evening doses of diuretics or fluid intake in the late evening contributes to nocturia,19 clinicians need to adjust timing for doses of diuretics and evaluate patients’ patterns of fluid consumption to alleviate nocturia-related sleep disturbance.

Snoring is a typical indication of obstructive sleep apnea.40 Although we did not collect information on sleep-disordered breathing (ie, obstructive and central sleep apnea), sleep-disordered breathing is a common comorbid condition in patients with heart failure.30,40 Sleep-disordered breathing is characterized by repetitive episodes of apnea or hypopnea or both followed by a recovery phase with hyperpnea. Oxyhemoglobin desaturations, frequent arousals, and activation of the sympathetic nervous system during sleep due to sleep-disordered breathing contribute to sleep disruption.30,40

Depressive symptoms and medications that cause daytime sleepiness are modifiable factors associated with impaired sleep.41 Like Riegel et al,41 we found that poor sleepers had higher levels of depressive symptoms than did good sleepers. Although we did not collect data on medications that induce daytime somnolence, we did not find a significant relationship between sleep quality and the prescription of β-blockers, which are associated with somnolence, insomnia, and nightmares.42 Possibly poor sleep quality is responsible for the composite of polypharmacy rather than a single drug associated with sleep disturbance. Thus, clinicians should review patients’ medications that may cause sleep disturbance.

Because sleep is imperative for human survival,7 a full understanding of sleep quality and its impact is important. The significant relationship between poor sleep quality and mortality in heart failure highlights the need for adequate assessment and management of sleep disturbance among patients with heart failure.

Sleep disturbance can be evaluated by using objective (eg, polysomnography and actigraphy) or subjective (eg, PSQI) methods. In sleep research, polysomnography is acknowledged as the gold standard method of measurement to objectively visualize sleep-wake patterns.43,44 However, this method is costly and requires specialized equipment, space, and trained personnel. Actigraphy, which requires a portable small device, is another method for obtaining objective estimates of sleep-wake patterns. Although actigraphy does not provide more sophisticated information on sleep than polysomnography does, the portability of the equipment allows clinicians to assess patients’ general sleep patterns in the patients’ home environments instead of in an unfamiliar laboratory setting.44

Subjective measures of sleep disturbances, such as questionnaires and sleep diaries, can be used to assess sleep disturbance. Although self-reported measures are widely used because of their practicality, patients’ reports of some sleep behaviors (eg, snoring and leg jerks) may not be reliable.43 Unruh et al46 found low correlations between subjective and objective sleep quality (correlations, 0.12-0.30). The limited correlation between self-reported sleep quality questionnaire is a quick tool to determine which patients with heart failure are at risk for a poor prognosis.
and objectively measured sleep may occur because a person’s subjective perception of sleep experiences assessed with self-reports is different from sleep-wake patterns measured with objective tools.27,44 Thus, subjective and objective measures are complementary to each other.

Although assessing sleep with both subjective and objective measures is important to comprehensively understand patients’ sleep, such a dual assessment may not be feasible in a busy clinical setting. Self-reported sleep assessment tools that are short and easy to complete (eg, PSQI) would be an attractive option for clinicians to screen patients for sleep problems, and further detailed diagnostic studies could be done for patients whose self-reported sleep measures indicated sleep disturbance. Because we found a significant relationship between PSQI scores and cardiac events, PSQI may be a useful tool in screening for sleep disturbance among patients with heart failure.

**Limitations**

We did not objectively measure sleep states by using polysomnography or actigraphy. Our interest in this study was self-reported quality of sleep, which is a subjective concept of how individuals judge their sleep states. Martin et al27 found that self-reported sleep was more sensitive than objectively measured sleep quality as a predictor of mortality among older adults after discharge from a rehabilitation unit. Because subjective and objective measures of sleep indicate slightly different aspects of sleep, including both objective and subjective measures is needed for future research to obtain a whole picture of the relationship between sleep disturbances and cardiac outcomes in heart failure. Our study was a secondary analysis of data from an observational study. Consequently, data on certain variables that may influence sleep quality, such as diagnosis of sleep-disordered breathing or history of treatment for other sleep disorders, were not available. Such information should be included in future research.

**Conclusions**

In summary, our results indicate that impaired sleep quality measured by using self-reports is commonly experienced by patients with heart failure and increases the risk for poor prognosis in heart failure. Because sleep quality is a potentially modifiable factor, clinicians should comprehensively assess sleep quality and develop interventions to enhance the quality. Also, our finding that self-assessed sleep quality was predictive of survival free of cardiac events indicates that a simple questionnaire rather than objective measures can be used to quickly gather information on sleep quality in a busy clinical setting.

**ACKNOWLEDGMENT**

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**REFERENCES**


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DIFFERING EFFECTS OF FATIGUE AND DEPRESSION ON HOSPITALIZATIONS IN MEN AND WOMEN WITH HEART FAILURE

By Seongkum Heo, RN, PhD, Jean McSweeney, RN, PhD, Pao-Feng Tsai, RN, PhD, and Songthip Ounpraseuth, PhD

**Background** In patients with heart failure, worsening of signs and symptoms and depression can affect hospitalization and also each other, resulting in synergistic effects on hospitalizations. A patient’s sex may play a role in these effects.

**Objectives** To determine the effects of fatigue and depression on all-cause hospitalization rates in the total sample and in subgroups of men and women.

**Methods** A secondary analysis was done of data collected January 1, 2010, through December 31, 2012 (N=582; mean age, 63.2 years [SD, 14.4]). Data were collected on fatigue, depression, sample characteristics, vital signs, results of laboratory tests, medications, and frequency of hospitalization. Patients were categorized into 4 groups on the basis of the International Classification of Diseases, Ninth Revision: no fatigue or depression, fatigue only, depression only, and both fatigue and depression. General linear regression was used to analyze the data.

**Results** In both the total sample and the subgroups, the number of hospitalizations in patients with both fatigue and depression was greater than the number in patients without either symptom. Among women, the number of hospitalizations in the fatigue-only group and in the depression-only group was greater than that in the group with neither symptom. In men, the number of hospitalizations in the fatigue-only group was greater than that in the group without either symptom.

**Conclusion** Fatigue and depression do not have synergistic effects on hospitalization, but men and women differ in the effects of these symptoms on hospitalization. (American Journal of Critical Care. 2016;25:526-534)
In the United States, the number of patients with heart failure is expected to increase from 5.7 million in 2012 to more than 8 million in 2030. Costs associated with heart failure are expected to skyrocket, from $31 billion in 2012 to $70 billion in 2030. Most of these costs are due to high hospitalization rates, and the reason for about 75% of these hospitalizations is exacerbation of signs and symptoms. About 50% of patients with heart failure are readmitted to hospitals within 6 months. Thus, identifying and managing factors that affect hospitalizations in patients with heart failure are critical.

Fatigue is one of the most common and distressing symptoms in patients with heart failure; about 80% experience it. Evidence indicates that fatigue is significantly related to risk for death. In addition, approximately 80% of hospitalized patients who experience heart failure have fatigue before hospitalization. However, the direct association between fatigue and hospitalizations has not been fully examined. The few investigators who examined factors affecting fatigue found that depression or depressive symptoms were associated with fatigue.

About 30% to 48% of patients with heart failure have depression, and depression has been associated with high rates of hospitalizations in patients with heart failure. In addition, evidence suggests that physical signs and symptoms and depression affect each other. Thus, depression and fatigue may have synergistic effects, culminating in hospitalization. However, these synergistic effects have not been examined in patients with heart failure. Because of the high prevalence of fatigue and depression in patients with heart failure, identifying the possible synergistic effects on hospitalizations is important.

Factors that have been associated with hospitalization and either depression or symptoms of heart failure were selected as covariates for hospitalization and for fatigue and depression. Covariates included were demographic factors (eg, age, sex, race or ethnicity, and body mass index), vital signs (eg, blood pressure and heart rate), comorbid conditions (eg, diabetes mellitus, coronary artery diseases, pulmonary disease, renal disease, and cerebrovascular disease), results of laboratory tests (eg, serum levels of creatinine, sodium, hemoglobin, and troponin I), clinical characteristics (eg, left ventricular ejection fraction and New York Heart Association functional class), and medications. The results of several studies on heart failure have suggested that fatigue, depression, hospitalization rates, and the factors associated with these 2 symptoms and hospitalization rates differ between men and women. Therefore, we examined the effects of fatigue and depression on hospitalization, including synergistic effects, and compared the effects of fatigue and depression on hospitalization between men and women with heart failure. Adjustments were made for demographic factors, vital signs, comorbid conditions, results of laboratory tests, clinical characteristics, and medications. We compared the effects of both fatigue and depression on hospitalization in 4 groups of patients: those without fatigue and depression (no-symptoms group), those with fatigue only (fatigue-only group), those with depression only (depression-only group), and those with both fatigue and depression (both-symptoms group).

Methods
Study Design, Setting, and Procedure
This study was a secondary analysis of a database accessed from the University of Arkansas for Medical Sciences, Little Rock, Arkansas, enterprise data warehouse. The study was approved by the University of Arkansas for Medical Sciences institutional review board. The warehouse provided data on all the study variables from January 1, 2010, through December 31, 2012, on patients who had a diagnosis of heart failure as indicated by codes 428 through 428.9 of the International Classification of Diseases, Ninth Revision (ICD-9). The warehouse team retrieved data on
Depression was defined as a diagnosis of depression as indicated by ICD-9 codes.

Measures

The number of hospitalizations was the number of all-cause hospitalizations from January 1, 2010, through December 31, 2012 (3 years). Fatigue was defined as a diagnosis of fatigue according to ICD-9 codes 780.7 through 780.79 at any time during the 3-year period. The ICD-9 has several diagonses for fatigue, such as code 780.71 (chronic fatigue syndrome) and code 780.79 (other malaise and fatigue, including fatigue and exhaustion). Depression was defined as a diagnosis of depression as indicated by ICD-9 codes 296 through 296.36 and 311 at any time during the study period.

Data on demographic and clinical characteristics were used to describe the sample, and some were used as covariates. Age was calculated by subtracting the date of birth from December 31, 2012. Marital status was categorized as never married, married, divorced, widowed, or separated. Race or ethnicity was categorized as white or other races. We used the means of body mass index, vital signs, results of laboratory tests, and clinical characteristics (left ventricular ejection fraction and New York Heart Association functional class), and medications (angiotensin-converting enzyme inhibitors, β-blockers, and antidepressants). In addition, data on fatigue and depression were retrieved from data on comorbid conditions by using ICD-9 codes.

Results

Sample Characteristics

Sample characteristics are presented in Table 1. The mean age of the total sample was 63.2 (SD, 14.4) years. A little more than half of the sample was male (54.6%) and white (51.2%). The mean number of hospitalizations was 3.4 during the 3 years of the study period, and the mortality rate was 37.3%. About 44% of the sample did not experience either fatigue or depression, 29.7% had fatigue only, 10.7% had depression only, and 15.6% had both fatigue and depression. Thus, 45.3% had a diagnosis of fatigue, and 26.3% had a diagnosis of depression. Men and women differed in the patterns of symptoms. More men (50.5%) than women (36.2%) were in the no-symptoms group, more women (14%) than men (7.9%) were in the depression-only group, and more women (21.1%) than men (11%) were in the both-symptoms group. Characteristics of men and women according to symptom groups are presented in Tables 1 and 2. The both-symptoms group had lower heart rates and longer lengths of stay than did all other groups. The both-symptoms group was older and had lower diastolic blood pressure, higher left ventricular ejection fraction, and more emergency
Table 1
Sample characteristics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Total sample (N = 582)</th>
<th>Men (n = 317)</th>
<th>Women (n = 265)</th>
<th>Statistics</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age, y</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>63.2 (14.4)</td>
<td>61.4 (14.0)</td>
<td>65.4 (15.7)</td>
<td>3.30</td>
<td>.001</td>
<td></td>
</tr>
<tr>
<td><strong>Blood pressure, mm Hg</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Systolic</td>
<td>135.4 (19.6)</td>
<td>133.0 (19.7)</td>
<td>138.2 (19.2)</td>
<td>3.24</td>
<td>.001</td>
<td></td>
</tr>
<tr>
<td>Diastolic</td>
<td>78.8 (12.6)</td>
<td>80.2 (13.3)</td>
<td>77.2 (11.5)</td>
<td>-2.91</td>
<td>.004</td>
<td></td>
</tr>
<tr>
<td><strong>Heart rate, beats per min</strong></td>
<td>81.2 (12.3)</td>
<td>81.4 (12.2)</td>
<td>80.8 (12.3)</td>
<td>-0.58</td>
<td>.56</td>
<td></td>
</tr>
<tr>
<td><strong>Body mass indexa</strong></td>
<td>31.0 (9.1)</td>
<td>30.2 (8.4)</td>
<td>32.1 (9.9)</td>
<td>2.47</td>
<td>.01</td>
<td></td>
</tr>
<tr>
<td><strong>LVEF, %</strong></td>
<td>40.8 (15.1)</td>
<td>37.2 (15.0)</td>
<td>45.0 (14.1)</td>
<td>6.41</td>
<td>&lt;.001</td>
<td></td>
</tr>
<tr>
<td><strong>Serum levels</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Troponin I, ng/mL</td>
<td>0.7 (3.2)</td>
<td>0.7 (3.0)</td>
<td>0.7 (3.5)</td>
<td>0.04</td>
<td>.97</td>
<td></td>
</tr>
<tr>
<td>Albumin, g/dL</td>
<td>3.2 (0.6)</td>
<td>3.2 (0.6)</td>
<td>3.2 (0.6)</td>
<td>-0.34</td>
<td>.73</td>
<td></td>
</tr>
<tr>
<td>Triglycerides, mg/dL</td>
<td>127.9 (90.9)</td>
<td>117.1 (73.4)</td>
<td>141.1 (106.8)</td>
<td>3.10</td>
<td>.002</td>
<td></td>
</tr>
<tr>
<td>Creatinine, mg/dL</td>
<td>1.8 (1.6)</td>
<td>1.9 (1.7)</td>
<td>1.8 (1.6)</td>
<td>-0.48</td>
<td>.63</td>
<td></td>
</tr>
<tr>
<td>Sodium, mEq/L</td>
<td>137.1 (2.9)</td>
<td>136.9 (2.9)</td>
<td>137.5 (2.9)</td>
<td>2.46</td>
<td>.01</td>
<td></td>
</tr>
<tr>
<td>Hemoglobin, g/dL</td>
<td>11.5 (1.8)</td>
<td>11.8 (1.9)</td>
<td>11.0 (1.6)</td>
<td>-5.75</td>
<td>&lt;.001</td>
<td></td>
</tr>
<tr>
<td>Monocytes, x1000/μLb</td>
<td>0.7 (0.3)</td>
<td>0.7 (0.3)</td>
<td>0.7 (0.2)</td>
<td>-2.88</td>
<td>.004</td>
<td></td>
</tr>
<tr>
<td>Neutrophils, x1000/μL</td>
<td>5.7 (2.5)</td>
<td>5.6 (2.5)</td>
<td>5.8 (2.5)</td>
<td>0.65</td>
<td>.52</td>
<td></td>
</tr>
<tr>
<td><strong>No. of hospitalizationsc</strong></td>
<td>3.4 (3.2)</td>
<td>3.3 (3.3)</td>
<td>3.5 (3.2)</td>
<td>1.05</td>
<td>.42</td>
<td></td>
</tr>
<tr>
<td><strong>Length of stay, d</strong></td>
<td>20.7 (26.3)</td>
<td>19.6 (24.6)</td>
<td>21.9 (28.3)</td>
<td>0.82</td>
<td>.29</td>
<td></td>
</tr>
<tr>
<td><strong>No. of ED visitsd</strong></td>
<td>1.8 (3.4)</td>
<td>1.6 (2.7)</td>
<td>2.1 (4.0)</td>
<td>1.85</td>
<td>.06</td>
<td></td>
</tr>
<tr>
<td><strong>Male sex</strong></td>
<td>318 (54.6)</td>
<td>NA</td>
<td>NA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>White race</strong></td>
<td>298 (51.2)</td>
<td>182 (57.4)</td>
<td>116 (43.8)</td>
<td>10.8</td>
<td>.001</td>
<td></td>
</tr>
<tr>
<td><strong>Diabetes mellitus</strong></td>
<td>305 (52.4)</td>
<td>159 (50.2)</td>
<td>146 (55.1)</td>
<td>1.4</td>
<td>.24</td>
<td></td>
</tr>
<tr>
<td><strong>Myocardial infarction</strong></td>
<td>223 (38.3)</td>
<td>129 (40.7)</td>
<td>94 (35.5)</td>
<td>1.7</td>
<td>.20</td>
<td></td>
</tr>
<tr>
<td><strong>CPHD</strong></td>
<td>85 (14.6)</td>
<td>42 (13.2)</td>
<td>43 (16.2)</td>
<td>1.0</td>
<td>.31</td>
<td></td>
</tr>
<tr>
<td><strong>Renal disease</strong></td>
<td>389 (66.8)</td>
<td>212 (66.9)</td>
<td>177 (66.8)</td>
<td>0.0</td>
<td>.98</td>
<td></td>
</tr>
<tr>
<td><strong>Cerebrovascular disease</strong></td>
<td>155 (26.6)</td>
<td>71 (22.4)</td>
<td>84 (31.7)</td>
<td>6.4</td>
<td>.01</td>
<td></td>
</tr>
<tr>
<td><strong>Cancer</strong></td>
<td>145 (24.9)</td>
<td>86 (27.1)</td>
<td>59 (22.3)</td>
<td>1.8</td>
<td>.18</td>
<td></td>
</tr>
<tr>
<td><strong>NYHA class II/III</strong></td>
<td>480 (82.5)</td>
<td>256 (80.8)</td>
<td>224 (84.5)</td>
<td>3.4</td>
<td>.18</td>
<td></td>
</tr>
<tr>
<td><strong>Use of ACE inhibitors</strong></td>
<td>271 (46.6)</td>
<td>154 (48.6)</td>
<td>117 (44.2)</td>
<td>1.1</td>
<td>.29</td>
<td></td>
</tr>
<tr>
<td><strong>Use of β-blockers</strong></td>
<td>367 (63.1)</td>
<td>201 (63.4)</td>
<td>166 (62.6)</td>
<td>0.0</td>
<td>.85</td>
<td></td>
</tr>
<tr>
<td><strong>Use of antidepressants</strong></td>
<td>241 (41.4)</td>
<td>136 (42.9)</td>
<td>105 (39.6)</td>
<td>0.6</td>
<td>.42</td>
<td></td>
</tr>
<tr>
<td><strong>Symptom group</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No symptoms</td>
<td>256 (44.0)</td>
<td>160 (50.5)</td>
<td>96 (36.2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fatigue only</td>
<td>173 (29.7)</td>
<td>97 (30.6)</td>
<td>76 (28.7)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depression only</td>
<td>62 (10.7)</td>
<td>25 (7.9)</td>
<td>37 (14.0)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Both symptoms</td>
<td>91 (15.6)</td>
<td>35 (11.0)</td>
<td>56 (21.1)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deathc</td>
<td>217 (37.3)</td>
<td>114 (36.0)</td>
<td>103 (38.9)</td>
<td>0.5</td>
<td>.47</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: ACE, angiotensin-converting enzyme inhibitor; CPHD, chronic pulmonary heart disease; ED, emergency department; LVEF, left ventricular ejection fraction; NA, not applicable; NYHA, New York Heart Association functional class.

