ICU Bereavement Services
Continuous Visitation and Family Needs
Congenital Cardiac Care Practice Quality
Managing Headache Pain After SAH
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Detail from "Energized"
Brigitte Wolf
46” x 46”
Acrylic
2015

To view other works by Brigitte Wolf visit her online gallery, www.brigittewolf.com or at Artspace 8, Chicago,IL www.artspace8.com.

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All of us in critical care know that our chosen profession can be quite stressful. As the editors in chief of the American Journal of Critical Care, we therefore felt it was important to offer readers some helpful coping mechanisms for those inevitable stressful situations that crop up.

We have all had days filled with emotional highs and lows, whether owing to our patients, our colleagues, our supervisors, or all 3. It’s not unusual to feel as though you are losing emotional control in some of these situations, and we subsequently feel we could have done better or reacted differently. The idea of taking a more structured approach to being aware of and modifying our emotions and reactions to them is known as emotional intelligence (EI).

Originally described by Peter Salovey and John Mayer in the early 1990s,1 EI was further elaborated by Daniel Goleman in his book Working With Emotional Intelligence in 1998.2 In this editorial we hope to share with all members of the multidisciplinary team exactly what EI entails, and how a greater understanding of the concept can help us function at our highest potential. One of the most important and encouraging things to note here is that one’s skills in EI can improve through training, conscious effort, discipline, motivation, and repetition.

Models of Emotional Intelligence

Multiple models of emotional intelligence have been suggested, and all have some degree of validity.3-7 The one by Goleman, known as the “mixed” model, has 5 major components: self-awareness, self-regulation, social skill, empathy, and motivation.

Self-awareness is simply the process of being aware of our emotional response to a situation. It seems counterintuitive at first, but the simple act of stating, for example, “this situation is making me upset, and I can feel my heart beating quickly,” can be enough to start down the road toward self-improvement.

Self-regulation is the process by which we consciously turn an instinctive emotional response into some sort of lesser response or no response at all.

Social skill is just what the words imply: conscious focused energy and efforts on managing relationships.

Empathy is making a deliberate effort to take other people’s emotions into account.

Finally, motivation is the ability to propel ourselves toward a specific goal. For the purposes of this editorial, we feel that the first 4 components (self-awareness, self-regulation, social skill, and empathy) are the most important and relevant for practicing critical care clinicians.

Usefulness of Emotional Intelligence

There is controversy regarding the validity and usefulness of the construct of EI, specifically with
We have a passion to help others, and we want to be with people who share our passion.

respect to nursing, but we feel there is value in using a structured approach when it comes to these “people skills.” Terms such as leadership, conflict management, and emotional intelligence can be vague and confusing, but the concepts are all interrelated. As a point of clarity, leaders often must have high-level conflict management skills, and one vital set of tools in the armamentarium of a quality leader is well-honed EI. The ability of leaders to be aware of their own emotional states to help choose how they will respond (rather than responding emotionally), combined with high levels of empathy, allows them to grow as leaders, gaining the trust of the people they are leading and becoming role models for appropriate behavior in the organization.

Keep the Passion, Control the Emotion

We began to notice a fundamental conundrum as we tried to develop our perspective of enhancing EI for the critical care practitioner. Those of us who practice in the ICU tend to be a passionate bunch. Usually this is why we went into the field in the first place. We want to help people who are critically ill and their family members. We have a passion to help others and we want to be with people who share our passion. We are naturally drawn to those who have infectious enthusiasm for every aspect of their job. We want to work with people who bring that passion to the ICU each and every day. But herein lies a problem.

As we move along in our careers, we must keep passion alive, but also we must learn to temper and modulate our emotions as we take on progressively more responsibility. For example, if we see something new in the literature that we feel should be implemented locally, it’s natural to feel excitement and passion. But what happens if, upon bringing this new idea to our leaders (eg, managers, physician leadership), we discover they do not understand or share our passion? What happens if they don’t “get it”? Our response may be to get up and storm out of the room. We might want to scream, “but of course we must do this!” Or perhaps, by contrast, our instinct is to be silent and give up at the first sign of resistance. We become frustrated and potentially cynical or jaded. None of those reactions is helpful, nor are they efficient ways to implement a plan. This is where EI can save the day.

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Emotional intelligence allows us to distance ourselves from our emotions just enough so we can function at a higher level. In the previous example, EI could help us transition from the idea of implementing a new protocol in the ICU to the actual implementation itself. That is, EI would help us say to ourselves “OK, I’m about to present this new idea at our staff meeting. I can feel my heart beating more quickly than usual; that’s just me being excited. No need to overreact.”

Emotional intelligence also can help us to strategize by knowing ahead that there likely will be pushback or resistance during the initial presentation. Plan for it. Expect it. Change is never easy. But it is easy—especially if it is your first time acting as a change agent—to become disheartened when you realize that not everyone is on the same page as you. Be at peace with that.

Use your EI to help you understand that wanting to make change is just the first step. Slowly, it will dawn on you that being successful requires more than just passion; it requires the development of an elusive combination of passion, resilience, follow-through, and EI. Perhaps some people in your group will never be as excited as you are about implementing the new protocol. Let that be OK. Become comfortable with the realization that, for those people, your leadership goals might be different. They may need to see the protocol fully implemented for some time before they are completely behind the project. In that case, your goal is to dissuade the naysayers from actively preventing your new protocol from being implemented. Again, EI gives you a structured approach to something as complex as working in an ICU and helping to be part of the implementation team of a new project.

Emotional Intelligence in Critical Care

We hope this exploratory discussion of EI was helpful. Every member of the multiprofessional critical care team can benefit by taking time to think about his or her emotions in a structured way. Of course, there is much more to read, learn, and digest about EI. This has simply been an overview to encourage the integration of EI into your daily work. Emotional intelligence helps us deal with our emotions more analytically, reminding us to carefully measure how we react to a situation. Important aspects of a quality EI skill set include becoming a better and more active listener and enhancing our relationship management abilities. The most difficult part of integrating the concepts of EI for the average practitioner in the ICU is striking a balance between keeping our youthful enthusiasm intact while tempering and modulating our emotions and emotional responses in important situations. Reaching that balance can be difficult, but we believe it is worth the effort.

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

FINANCIAL DISCLOSURES

None reported.