SI conversion factors: To convert triglycerides to mmol/L, multiply by 0.0013. To convert creatinine to μmol/L, multiply by 88.4.

a Calculated as weight in kilograms divided by height in meters squared.

b Monocytes: men, 0.68 (0.24) vs women: 0.74 (0.29).
c Number of hospitalizations from January 1, 2010, through December 31, 2012.
d Number of ED visits from January 1, 2010, through December 31, 2012.

e Number of deaths from January 1, 2010, through December 31, 2012.
department visits than did the no-symptoms group, the depression-only group or the fatigue-only group. Finally, the both-symptoms group had lower systolic blood pressure and more hospitalizations than did the no-symptoms group (Table 2). In addition, more patients in the both-symptoms group

<table>
<thead>
<tr>
<th>Variable</th>
<th>Total (N=582)</th>
<th>No symptom (n=256)</th>
<th>Depression only (n=62)</th>
<th>Fatigue only (n=173)</th>
<th>Both symptoms (n=91)</th>
<th>Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (SD)</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Age, y</td>
<td>63.2 (14.4)</td>
<td>61.6 (14.0)</td>
<td>59.0 (14.1)</td>
<td>64.5 (14.0)</td>
<td>68.1 (15.2)</td>
<td>6.89</td>
</tr>
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<td>&lt;.001</td>
</tr>
<tr>
<td>Blood pressure, mm Hg</td>
<td>135.4 (19.6)</td>
<td>137.9 (22.0)</td>
<td>134.6 (15.6)</td>
<td>133.7 (18.3)</td>
<td>131.8 (16.5)</td>
<td>2.89</td>
</tr>
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<td></td>
<td>.04</td>
</tr>
<tr>
<td></td>
<td>78.8 (12.6)</td>
<td>80.9 (14.4)</td>
<td>78.1 (11.0)</td>
<td>78.1 (10.9)</td>
<td>74.7 (9.5)</td>
<td>6.03</td>
</tr>
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<td></td>
<td></td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Heart rate, beats per min</td>
<td>81.2 (12.3)</td>
<td>81.4 (14.0)</td>
<td>83.8 (11.8)</td>
<td>81.4 (10.4)</td>
<td>78.2 (9.9)</td>
<td>2.81</td>
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<td></td>
<td></td>
<td>.04</td>
</tr>
<tr>
<td>Body mass index&lt;sup&gt;a&lt;/sup&gt;</td>
<td>31.0 (9.1)</td>
<td>31.6 (9.3)</td>
<td>32.6 (12.5)</td>
<td>29.9 (7.8)</td>
<td>30.7 (8.1)</td>
<td>1.82</td>
</tr>
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<td>.14</td>
</tr>
<tr>
<td>LVEF, %</td>
<td>40.8 (15.1)</td>
<td>39.8 (14.9)</td>
<td>43.0 (16.1)</td>
<td>39.6 (14.9)</td>
<td>44.2 (15.0)</td>
<td>2.83</td>
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<td>.04</td>
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<td>Serum levels</td>
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<tr>
<td>Troponin I, ng/mL</td>
<td>0.7 (3.2)</td>
<td>0.9 (3.7)</td>
<td>0.6 (2.0)</td>
<td>0.5 (1.7)</td>
<td>0.8 (4.5)</td>
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<tr>
<td>Albumin, g/dL</td>
<td>3.2 (0.6)</td>
<td>3.2 (0.7)</td>
<td>3.2 (0.6)</td>
<td>3.2 (0.6)</td>
<td>3.1 (0.6)</td>
<td>0.60</td>
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<td></td>
<td>.61</td>
</tr>
<tr>
<td>Triglycerides, mg/dL</td>
<td>128.0 (90.9)</td>
<td>125.4 (83.3)</td>
<td>128.2 (80.8)</td>
<td>126.1 (106.1)</td>
<td>138.7 (86.9)</td>
<td>0.51</td>
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<td>.67</td>
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<tr>
<td>Creatinine, mg/dL</td>
<td>1.8 (1.6)</td>
<td>1.9 (1.5)</td>
<td>1.9 (1.7)</td>
<td>1.8 (1.9)</td>
<td>1.8 (1.9)</td>
<td>0.50</td>
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<td>.68</td>
</tr>
<tr>
<td>Sodium, mEq/L</td>
<td>137.1 (2.9)</td>
<td>137.1 (3.1)</td>
<td>136.7 (3.1)</td>
<td>137.1 (2.8)</td>
<td>137.5 (2.5)</td>
<td>1.15</td>
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<td>.33</td>
</tr>
<tr>
<td>Hemoglobin, g/dL</td>
<td>11.5 (1.8)</td>
<td>11.6 (1.9)</td>
<td>11.1 (1.7)</td>
<td>11.4 (1.7)</td>
<td>11.3 (1.6)</td>
<td>0.96</td>
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<td>.41</td>
</tr>
<tr>
<td>Monocytes, x1000/μL&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.7 (0.3)</td>
<td>0.8 (0.3)</td>
<td>0.7 (0.3)</td>
<td>0.7 (0.2)</td>
<td>0.7 (0.2)</td>
<td>3.75</td>
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<td>.01</td>
</tr>
<tr>
<td>Neutrophils, x1000/μL</td>
<td>5.7 (2.5)</td>
<td>6.1 (2.7)</td>
<td>5.9 (2.7)</td>
<td>5.2 (2.1)</td>
<td>5.5 (2.2)</td>
<td>4.85</td>
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<td>.002</td>
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<tr>
<td>No. of hospitalizations&lt;sup&gt;c&lt;/sup&gt;</td>
<td>3.4 (3.2)</td>
<td>2.4 (1.9)</td>
<td>3.6 (3.0)</td>
<td>4.2 (4.0)</td>
<td>4.5 (4.1)</td>
<td>16.05</td>
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<td>&lt;.001</td>
</tr>
<tr>
<td>Length of stay, d</td>
<td>20.7 (26.4)</td>
<td>14.4 (20.9)</td>
<td>22.4 (24.3)</td>
<td>23.9 (25.1)</td>
<td>30.9 (37.4)</td>
<td>10.84</td>
</tr>
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<td></td>
<td></td>
<td>&lt;.001</td>
</tr>
<tr>
<td>No. of ED visits&lt;sup&gt;d&lt;/sup&gt;</td>
<td>1.8 (3.4)</td>
<td>1.2 (2.4)</td>
<td>1.6 (2.3)</td>
<td>2.1 (3.5)</td>
<td>2.9 (5.3)</td>
<td>6.80</td>
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<td>&lt;.001</td>
</tr>
</tbody>
</table>

Abbreviations: ACE, angiotensin-converting enzyme inhibitor; CHF, chronic pulmonary heart disease; ED, emergency department; LVEF, left ventricular ejection fraction; NYHA, New York Heart Association functional class. SI conversion factors: To convert triglycerides to mmol/L, multiply by 0.0013; to convert creatinine to μmol/L, multiply by 88.4.

<sup>a</sup> Calculated as weight in kilograms divided by height in meters squared.

<sup>b</sup> Monocytes: men, 0.68 (0.24) vs women: 0.74 (0.29).

<sup>c</sup> Number of hospitalizations from January 1, 2010, through December 31, 2012.

<sup>d</sup> Number of ED visits from January 1, 2010, through December 31, 2012.

<sup>e</sup> Number of deaths from January 1, 2010, through December 31, 2012.

<sup>r</sup>2
were women, were white, and had cerebrovascular disease or cancer compared with patients in some of the other 3 groups.

**Effects of Fatigue and Depression on Hospitalization and Factors Associated With Hospitalization**

The symptom group variable was associated with the number of all-cause hospitalizations in the total sample and in subgroups of men and women, after adjustments for demographic characteristics, vital signs, comorbid conditions, results of laboratory tests, clinical characteristics, and medications (Table 3). The both-symptoms group had more hospitalizations than the no-symptoms group did ($t = -5.12$; $P < 0.001$; partial $\eta^2 = .045$) but not more than the depression-only group ($P = .05$) or the fatigue-only group ($P = .39$) in the total sample or in the subgroups of men and women. Thus, fatigue

<table>
<thead>
<tr>
<th>Variable</th>
<th>Total sample (N=582)</th>
<th>Men (n=317)</th>
<th>Women (n=265)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$t$ P 95% CI</td>
<td>$t$ P 95% CI</td>
<td>$t$ P 95% CI</td>
</tr>
<tr>
<td><strong>Blood pressure</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Systolic</td>
<td>-0.43 .67 -0.02 to 0.02 &lt;.001</td>
<td>0.69 .49 -0.02 to 0.04 .002</td>
<td>-1.08 .28 -0.04 to 0.01 .005</td>
</tr>
<tr>
<td>Diastolic</td>
<td>0.51 .61 -0.02 to 0.04 &lt;.001</td>
<td>-1.34 .18 -0.08 to 0.01 .006</td>
<td>1.68 .09 -0.01 to 0.09 .012</td>
</tr>
<tr>
<td>Heart rate</td>
<td>1.08 .28 -0.01 to 0.04 .002</td>
<td>2.45 .02 0.01 to 0.07 .020</td>
<td>-0.84 .40 -0.05 to 0.02 .003</td>
</tr>
<tr>
<td>LVEF</td>
<td>1.72 .09 &lt; -0.01 to 0.04 .005</td>
<td>1.26 .21 -0.01 to 0.04 .005</td>
<td>0.79 .43 -0.02 to 0.04 .003</td>
</tr>
<tr>
<td>NYHA class</td>
<td>2.71 .007 0.22 to 1.38 .013</td>
<td>2.42 .02 0.18 to 1.76 .020</td>
<td>1.64 .10 -0.15 to 1.62 .011</td>
</tr>
<tr>
<td>Use of ACE inhibitors</td>
<td>-0.78 .44 -0.69 to 0.30 .001</td>
<td>0.47 .64 -0.86 to 0.53 .001</td>
<td>-0.26 .79 -0.81 to 0.62 &lt;.001</td>
</tr>
<tr>
<td>Use of ß-blockers</td>
<td>1.66 .10 -0.08 to 0.95 .005</td>
<td>1.03 .30 -0.34 to 1.09 .004</td>
<td>1.10 .27 -0.33 to 1.18 .005</td>
</tr>
<tr>
<td>Use of antidepressants</td>
<td>0.12 .90 -0.44 to 0.51 &lt;.001</td>
<td>-0.51 .61 -0.84 to 0.50 .001</td>
<td>0.43 .67 -0.54 to 0.84 .001</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>2.18 .03 0.06 to 1.09 .009</td>
<td>2.59 .01 0.23 to 1.66 .023</td>
<td>0.78 .44 -0.46 to 1.07 .003</td>
</tr>
<tr>
<td>Myocardial infarction</td>
<td>2.37 .02 0.11 to 1.14 .010</td>
<td>0.32 .75 -0.62 to 0.86 &lt;.001</td>
<td>3.45 .001 0.56 to 2.07 .048</td>
</tr>
<tr>
<td>CHF</td>
<td>2.94 .003 0.34 to 1.70 .015</td>
<td>1.26 .21 -0.36 to 1.63 .005</td>
<td>2.98 .003 0.48 to 2.37 .036</td>
</tr>
<tr>
<td>Renal disease</td>
<td>3.24 .001 0.37 to 1.50 .019</td>
<td>1.07 .29 -0.36 to 1.23 .004</td>
<td>3.96 &lt;.001 0.84 to 2.50 .062</td>
</tr>
<tr>
<td>Cerebrovascular disease</td>
<td>3.38 .001 0.40 to 1.52 .020</td>
<td>2.69 .008 0.30 to 1.96 .024</td>
<td>1.50 .14 -0.18 to 1.34 .009</td>
</tr>
<tr>
<td>Cancer</td>
<td>1.42 .16 -0.16 to 1.01 .004</td>
<td>0.94 .35 -0.44 to 1.24 .003</td>
<td>1.00 .32 -0.42 to 1.30 .004</td>
</tr>
<tr>
<td>Serum levels</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Troponin I</td>
<td>-0.94 .35 -0.11 to 0.04 .002</td>
<td>-0.40 .69 -0.14 to 0.09 .001</td>
<td>-1.05 .30 -0.16 to 0.05 .005</td>
</tr>
<tr>
<td>Albumin</td>
<td>-0.16 .87 -0.46 to 0.39 &lt;.001</td>
<td>0.27 .79 -0.53 to 0.70 &lt;.001</td>
<td>-0.47 .64 -0.77 to 0.47 .001</td>
</tr>
<tr>
<td>Triglycerides</td>
<td>-1.98 .05 &lt; -0.01 to -0.01 .007</td>
<td>-1.54 .12 -0.01 to &lt;0.01 .008</td>
<td>-1.34 .18 -0.01 to &lt;0.01 .008</td>
</tr>
<tr>
<td>Creatinine</td>
<td>3.34 .001 0.12 to 0.45 .020</td>
<td>4.03 &lt;.001 0.24 to 0.68 .053</td>
<td>0.20 .84 -0.23 to 0.28 &lt;.001</td>
</tr>
<tr>
<td>Sodium</td>
<td>-0.97 .34 -0.13 to 0.04 .002</td>
<td>0.57 .57 -0.09 to 0.16 .001</td>
<td>-1.25 .21 -0.21 to 0.05 .007</td>
</tr>
<tr>
<td>Hemoglobin</td>
<td>-2.55 .01 -0.38 to -0.05 .012</td>
<td>-1.37 .17 -0.37 to 0.07 .006</td>
<td>-2.35 .02 -0.57 to -0.05 .023</td>
</tr>
<tr>
<td>Monocytes</td>
<td>-0.40 .69 -1.28 to 0.85 &lt;.001</td>
<td>-0.56 .57 -1.80 to 1.00 .001</td>
<td>-0.36 .72 -2.08 to 1.44 .001</td>
</tr>
<tr>
<td>Neutrophils</td>
<td>1.19 .23 0.05 to 0.19 .003</td>
<td>1.92 .06 -0.01 to 0.33 .013</td>
<td>0.23 .82 -0.15 to 0.19 &lt;.001</td>
</tr>
<tr>
<td>Symptom group</td>
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</tr>
<tr>
<td>No symptoms</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Depression only</td>
<td>-1.94 .05 -1.89 to 0.01 .001</td>
<td>1.39 .17 -2.71 to 0.47 .007</td>
<td>-1.39 .17 -2.00 to 0.34 .008</td>
</tr>
<tr>
<td>Fatigue only</td>
<td>-0.86 .39 -1.06 to 0.42 .001</td>
<td>-0.61 .54 -1.54 to 0.81 .001</td>
<td>0.02 .98 0.97 to 0.99 &lt;.001</td>
</tr>
<tr>
<td>Both symptoms</td>
<td></td>
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</tr>
</tbody>
</table>

Abbreviations: ACE, angiotensin-converting enzyme inhibitor; CHF, chronic pulmonary heart disease; LVEF, left ventricular ejection fraction; NA, not applicable; NYHA, New York Heart Association functional class.

SI conversion factors: To convert triglycerides to mmol/L, multiply by 0.0013. To convert creatinine to umol/L, multiply by 88.4.

$^a$ Calculated as weight in kilograms divided by height in meters squared.
and depression had no synergistic effects on the number of all-cause hospitalizations. In additional analyses (no table), in the total sample, the depression-only group and the fatigue-only group had more hospitalizations than the no-symptoms group did. The statistics were $t = 2.28, P = .02$, partial $\eta^2 = .009$ for depression only, and $t = 5.36, P < .001$, and partial $\eta^2 = .050$ for fatigue only. Among men, the fatigue-only group had more hospitalizations than the no-symptom group did ($t = 3.78; P < .001$; partial $\eta^2 = .047$), but the depression-only group did not ($P = .23$). In contrast, among women, the fatigue-only group and the depression-only group had more hospitalizations than the no-symptom group did. The statistics were $t = 4.56, P < .001$, and partial $\eta^2 = .081$ for the fatigue-only group, and $t = 2.07, P = .04$, and partial $\eta^2 = .018$ for the depression-only group.

Furthermore, differences were found between men and women in the factors associated with the number of all-cause hospitalizations (Table 3). In addition to symptom group, in men, age, heart rate, New York Heart Association functional class, diabetes mellitus, cerebrovascular disease, and creatinine level were associated with the number of all-cause hospitalizations, whereas in women, age, myocardial infarction, chronic pulmonary heart disease, renal disease, and hemoglobin level were associated with the number of all-cause hospitalizations.

**Discussion**

Our findings indicate the importance of fatigue and depression in all-cause hospitalizations in patients with heart failure. The both-symptoms group did not have more hospitalizations than did the fatigue-only group or the depression-only group but did have more hospitalizations than did the no-symptom group. Thus, fatigue and depression did not have synergistic effects on the number of hospitalizations. Our findings also indicate the importance of the diagnoses of fatigue and depression in the number of all-cause hospitalizations and differences between men and women in the relationships between these 2 symptoms and hospitalization. A diagnosis of fatigue was significantly associated with a greater number of all-cause hospitalizations in both men and women, whereas a diagnosis of depression was significantly associated with a greater number of all-cause hospitalizations in women only. Thus, fatigue needs to be addressed in patients with heart failure, and depression needs to be managed, especially in women.

Approximately 80% of patients with heart failure have reported that they experienced fatigue, and approximately 44% reported that they had profound fatigue. Among our sample, approximately 45% of the patients had a diagnosis of fatigue. Investigators have found that fatigue is one of the most distressing symptoms for patients with heart failure. Fatigue is also associated with mortality risk in heart failure patients. However, the relationship of fatigue to hospitalization previously had not been fully examined. The findings of the earlier study and of our study indicate the important roles of fatigue in hospitalization and mortality. Thus, fatigue should be assessed and managed appropriately in patients with heart failure to reduce hospitalization and mortality rates and, in turn, reduce costs. Compared with dyspnea, fatigue improved less during hospitalization, and patients with fatigue at baseline had more experience of worst symptoms at 6 month follow-up ($P = .002$). These findings imply that more active assessment, diagnosis, and management of fatigue are needed to lessen fatigue over time. Even though fatigue was reported as one of the most distressing symptoms, not many researchers have investigated factors associated with fatigue. Fink et al and Evangelista et al found that depression, physical health, and hemoglobin were associated with fatigue.

In addition to the both-symptoms group and the fatigue-only group, the depression-only group had more all-cause hospitalizations than did the no-symptoms group in the total sample and in the subgroup of women. When we combined data on the depression-only group with data on the both-symptoms group, more women (35%) had a diagnosis of depression than did men (19%), and the prevalence of depression in the total sample was approximately 26%. In other studies, prevalence indicated by depressive symptom questionnaires in patients with heart failure has ranged from approximately 30% to 50%. Depression is known to affect hospitalization and mortality in patients with heart failure. In addition, the evidence suggests that physical signs and symptoms and depression affect each other. Despite the adverse effects of depression on hospitalization, mortality, and physical signs and symptoms, diagnosis and management of depression may be inappropriate in patients with heart failure.

Among our sample, 26% had a diagnosis of depression, and 41% were taking antidepressants.
These findings are comparable to those of Jiménez et al. In their study of patients with heart failure, approximately 23% of the patients had a diagnosis of depression, 33% were taking antidepressants, and 43% had depressive symptoms, according to scores on the Beck Depression Inventory. Jiménez et al also found that 26% of the patients who took antidepressants did not have a diagnosis of depression when the patients started to take the medications and that cardiologists did not often prescribe antidepressants. Our findings and those of Jiménez et al indicate that clinicians, including cardiologists, need to assess depression more actively, especially in women. Furthermore, in the study by Jiménez et al, even though the percentage of patients taking antidepressants was higher than the percentage of patients with a diagnosis of depression, 64% of the depressed patients still had mild to moderate depressive symptoms according to scores on the Beck Depression Inventory. In a study by Faris et al, even though 60% of clinically depressed patients with heart failure were taking antidepressants, the depressed patients had higher morality and hospitalization rates than did nondepressed patients (36% vs 16%, \( P = .004 \) and 87% vs 74%, \( P = .03 \), respectively). Thus, more effective treatment and interventions are needed to prevent or reduce the adverse effects of depression on hospitalization and mortality in patients with heart failure.

We found some differences between men and women in factors associated with all-cause hospitalization. Factors associated with number of hospitalizations were age, functional status, comorbid conditions, creatinine level, and symptom group in men and age, comorbid conditions, hemoglobin level, and symptom group in women. The comorbid conditions associated with hospitalization differed between men and women. Thus, these differences should be considered during the development of interventions to reduce hospitalization in these patients.

Our study had some limitations. Patients who were included in the analysis had more fatigue and depression and more severe functional impairment than did those who were excluded. Thus, the generalizability of our findings may be limited. The diagnoses of fatigue and depression were based on data in medical records. In patients with heart failure, the percentage of patients with depression diagnosed by health care providers was less than the percentage of patients with depressive symptoms assessed via a self-report depressive symptom questionnaire. Thus, the diagnoses of fatigue and depression might not reflect patients’ actual symptom status of fatigue and depression. Dekker has divided depressive symptoms into cognitive-affective symptoms and somatic symptoms. Somatic symptoms may overlap with fatigue symptoms, even though when patients with heart failure described depression, they reported cognitive-affective symptoms, not somatic symptoms. Because depression in our study was based on ICD-9 codes, we could not separate depression into cognitive-affective symptoms and somatic symptoms to examine whether symptoms of fatigue and depression overlapped or not. However, our sample included both white patients and patients of other races or ethnic groups and both men and women, and our findings provide a good picture of the relationships of fatigue and depression to hospitalization in heart failure patients with severe conditions. Further studies are needed to develop and test interventions to lessen fatigue and depression and, in turn, reduce hospitalizations of patients with heart failure.

**ACKNOWLEDGMENTS**

The content of this article is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

**FINANCIAL DISCLOSURES**

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**REFERENCES**


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Effect of ABCDE Bundle Implementation on Prevalence of Delirium in Intensive Care Unit Patients

By Mandy Bounds, RN, MSN, CCRN, Stacey Kram, RN-BC, DNP, PCCN, CCRN, Karen Gabel Speroni, RN, PhD, MHSA, Kim Brice, RN, MSN, CCRN, Mary Anne Luschinski, RN, CCRN, Stephanie Harte, PT, MPT, and Marlon G. Daniel, MHA.

Background
The ABCDE bundle incorporates multidisciplinary measures to improve and/or preserve patients’ physical, functional, and neurocognitive status through awakening and breathing coordination, delirium prevention and management, and early physical mobility.

Objectives
To quantify the prevalence and duration of delirium in patients in the intensive care unit (ICU) before and after implementation of the ABCDE bundle.

Methods
Delirium prevalence was defined as the percentage of patients who had at least 1 positive delirium score on the Intensive Care Delirium Screening Checklist (ICDSC) during the ICU stay; delirium duration was the number of days during the ICU stay that a positive ICDSC score was noted. Retrospective data were collected from before and after implementation of the ABCDE bundle.

Results
Of the 159 records reviewed (80 before and 79 after bundle implementation), most were for white men (mean age, 66.3 years). After implementation of the ABCDE bundle, the prevalence of delirium decreased significantly (from 38% to 23%, \( P = 0.01 \)) and the mean number of days of delirium decreased significantly (from 3.8 to 1.72 days, \( P < 0.001 \)). The number of patients with delirium-free stays increased after bundle implementation.

Conclusions
Delirium in the intensive care unit (ICU) affects 60% to 80% of patients receiving mechanical ventilation and 20% to 50% of patients who are not receiving mechanical ventilation. Patients in the ICU with delirium are at a greater risk for prolonged mechanical ventilation, catheter removal, self-extubation, use of restraints, longer hospital stays, increased hospital costs, and death. The odds of being discharged to another institution rather than being discharged to home also are higher for patients who have delirium while hospitalized.

Because of the multiple associated risks and adverse outcomes that may result from delirium, strategies to reduce the prevalence and duration of delirium should be implemented in ICUs. Delirium prevalence is defined as the percentage of patients who had at least 1 positive delirium screening during the study period. Delirium duration is defined as the number of ICU days with a positive delirium assessment. A not-for-profit, rural, 2-hospital community health care system with a total of 18 ICU beds had a mean delirium prevalence of approximately 24% based on monthly prevalences of 21% to 32% between December 2012 and July 2013.

At a national critical care conference in 2012, the research team heard of an evidence-based bundle of care to improve patients’ outcomes and wanted to deliver best practices and optimal care for patients in this rural health care system. The research team also wanted to prevent and manage delirium in the ICUs because of its harmful and long-term effects on patients. Because of the varying prevalence of delirium at our hospitals, evidence-based methods to prevent and manage delirium for ICU patients were needed. Before initiation of this study, these medical centers did not quantify the duration of delirium.

A review of the literature was completed by searching CINAHL, MEDLINE, Cochrane, and PubMed databases from 2009 to 2014. Search terms used were delirium, intensive care unit, ICU, ABCDE protocol, and restraints. Additional studies found in the reference lists of the research articles examined during the literature review also were reviewed. The body of evidence regarding the prevention and management of delirium strongly suggested implementation of the ABCDE bundle. The bundle incorporates multidisciplinary measures to improve and/or preserve patients’ physical, functional, and neurocognitive status: awakening and breathing coordination, delirium prevention and management, and early physical mobility; some institutions adopt choice of sedation and analgesia for the C component as well. Incorporation of each of the ABCDE bundle components into practice on a daily basis in the ICU setting is an evidence-based strategy to effectively prevent delirium or minimize the prevalence of delirium. Table 1 provides additional information on the ABCDE bundle components summarized from Balas and colleagues.

Although the ABCDE bundle is effective, the data demonstrating the bundle’s effectiveness in reducing delirium prevalence and duration are limited, particularly in smaller/rural hospital settings, where the bundle can be more complex to implement because of its requirements for participation of professionals from various disciplines. Further research was warranted to evaluate use of the ABCDE bundle in a rural hospital system. Although components of the bundle had been implemented or partially implemented within the ICUs at both system hospitals, the ABCDE bundle had not yet fully been implemented within the interprofessional team (Table 2) in either ICU. The interprofessional team

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**About the Authors**

Mandy Bounds is a former nurse manager at University of Maryland Shore Medical Center at Dorchester, Cambridge, Maryland. Stacey Kram is a former nurse manager at University of Maryland Shore Regional Health, Easton, Maryland. Karen Gabel Speroni is chair of the nursing research council, University of Maryland Shore Regional Health. Kim Brice is an intensive care unit (ICU)/telemetry clinical educator/ICU staff nurse at University of Maryland Shore Medical Center at Easton, Easton, Maryland. Mary Anne Luschinski is an ICU staff nurse at University of Maryland Shore Medical Center. Stephanie Harte is a former physical therapist at University of Maryland Shore Medical Center at Easton and Dorchester. Marlon G. Daniel is a biostatistician at University of Maryland Shore Regional Health.

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### ABCDE bundle components

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
</table>
| **A, Sedation awakening trial (SAT)** | All patients receiving mechanical ventilation have an SAT at a minimum of every 24 h after a successful SAT safety screening. A patient has a successful SAT safety screening if the following criteria are met:  
- No active seizures  
- No alcohol withdrawal  
- No agitation  
- No paralytic agents/neuromuscular blockers  
- No myocardial infarction in past 24 h  
- Normal intracranial pressure (ICP)  
A patient has an unsuccessful SAT if any of the following criteria are met:  
- Anxiety, agitation, or pain  
- Respiratory rate >35/min  
- Peripheral oxygen saturation (${\text{Sp}}_{\text{O}_2}$) < 88% for more than 5 min  
- Acute cardiac arrhythmia  
- 2 or more signs of respiratory distress  
If a patient has a successful safety screening, start the SAT. If a patient has an unsuccessful SAT safety screening, the SAT will be completed at a minimum in 24 h. |
| **B, Spontaneous breathing trial (SBT)** | All patients receiving mechanical ventilation receive an SBT at a minimum of every 24 h after successful SAT and SBT safety screenings. A patient has a successful SBT safety screening if the following criteria are met:  
- Oxygen saturation > 88%  
- Fraction of inspired oxygen (${\text{Fi}}_{\text{O}_2}$) < 0.50  
- Positive end-expiratory pressure (PEEP) < 8 cm H$_2$O  
- Minute ventilation < 15 L/min  
- Stable airway  
- No agitation  
- No myocardial infarction in past 24 h  
- No changes in ICP (ICP > 15 mm Hg or suspected high ICP)  
- No neuromuscular blockade  
- Systolic blood pressures > 90 mm Hg and < 160 mm Hg  
- Increasing titration of vasopressors  
A patient has an unsuccessful SBT if any of the following criteria are met:  
- Respiratory rate > 30/min or < 12/min  
- Oxygen saturation < 88%  
- Hypertension or hypotension  
- Apnea > 60 s  
- Mental status change  
- Anxiety or agitation, significant or unresolved  
- Acute cardiac arrhythmia  
- 2 or more signs of respiratory distress  
If the patient has a successful SBT, the patient will continue on current sedation and settings for consideration of extubation; this will be discussed during interprofessional rounds. If the patient has an unsuccessful SBT, the patient is placed on previous settings and plans are discussed during rounds. |
| **C, Coordination** | The SAT and SBT are coordinated between the registered nurse and the respiratory care practitioner daily and occur within 90 min of interprofessional rounds. |
| **C, Choice of analgesia and sedation** | Pain assessed every 4 h and as needed. Agitation and sedation assessed every 4 h and as needed, by using the Richmond Agitation-Sedation Scale (RASS). Pain management first priority. Minimal sedation toward a targeted RASS score by using a sedation protocol. Pain and sedation discussed at interprofessional rounds. |
| **D, Delirium prevention and management** | Delirium screening assessment every 12 h using the Intensive Care Delirium Screening Checklist (ICDSC). Delirium score discussed at interprofessional rounds. Nonpharmacological interventions used for prevention and management of intensive care unit delirium: assessment for catheter removal, bed alarms, bundling of care to allow rest periods, cognitive stimulation, covering catheters, tubes, and dressings, educating family/support system, maintaining sleep/wake cycle, reviewing medications, minimizing environmental stimuli, assessing pain, reorientation, range-of-motion exercises, and sensory aids. |
that conducts daily rounds on all patients admitted to the ICU is composed of the intensivist, a registered nurse, a physical therapist, a respiratory care practitioner, an occupational therapist, a pharmacist, and a nursing care coordinator. Interprofessional rounds are conducted twice a day. As the result of a system-wide interprofessional task force, the ABCDE bundle was initiated in September 2013.