REFERENCES


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Clinical Pearls

Rhonda Board, RN, PhD, CCRN, Section Editor

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

Continuous Visitation and the Needs of Patients’ Families

Family members of critically ill adult patients can experience major psychological and physiological stress. Despite family research over the past 2 decades that indicates patient information and geographic proximity are highly ranked needs, many intensive care units (ICU) still have moderately restrictive visitation policies. Jacob and colleagues surveyed 45 family members who had a family member hospitalized in a neuroscience ICU that provides continuous family visitation (24 hours/day), family suites adjacent to patient rooms, and a family coordinator to assist family members. The researchers found the most important needs were related to the following:

• Receiving information about the patient
• Visiting the patient
• Being given hope
• Talking to a physician daily
• Being assured that the patient was receiving the best care.

The ranking of needs did not differ from research in ICUs with limited visitation, but what did differ is that family members stated their needs were met at a high level. The researchers suggest an unrestrictive visitation policy and supportive physical environment for family presence could greatly meet family needs.

See Article, pp 118-125

Timing of Oral Chlorhexidine Prophylaxis

Ventilator-associated pneumonia (VAP) is a common nosocomial infection that has been associated with longer hospital stays and significant financial costs. Routine chlorhexidine prophylaxis has been shown to prevent VAP among intubated patients and was recommended in 2010 by the Institute for Healthcare Improvement. However, little is known about the timing of this preventive care on clinical outcomes. Wong and colleagues retrospectively studied the association of early chlorhexidine administration on incidence of VAP with 134 intubated adult patients transferred by air ambulance to a surgical intensive care unit (ICU). Time to chlorhexidine was defined as time from helicopter departure to treatment administration in the ICU. The researchers concluded the following:

• There was no association between early treatment (initial 12 hours) and development of pneumonia within 5 days.
• The role of VAP prevention, with respect to timing of interventions and the interventions themselves, should be explored further.

See Article, pp 173-177

Headache Pain After Subarachnoid Hemorrhage

Headache after an aneurysmal subarachnoid hemorrhage (SAH) is the second leading cause of hospital readmission and can greatly affect a patient’s neurological assessment and treatment during both the acute and chronic phases. Yet current American Heart Association guidelines for SAH do not offer evidence-based recommendations for headache management. Glisic and colleagues examined the prevalence, severity, and treatment of SAH headaches in 77 patients during a 15-day period and found the following:

• 73% had severe and persistent headaches during hospitalization
• 94% received opioids, often at high doses
• 75% required opioid prescriptions for discharge
• Younger patients, patients with greater subarachnoid blood, and those classified with severe SAH had higher incidence of severe headaches.

The researchers were able to quantify inpatient headache burden and found that overall management was inadequate. Recommendations include development of a pain scale designed specifically for SAH patient assessment as well as novel and effective therapies for pain management.

See Article, pp 136-143

Texting While Using Mechanical Ventilation

For patients being treated with mechanical ventilation (MV), the inability to communicate can be very distressing to them, their families, and hospital staff. Shiber and colleagues discuss the use of smartphones with 2 adult patients who were awake and interactive but had to remain on MV. They found the following:

• Both patients were able to text and communicate effectively.
• Staff was able to answer the patients’ questions directly.

The authors recommend asking patients or family members about electronic device use, and to consider it as a method of communication while on MV. They acknowledge the 2 case study patients were good candidates for this communication method; both were young and adept at using their own devices. Some hospitals may have policies against cell phone use in an intensive care unit and this, along with other best-practice care, should be explored before instituting this technique.

See Article, pp e38-e39

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**IMPROVING SURVEILLANCE AND PREVENTION OF SURGICAL SITE INFECTION IN PEDIATRIC CARDIAC SURGERY**

By Melissa Cannon, MS, CPNP-AC, Diane Hersey, RN, BSN, Sheilah Harrison, BSISE, PMP, CPHQ, Brian Joy, MD, Aymen Naguib, MD, Mark Galantowicz, MD, and Janet Simsic, MD

**Background**  Postoperative cardiovascular surgical site infections are preventable events that may lead to increased morbidity, mortality, and health care costs.

**Objective**  To improve surgical wound surveillance and reduce the incidence of surgical site infections.

**Methods**  An institutional review of surgical site infections led to implementation of 8 surveillance and process measures: appropriate preparation the night before surgery and the day of surgery, use of appropriate preparation solution in the operating room, appropriate timing of preoperative antibiotic administration, placement of a photograph of the surgical site in the patient's chart at discharge, sending a photograph of the surgical site to the patient's primary care physician, 30-day follow-up of the surgical site by an advanced nurse practitioner, and placing a photograph of the surgical site obtained on postoperative day 30 in the patient's chart.

**Results**  Mean overall compliance with the 8 measures from March 2013 through February 2014 was 88%. Infections occurred in 10 of 417 total operative cases (2%) in 2012, in 8 of 437 total operative cases (2%) in 2013, and in 7 of 452 total operative cases (1.5%) in 2014.

**Conclusions**  Institution of the surveillance process has resulted in improved identification of suspected surgical site infections via direct rather than indirect measures, accurate identification of all surgical site infections based on definitions of the National Healthcare Safety Network, collaboration with all persons involved, and enhanced communication with patients’ family members and referring physicians. (American Journal of Critical Care. 2016;25:e30-e37)

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**COMMUNICATING WHILE RECEIVING MECHANICAL VENTILATION: TEXTING WITH A SMARTPHONE**

By Joseph Shiber, MD, Ayesha Thomas, MD, and Ashley Northcutt, MD

**Abstract**  Two young adults with severe facial injuries were receiving care in the trauma/surgical intensive care unit at a tertiary care, level I trauma center in the southeastern United States. Both patients were able to communicate by texting on their cellphones to family members, friends, and caregivers in the intensive care unit. Patients who are awake and already have experience texting with a smartphone or other electronic handheld device may be able to communicate well while receiving mechanical ventilation. (American Journal of Critical Care. 2016;25:e38-e39)

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A major frustration for patients with artificial airways is the difficulty in communicating with caregivers, family, and friends. Many patients will attempt to mouth words or write using pencil and paper—both of which are fraught with confusion and stress for the patient and caregiver. Several types of message boards or picture boards have been initiated over the years with varying success rates. Inability to reuse or appropriately clean these tools between patients has caused concern about possible infection transmission.

In the current environment, many patients have been using technology-based methods such as texting, email, or instant messaging conversations in their daily lives. The opportunity to use these technologies in hospitals for communication with caregivers deserves exploration. Communication was facilitated and augmented in the cases presented by Shiber and colleagues with use of the patients’ smartphones, allowing them to text messages for the care provider. This option may not work with every patient or in every environment, but it should be considered as a potential method of communication for patients with artificial airways.

Here’s what you can do:

- In staff meetings or practice councils, discuss communications options that could be available to your patients.
- Research the literature to determine what issues could arise (eg, potential interaction with machinery like the ventilator, cleaning/decontamination processes, or safety of patient owned electronics in the health care environment).
- Include the Risk Management and Biomedical Engineering departments in the discussion to determine what limits would need to be considered before initiating the practice.
- Consider implications with current facility policies and procedures.

Other helpful resources:


Based on material from and published as a supplement to the online article by Shiber and colleagues, “Communicating While Receiving Mechanical Ventilation: Texting With a Smartphone” (American Journal of Critical Care. 2015;25:e38-e39).
Background Losing a loved one in the intensive care unit (ICU) is stressful for family members. Providing bereavement support to them is recommended. However, little is known about the prevalence of bereavement services implemented in adult ICUs.

Objective To describe current bereavement follow-up services in adult ICUs.

Method A cross-sectional prospective study design was used. ICU nurse leaders completed a 26-item online survey posted in the American Association of Critical-Care Nurses e-newsletter. The survey contained questions about current practices in bereavement care. Data were collected for 1 month and were analyzed by using descriptive statistics and binary logistic regression.

Results A total of 237 ICU nurse leaders responded to the survey. Hospital and ICU types were diverse, with most being community (n = 81, 34.2%) and medical (n = 61, 25.7%). Most respondents reported that their ICUs (n = 148, 62.4%) did not offer bereavement follow-up services, and many barriers were noted. When bereavement follow-up care was offered, it was mainly informal (eg, condolence cards, brochures). Multiple logistic regression indicated that ICUs in hospitals with palliative care were almost 8 times (odds ratio, 7.66) more likely to provide bereavement support than were ICUs in hospitals without palliative care.

Conclusions The study findings provide insight into what type of bereavement evaluation methods are being used, what barriers are present that hinder use of bereavement follow-up services, and potential interventions to overcome those barriers in adult ICUs in the United States. (American Journal of Critical Care. 2016;25:110-117)
The intensive care unit (ICU) experience is often traumatic and fear provoking, yet it offers the hope of stabilizing a crisis situation. Despite all efforts, an estimated 20% of patients will die in an ICU or shortly after being in one.1 Although the care of the ICU patient may end at the patient’s death, the care of the patient’s family members should not. Experiencing a loved one dying in the ICU may differ from experiencing a death elsewhere in the hospital and can be very stressful for family members.2,3 Researchers have reported that outcomes for family members were worse when the patient died in the ICU rather than outside the ICU. Family members of patients who died in the ICU were at increased risk for posttraumatic stress disorder,4-7 anxiety,8,9 major depressive disorder,9,10 sleep disorders,6,7 and prolonged grief.9,11

Published reports support providing emotional and practical support to bereaved family members to help alleviate their psychological distress and assist them in working through the grief process.3,12 Guidelines from major critical care consensus groups13-16 strongly recommend bereavement support in an effort to improve end-of-life and family-centered care in the ICU. However, little is known about whether these recommendations are routinely implemented.

The body of research on ICU bereavement studies is small but growing. To date, researchers in 2 studies17,18 have assessed the prevalence of ICU bereavement services. In 1992, Jackson17 surveyed 100 senior sisters from general ICUs in England. She reported that 56% of the ICUs offered no follow-up bereavement services, 32% offered some informal follow-up services (eg, cards or occasional phone calls), and only 12% offered formal bereavement follow-up services. Valks and colleagues,18 in a survey of 99 Australian ICUs, reported that although 87% offered minimal components of bereavement care, such as viewing the deceased and communicating about the death to family members, less than one-third (30%) provided formal bereavement follow-up services. Although these studies provide insight on the prevalence of bereavement follow-up in adult ICUs, the prevalence of bereavement programs in the United States is still unknown.

More reports have described individual bereavement programs in adult ICUs. One program occurred in a neurological ICU, where a multidisciplinary team described use of an end-of-life intervention, “Embrace Hope,” to help patients and family members.19 This group used a 12-item checklist that included items such as offering families a bereavement packet, a lock of the patient’s hair or handprint, and a sympathy card. In a cardiovascular ICU,20 a researcher described implementing a bereavement program where bereaved family members received a grief folder, a sympathy card, and follow-up telephone calls for a year.

Another bereavement program occurred in an ICU in England, where researchers described organizing and delivering a yearly memorial service for family members of patients who died in the ICU.21 Finally, a group of Australian researchers22 described and evaluated bereavement services such as a grief booklet, a condolence card, and a follow-up family meeting. These studies provide evidence that ICUs are implementing a range of individual bereavement programs; however, it remains unclear how widespread these services are in adult ICUs.

Additionally, little is known about what type of bereavement services ICU family members desire. In 2 recent studies,23,24 researchers suggest that family members would appreciate this type of support but indicate that it may be lacking. In a qualitative study by Nelson et al,23 ICU family members from 4 different hospital systems reported that they would have benefited from bereavement follow-up care but, in actuality, very few of them received this type of care. van der Klink24 and colleagues reported similar findings from a study in a mixed medical-surgical ICU in the Netherlands. They reported that a significant minority (35%) of ICU family members would have appreciated bereavement follow-up but did not receive it. The findings from these 2 studies suggest that family
Nurse leaders were surveyed about the bereavement practices provided by their unit and hospital.

members of ICU patients do not routinely receive bereavement support.

In order to have a better understanding of the prevalence of bereavement follow-up in US adult ICUs, more needs to be known about what is being offered. Therefore, the overall aims of this study were as follows:

1. To describe current bereavement follow-up services in adult ICUs,
2. To describe the process for evaluating bereavement follow-up services in adult ICUs,
3. To explore barriers to establishing bereavement follow-up services in adult ICUs, and
4. To investigate predictors associated with ICUs that have bereavement follow-up services versus ICUs that do not have bereavement follow-up services.

Methods

This prospective study used a cross-sectional design. A self-administered questionnaire was used to obtain data on bereavement follow-up services in adult ICUs. The study was approved by the institutional review board at Samuel Merritt University. Written informed consent was waived because participation was voluntary and confidential.