The objective of this study was to quantify the prevalence and duration of delirium in ICU patients before and after implementation of the ABCDE bundle. The hypothesis was that the prevalence and duration of delirium would be lower after implementation of the ABCDE bundle than before implementation.

Methods

In this retrospective study, electronic medical records were reviewed to collect data for the same 3 months before (December 2012-February 2013) and after (December 2013-February 2014) implementation of the ABCDE bundle. To account for variations in admissions of ICU patients, such as influenza, the post-implementation period was the same 3 months exactly 1 year after implementation of the ABCDE bundle. The study was reviewed by the institutional review board and was deemed exempt.

The study setting was a rural hospital system’s general medical/surgical ICUs, part of University of Maryland Shore Regional Health. University of Maryland Shore Medical Center at Dorchester has 8 ICU beds and University of Maryland Shore Medical Center at Easton has 10 ICU beds. Both of these hospitals have been designated Magnet hospitals by the American Nurses Credentialing Center. Inclusion criteria were that patients be 18 years of age or older and have stayed in the ICU more than 24 hours. Exclusion criteria were as follows: intracranial pressure increased more than 50% from first ICU measure for hospitalization; quadriplegia; score on Glasgow Coma Scale less than 8 without use of sedatives; comfort measures only as documented in the medical record by medical orders for life-sustaining treatment and/or palliative care; and cardiopulmonary arrest resulting in death.

Standard procedures were followed for all patients. Research procedures included documentation of the following study-related data: demographics; ICU primary and secondary admitting diagnoses; body mass index (calculated as weight in kilograms divided by height in meters squared); length of stay in the ICU and hospital; days of mechanical ventilation; Intensive Care Delirium Screening Checklist (ICDSC) scores; completion and number of awakening/sedation vacation trials; completion and number of spontaneous breathing trials; Richmond Agitation Sedation Scale (RASS) scores; analgesics and sedatives used; early mobility; and other factors reported to be associated with delirium, such as use of restraints and falls.

A total of 80 patients met study eligibility criteria before implementation of the ABCDE bundle. Of the 81 patients who met the eligibility criteria after implementation, 2 were excluded because of incomplete documentation, generating a sample

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### Table 1

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>E, Early physical mobility</td>
<td>Intensive care patients are screened daily for early physical mobility. Nurse performs the following interventions unless contraindicated: passive/active range-of-motion exercises and stretching 3 times daily and turn and reposition every 2 h at minimum. Continuous lateral rotation to maximum angle tolerated for minimum 18 h unless contraindicated. If patient's daily safety screening is successful, physical and occupational therapy begin to provide services for the patient. A patient has a successful early mobility safety screening if the following criteria are met: • Patient responds to verbal stimulation/RASS score between -2 and +2 • Fio2 &lt; 0.60 • PEEP &lt; 10 cm H2O • SpO2 &gt;88% at rest • No increase in dose of vasopressors for at least 2 h • No evidence of active myocardial infarction in past 24 h • No arrhythmia requiring medication in past 12 h • No acute cerebral vascular accident • Normal ICP</td>
</tr>
</tbody>
</table>

The study examined prevalence and duration of delirium before and after implementation of the ABCDE bundle.
### Table 2
Difference between ABCDE bundle components before and after bundle implementation

<table>
<thead>
<tr>
<th>Bundle component</th>
<th>Before implementation (December 2012-February 2013)</th>
<th>Team member type</th>
<th>After implementation (December 2013-February 2014)</th>
<th>Team member type</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Awakening</strong></td>
<td>Sedation awakening trial (SAT) coordination between nurse and RCP in conjunction with spontaneous breathing trial (SBT). Success or lack of success of trials discussed at interprofessional rounds.</td>
<td>Nurse RCP</td>
<td>SAT coordination between nurse and RCP in conjunction with SBT. SAT to occur within 90 min of interprofessional rounds. Success or lack of success of trials discussed at interprofessional rounds.</td>
<td>Nurse RCP</td>
</tr>
<tr>
<td><strong>Breathing</strong></td>
<td>SAT coordination between nurse and RCP in conjunction with SBT for every patient undergoing mechanical ventilation unless clinically contraindicated. Success or lack of success of trials discussed at interprofessional rounds. Standing order for SBT by intensivist for every patient undergoing mechanical ventilation if safety screening is successful and patient has been intubated &gt;24 hours. After SBT, patient placed on pre-SBT ventilator settings.</td>
<td>Nurse RCP Intensivist</td>
<td>SAT coordination between nurse and RCP in conjunction with SBT for every patient undergoing mechanical ventilation unless clinically contraindicated. Standing order for SBT by intensivist for every patient undergoing mechanical ventilation if safety screening is successful. Patient remains on weaning settings until interprofessional rounds unless condition declines as indicated by bundle parameters. SBT to occur within 90 min of interprofessional rounds.</td>
<td>Nurse RCP Intensivist</td>
</tr>
<tr>
<td><strong>Coordination</strong></td>
<td>Coordination of SAT and SBT between nurse and RCP daily on every patient undergoing mechanical ventilation unless clinically contraindicated.</td>
<td>Nurse RCP</td>
<td>Coordination of SAT and SBT between nurse and RCP daily on every patient undergoing mechanical ventilation unless clinically contraindicated.</td>
<td>Nurse RCP</td>
</tr>
<tr>
<td><strong>Choice of analgesia and sedation</strong></td>
<td>Sedation protocol followed. Sedation and analgesia not part of interprofessional rounding tool.</td>
<td>Nurse Intensivist Pharmacist</td>
<td>Sedation protocol revised to be a sedation and analgesia protocol with inclusion of pharmacological practices, including titration of sedatives to targeted Richmond Agitation Sedation Scale (RASS). Sedation and analgesia part of interprofessional rounding tool.</td>
<td>Nurse Intensivist Pharmacist</td>
</tr>
<tr>
<td><strong>Delirium prevention and management</strong></td>
<td>Delirium screening with Intensive Care Delirium Screening checklist (ICDSC). Delirium screening status discussed at interprofessional rounds and in place on rounding tool.</td>
<td>Nurse</td>
<td>Delirium screening with ICDSC. Delirium screening status discussed at interprofessional rounds and in place on tool. Education of intensive care unit (ICU) nurses regarding standard of practice for provision of and documentation of nonpharmacological nursing interventions for ICU patients with delirium (eg, assess for catheter removal, ensure bed alarm present, bundle care to allow periods of rest, cognitive stimulation, cover catheters, tubes, and dressings, early mobilization, education of patient's family and support system, maintain sleep/wake cycle, review medications, minimize environmental stimuli, assess pain, reorient patient frequently, do range-of-motion exercises, and have sensory aids available)</td>
<td>Nurse Intensivist Pharmacist</td>
</tr>
<tr>
<td><strong>Early physical mobility</strong></td>
<td>Incorporated daily physical therapy and occupational therapy on ICU patients with intensivist order.</td>
<td>Nurse Intensivist Physical therapist Occupational therapist</td>
<td>Incorporated daily physical therapy and occupational therapy on every ICU patient who had a successful early mobility safety screening.</td>
<td>Nurse Intensivist Physical therapist Occupational therapist</td>
</tr>
</tbody>
</table>
of 79 patients. Thus a total of 159 patients were included in the final sample for analysis.

Primary variables of interest in this analysis were delirium duration and prevalence, length of stay in the ICU and hospital, and days of mechanical ventilation. Delirium prevalence was operationalized as the percentage of patients with at least 1 positive ICDSC delirium score during their ICU stay. Delirium duration was operationalized as the number of days a patient had a positive ICDSC delirium score while in the ICU. Delirium was measured once per 12-hour shift at specific times of 5 AM and 5 PM. The ICDSC has 99% sensitivity, 64% specificity, and more than 97% interrater reliability and was the screening tool used for delirium screening in the ICUs at this hospital.\textsuperscript{30} The ICU nurses caring for the patients each shift measured the ICDSC score. The direct-care nurses received extensive training in delirium screening, which included delirium education and validated screening tools, ICDSC live education sessions, handouts, self-learning modules, and competency assessment case studies for user validation. The education was provided initially with the rollout of delirium screening in the ICUs in July 2012, with competency validation occurring in November 2012 before the start of the ABCDE study.\textsuperscript{30}

Means and frequencies were used to describe the sample. Both $\chi^2$ and 2-sample $t$ tests were used to assess bivariate statistical associations. Multivariable linear and logistic regression models were used to test for associations between the main independent variable of interest (before and after implementation of the ABCDE bundle) and selected dependent variables while adjusting for predetermined confounders such as age, sex, Charlson Comorbidity Index, and dementia history. Statistical assumptions were tested to ensure validity of the models. Post hoc pair-wise comparison error rates were adjusted by using Bonferroni methods. All statistical assumptions were tested and validated. All analyses were 2-tailed with an $\alpha$ of .05. Analysis was done by using SAS version 9.3 (SAS Institute, Inc) and StatXact version 9 (Cytel Inc).

### Results

In this retrospective study of 159 patients (80 before and 79 after implementation of the ABCDE bundle), most were white men (mean age, 66.3 years). Primary ICU admitting diagnoses were for

<table>
<thead>
<tr>
<th>Variables studied were delirium duration, length of stay, and days of mechanical ventilation.</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Demographic characteristic\textsuperscript{a}</td>
<td>Before bundle implementation ($n = 80$)</td>
<td>After bundle implementation ($n = 79$)</td>
</tr>
<tr>
<td>Male sex</td>
<td>44 (55)</td>
<td>49 (62)</td>
</tr>
<tr>
<td>Race/ethnicity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>61 (76)</td>
<td>65 (82)</td>
</tr>
<tr>
<td>African American</td>
<td>18 (22)</td>
<td>12 (15)</td>
</tr>
<tr>
<td>Other</td>
<td>1 (1)</td>
<td>2 (3)</td>
</tr>
<tr>
<td>Age, mean (SD), y</td>
<td>67.2 (14.6)</td>
<td>65.3 (15.5)</td>
</tr>
<tr>
<td>Primary diagnosis for admission to intensive care unit\textsuperscript{b}</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Respiratory</td>
<td>28 (35)</td>
<td>27 (34)</td>
</tr>
<tr>
<td>Cardiovascular</td>
<td>13 (16)</td>
<td>12 (15)</td>
</tr>
<tr>
<td>Neurological</td>
<td>10 (12)</td>
<td>13 (16)</td>
</tr>
<tr>
<td>Gastrointestinal</td>
<td>12 (15)</td>
<td>10 (13)</td>
</tr>
<tr>
<td>Sepsis</td>
<td>5 (6)</td>
<td>6 (8)</td>
</tr>
<tr>
<td>Metabolic</td>
<td>4 (5)</td>
<td>6 (8)</td>
</tr>
<tr>
<td>Renal</td>
<td>1 (1)</td>
<td>2 (2)</td>
</tr>
<tr>
<td>Other</td>
<td>7 (9)</td>
<td>3 (4)</td>
</tr>
<tr>
<td>Body mass index,\textsuperscript{c} mean (SD)</td>
<td>29.66 (8.00)</td>
<td>28.15 (8.65)</td>
</tr>
<tr>
<td>History of dementia</td>
<td>2 (2)</td>
<td>3 (4)</td>
</tr>
<tr>
<td>No. of diagnoses at admission, median (interquartile range)</td>
<td>4.00 (2.00-5.00)</td>
<td>4.00 (2.00-5.00)</td>
</tr>
<tr>
<td>Charlson Comorbidity Index, mean (SD)</td>
<td>3.03 (2.48)</td>
<td>5.88 (2.85)</td>
</tr>
</tbody>
</table>

\textsuperscript{a} Values in the second and third columns are number (%) unless otherwise indicated in the first column.

\textsuperscript{b} Diagnoses are not mutually exclusive.

\textsuperscript{c} Calculated as weight in kilograms divided by height in meters squared.
conditions categorized as respiratory, cardiovascular, neurological, and/or gastrointestinal. Neither demographic characteristics nor potential confounding baseline variables for history of dementia differed significantly between the groups from before and after implementation of the ABCDE bundle (Table 3). However, patients in the group after implementation of the ABCDE bundle had significantly higher Charlson Comorbidity Indexes ($P < .001$). Other confounding variables for delirium were compared between the 2 groups. Before bundle implementation, 4 total patients were admitted with conditions that may have influenced the development of delirium, including alcohol withdrawal, drug overdose, and encephalopathy. After bundle implementation, 6 total patients were admitted with these same conditions that may have influenced delirium.

The prevalence of delirium decreased significantly after implementation of the ABCDE bundle (from 38% to 23%; $P = .01$). The mean number of days of delirium decreased significantly (from 3.8 to 1.72 days, $P < .001$). The number of patients with delirium-free stays increased significantly (from 31% to 69%; $P < .001$; Table 4) after implementation of the ABCDE bundle.

Length of stay in the ICU or hospital and total days of mechanical ventilation did not differ significantly from before to after bundle implementation (Table 5). Also, the mean number of daily sedation awakening trials (SATs) was the same (2.8) before and after bundle implementation. The SATs were completed 89% of the time in the eligible patients both before and after bundle implementation. The mean number of daily spontaneous breathing trials (SBTs) increased slightly after bundle implementation (from 2.8 to 3.3). The SBTs were completed 96% of the time in the eligible patients before bundle implementation and 88% of the time after bundle implementation. The mean daily RASS score changed slightly after bundle implementation (from -1.01 to -0.72, $P = .21$), indicating slightly less sedation.

Use of sedation and analgesics administered did not change significantly from before to after bundle implementation. Propofol was the primary medication used for sedation both before (41%, 1.7 days) and after (39%, 1.8 days) bundle implementation. The mean number of analgesia days increased significantly after bundle implementation.

The prevalence of delirium decreased significantly after implementing the ABCDE bundle.

### Table 4

<table>
<thead>
<tr>
<th>Delirium and sedation outcomes</th>
<th>Before implementation (n = 80)</th>
<th>After implementation (n = 79)</th>
<th>$P^a$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients with delirium, No. (%)</td>
<td>30 (38)</td>
<td>18 (23)</td>
<td>.01</td>
</tr>
<tr>
<td>No. of days of delirium, mean (SD), range</td>
<td>3.8 (2.9), 1.0-14.0</td>
<td>1.72 (0.8), 1.0-4.0</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Patients with 0 delirium days, No. (%)</td>
<td>50 (62)</td>
<td>61 (77)</td>
<td>.01</td>
</tr>
<tr>
<td>Patients receiving mechanical ventilation, No. (%)</td>
<td>32 (40)</td>
<td>32 (40)</td>
<td>.49</td>
</tr>
<tr>
<td>Patients receiving mechanical ventilation who had delirium, No. (%)</td>
<td>22 (69)</td>
<td>10 (31)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Days of delirium in patients receiving mechanical ventilation, mean (SD), range</td>
<td>2.96 (3.3), 0-14</td>
<td>0.56 (1.0), 0-4</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Patients receiving mechanical ventilation who had 0 days of delirium, No. (%)</td>
<td>10 (31)</td>
<td>22 (69)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Patients not receiving mechanical ventilation who had delirium, No. (%)</td>
<td>8 (17)</td>
<td>8 (17)</td>
<td>.71</td>
</tr>
<tr>
<td>Days of delirium in patients not receiving mechanical ventilation, mean (SD), range</td>
<td>0.42 (1.0), 0-4</td>
<td>0.28 (0.7), 0-2</td>
<td>.23</td>
</tr>
<tr>
<td>Daily RASS score, mean (SD), range</td>
<td>-1.01 (0.8), -3.2 to 0.83</td>
<td>-0.72 (1.3), -3.3 to 2.0</td>
<td>.21</td>
</tr>
</tbody>
</table>

$a$ Adjusted for age, sex, history of dementia, and Charlson Comorbidity Index at admission.
Discussion

Findings from this retrospective analysis demonstrating reduced prevalence and duration of delirium after implementation of the ABCDE bundle are consistent with published reports. Balas and colleagues reported lower prevalence and duration of delirium after implementation of the ABCDE bundle in five adult ICUs in a prospective cohort study. Needham and colleagues reported decreased prevalence of delirium in their ICU as a result of a quality improvement project that focused on reducing heavy sedation and increased staffing with physical and occupational therapists with new consultation guidelines. In a randomized controlled trial, Schwickert and colleagues reported decreased duration of delirium in the ICUs as a result of an early mobility intervention.

In our study, we did not find a significant increase in ventilator-free days as researchers in other studies have reported. \(^{(1,3,8)}\) Girard and colleagues found in their randomized controlled trial that patients in the control group spent more days breathing without ventilator assistance as a result of SAT and SBT coordination. Balas and colleagues also reported more days breathing without ventilator assistance as result of the bundle implementation. Girard et al reported that patients experiencing the SAT and SBT coordination were discharged from the ICU and hospital earlier. We attribute the absence of a significant increase in ventilator-free days from before to after implementation of the ABCDE bundle to the fact that our ICU was already doing SATs and SBTs before the ABCDE bundle was implemented (Table 2).

Regarding the increased use of analgesia after the ABCDE bundle was implemented, these findings were consistent with results reported by Balas et al, who also reported a trend toward increased use of opiates after implementation of the ABCDE bundle. As for early mobility, although implementation of the ABCDE bundle led to a statistically significant increase in the number of patients in the chair position or sitting on the edge of the bed, it did not lead to an increase in the number of patients out of bed. Balas et al reported that ICU patients spend more than 65% of ICU days in bed, even with the early mobility intervention as part of the bundle. A more intensive mobility program may result in better outcomes for ICU patients. More research is needed to determine multidisciplinary barriers to early mobilization and strategies to decrease barriers.

Several components of the ABCDE bundle were partially implemented before this study, to which we attribute the absence of significant changes in length of stay in the ICU and hospital and the lack of increase in the number of ventilator-free days. The major components of the bundle implemented as part of the study included enhanced collaboration between nurses and respiratory care practitioners during SATs and SBTs, a revised sedation protocol with a physician-ordered targeted RASS score and a focus on analgesia, enhanced focus on nonpharmacological management and prevention of delirium, incorporation of daily physical and occupational therapy for every ICU patient who had a successful safety screening for early mobility, and interprofessional collaboration on all components of the bundle at daily rounds (Table 2). The research team attributes the significant outcomes in delirium prevalence and duration to the education and focus on

---

Table 5
Length of stay and ventilator days before and after implementation of the ABCDE bundle

<table>
<thead>
<tr>
<th>Secondary outcomes</th>
<th>Before implementation (n = 80)</th>
<th>After implementation (n = 79)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Days in intensive care unit, mean (SD), range</td>
<td>4.02 (5.0), 1.0-43.0</td>
<td>4.62 (5.1), 1.0-29.7</td>
<td>.47</td>
</tr>
<tr>
<td>Days in hospital, mean (SD), range</td>
<td>9.7 (7.3), 1.7-43.0</td>
<td>11.11 (8.5), 1.4-52.9</td>
<td>.15</td>
</tr>
<tr>
<td>Days of mechanical ventilation, mean (SD), range</td>
<td>4.6 (7.3), 0.3-42.0</td>
<td>5.26 (6.5), 0.3-28.2</td>
<td>.78</td>
</tr>
<tr>
<td>Patients with 0 ventilator days, No. (%)</td>
<td>48 (60)</td>
<td>47 (59)</td>
<td>.55</td>
</tr>
</tbody>
</table>

(from 1.37 to 2.51; \(P = .03\)). The increase in the percentage of patients who received analgesics was not statistically significant (from 44% before to 54% after, \(P = .48\)). Early mobility and falls also were compared. The number of patients assisted to a sitting position, either placed in a chair position using the bed or sitting on the edge of the bed, increased significantly (from 1% to 10%, \(P = .01\)) after the ABCDE bundle was implemented. Neither the percentage of patients assisted out of bed during their ICU stay (35% before vs 33% after, \(P = .62\)) nor the percentage of patients who did not receive any components of the early mobility intervention (14% before vs 13% after, \(P = .19\)) changed significantly from before to after bundle implementation. No falls were documented before and 1 fall was documented after implementation of the ABCDE bundle. Delirium was not present at the time of the fall, and this was a fall without injury.
nonpharmacological methods of preventing and managing delirium that were implemented as part of the bundle and to the scientific and robust methods that work together in a bundle to synergistically affect patients’ outcomes. Since the start of this research study, the ABCDE bundle has been revised to the ABCDEF bundle. The changes to the bundle include the following: A, assess, prevent, and manage pain; B, both spontaneous awakening trials and spontaneous breathing trials; C, choice of analgesia and sedation; D, delirium: assess, prevent, and manage; E, early mobility and exercise; and F, family engagement and empowerment. The research team implemented all components of this bundle for this research study except for the focus on family engagement and empowerment. Additional research to evaluate use of the revised bundle with respect to delirium prevalence is warranted.

Limitations of this analysis include the retrospective nature of the electronic medical record and hence a lack of random assignment. Although it is complex to effectively provide ABCDE in smaller or rural hospitals, the results of this study demonstrate the effectiveness of the bundle. Data in this setting, however, remain limited. Also, the patients in this study were from a rural hospital’s general medical/surgical ICU, so our results may not be generalizable to other types of ICUs. In addition, practice changes (beyond ABCDE) over time are critical unmeasured variables that may explain differences in outcomes from before to after implementation of the ABCDE bundle. Another limitation of this study is the potential variability among nurses regarding delirium screening with the ICDSC.

Conclusions
This retrospective analysis quantifying differences in the prevalence and duration of delirium in ICU patients before and after implementation of the evidence-based ABCDE bundle in a rural setting demonstrated significant decreases. Length of stay in the ICU and hospital and days of mechanical ventilation did not differ significantly from before to after implementation of the ABCDE bundle. From the perspective of evidence-based practice, findings from this analysis are consistent with the findings from other research that indicate that the multidisciplinary ABCDE bundle may be effective in optimizing care delivery to improve patients’ outcomes. Results of this study also show that the ABCDE bundle can be successfully implemented with an interprofessional team in a rural hospital system.

ACKNOWLEDGMENTS
We thank our librarian, Lois Sanger, MLS, and study team member Ramona Taylor, RN, PCNC, ICU staff nurse. We thank Peyman Otmishi, MD, FCCP, for dedication and support with implementation of the ABCDE bundle.

FINANCIAL DISCLOSURES
None reported.

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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) 362-2049; e-mail, reprints@aacn.org.
Background  Improved recognition of patient-ventilator asynchrony may reduce duration of mechanical ventilation.

Objective  To evaluate the effects of education about patient-ventilator synchrony on clinicians’ level of knowledge and patients’ mean duration of mechanical ventilation.

Methods  A quasi-experimental 1-group pretest-posttest study was performed in a 16-bed intensive care unit. Analysis included 33 clinicians and 97 ventilator patients. The intervention consisted of PowerPoint lectures on patient-ventilator synchrony. Data included test scores before and after the education, scores on the Acute Physiology and Chronic Health Evaluation II, and mean duration of mechanical ventilation. Differences in scores before and after education, mean duration of mechanical ventilation, and mean health evaluation scores before and after education were determined by using t tests.

Results  Of the 33 clinicians, 17 were registered nurses and 16 were respiratory therapists. Posttest scores were 63% higher than pretest scores ($P<.001$). Before the lecture, 47 patients had a mean health evaluation score of 21 (SD, 7.8) and mean duration of mechanical ventilation of 5.4 (SD, 4.6) days. After the lecture, 50 patients had a mean health evaluation score of 24.6 (SD, 8.2) and mean duration of mechanical ventilation of 4.8 (SD, 4.3) days. Mean health evaluation score was marginally higher after the lecture ($P=.054$). Mean duration of mechanical ventilation did not differ ($P=.54$).

Conclusions  Clinicians’ test scores increased significantly after patient-ventilator synchrony lectures. Mean duration of mechanical ventilation decreased by 0.6 days and health evaluation scores were marginally higher after the lectures. (American Journal of Critical Care. 2016;25:545-551)
The purpose of mechanical ventilation is to improve oxygenation and ventilation while reversing the underlying disease process that is causing respiratory failure. Optimal oxygenation and ventilation require synchronous interaction between the ventilator and the patient. Patient-ventilator synchrony (see Figure) is defined as harmonious interaction between 2 pumps: the patient’s respiratory system and the ventilator. The patient’s respiratory system is affected by the neuromuscular system and the mechanical properties of the lungs and thorax, and the ventilator is controlled by the operator and the demand valve. Patient-ventilator synchrony can be detected by clinical inspection of the patient and interpretation of breath-to-breath real-time ventilator waveforms.

The opposite of patient-ventilator synchrony is patient-ventilator asynchrony. Patient-ventilator asynchrony was described as early as the 1970s as "fighting the ventilator." More recently, Sassoon and Foster described patient-ventilator asynchrony as mismatching of patient-initiated breaths and ventilator-assisted breaths. Therefore, patient-ventilator synchrony consists of patient-related factors and ventilator-related factors. Patient-related factors include respiratory neural inspiratory time and respiratory system mechanics. Ventilator-related factors are triggering, flow delivery, breath termination, and intrinsic positive end-expiratory pressure (autoPEEP). Triggering is responsible for initiation of the breath. Flow delivery is the rate at which the tidal volume of air is delivered. Breath termination is the end of the ventilator-assisted breath. Last, autoPEEP is gas trapped during dynamic hyperinflation states; that is, an increase in lung volume due to a decrease in expiratory time that is referred to as air stacking.

The main categories of asynchrony in ventilator-assisted breaths are triggering, flow, and rate. The most common asynchrony is ineffective triggering. This asynchrony occurs when a patient’s inspiratory effort does not trigger a machine breath because of inappropriate triggering or flow sensitivity setting, decreased respiratory drive, muscle weakness, or dynamic hyperinflation. Other triggering asynchronies include auto triggering and double triggering. Auto triggering occurs when a patient receives a mechanical breath in the absence of inspiratory effort. This event is due to artifacts in the ventilator, such as motion in the circuit, and cardiac oscillation in the patient. Double triggering is the occurrence of two consecutive inspirations with an interval less than the mean inspiratory time and occurs when the volume and flow settings do not meet the demands of the patient. Rate asynchrony occurs when a patient’s respiratory rate and the ventilator rate are not synchronized. It takes place during the end of the patient’s inspiratory phase and the beginning of the expiratory phase, thus causing asynchrony between the patient’s rate and the ventilator’s rate. Causes of rate asynchrony may be air hunger or neurological injury resulting in an increase in spontaneous rate. Flow asynchrony occurs during inspiration when the ventilator does not meet the flow demands of the patient, thus causing air hunger, which usually occurs in patients with acute respiratory failure.

Several studies have been done on the prevalence of patient-ventilator asynchrony; however, only a few have been focused on standardization of clinical inspection, ventilator waveform analysis, and management of patient-ventilator asynchrony. Chao et al found that greater than 10% of patients receiving mechanical ventilation had indications of triggering asynchrony, with a resultant duration of mechanical ventilation twice that of patients who did not have triggering asynchrony. Similarly, Thille et al found that the presence of triggering asynchrony occurred in one-fourth of patients who were receiving...
mechanical ventilation. In addition, the duration of mechanical ventilation was more than 3 times longer than the duration in patients who did not experience asynchrony. In another study, Thille and Brochard evaluated 3 strategies (reduction in pressure support, reduction in insufflation time, and application of PEEP) for their effects on patient-ventilator asynchrony. Use of these strategies significantly reduced patient-ventilator asynchrony and clinicians’ recognition of asynchrony and resulted in a significant decrease in duration of mechanical ventilation.

In an observational study on the relationship of sedation to patient-ventilator asynchrony, de Wit et al found that ineffective triggering was the most frequent asynchrony (88%). Short cycling and double triggering were the next most frequent asynchronies. Also of note, unlike in the aforementioned studies, the mode of mechanical ventilation, including levels of pressure support, peak inspiratory pressure, plateau pressure, and level of P\textsubscript{CO\textsubscript{2}}, and the presence of chronic obstructive pulmonary disease had no effect on the occurrence of ineffective triggering. In a prospective crossover randomized controlled trial of 14 intubated patients randomly given 25-minute trials of pressure support ventilation and neutrally adjusted ventilator assist who were lightly or deeply sedated, Vachetto et al found increased asynchronies in those patients who were receiving pressure support ventilation and were in deep sedation.

Mellott et al found that among 27 patients, 77% experienced several types of asynchronous events. Similar to the findings of other studies, the most common asynchronous event was ineffective triggering, occurring in 63% of asynchronous events. Mellott et al also identified new asynchronous events during the flow phase that have not been previously reported: variant inspiratory effort, unusual double trigger, combined phase premature termination flow, combined phase double trigger flow, double trigger-premature termination, combined phase active

**Figure** Patient-ventilator synchrony.

Abbreviations: F\textsubscript{IO\textsubscript{2}}, fraction of inspired oxygen; PEEP, positive end-expiratory pressure.
The educational presentation for nurses consisted of a 54-slide PowerPoint presentation. Tennessee. The information on patient-ventilator synchrony and asynchrony was presented in the critical care and respiratory care classrooms. Staff members were included if they were a registered nurse or a registered respiratory therapist not currently in a critical care orientation program. Definitions of asynchrony according to Thille et al,5 Sassoon and Foster,4 Nilsenstuen and Hargett,2 and Waugh et al13 were used for the education.

A 1-hour lecture on patient-ventilator synchrony and asynchrony was given by the investigator (D.L-S.) 7 different times in the critical care classroom, the respiratory care department classroom, and the critical care unit. The educational presentation consisted of a 54-slide PowerPoint presentation for nurses that included definitions of patient-ventilator synchrony and asynchrony; basic mechanical ventilation waveforms and interpretations; synchronous and asynchronous waveforms and interpretations; strategies to improve triggering, flow, and rate asynchronies; measures of oxygenation and ventilation; and ventilator setup and adjustments. The educational presentation for respiratory therapists consisted of the same 54 slides used for nurses plus an additional 23 PowerPoint slides on inspiratory rise time and pressure- and flow-volume loop interpretation. Handouts of the PowerPoint presentation were given to all participants at the beginning of the lecture.

A closed-book pretest was administered before the 1-hour lecture on patient-ventilator synchrony and asynchrony. The pretests were collected immediately after their completion. After the lecture, a closed-book posttest was administered and was collected immediately after the posttests were completed. Answers to the test questions were made known to the staff after completion of the study.