Study Instrument

The questionnaire was developed by the study investigators (J.L.M., A.E.), who have extensive experience in critical care, end-of-life care, and bereavement care. The investigators reviewed the literature, used items modified from previous studies, and developed items from discussions with clinical experts. The questionnaire was evaluated for clinical sensibility; face and content validity, clarity, utility, redundancy, and discriminability were assessed. We distributed the questionnaire along with the clinical sensibility questionnaire to 1 ICU nurse manager, 6 ICU charge nurses, and 3 doctorally prepared nurse researchers with expertise in critical care.

The clinical sensibility ratings of the instrument were high. On a scale from 0 (least sensible) to 5 (most sensible) for each component, the mean (SD) was 4.4 (0.52) for clarity, 4.3 (0.79) for utility, 4.6 (0.52) for face validity, 4.8 (0.44) for content validity, 3.9 (0.57) for discriminability, and 4.6 (0.52) for redundancy. Using the clinical sensibility findings, the questionnaire was refined further.

The final online questionnaire contained 2 main sections. The first section consisted of 10 questions to ascertain demographic information about the hospitals and ICUs. The second section contained 13 additional questions assessing if the ICU had bereavement follow-up services or 5 additional questions if the ICU did not have bereavement follow-up services. In addition, each of the questions provided opportunities to supply additional information to allow further description regarding bereavement practices (see Appendix—available online only at www.ajcconline.org).

Sample and Procedure

After obtaining written permission from the American Association of Critical-Care Nurses (AACN), we administered the questionnaire electronically via SurveyMonkey to nurse leaders in the AACN database for 4 weeks in March 2013. Nurse leaders were chosen because each nurse leader can serve as a single representative from their unit to report on bereavement practices, rather than collecting data on multiple staff nurses’ perspectives. Nurse leader was defined as one of the following: a nurse manager, supervisor, director, charge nurse, clinical nurse specialist, nurse practitioner, or clinical nurse leader. Surveys were sent to 1 nurse leader per ICU. However, because each hospital system may have more than 1 ICU (eg, neurological, cardiac), and bereavement care may differ among them, more than 1 ICU nurse leader within a hospital system could be included in the sample. The sample excluded nurse leaders from neonatal and pediatric ICUs, postanesthesia care units, and step-down units. At the end of the survey, participants had the option to provide their e-mail address and receive a $5 Starbucks e-gift card as appreciation for their time.

Analysis

SPSS version 20 was used to analyze the data (SPSS, IBM). All continuous variables were described with means and standard deviations. Categorical variables were reported as proportions and frequencies. The first 3 aims were analyzed by using descriptive statistics. The fourth aim was analyzed by using multiple logistic regression.

Results

Hospital and ICU Characteristics

A total of 237 ICU nurse leaders responded to the survey out of 1003 estimated in the AACN database, a response rate of 24%. The majority of the respondents were charge nurses (n = 84, 35.4%). The respondents were from hospitals classified as community (n = 81, 34.2%), public (n = 65, 27.4%), academic (n = 54, 22.8%), and private (n = 34, 14.3%). The geographic location of the ICU settings included hospitals in the South (n = 75, 31.6%), Northeast (n = 61, 25.7%), Midwest (n = 58, 24.5%), and West (n = 43, 18.1%) regions. ICU types were diverse,
with most ICUs being mixed (n = 86, 36.3%) with a mean of 11 to 20 beds (n = 115, 48.5%) and 301 or more admissions per year (n = 148, 62.4%). Eighty-one percent of the nurse leaders (n = 192) reported that their hospitals had palliative care services and 67.1% (n = 159) reported that another service provided bereavement follow-up care (Table 1).

Current Bereavement Programs or Bereavement Follow-Up Services in Adult ICUs

Eighty-nine of the 237 nurse leaders reported that their ICUs (37.6%) offered bereavement follow-up services, and 44 (49.4%) of the 89 reported that staff nurses were primarily responsible for delivering the services. These services included condolence cards (n = 56, 62.9%), brochures (n = 39, 43.8%), and follow-up telephone calls (n = 32, 36.0%). Most (n = 46, 51.7%) initiated contact within 1 month following the ICU death. Only 14 (15.7%) of the 89 ICU leaders reported that they planned to expand current bereavement services (Table 2).

Resources and Evaluation Process of Bereavement Programs and Bereavement Follow-Up Services in Adult ICUs

The resources in support of bereavement programs varied, with 28.1% of nurse leaders (n = 25) reporting that their ICU had money allocated for these services. Most leaders reported that their hospital did not have a bereavement or an end-of-life care committee (n = 40, 44.9%). Very few ICUs (n = 8, 9.0%) that offered bereavement follow-up used a bereavement risk assessment tool. Seventy-four percent of the leaders stated that their ICUs evaluated their bereavement services by using methods such as verbal family feedback (n = 30, 33.7%), staff feedback (n = 25, 28.1%), and survey feedback (n = 19, 21.3%; Table 2).

Barriers in Establishing Bereavement Programs and Bereavement Follow-up Services in Adult ICUs

Most leaders of adult ICUs in this study reported that their setting did not offer bereavement services (n = 148, 62.4%). Of these ICUs, 44.6% (n = 66) were interested in starting a bereavement program and 41.2% (n = 61) were unsure. The respondents reported being most interested in using condolence cards (n = 79, 53.4%), brochures (n = 71, 48.0%), and telephone calls (n = 52, 35.1%). Barriers to implementing bereavement services were numerous and included lack of education (n = 71, 48.0%), lack of money (n = 70, 47.3%), lack of knowledge on family bereavement needs (n = 59, 39.9%), not feeling qualified to offer the service (n = 57, 38.5%), and no time (n = 48, 32.4%; Table 3).