The pretest and the posttest were the same except for the ordering of questions. The content included questions on determinants of patient-ventilator synchrony, phases of patient-ventilator synchrony, causes of patient-ventilator asynchrony, management of patient-ventilator asynchrony, and basic waveform analysis. Each test consisted of 12 questions worth a total of 25 points. Among the questions, 3 were multiple choice (3 points), 1 was true-false (1 point), 1 was check all that apply (8 points), 1 was a matching question (3 points), 5 were waveform analyses (5 points), and 1 was a case study (5 points). Data on patients’ mean duration of mechanical ventilation were collected by personnel in the respiratory care department 1 month before and 1 month after the lecture on patient-ventilator synchrony and asynchrony.

Methods

We conducted a prospective quasi-experimental study. The study was approved by the appropriate institutional review boards, and a waiver of consent and Health Insurance Portability and Accountability Act authorization for the patients in the study was granted by the boards. Because we were evaluating an educational program, both review boards allowed a cover statement to be used instead of a consent form for the staff members in the study. The research was carried out at Methodist University Hospital, an urban teaching medical center in Memphis.
A safety study was conducted in the medical intensive care unit 1 month before and 1 month after the lecture on patient-ventilator synchrony and asynchrony. The inclusion criterion for patients was treatment with mechanical ventilation for 24 hours or longer. Demographic data collected on patients included age, sex, scores on the Acute Physiology and Chronic Health Evaluation (APACHE) II, and the primary cause of respiratory failure.

The effects of the educational lectures on the knowledge of nurses and respiratory therapists were assessed by using paired t tests to detect any difference between pretest and posttest scores. Improvement as a percent increase in the posttest score compared with the pretest score was assessed by using simple t tests and a null value of zero. A 2-sample t test was used to determine whether the duration of mechanical ventilation was the same before and after the educational intervention. The results are depicted as means and standard deviations. Findings were considered significant at \( P = .05 \), without adjustment for multiplicity.

### Results

#### Education Intervention

A total of 33 staff members volunteered to participate in the study: 17 of 30 nurses from the medical intensive care unit and 16 of 44 registered respiratory therapists from the respiratory care department. The mean number of years of critical care experience of the 2 groups was similar (\( P = .06 \)). Mean number of years of critical care experience was 5.8 (SD, 6.1; range, 1-20) for nurses and 13.2 (SD, 14.2; range, 1-40) for respiratory therapists.

For all participants, scores on the posttests were higher than the scores on the pretests (Table 1). For nurses, mean overall scores were 10.3 (SD, 3.2) before the lecture and 15.9 (SD, 3.6) after the lecture. The mean increase in posttest scores compared with pretest scores was 5.6 (SD, 2.9) points (\( P < .001 \)), for a mean improvement of 55% (SD, 60%; \( P = .002 \)). For respiratory therapists, the mean overall pretest score was 14.6 (SD, 4.6) points, and the mean overall posttest score was 20.3 (SD, 2.3) points. The mean increase in the posttest score compared with the pretest score was 5.6 (SD, 3.8) points (\( P < .001 \)), for a mean improvement of 55% (SD, 60%; \( P = .002 \)). Whether measured as points or as a percentage, improvement did not differ between the nurses and the respiratory therapists. For both groups of participants, years of critical care experience was independent of the increase in knowledge as measured by increase in posttest score over the pretest score. Posttest scores increased by 63% (\( P < .001 \)).

### Safety Study

A total of 97 patients were treated with mechanical ventilation during the safety study. Of the 97, a total of 47 were receiving mechanical ventilation the month before the patient-ventilator lectures. In this group of 47, the cumulative mean duration of mechanical ventilation for the month was 5.36 days (252 ventilator days). Fifty patients were treated with mechanical ventilation during the month after the patient-ventilator lectures. The cumulative mean duration of mechanical ventilation for the month after the lectures was 4.8 days (240 ventilator days). Demographic characteristics and main causes of respiratory failure in the 2 groups of patients are given in Table 2.

The mean APACHE score in patients after the lectures was higher than the score in patients before the lectures, but the difference was not significant (\( P = .054 \)). The postlecture group was slightly younger than the prelecture group. The main cause of respiratory failure in both groups of patients was pulmonary. The mean duration of mechanical ventilation represents aggregate data for the 2 groups of patients. Mean duration was 5.4 (SD, 4.6) days for the prelecture group and 4.8 (SD, 4.3) days for the postlecture group (\( P = .54 \)). The postlecture group had a minimal nonsignificant decrease in mean duration of 0.6 days.

### The educational intervention made a significant difference in the posttest scores of nurses and respiratory therapists.
**Table 2**

Patient demographics and mean duration of mechanical ventilation (N = 97)

<table>
<thead>
<tr>
<th>Descriptor</th>
<th>Prelecture (n = 47)</th>
<th>Postlecture (n = 50)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean (SD), y</td>
<td>62.7 (14.6)</td>
<td>58.4 (16.7)</td>
<td></td>
</tr>
<tr>
<td>Male sex, %</td>
<td>47</td>
<td>56</td>
<td></td>
</tr>
<tr>
<td>APACHE II score at admission, mean (SD)</td>
<td>21 (7.8)</td>
<td>24.6 (8.2)</td>
<td>.054</td>
</tr>
<tr>
<td>Main cause of respiratory failure, %</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cardiac</td>
<td>28</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Neurological</td>
<td>17</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>Pulmonary</td>
<td>30</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Gastrointestinal</td>
<td>8</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Renal</td>
<td>2</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Metabolic</td>
<td>13</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Hematologic</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Days of mechanical ventilation, mean (SD)</td>
<td>5.4 (4.6)</td>
<td>4.8 (4.3)</td>
<td>.54</td>
</tr>
</tbody>
</table>

Abbreviation: APACHE, Acute Physiology and Chronic Health Evaluation.

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**Discussion**

Patient-ventilator asynchronies occur frequently in patients treated with mechanical ventilation. The most common asynchrony is ineffective triggering, which is associated with increased morbidity and mortality.\(^9,^{10}\) An asynchronous index of 10% or greater is associated with an increase in duration of mechanical ventilation and an increase in the length of stay in the intensive care unit.\(^{18}\) Clinical inspection and ventilator graphic waveform interpretation of patient-ventilator asynchrony may decrease mean duration of mechanical ventilation and morbidity due to mechanical ventilation. Studies\(^6-^8\) have indicated that increasing the knowledge of patient-ventilator synchrony and interpretation of real-time breath-to-breath waveforms among nurses and respiratory therapists significantly decreased the number of asynchronous events and the duration of mechanical ventilation. In a prospective observational study, Colombo et al\(^9\) found that both physicians who were clinically experienced in waveform analysis and physicians who were not were only able to detect less than one-third of patient-ventilator asynchronies by using flow and airway pressure tracings. In addition, as the rate of asynchronies increased, the rate of detection decreased. Therefore, additional technologies such as esophageal pressure monitoring, diaphragm electrical activity, and BetterCare could aid in identifying more asynchronies that are difficult to detect.\(^8,^{16,19}\)

We found that the patient-ventilator synchrony and asynchrony lectures made a significant difference in the posttest scores of nurses (71%) and respiratory therapists (55%). In the safety study, mean duration of mechanical ventilation was not affected; duration decreased only 0.6 days after the lecture. The APACHE scores were higher in the postlecture group than in the prelecture group, but the difference was not significant (\(P = .054\)).

**Limitations**

Our study had several limitations. First it was a pilot study with a limited power of 33 staff members (17 nurses, and 16 respiratory therapists). All patients treated with mechanical ventilation for more than 24 hours for the month before and the month after the presentation on patient-ventilator synchrony and asynchrony were included in the study. A power analysis will need to be done to estimate adequate sample sizes of staff members and patients receiving mechanical ventilation. Another limitation was that data on mode of mechanical ventilation and level of sedation were gathered for the sample but were not reported. Studies have indicated that certain modes of ventilation and increasing levels of sedation are associated with asynchronous events.\(^9,^{18}\) The fourth limitation was that the pretest and the posttest consisted of the same questions; only the ordering of the questions differed. The time in between the pretest and the posttest was 1.5 hours; therefore, the nurses and the respiratory therapists possibly could have memorized the questions. Future pretests and posttests will need to have different questions with equivalent constructs of patient-ventilator synchrony and asynchrony.

Another limitation of the study was that the clinicians were not directly observed during their interpretations of air flow and airway pressure waveforms reflecting patient-ventilator synchrony and asynchrony. Further studies are needed to evaluate clinicians’ ability to identify patient-ventilator asynchronies according to ventilator waveforms. Collecting aggregate mean duration of mechanical ventilation was also a limitation to the study. Data on mean duration must be collected on all patients.

**Conclusion**

In this study, education on patient-ventilator synchrony and asynchrony had a significant effect on nurses’ and respiratory therapists’ posttest scores. These results support the hypothesis that education on patient-ventilator synchrony and asynchrony would increase knowledge scores of nurses and respiratory therapists. In order to ascertain if such education has an effect on nurses’ and respiratory therapists’ knowledge level at the bedside, direct observations of clinical inspection and waveform interpretation will be required.
ACKNOWLEDGMENTS
This research was done at Methodist University Hospital; Memphis, Tennessee. We acknowledge Dr Mona Wicks and Elizabeth Tornquist for content revisions and Gail Spake for editorial revisions. We also acknowledge the outstanding editorial assistance and support provided by Mr Curtis Roby, MA, during preparation of the manuscript.

FINANCIAL DISCLOSURES
None reported.

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The role of the nurse is to put the patient in the best possible condition for nature to act so healing can occur.

—Florence Nightingale

Notes on Nursing

H ealing is central to the art and science of nursing. To Nightingale,\(^1\) healing involved bringing the body, mind, and spirit together to achieve and maintain integration and balance. Believing that nature—or the environment—can heal, Nightingale was a forerunner in the concept of an optimal healing environment (OHE). As Kreitzer and Zborowsky\(^2\) explained, OHEs are composed of “people,” “place,” and “process.”

The “place” of interest is the critical care environment. Critical care units were created in the 1950s to provide life-sustaining technology. The environment has brought unintended consequences in the form of noxious stimuli such as excessive noise, bright lights, and frequent interruptions due to the necessity for 24-hour care. Since 1960, the mean noise level in hospitals has increased by 26% during the day (from 57 to 72 dB) and 43% at night (from 42 to 60 dB).\(^3\) These circumstances far exceed the recommendations of the World Health Organization (WHO) and the Environmental Protection Agency (EPA), which suggest that hospital sound levels should not exceed 35 to 45 dB during the day and 30 to 35 dB at night.\(^4,5\)

Noise in critical care areas also far exceeds these recommendations. Just imagine how many of these common equipment sounds (with associated decibels) occur simultaneously and repeatedly in critical care: suctioning (50-75 dB), ventilators (60-86 dB), oximeter alarms (60-80 dB), infusion pump alarms (65-84 dB), ventilator alarms (70-85 dB), monitor alarms (73-79 dB), nebulizers (80 dB), connection of gas supply (88 dB), and movement of equipment such as beds, supply carts, and portable radiography machines (77-90 dB). On top of equipment noise, other sources include conversations (60-85 dB), telephones (70-80 dB), televisions (79 dB), pagers (84 dB), closing doors (85 dB), and falling objects (90-92 dB).\(^6-11\) Not surprisingly, noise levels increase when more staff are present, making day shifts and weekdays noisier.\(^9,12,13\)

Unwanted noise has adverse physiological and psychological effects. Studies have shown that noise levels exceeding 40 dBA may affect perception and judgment and interrupt complex intellectual functions that require concentration, such as problem solving. Performance of complex tasks may also be adversely affected by delayed recognition; for example, response to alarms—effects that can have detrimental consequences for patients. Thus, these cognitive and psychomotor effects can set nurses up for potential errors.\(^9,14,15\) As background noise reaches 45 to 50 dB, people generally tend to raise their voices, a phenomenon known as the Lombard effect, further contributing to excessive noise.\(^9\)

Once noise levels surpass 50 dBA, sleep disturbances begin, and those effects can lead to delirium and impaired immune response.\(^3,9,14,15\) As noise levels increase to higher than 85 dBA, cortisol and adrenaline levels increase. These physiological effects elevate heart rate and blood pressure, increase risk for ischemic heart disease from the accumulation of coronary artery plaque, and delay wound healing.\(^3,9,14\) In critically ill neonates, exposure to noise also changes autonomic and endocrine-metabolic functions and physiological stability, and it can cause hearing loss if exposure to loud noise is prolonged.\(^15\) As Konkani and Oakley\(^9\) pointed out, nurses are exposed to the same sound levels as patients, and thus, noise-induced stress may contribute to higher heart rates, tachycardia, headaches, stress, irritability, annoyance, fatigue, and risk of burnout among nurses.\(^14-17\) Although many interventions can improve an OHE’s “place,” the PICO (population, intervention, comparator, outcome) question of interest for this review was, What effect do quiet time periods have on unit noise levels and patient and nurse outcomes?

Method

The strategy involved searching CINAHL and MEDLINE and hand-searching bibliographies. Key words included quiet time/hours, noise reduction, and critical care. The search was limited to the past 10 years and critical care reports.
### Table 1
Evidence summary on quiet time interventions

<table>
<thead>
<tr>
<th>Reference</th>
<th>Design and intervention (N, sample)</th>
<th>Main findingsa</th>
<th>Level of evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Riemer et al18</td>
<td>Observational Quiet time from 2-4 PM (N=124 observations of 22 clinical nurses in medical/surgical ICU)</td>
<td>Decreased over time (369 lux baseline vs 179 lux at 2 h)</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Decreased from baseline (62.9 dB) through 1 h (60.9 dB); levels began to increase after 2 h (61.7 dB)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Visual analog scores decreased from baseline (49.4) at 2 h (35.4)</td>
<td></td>
</tr>
<tr>
<td>Harrington and DeLeskey19</td>
<td>Quality improvement Quiet time from 2-4 PM for 3 months (N=473, ICU)</td>
<td>Decreased from before quiet time (51-66 dB) to during quiet time (43-46 dB), but only measured for 2 quiet times 5 days apart</td>
<td>C</td>
</tr>
<tr>
<td>Li et al20</td>
<td>Quasi-experimental Control phase: usual care Experimental phase: noise/light reduction from 11 PM to 5 AM (N=60, surgical ICU)</td>
<td>Experimental phase: • Reduced hourly peak sound (54.1 vs 58.8 dB) and mean noise levels (51.4 vs 56.7 dB) • Lower perceived noise among patients only (not nurses)</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Experimental phase: • Lower perceived sleep interruptions from noises/care activities • Better sleep quality/efficiency</td>
<td></td>
</tr>
<tr>
<td>Dennis et al21</td>
<td>Observational Quiet time at 2-4 PM and 1:30-3:30 AM for 6 months (N=50; neuroscience ICU)</td>
<td>Lower mean light levels during quiet time on day shift only: • Center of nursing station (53.5 vs 283.6 lux prior) • Door of room (26.1 vs 111.2 lux prior) • Head of bed (22.8 vs 165.4 lux prior)</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reduced mean noise levels during quiet time on day shift: • Center of nursing station (71.9 vs 83.1 dB) • Door of room (65.1 vs 74.1 dB) • Head of bed (62.2 vs 71.2 dB)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Odds ratios showed patients were more likely to be observed sleeping during quiet time on day shift (71%-74%) than before quiet time session (27%)</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviation: ICU, intensive care unit.

a P<.05.

### About the Authors
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Corresponding author: Margo Halm, RN, PhD, NEA-BC, Salem Health, Salem, OR 97309 (e-mail: margo.halm@salemhealth.org).

### Results

As shown in Table 1, 3 research studies18,20,21 and 1 quality improvement project19 were retrieved. Variables measured included (1) environmental: unit light and sound levels; (2) patient-perceived noise and sleep interruptions, sleep quality/efficiency and
Table 2
American Association of Critical-Care Nurses evidence-leveling system

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Meta-analysis of multiple controlled studies or metasynthesis of qualitative studies with results that consistently support a specific action, intervention, or treatment</td>
</tr>
<tr>
<td>B</td>
<td>Well-designed controlled studies, both randomized and non-randomized, with results that consistently support a specific action, intervention, or treatment</td>
</tr>
<tr>
<td>C</td>
<td>Qualitative studies, descriptive or correlational studies, integrative reviews, systematic reviews, or randomized controlled trials with inconsistent results</td>
</tr>
<tr>
<td>D</td>
<td>Peer-reviewed professional organizational standards, with clinical studies to support recommendations</td>
</tr>
<tr>
<td>E</td>
<td>Theory-based evidence from expert opinion or multiple case reports</td>
</tr>
<tr>
<td>M</td>
<td>Manufacturer’s recommendation only</td>
</tr>
</tbody>
</table>

*From Armola et al.*

Sleeping percentages, and patient satisfaction related to quiet hospital environment; and (3) nurses’ stress levels. Quiet times were usually 2-hour time blocks on the day and/or night shift coinciding with circadian rhythms; however, 1 investigation was of a 6-hour quiet time during the night.