Variables Associated with ICUs That Have Bereavement Follow-Up Services Versus ICUs That Do Not Have Bereavement Follow-Up Services

The overall logistic regression model was significant ($\chi^2 = 47.4, P = .001$), with 3 variables significantly

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Percent (No.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary position in the intensive care unit</td>
<td>Charge nurse 35.4 (84) Nurse manager 29.5 (70) Clinical educator 12.7 (30) Clinical nurse specialist 10.1 (24) Other 12.2 (29)</td>
</tr>
<tr>
<td>Type of hospital</td>
<td>Community 34.2 (81) Public 27.4 (65) Academic 22.8 (54) Private 14.3 (34) Government 1.3 (3)</td>
</tr>
<tr>
<td>Geographic region of hospital</td>
<td>South 31.6 (75) Northeast 25.7 (61) Midwest 24.5 (58) West 18.1 (43)</td>
</tr>
<tr>
<td>Type of intensive care unit</td>
<td>Medical 25.7 (61) Surgical 10.5 (25) Cardiac 15.6 (37) Other 48.2 (114)</td>
</tr>
<tr>
<td>Number of beds in intensive care unit</td>
<td>≤10 19.0 (45) 11-20 48.5 (115) ≥21 31.2 (74) Did not answer 1.3 (3)</td>
</tr>
<tr>
<td>Number of admissions to intensive care unit per year</td>
<td>≤100 0.8 (2) 101-200 5.5 (13) 201-300 15.6 (37) ≥301 62.4 (148) Did not answer 15.6 (37)</td>
</tr>
<tr>
<td>Hospital offers palliative care services</td>
<td>Yes 81.0 (192) No 18.1 (43) Did not answer 0.8 (2)</td>
</tr>
<tr>
<td>Another service in the hospital provides bereavement care</td>
<td>Yes 67.1 (159) No 26.6 (63) Did not answer 6.3 (15)</td>
</tr>
<tr>
<td>Other services that provide bereavement care (n = 159)$^a$</td>
<td>Spiritual care 75.5 (120) Palliative care 49.1 (78) Social work 34.6 (55) Patient relations 11.9 (19) Other 14.5 (23)</td>
</tr>
</tbody>
</table>

$^a$ Number may be greater than 159 because participants could select more than 1 service.
associated with ICUs providing bereavement services (Table 4). First, if the hospital had a palliative care service, then the ICU was almost 8 times (odds ratio, 7.66; \( P = .002 \)) more likely to offer bereavement follow-up services than were ICUs in hospitals without palliative care. Second, if the hospital had another service that provided bereavement support (eg, spiritual care), the ICU was almost 4 times more likely (odds ratio, 3.81; \( P = .002 \)) to offer bereavement follow-up services when compared with ICUs in hospitals without those services. Finally, surgical ICUs were about 3 times (odds ratio, 3.33; \( P = .03 \)) more likely to offer bereavement services than were medical ICUs.

Discussion

To our knowledge, this study is one of the first to assess bereavement follow-up care in ICUs across the United States. Although our response rate was low and our interpretation of the findings is cautious, the results provide insight into the status of current bereavement services based on the wide variety of geographical locations, types of hospitals, and types of ICUs represented. Only 38% of the ICUs in our study provided some type of bereavement follow-up services. These findings are consistent with the results of other researchers.17,18 Although bereavement support is strongly encouraged,12-16 it does not appear to be routinely offered in practice.

The respondents reported that when bereavement follow-up care was offered, it was mainly provided by staff nurses and was informal and minimal in nature (eg, condolence cards and brochures). These findings support those of other investigators, both in the ICU17,18 and in acute care settings.26,30 The increased use of bereavement services is most likely due to their cost-effectiveness and ease of implementation. Inexpensive and informal services may be attractive to staff who want to provide care to bereaved family members,31 but do not have adequate resources or time for more comprehensive services. And indeed, in our study, only 28% of ICU nurse leaders reported that they had money specifically allocated to provide these services. This major barrier of lack of funding and lack of time is consistent with results of other studies.26,30,32,33 The limited reimbursement or lack of reimbursement for bereavement services may be a significant barrier to further development of services in many settings.

Another explanation for these findings could be that providing formal and comprehensive services, such as counseling or memorial services, requires specialized training that goes beyond the scope of practice for ICU staff. They may feel unqualified to provide this type of service and indeed, almost 40% of our participants reported this as a major

### Table 2

Characteristics of intensive care units with bereavement follow-up services

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Percent (No.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does the intensive care unit currently offer bereavement follow-up? (n = 237)</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>62.4 (148)</td>
</tr>
<tr>
<td>Yes</td>
<td>37.6 (89)</td>
</tr>
<tr>
<td>Bereavement follow-up services offered (n = 89)*</td>
<td></td>
</tr>
<tr>
<td>Condolence card</td>
<td>62.9 (56)</td>
</tr>
<tr>
<td>Brochure</td>
<td>43.8 (39)</td>
</tr>
<tr>
<td>Follow-up telephone call</td>
<td>36.0 (32)</td>
</tr>
<tr>
<td>Group counseling</td>
<td>31.3 (12)</td>
</tr>
<tr>
<td>Memorial service</td>
<td>12.4 (11)</td>
</tr>
<tr>
<td>Family counseling</td>
<td>11.2 (10)</td>
</tr>
<tr>
<td>Social group meeting</td>
<td>11.2 (10)</td>
</tr>
<tr>
<td>Individual counseling</td>
<td>9.0 (8)</td>
</tr>
<tr>
<td>Self-help groups</td>
<td>5.6 (5)</td>
</tr>
<tr>
<td>Home visit</td>
<td>4.5 (4)</td>
</tr>
<tr>
<td>Other</td>
<td>9.0 (8)</td>
</tr>
<tr>
<td>Time bereavement follow-up contact first initiated (n = 89)*</td>
<td></td>
</tr>
<tr>
<td>1 month</td>
<td>51.7 (46)</td>
</tr>
<tr>
<td>3 months</td>
<td>6.7 (6)</td>
</tr>
<tr>
<td>6 months</td>
<td>4.5 (4)</td>
</tr>
<tr>
<td>1 year</td>
<td>1.1 (1)</td>
</tr>
<tr>
<td>Other</td>
<td>35.9 (32)</td>
</tr>
<tr>
<td>Plans to expand bereavement follow-up services (n = 89)*</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>24.7 (22)</td>
</tr>
<tr>
<td>Yes</td>
<td>15.7 (14)</td>
</tr>
<tr>
<td>Do not know</td>
<td>43.8 (39)</td>
</tr>
<tr>
<td>Other</td>
<td>15.8 (14)</td>
</tr>
<tr>
<td>Money allocated for bereavement follow-up (n = 89)*</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>36 (32)</td>
</tr>
<tr>
<td>Yes</td>
<td>28.1 (25)</td>
</tr>
<tr>
<td>Do not know</td>
<td>20.2 (18)</td>
</tr>
<tr>
<td>Other</td>
<td>15.7 (14)</td>
</tr>
<tr>
<td>Does the intensive care unit have an end-of-life or bereavement committee? (n = 89)*</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>44.9 (40)</td>
</tr>
<tr>
<td>Yes</td>
<td>38.2 (34)</td>
</tr>
<tr>
<td>Do not know</td>
<td>18.9 (15)</td>
</tr>
<tr>
<td>Use of a bereavement risk assessment tool (n = 89)*</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>66.3 (59)</td>
</tr>
<tr>
<td>Yes</td>
<td>9.0 (8)</td>
</tr>
<tr>
<td>Do not know</td>
<td>24.7 (22)</td>
</tr>
<tr>
<td>Evaluation of bereavement follow-up services (n = 89)*</td>
<td></td>
</tr>
<tr>
<td>Verbal family feedback</td>
<td>33.7 (30)</td>
</tr>
<tr>
<td>Staff feedback</td>
<td>28.1 (25)</td>
</tr>
<tr>
<td>Survey</td>
<td>21.3 (19)</td>
</tr>
<tr>
<td>No evaluation</td>
<td>25.8 (23)</td>
</tr>
<tr>
<td>Other</td>
<td>2.2 (2)</td>
</tr>
</tbody>
</table>