**Recommendations for Practice**

Most of the evidence for quiet times is level C evidence (Table 2). With only 4 formal evaluations of quiet time, this intervention could be considered a promising practice at best as the levels recommended by the WHO and EPA were not achieved. For day-shift quiet times, noise level reductions ranged from 2 to 20 dB, although the latter was only 2 close observations (most likely the Hawthorne effect). The lowest sound level achieved was 51 dB during the 6-hour night-shift quiet time. As would be predicted, light levels were only lower on the day shift. Patient satisfaction with the quiet hospital environment increased, and nurses reported less stress with quiet times on the day shift in different investigations.

Day-shift quiet times were associated with more patients asleep (>70%). During the 6-hour nighttime quiet time, patients perceived fewer sleep interruptions and had better sleep quality. Researchers in one sleep laboratory study investigated the effect of simulated intensive care unit noises and reported that they adversely affected sleep, specifically increasing sleep fragmentation, arousals, and time awake. In another controlled hospital laboratory study, researchers found that intravenous alarms and phones—which are designed for high alert—had the highest sleep arousal probabilities. Staff conversations were also highly alerting, even at lower dB levels. Other sounds with shifting contours, like closing doors, electronic towel dispensers, and ice machines were also more alerting than were continuous sounds such as laundry carts. Light sleep, the stage in which most hospitalized patients spend most sleep time, had the greatest vulnerability to sound disruption.

The 3 main components of the quiet time intervention coincide with OHE elements. First, in keeping with Nightingale’s legacy, managing the environment or place included posting quiet room signage to reinforce unit guidelines for staff, providers, patients, and visitors. Lights were dimmed in patients’ rooms and the central nursing station, and doors to patients’ rooms were closed at 11 PM. (In a different investigation, Lawson and colleagues confirmed that closing patients’ doors decreases mean noise levels in the room but does not affect peak noise levels.) Other noise abatement strategies included turning telephone ringers and bedside monitor alarms down; turning off televisions, radios, personal devices, and wall suction unless it was essential; checking volume of intravenous fluids and tube feedings and replacing before alarming; and charting at the central nursing station. Next, the “people” components emphasized enforcing expectations for staff to lower conversation level and reinforce quiet time guidelines and discouraging families from visiting during quiet time in order to promote rest and sleep.

Last, the “process” components of the quiet time protocol involved care activities. Teams intentionally strived to avoid interruptions during quiet time, especially on the night shift, in an effort to promote good sleep hygiene. Assessments and physical examinations, as well as routine diagnostic and therapeutic procedures such as laboratory tests and chest radiographs were limited unless the patient’s condition required it. Nursing routines and other care activities were also rearranged to honor the quiet time as much as clinically feasible to allow adequate sleep periods.

A pressing question is, How can we manipulate features of our critical care environments to transform them into an OHE? Changing our culture of what currently constitutes a typical critical care environment won’t happen overnight. Critical care units are full of constant activity because patients’ lives are at stake. However, by remembering the physiological effects of noise on the body, we can reinforce to our colleagues how important uninterrupted sleep is on the healing process, not to mention how loud noises can alter physiological responses that have even more detrimental effects.

One way to start transforming the critical care environment is with an environmental assessment. Collect some data on sound levels at peak times at common places where care and interactions occur. Monitor how long patients sleep. Review your patients’ satisfaction with quiet environment scores. Ask your colleagues how noise affects their stress levels and performance. Assess barriers in the environment and generate creative solutions to overcome them. Educate your team members about the little things they can do to alter the environment and their behavior—they add up! As Milette
reported, noise awareness educational programs can be successful in reducing noise. Introduce small components of the quiet time intervention on your unit and assess their impact on patients and staff. Making time for quiet, one change at a time, can build up to a significant transformation that can help us all reach the goal of creating healing places that improve the well-being of patients, their families, staff, and providers.

FINANCIAL DISCLOSURES
None reported.

eLetters
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REFERENCES

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Consider 3 different cases that illustrate the scope of postresuscitation disease.

The first patient is a 78-year-old man with known coronary disease who collapses, receives 8 minutes of bystander cardiopulmonary resuscitation (CPR), has pulseless ventricular fibrillation when the paramedics arrive, receives CPR and 4 defibrillations, and has return of spontaneous circulation (ROSC) at 18 minutes after his cardiac arrest. In the emergency department, he is intubated, unresponsive to verbal commands, withdraws extremities to painful stimulation, exhibits ST-segment depressions in the lateral electrocardiography (ECG) leads, and requires 2 vasopressors to maintain a mean arterial pressure of 65 mm Hg. Urgent echocardiography shows severe left ventricular dysfunction with anteroapical akinesis, and processed electroencephalography (EEG) shows a continuous electrical background and a very low suppression ratio.

The second patient is a 32-year-old woman with a history of prescription opioid abuse who was found with no palpable pulse or respiratory effort, pinpoint pupils, no motor or autonomic response to pain stimulus, and a slow, wide complex electrical rhythm. After 34 minutes of CPR, intravenous epinephrine, intubation, and administration of saline solution, sodium bicarbonate, and intravenous naloxone, she achieves a narrow complex tachycardia. The arterial pH is 7.08, score on the Glasgow Coma Scale is 3T, blood pressure is 172/110 mm Hg, no ST-segment abnormalities, and oxyhemoglobin saturation is 86% on 100% oxygen and positive end-expiratory pressure of 10 cm H₂O. Chest radiography shows bibasilar opacities, findings on the echocardiogram are normal, and continuous EEG shows very low voltage, no reactivity, and occasional generalized bursts of sharp wave activity.

The third patient is a 59-year-old man with chest pain and dyspnea, followed by collapse and cardiac arrest during a physical therapy session 2 weeks after knee arthroscopy. CPR is initiated by the physical therapist, and when paramedics arrive 6 minutes...
Hemodynamic support is necessary to prevent not only rearrest but also secondary brain injury.

Later, the heart rhythm is ventricular fibrillation. ROSC is achieved after administration of 2 mg epinephrine and 6 minutes of CPR, but the pulse is lost again after 8 minutes, necessitating administration of more epinephrine and 5 minutes additional CPR before pulseless sinus tachycardia recurs. The ECG shows right ventricular strain, blood pressure is 98/52 mm Hg, and the patient localizes pain to the upper extremities but does not follow commands. Administration of norepinephrine is initiated to maintain a mean arterial pressure greater than 65 mm Hg, and a bolus of heparin is infused. The arterial lactate level is 12 mg/dL (to convert to mmol/L, multiply by 0.111), pH is 7.02, serum creatinine level is 2.8 mg/dL (to convert to μmol/L, multiply by 88.4), and serum level of aspartate aminotransferase is 1830 U/L (to convert to μkat/L, multiply by 0.0167). Processed EEG shows continuous and reactive background activity with a suppression ratio of 0.

These patients share the pathophysiology of a systemic ischemia-reperfusion injury, but exhibit fundamental and important differences in the type and severity of their injuries. Because the pattern of injuries dictates the most effective treatments, it is crucial for clinicians to stratify risk, weighing relative risks and benefits of various interventions. This article describes that process of early assessment and risk stratification.

Understanding the Cause of Cardiac Arrest and Stabilizing the Patient

Registry data show that about 16% of patients successfully resuscitated after cardiac arrest experience a second cardiac arrest after hospital admission (International Cardiac Arrest Registry, unpublished data, 2016). To prevent rearrest, the cause of the arrest must be determined and treated. When a protocolized approach (see Figure) to determining the cause of a cardiac arrest that used coronary angiography and/or computed tomography scans of the chest or head was employed, a French group was able to determine the cause in 93% of cases.

Hemodynamic support is necessary to prevent not only rearrest but also secondary brain injury related to ongoing microvascular ischemia. Experimental models show that after cardiac arrest the cerebral capillary beds are characterized by thrombosis, endothelial damage, and sluggish flow. Higher cerebral blood flow in the critical hours after a cardiac arrest can prevent infarction of the

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About the Authors

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Corresponding author: David B. Seder, MD, FCCP, FCCM, FNCS, Maine Medical Center, 22 Bramhall St, Portland ME 04102 (e-mail: sederd@mmc.org).
Neurological Assessment and Treatment of Seizures

Neurological assessment when the patient arrives in the intensive care unit (ICU) is rendered inaccurate by neuronal stunning, medications, brain ischemia, metabolic disturbances, and seizures. As such, accuracy is poor, and prognostication should not be performed at the time of admission unless the patients appear dead according to neurological criteria. In 1 study, researchers concluded that inappropriate early neurological prognostication (within the first 3 days after ROSC) leading to withdrawal of life-support measures may result in excess deaths after cardiac arrest annually in the United States.

Although early prognostication is inappropriate, early and continuous assessment of the severity and type of neurological injury allows for risk stratification and triage to the most appropriate treatment pathways. The best tools for such assessment are a focused neurological examination and raw or processed EEG. Patients with early continuous and reactive EEG activity have a favorable neurological prognosis and should receive aggressive interventions for hemodynamic and circulatory support. Conversely, such measures in patients with high neurological risk and significant brain injury are unlikely to be cost-effective.

Seizures after cardiac arrest cause severe cerebral metabolic stress and must be treated effectively. More and more published reports describe good functional outcomes in patients with "postanoxic" seizures or myoclonus that receive aggressive therapy. When cardiac arrest patients undergo therapy with benzodiazepines and barbiturates, their awakening may be slowed, especially in the presence of renal dysfunction, and prognostication must be delayed or performed with modalities other than the physical examination.

Targeted Temperature Management

Targeted temperature management (TTM) is neuroprotective and associated with improved survival and functional outcome after cardiac arrest. In a landmark clinical trial using TTM for 72 hours after resuscitation, a temperature target of 33°C was not superior to a target of 36°C in unselected survivors of cardiac arrest. Subsequent analyses have shown that the colder target temperature may be dangerous in patients with hemodynamic instability. As such, TTM at 33°C is more appropriate in hemodynamically stable patients without excessive bleeding risk, and 36°C is more appropriate in those with significant shock, myocardial dysfunction, or excessive risk of bleeding. This paradigm allows the target temperature to be tailored to an individual patient, maximizing the neuroprotective benefits of hypothermia, while minimizing its risks.

Critical Care Concerns

Elements of ICU care shown to influence the outcomes of patients after cardiac arrest include glycemic control, oxygen delivery, and ventilation. In each of these areas, physiological derangements are associated with worse outcomes, and rapid correction to a state of physiologic homeostasis is the goal. We suggest an upper glycemic threshold of 144 mg/dL, but hypoglycemia must not be
allowed to occur. In a large randomized trial of glucose control after cardiac arrest, a very low target range of 72 to 108 mg/dL did not show benefit when compared with a moderate regimen of 108 to 144 mg/dL.

Hyperoxia worsens reperfusion injury by facilitating formation of reactive oxygen species, and clinicians should decrease the inhaled fraction of oxygen to 0.5 (50%) after ROSC, titrating the fraction of inspired oxygen up only when the oxyhemoglobin saturation decreases to less than 95%. Hyperoxia is similarly damaging to the injured organs, and an oxyhemoglobin saturation of at least 95%, or a \( \text{Pa}_2 \) of at least 80 mm Hg is recommended. This higher-than-normal threshold takes into account the confounding effects of low body temperature on the measured oxygen content of arterial blood. We suggest a target \( \text{Pa}_2 \) range of 80 to 300 mm Hg.

After resuscitation from cardiac arrest, the carbon dioxide level and systemic pH are controlled by ventilation, especially when continuous or intermittent neuromuscular blockade are used to control shivering. Because pH affects physiological processes, and \( \text{Pa}_2 \) levels directly affect cerebrovascular tone and cerebral blood flow, it is important to monitor \( \text{Pa}_2 \) in real time and adjust the ventilator to maintain a physiological range. We suggest a pH target of 7.3 to 7.4 with \( \text{Pa}_2 \) ideally in the range of 30 to 45 mm Hg unless metabolic acidosis requires more aggressive ventilation to maintain pH at 7.3 or greater.

Early-onset pneumonia may occur in up to 63% of cardiac arrest survivors and has been associated with worse clinical outcomes. Pneumonia is most likely due to aspiration, introduction of oropharyngeal flora into the lungs during airway management, gastrointestinal bacterial translocation, and the immunosuppressive effects of critical illness. Several studies in comatose patients admitted after a variety of brain injuries show that prophylactic antibiotics decrease the incidence of pneumonia by about 50%, and a retrospective study showed that antibiotic prophylaxis following cardiac arrest was associated with a reduced incidence of early-onset pneumonia. The routine administration of antibiotic prophylaxis following cardiac arrest requires confirmation in prospective studies.

Nursing Care

Targeted temperature management is usually performed by nurses, who should understand the fundamental goals and anticipate the physiological changes seen with TTM. The 4 phases of TTM are induction, during which the patient’s core temperature is brought to the target range; maintenance, during which the patient is held at that target temperature; rewarming, in which the patient is actively warmed to normal body temperature; and normothermia, often continued until at least 72 hours after ROSC. The Table describes common adverse events associated with TTM and potential corrective strategies.

Temperature management is performed with surface cooling devices and ice packs, or by intravascular means such as cold fluids and heat-exchange catheters. The application of surface cooling devices may expedite time to initiation of TTM and time to target temperature. In comparison, conventional surface cooling methods (eg, cooling pads without feedback loops or ice packs) are less expensive, but lack a mechanism to tightly regulate core temperature, which is nursing-intensive and associated with a risk of overcooling. Intravascular cooling devices provide precise temperature control, but require central venous access, which is associated with central catheter–associated blood stream infections and thrombosis. The automated temperature regulation performed by servo-regulated cooling devices allows the nurse to focus on patient assessments and risk minimization. Finally, commercial devices require a significant financial investment that may require a lengthy process of budgeting and financial approval before purchasing.

Pharmacology of Postresuscitation Care

The postresuscitation state is characterized by physiological changes that alter the disposition and activity of routinely used medications. Despite the fact that TTM after cardiac arrest has been considered the standard of care for more than a decade, little is known about how it affects drug therapy. A recent systematic review showed that 74% of studies on drug disposition during TTM were conducted in animals, 69% used temperatures less than 32 °C, and 70% were published before 1999. Some generalizations can be made, but more data in this population of patients are needed.
## Table

### Risks associated with targeted temperature management

<table>
<thead>
<tr>
<th>Risk</th>
<th>Alert</th>
<th>Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infection</td>
<td>In patients with serious infections, consider treatment at 36°C not 33°C</td>
<td>Administer prophylactic antibiotics (eg, cefuroxime 1.5 g every 12 h x 2 doses)</td>
</tr>
</tbody>
</table>
| Shivering                   | Increases metabolic rate and oxygen consumption  
*Ensure adequate sedation during paralysis* | Paralyze with as-needed boluses of pancuronium or vecuronium, or a continuous infusion of cisatracurium  
During/after rewarming, do not paralyze  
Focal counterwarming (warm blanket)  
Pharmacological agents to reduce shivering |
| Electrolyte abnormalities   | Hypokalemia and hypomagnesemia are most common                          | Monitor and replace potassium simultaneously with onset of cooling, but do not delay initiation of targeted temperature management  
Monitor and replace potassium and magnesium every 6 h, maintain serum level of potassium ≥4.0 mEq/L and serum level of magnesium ≥2.0 mEq/L  
Monitor and replace phosphate and calcium daily |
| Hyperglycemia               | Targeted temperature management causes insulin resistance  
Point-of-care capillary glucose testing can be inaccurate—potentially leading to dangerous hypoglycemia | Monitor glucose levels closely, obtaining samples from arterial or central venous catheters. Initiate insulin infusion with target glucose level of 72-144 mg/dL |
| Cardiac arrhythmias         | Hypothermia causes bradycardia  
Bradycardia is common and typically well tolerated in the setting of stable hemodynamics  
Ventricular arrhythmias are uncommon | Treat bradycardia only when mean arterial pressure <80 mm Hg or heart block occurs  
Use a cooling device with an automated temperature feedback mechanism to avoid overshoot <32°C and provide slow and controlled rewarming |
| Delayed drug metabolism     | Hypothermia causes delayed drug metabolism, resulting in accumulation  
Caution with drugs likely to achieve toxic levels  
Extreme caution in neurological prognostication—uncertain clearance of paralytic and sedative medications | Adjust dosing if appropriate for at least a 35% reduction in drug clearance at 33°C; consider less frequent dosing during targeted temperature management |
| Skin breakdown              | Hypothermia poses a risk for skin injury, especially in patients with severe shock treated with adhesive cooling pads | Document skin assessment before targeted temperature management, every 4 h and as needed, protecting “at risk” areas (ie, redness, lacerations) with transparent or gauze dressing  
Reposition patient at least every 2 h; place patient on low-air-loss mattress |
| Fever                       | Avoid fever for at least 72 hours after resuscitation, as it may negatively influence neurological outcome | Maintain temperature management devices the first 36 hours of normothermia or 72 hours after return of spontaneous circulation  
Consider intravenous acetaminophen 500-1000 mg every 6 h (maximum 4 g/24 h, 2 g if hepatic dysfunction) |
| Bleeding                    | Targeted temperature management does not cause bleeding but it may be harder to stop active bleeding.  
Patients with active, severe bleeding should be treated at 36°C  
Low platelet counts and mild/moderate coagulopathy without bleeding are not a contraindication to targeted temperature management | Adjust target temperature with active bleeding or high bleeding risk to favor 35°C-36°C |

SI conversion factors: To convert magnesium to mmol/L, multiply by 0.50; to convert glucose to mmol/L, multiply by 0.0555.
Drug Absorption
Absorption can occur along a high-to-low concentration gradient (passive absorption) or it can require energy for transport (active absorption). Active absorption is most likely reduced during TTM; according to the Arrhenius rule, every 4°C decrease in body temperature results in about a 20% decrease in chemical reactions. Fortunately, most medications are passively absorbed. Drug absorption is also affected by low blood flow to the gastrointestinal tract, by ischemia-reperfusion injury to the mesentry, and by arteriovenous shunting of blood away from the gastrointestinal tract during TTM.

In only 1 human study have researchers examined enteral drug absorption during TTM. In that study, phenazone (antipyrine) absorption was unchanged, but the onset of activity was delayed, suggesting that enterally administered drugs have a slower onset of action during TTM. Critical medications should be administered intravenously during TTM to avoid uncertain enteral absorption.

Drug Distribution
Medications distribute to their site of action following absorption or intravenous administration. This process depends on physiological factors (eg, blood flow and pH) and physiochemical characteristics of a drug (eg, plasma protein binding and lipid solubility). The effect of TTM on drug distribution is highly variable, with few consistencies identified.

Drug Clearance
Drug absorption, distribution, and clearance are all influenced by transmembrane transporters. The P-glycoprotein efflux transporter in kidneys, intestines, brain, and other organs works to remove commonly used drugs like fentanyl, digoxin, morphine, phenytoin, and vecuronium from the body. The activity of these transporters may decrease by 50% or more, leading to reduced drug clearance and increased exposure.

Medications metabolized by the liver are characterized as having a high or low extraction ratio. Drugs with a high extraction ratio (eg, propofol and fentanyl) rely on hepatic blood flow for metabolism. Clearance of drugs that have a low extraction ratio (eg, midazolam and valproate) depends on intrinsic hepatic clearance and the free fraction of drug.

Reductions in portal blood flow and hepatic intrinsic clearance have been described during TTM. The free fraction of a drug is dictated by plasma protein binding, which can be altered in the setting of hypoalbuminemia, drug-drug interactions, and uremia. These alterations are common following cardiac arrest and may lead to altered drug clearance.

Cytochrome P450 (CYP450) isozymes catalyze oxidative reactions, which make drugs more water soluble and suitable for elimination by the kidneys. CYP450 isozymes are primarily found in the liver, but are also found in intestinal enterocytes. The CYP3A family may be responsible for the metabolism of approximately 50% of all medications. A mechanistic study demonstrated that CYP3A4-mediated metabolism of midazolam during TTM was decreased because of a 13% reduction in metabolic capacity. This finding is important because several medications administered during TTM (ie, fentanyl and midazolam) undergo CYP3A4 metabolism and are subject to delayed clearance.

The kidneys eliminate water-soluble drugs and metabolites from the body passively via glomerular filtration or actively via tubular secretion. When kidney perfusion is maintained, the elimination of drugs by passive glomerular filtration is largely unchanged. Studies using gentamicin, an aminoglycoside antibiotic that is eliminated unchanged via glomerular filtration, have shown that its elimination is unchanged during TTM. Renal tubular secretion, an energy-dependent process, and renal P-glycoprotein pump activity may be decreased during TTM, but data are needed to confirm this.

Clearance of most medications administered during TTM is reduced. Serum concentrations of propofol may increase 30% during TTM because of a reduction in hepatic blood flow, hepatic clearance, and movement between the central and peripheral compartments. Midazolam serum concentrations may increase up to 5-fold during TTM, and clearance of midazolam decreases by 11% for each 1°C reduction in body temperature. Serum concentrations of fentanyl may increase 25% during TTM and remain elevated for 6 to 8 hours after rewarming. These changes are most likely due to suppressed CYP3A4 metabolic capacity and reduced hepatic blood flow. Vecuronium clearance may be reduced by about 11% for each 1°C change in body temperature.

“Drug absorption may be altered . . . the intravenous route of administration should be used whenever possible.”

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temperature, and rocuronium clearance may decrease by 2-fold. Changes in vecuronium and rocuronium disposition are probably the result of reduced hepatic metabolic activity.

**Clinical Application**

Drug absorption may be altered during TTM, and the intravenous route of administration should be used whenever possible. Distribution of medications is highly variable and poorly understood. Serum drug concentrations can be monitored and free serum concentrations should be measured for highly protein bound medications including phenytoin and valproate. Clearance of hepatically metabolized medications is reduced during TTM. Because of this, sedatives and analgesics should be administered in moderate doses in order to avoid accumulation, which may lead to prolonged activity and interference with neurological prognostication. Caregivers should also be aware that the duration of action of neuromuscular blocking agents may be increased and thus should provide adequate sedation.

**Case Discussion**

The clinical outcome of the first patient described here is likely to be determined by his cardiac event. On presentation, he exhibits shock, severe cardiomyopathy, and a probable acute coronary syndrome—the risk of death due to circulatory issues is high. In contrast, he is moving, with intact brainstem reflexes and favorable background EEG, suggesting a mild brain injury. This patient belongs in the cardiac catheterization laboratory and deserves aggressive circulatory support by mechanical means and revascularization if necessary. His ICU course should include hemodynamic monitoring, maintenance of a robust blood pressure and cardiac index, rapid restoration of hemodynamic and biochemical homeostasis, targeted temperature management at 36°C, and careful attention to changes in drug disposition and effect during TTM.

The second patient most likely has a severe brain injury, characterized by prolonged resuscitation time with unfavorable clinical findings and EEG background. Although she is hemodynamically stable, she has aspiration-related lung injury and should receive antibiotics to prevent or minimize early onset pneumonia, and lung-protective ventilation to minimize injury of the lung and remote organs. This patient should have EEG monitoring for seizures, which should be aggressively treated. She should undergo therapeutic hypothermia to 32°C or 33°C, with delayed neurological prognostication. She does not require cardiac catheterization, but computed tomography of the brain with intravenous contrast material is needed to rule out subarachnoid hemorrhage or basilar artery thrombosis as the cause of her cardiac arrest.

The third patient has life-threatening pulmonary embolism with hemodynamic instability and severe shock, and he should receive thrombolysis or thrombectomy to prevent re-arrrest. This patient has a favorable neurological prognosis thanks to a short down time, immediate provision of CPR, and the neurological and EEG findings. He deserves aggressive therapy to treat the pulmonary embolism, and on arrival in the ICU, should be treated with TTM at 35°C or 36°C, with a focus on rapid reestablishment of physiological homeostasis, prevention of hypotension and hypoxia, and cautious attention to pharmacology to prevent dosing errors in the setting of acute renal failure, multiple organ dysfunction, and TTM.

**Quality and Outcomes Assessment**

High-quality postresuscitation cardiac arrest care is best performed by teams of professionals from various disciplines. These teams require collaboration supported by staff education, protocols, and standardized order sets to guide interprofessional care and optimize outcomes. Standard tracking of cardiac arrest processes of care and outcomes includes recording patients’ demographic data, clinical factors, treatments, and a gross assessment of neurological function at discharge and after 6 months. Continuous quality improvement projects vary by site but should evaluate process measures such as how well clinical guidelines are followed, appropriate use of coronary angiography, prevention of fever, seizure detection and suppression, glycemic management, and the prevention of dysoxia and hypotension. Clinical teams should investigate the barriers to high-quality care and strive continuously to improve outcomes and the experience of patients and their families.

**Conclusions**

Modern postresuscitation cardiac arrest care is complex, highly individualized, and requires treatment teams supported by protocols, educational programs, and order sets. The best care involves aggressive hemodynamic and circulatory stabilization, a protocolized etiological workup, targeted temperature management, and high-quality critical care in which continuous hemodynamic and neurological monitoring are performed, and quality is ensured by ongoing assessment and process improvement.
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**ECG Puzzler**

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**VENTRICULAR ECTOPY IN HOSPITALIZED ELDERLY ADULTS**

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

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**Scenario:** This is a telemetry rhythm strip (lead II and V₁) from an 88-year-old sleeping woman who is being monitored on a medical surgical unit after falling at home without injury. She is being considered for discharge home. The patient has no significant medical history and is asymptomatic to the rhythm below. Do you think further evaluation is needed before hospital discharge?

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**Operator Selected Strip**

<table>
<thead>
<tr>
<th>N</th>
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**Rate 90 BPM**

**10 mm/mV**

**Interpretation Questions:**

1. Is the ECG properly calibrated (10 mm) and are leads properly placed?  
   - Yes  
   - No  
   - NA

2. Is this a sinus rhythm (one P wave preceding every QRS complex)?  
   - Yes  
   - No  
   - NA

3. Is the heart rate (R-R interval) normal (60-100/min)?  
   - Yes  
   - No  
   - NA

4. Is the QRS complex narrow (duration <110 milliseconds [ms] in V₁)?  
   - Yes  
   - No  
   - NA

5. Is the ST segment deviated (>2 mm in V₂-V₃, or >1 mm in other leads)?  
   - Yes  
   - No  
   - NA

6. Is the T wave inverted in relation to the QRS (>0.5 mV)?  
   - Yes  
   - No  
   - NA

7. Is the QT interval lengthened (>450 ms [men] or >470 ms [women])?  
   - Yes  
   - No  
   - NA

8. Is R- or S-wave amplitude enlarged (S wave V₁ + R wave V₅ >35 mm)?  
   - Yes  
   - No  
   - NA

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Interpretation

Normal sinus rhythm at 90 beats/min with premature atrial contractions (beats 4 and 10), a premature ventricular contraction (PVC) (beat 5), followed by a compensatory pause, then one normal sinus beat (beat 6), followed by a unifocal ventricular couplet (beats 7 and 8) originating from the right ventricle, which is also followed by a compensatory pause.

Rationale

The most dominant rhythm (the underlying rhythm) is sinus. However, in addition to premature atrial contractions, there are 2 episodes of PVCs that result in wide (>110 ms) and bizarre-looking QRS complexes. These are characteristic of ventricular ectopy because the impulses originate and propagate outside of the normal conduction pathway of the heart. When there are 2 PVCs together, they are called a couplet, and 3 (a triplet) or more are considered ventricular tachycardia. Other characteristics of PVCs include: 1) they occur prematurely, 2) there is no associated P wave with the QRS complex, 3) the ST segment and T wave are discordant (deflect in the opposite direction of the QRS complex), and 4) the PVC is usually followed by a compensatory pause. In this case, the PVCs look similar so they are considered arising from a single ectopic focus (unifocal); if the PVCs looked different from each other, then they most likely originated from different foci and are termed multifocal. Finally, lead V1 is helpful for identifying the ventricle the PVC is coming from. PVCs originating from the right ventricle have a left bundle-branch morphology (dominant S wave), whereas PVCs arising from the left ventricle have a right bundle-branch morphology (dominate R wave) as seen in the Figures.

Management

Research shows that PVCs are a normal electrophysiological phenomenon not usually requiring investigation or treatment. However this patient is an elder who had an unwitnessed fall at home. Considering this patient’s age, recent unwitnessed fall, and relatively elevated resting heart rate at 90 beats/min, delaying discharge to complete a cardiac workup may be warranted.
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Anchorage
CCRN/PCCN Review
Date: November 3-4, 2016. Place: Anchorage, AK. Sponsor: South Central Alaska Chapter of AACN. Keynote Speaker: Nicole Kupchik. Contact: Michelle Husberg. E-mail: michelle@husberg.net. Credits: 15 CEUs.

CALIFORNIA
Rocklin
PCCN and CCRN Review
Date: November 14-15, 2016. Place: Rocklin Event Center. Address: 2650 Sunset Blvd, Rocklin, CA 95765. Sponsor: Sacramento Area Chapter of AACN. Keynote Speaker: Carol Rauen. Contact: Laura Ullery. Phone: (916) 781-1651. E-mail: Tobs4@hotmail.com. Fee: Member, $175; nonmember, $225. Credits: 15 CEUs.

FLORIDA
Plantation
42nd Annual Spring Seminar
Date: April 1, 2017. Place: Renaissance Hotel. Address: 1230 S Pine Island Rd, Plantation, FL 33324. Keynote Speakers: Clareen Wiencek, Kendra Menzies-Kent, Douglas Houghton, Elizabeth Lavelle. Sponsor: Broward County Chapter of AACN. Contact: Patty Kelly. Phone: (954) 722-8020. E-mail: pattykelly7@att.net. Fee: Before March 14: member, $75 and nonmembers, $100. After March 14, member, $100 and nonmember, $125. At the door: member, $125 and nonmember, $150. Credits: 6.5 CEUs.

MASSACHUSETTS
Westford
Care of the Critically Ill From Beginning to End
Date: November 15, 2016. Place: Westford Regency Hotel, Westford, MA. Keynote Speakers: Gina Farquharson, Susan Flewelling Goran, Virginia Silva, Suzanne Trudel. Sponsor: Merrimack Valley Chapter of AACN. Contact: Maureen McLaughlin. Phone: (781) 744-2125. E-mail: mmclaugh@verizon.net. Fee: Member, $75; nonmember, $100. Credits: 6.9 CEUs.

NEVADA
Las Vegas
Advanced Critical Care and Emergency Nursing

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

OKLAHOMA
Norman
Sepsis Recognition & Management/Stop Silence in the Workplace/Advances in Hemodynamic Monitoring
Date: November 7, 2016. Place: Norman's Regional Health System's Porter Campus. Address: 901 N Porter, Norman, OK 73071 (8:00 AM - 4:00 PM with registration beginning at 7:30 AM). Keynote Speakers: Thomas S Ahrens, Michael (Mike) Ackerman. Sponsor: Oklahoma City Area Chapter of AACN. Contact: Libby Morris. E-mail: Libby.Morris@integrisok.com. Fee: Early bird by 10/21/16, $50; after 10/21/16, $60. Credits: 6 CEUs.

WASHINGTON
Vancouver
Acute and Critical Care Fall Symposium
Date: November 7-8 2016. Place: Vancouver, WA. Keynote Speakers: Vicki Good, Ken Christopher, Robert Martindale, Nicole Kupchick. Sponsor: Greater Portland Chapter. Contact: Michelle Dedeo. E-mail: criticalcarefallsymposium@gmail.com. Website for registration: http://www.aacngpc.org

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