* Number may be greater than 89 because participants could choose more than 1 option.
challenge. This unqualified feeling has been reported consistently in the ICU, in areas outside the ICU, and with nurses and physicians.30,32,34-37

Another reported barrier is the type of bereavement care that is appropriate to provide family members. Other investigators39 have cited this challenge as well. It seems that family members want bereavement support,24 but in some studies, use of such services ranged from 6%22 to 30%.38 Additionally, only minimal evidence supports routine intervention with all bereaved family members. Rather, the recommendation is that this type of care should be directed to those at high risk.39 Further research is warranted in this area to ascertain which bereaved ICU family members would benefit most and what type of bereavement support they would use and find helpful.

Even with all the barriers cited, we think that the barriers are amenable to intervention. For example, ICUs can use clinical nurse specialists (CNSs) to initiate projects for implementing bereavement programs. One investigator reported the success of a CNS-driven bereavement program that increased referrals for palliative care and improved bereavement satisfaction.40 In addition, critical care nurses and other health care practitioners could participate in palliative care and end-of-life training courses that are focused on incorporating bereavement support. Researchers have reported that this type of training has improved health care professionals’ comfort level and competency with providing this type of care.41-45

We found that most of the ICUs evaluated their bereavement follow-up services through anecdotal methods (eg, family or staff feedback). Less than 25% of the ICUs used measurable survey data. In addition, most ICUs did not use bereavement risk assessment tools. Because death in the ICU has been associated with a higher burden of psychological symptoms among bereaved family members,6,7,46-48 researchers recommend use of a reliable and valid bereavement risk assessment tool.49,50 Use of such a tool can help to identify family members at higher risk for complicated bereavement and help to develop beneficial interventions. Subsequently, intervening for at-risk family members may save valuable money and time and is also consistent with recommendations in palliative care guidelines.39

In this study, a significant factor associated with ICU bereavement services was that the hospital has a palliative care service or another support service. The nurse leaders reported their members of ICU staff were able to call on such services to provide bereavement follow-up care. Perhaps this finding suggests that awareness of the need for bereavement care is greater in hospitals with palliative care services, and

**Table 3**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Percent (No.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interested in starting a program</td>
<td>44.6 (66)</td>
</tr>
<tr>
<td>Unsure</td>
<td>41.2 (61)</td>
</tr>
<tr>
<td>No</td>
<td>6.1 (9)</td>
</tr>
<tr>
<td>Did not answer</td>
<td>8.1 (12)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Services interested in starting for bereavement follow-up</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sending condolence card</td>
<td>53.4 (79)</td>
</tr>
<tr>
<td>Brochure of community services</td>
<td>48.0 (71)</td>
</tr>
<tr>
<td>Follow-up telephone call</td>
<td>35.1 (52)</td>
</tr>
<tr>
<td>Family counseling</td>
<td>14.2 (21)</td>
</tr>
<tr>
<td>Offer a memorial service</td>
<td>11.5 (17)</td>
</tr>
<tr>
<td>Social group meetings</td>
<td>10.8 (16)</td>
</tr>
<tr>
<td>Self-help group</td>
<td>10.8 (16)</td>
</tr>
<tr>
<td>Group counseling</td>
<td>8.8 (13)</td>
</tr>
<tr>
<td>Individual counseling</td>
<td>5.4 (8)</td>
</tr>
<tr>
<td>Other</td>
<td>4.1 (6)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Barriers to starting bereavement follow-up services</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of education, mentoring, or support for staff</td>
<td>48.0 (71)</td>
</tr>
<tr>
<td>Lack of available funds</td>
<td>47.3 (70)</td>
</tr>
<tr>
<td>Lack of knowledge on family bereavement needs</td>
<td>39.9 (59)</td>
</tr>
<tr>
<td>Staff does not feel qualified</td>
<td>38.5 (57)</td>
</tr>
<tr>
<td>Lack of time</td>
<td>32.4 (48)</td>
</tr>
<tr>
<td>Lack of space</td>
<td>20.3 (30)</td>
</tr>
<tr>
<td>Lack of interest in implementing a program</td>
<td>20.3 (30)</td>
</tr>
<tr>
<td>Geographical distance of family members</td>
<td>15.5 (23)</td>
</tr>
<tr>
<td>Language and/or cultural differences in families</td>
<td>14.2 (21)</td>
</tr>
<tr>
<td>Other hospital services provide intensive care unit follow-up</td>
<td>13.5 (20)</td>
</tr>
<tr>
<td>Not the responsibility of the intensive care unit</td>
<td>6.8 (10)</td>
</tr>
<tr>
<td>Families do not need the service</td>
<td>2.0 (3)</td>
</tr>
<tr>
<td>Other</td>
<td>2.7 (4)</td>
</tr>
</tbody>
</table>

a Number may be greater than 148 because participants could choose more than 1 option.

**Table 4**

<table>
<thead>
<tr>
<th>Variable</th>
<th>No. (%)</th>
<th>Odds ratio</th>
<th>95% CI</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICU type surgical</td>
<td>25 (11)</td>
<td>3.33</td>
<td>1.10-10.14</td>
<td>.03</td>
</tr>
<tr>
<td>ICU type medical-surgical</td>
<td>28 (12)</td>
<td>0.59</td>
<td>0.19-1.88</td>
<td>.37</td>
</tr>
<tr>
<td>ICU type cardiac</td>
<td>37 (16)</td>
<td>1.11</td>
<td>0.44-2.82</td>
<td>.83</td>
</tr>
<tr>
<td>ICU type mixed</td>
<td>86 (36)</td>
<td>1.18</td>
<td>0.55-2.55</td>
<td>.67</td>
</tr>
<tr>
<td>Yes, hospital offers palliative care service</td>
<td>192 (81)</td>
<td>7.66</td>
<td>2.15-27.32</td>
<td>.002</td>
</tr>
<tr>
<td>Yes, hospital has another service for bereavement support</td>
<td>159 (67)</td>
<td>3.81</td>
<td>1.66-8.71</td>
<td>.002</td>
</tr>
</tbody>
</table>

a A significance level of .05 was used in the analysis. Variables that were significantly related to the intensive care unit offering bereavement follow-up services at the univariate level were included in the final multivariate model. The overall model was significant ($\chi^2=47.4$, $P=.001$).
thus they offer more training and leadership in this area. Several researchers\(^1\) have reported that palliative care models in hospitals and other units improve the quality of care, lower use of nonbeneficial life-prolonging treatments, and improve family satisfaction. However, more research is needed to ascertain whether these services are provided directly by the ICU or the ICU outsources this care to another service.

The responses indicated that surgical ICUs were more likely to offer bereavement follow-up services than were medical ICUs. This finding is interpreted with caution because the sample of surgical ICUs was small. One explanation for this could be that the surgical units in our study may have performed organ and tissue transplants, as they were from large tertiary medical centers. Bereavement training may be more acknowledged and practiced in transplant units because deceased donations and rejection are more prevalent.\(^5\) Another possible explanation could be that the risk of sudden and traumatic deaths is higher in surgical ICUs, making bereavement support more needed.\(^4\) However, further research is warranted to assess whether the type of ICU influences the use of bereavement practice.

**Limitations**

This study has several limitations. First, we would have preferred our response rate to be higher; however, we surveyed a wide variety of nurse leaders from diverse hospitals and ICUs, which improved the generalizability of our findings. Second, the surveys were completed by nurse leaders and may not represent the opinions and attitudes of other health care staff. Third, nurse leaders could select more than one service that also provides bereavement support, which may not accurately reflect what services ICUs are directly providing families. Fourth, survey data can provide insights into bereavement care practices; however, such data are indirect when compared with actual observation. Finally, the results were dependent on response rates and potential nonresponders may have answered the questions differently than respondents, which could be a potential source of bias.

**Implications**

Study findings help determine the prevalence of bereavement programs and follow-up support that is currently being offered in adult ICUs in the United States. The findings address a significant gap in the research about the prevalence of bereavement practices. In addition, the findings provide insight into what type of bereavement methods are being used, what barriers are present that hinder bereavement programs and follow-up services in the ICU, and potential interventions in overcoming the barriers.

FINANCIAL DISCLOSURES

This study was supported by a $2500 faculty research grant from Samuel Merritt University, Oakland, California.

**See Also**

For more about bereavement support, visit the Critical Care Nurse website, www.ccnonline.org, and click “Submit a response” in either the full-text or PDF view of the article.

**REFERENCES**


N E E D S  O F  P A T I E N T S ’  
F A M I L Y  M E M B E R S  I N  A N  
I N T E N S I V E  C A R E  U N I T  W I T H  
C O N T I N U O U S  V I S I T A T I O N  

By Mini Jacob, RN, MSN, Cynthia Horton, RN, BS, CRRN, Sharon Rance-Ashley, RN, BSN, Tera Field, RN, MSN, Robbie Patterson, RN, MSN, Claudette Johnson, RN, MSN, Holly Saunders, RN, BSN, Tracy Shelton, RN, BSN, Jessica Miller, RN, BSN, and Carmen Frobos, BS

Background Although many critical care experts and national organizations support open visitation in intensive care units (ICUs), most ICU visiting policies do not allow unrestricted presence of patients’ family members.

Objective To describe how well the needs of family members were met in an adult neuroscience ICU with a continuous visitation policy and an adjoining private suite for patients’ family members.

Methods An exploratory, descriptive study design was used to identify the effects of continuous family visitation in the neuroscience ICU on patients’ family members and their needs and experiences during their time in the unit. A convenience sample of consenting family members completed a survey of family need items 72 hours after the patient was admitted to the unit.

Results The most important needs identified by the 45 family members surveyed were items relating to information about the patient, visiting the patient, being given hope, talking with a doctor each day, and being assured that the best care is being given to the patient. Least important items were related to physical comforts for the family members. The vast majority of family members rated their needs as being met for all of the items in the survey and reported a high level of satisfaction with care.

Conclusion In a neuroscience ICU with an open visitation policy and a private suite for patients’ family members, family members rated their needs as being met at a high level, unlike in prior studies in units with limitations on family visitation. The rank order of the importance of each need in the survey was similar to rankings in prior studies in a variety of critical care units. (American Journal of Critical Care. 2016;25:118-125)
Family members of critically ill patients experience significant psychological and physiological stress during their loved one’s stay in an intensive care unit (ICU). In descriptive research studies in the 1970s and 1980s, family members of ICU adult patients consistently identified similar high-priority needs during the time of the critical illness. Some of the highest ranked needs included the need for information about their loved one, to be geographically close to their loved one, and to know that their loved one is receiving the best care possible. In more recent descriptive studies of family needs in a variety of different critical care situations, ranking of needs was similar to the rankings in the earlier studies. In some of these studies, researchers also sought to determine how well family members’ needs were met during the patient’s stay in the ICU. Several of the most important needs identified by patients’ family members were not found to be met at a high level, including needs for information and presence.

On the basis of the identified needs of patients’ family members for information about their loved ones and the need for proximity to the loved ones during their ICU stay, critical care experts and professional organizations have advocated for visitation policies in critical care units that minimize restrictions on family member visitation. Despite these recommendations, surveys of critical care unit administrators indicate that most critical care units continue to have moderately restrictive policies for family visitation. Although it is not clear why such a disparity exists between the recommended visitation policy and actual practice, one likely reason is the negative attitude that many critical care nurses have toward “open” or less restrictive visitation policies.

Since 2007, the policy for family visitation in the neuroscience intensive care unit at Emory University Hospital (Atlanta, Georgia) has allowed continuous visitation by patients’ family members. The continuous visitation policy not only allows family members to be at their loved one’s bedside 24 hours a day, but also allows family members to sleep in a family suite adjacent to the patient’s room. Patients’ rooms can accommodate 4 family members at the bedside during the day and 2 during the night. Family suites are equipped with 2 chairs that can convert to beds, telephone, cable television, wireless Internet access, a table, chairs, a closet, and a sink. A family coordinator for the unit is also available to provide information and logistical support to patients’ family members. Family members are provided with an identification card for unit access during the night.

Family members may stay with the patient and observe any procedures that occur in the patient’s room, including placement of invasive devices. During emergency situations, a unit staff nurse and hospital chaplain stay with the family members to provide support and minute-to-minute updates on the patient’s condition. Family members are also invited to join the bedside shift report and the nursing and medical team rounds; they are also updated on the patient’s status and encouraged to create goals for the day. In the case of dying patients, all family members are allowed to be with the patient at the same time, including underage children.

This level of open visitation is rare. Although approximately 50% of hospitals report “open visitation,” patients’ family members are not encouraged to stay continuously with adult patients if they desire. Several studies have involved surveys of nurses about visitation in ICUs with “open” visitation policies, but no studies have involved surveys of patients’ family members about their needs and how well those needs have been met in ICUs with visitation policies that allow unrestricted or continuous visitation. Although staff in our neuroscience ICU and national experts believe that a continuous visitation policy should ensure that family members’ needs for information about and presence with their loved one are completely met, to date, no data have validated that belief or assumption.

The purpose of this study was to determine the needs of patients’ family members, and how well those needs were met, in an adult neuroscience ICU with a policy of continuous visitation for patients’ family members.

About the Authors
Cynthia Horton, Sharon Rance-Ashley, Tera Field, Robbie Patterson, Claudette Johnson, Holly Sauders, Tracy Sheldon, and Jessica Miller are staff nurses, Carmen Frobos is a family coordinator, and Mini Jacob is the nurse educator in the neuroscience intensive care unit, Emory University Hospital, Atlanta, Georgia. Corresponding author: Mini Jacob, RN, MSN, Neuro ICU, Emory University Hospital, 1364 Clifton Rd NE, Atlanta, GA (e-mail: mini.johnney.jacob@emoryhealthcare.org).

Most critical care units still have moderately restrictive visiting policies.
The neuroscience unit was designed for patients and their families to feel comfortable and welcome.

Materials and Methods

This study was conducted in a 27-bed neuroscience ICU at Emory University Hospital, a 571-bed academic medical center in Atlanta, Georgia. Study approval was obtained from the institution’s investigational review board before data collection.

Study Design

An exploratory, descriptive study design was used to identify the needs and experiences of family members of patients in a neuroscience ICU with continuous family visitation. Dependent variables were the needs and the experiences of patients’ family members.

Sample Selection

A convenience sample of family members was studied for 2 months. Inclusion criteria were that the individual was mentally competent and was a family member, significant other, and/or close friend of a patient who had been present in the neuroscience ICU for at least 48 hours during the preceding 3 days.

Family Member Needs Survey

The survey completed by family members was composed from 3 different sources: the Critical Care Needs Inventory (CCNI),2,3 the Family Satisfaction in the ICU (FS-ICU) survey,31-35 and investigator-developed statements specific to the neuroscience ICU at the facility. Total time to complete the paper and pencil survey was less than 15 minutes. Participants were offered assistance in completing the survey, if needed.

1. The original CCNI tool was a 45-item listing of family members’ needs.2,3 The importance of each individual need is rated on a 4-level Likert scale (4 = very important, 3 = important, 2 = not important, 1 = not important at all), as is the family member’s experience with how well that need was met during the ICU stay (1 = met, 2 = partly met, 3 = not met, no score = do not remember). Space was also provided for additional comments or suggestions by the family member about each need item. The CCNI is a valid and reliable survey tool.30 For this study, the final item on each need item is rated on a 4-level Likert scale (1 = met, 2 = partly met, 3 = not met, 4 = not met at all), as is the family member’s experience with how well that need was met during the ICU stay (1 = met, 2 = partly met, 3 = not met, 4 = not met at all).

2. Twelve items from the 24-item FS-ICU survey were deleted for this study because of redundancy with items on the CCNI.

3. FS-ICU survey. The original FS-ICU survey was a 34-item listing of various aspects or components of patient care in the ICU.31-33 Later revised to a 24-item survey.33-35 Family members rate how well they perceived care delivery for each aspect or component on a 5-level Likert scale (1 = excellent, 2 = very good, 3 = good, 4 = fair, 5 = poor). The FS-ICU is a valid and reliable survey tool.31,33

Neuroscience ICU’s Physical Environment and Visitation Policy

The neuroscience ICU was designed for patients and their families to feel comfortable and welcome in the ICU and with a goal to better meet the needs of patients’ family members to be present with their loved one. A family waiting room outside the patient care area consists of a large waiting room, an eating area, including a refrigerator to store family members’ food, a microwave, an ice machine, a children’s corner with toys and entertainment, a quiet room, and several computers for family use. A family coordinator is also present in this area to greet and orient family members to the unit and the policies and procedures and resources available to support families during their loved one’s stay (eg, CaringBridge, dining resources, social workers, chaplains, and financial aid services). The large waiting room has sofas, chairs, a large television, wireless Internet service (also available throughout the unit), and laundry and shower facilities for family use.

The patient care area of the neuroscience ICU has 20 private rooms with 2 central nurses’ stations. Each patient’s room has an entry area for hospital staff to use medical computers with the patient easily visible. Connected to the patient’s room is the family studio, with a door to ensure privacy (see Figure). The studio has 2 reclining chairs that can be converted into beds, a table and 2 chairs, a lamp, a telephone, a large closet, a sink, a television, and wireless Internet access.

Family members are encouraged to physically stay in the patient’s room or the family studio 24 hours a day. Up to 4 visitors, 12 years or older, may visit from 9 AM to 9 PM, and 2 family members over the age of 18 years may stay overnight. Exceptions to the number and age of visitors are made for end-of-life situations and individual circumstances.
Study Procedure
Between 48 and 72 hours after a patient was admitted to the neuroscience ICU, informed consent was obtained from 1 eligible family member by a study investigator not involved in the direct care of the patient. The consenting family member was given the Family Member Needs survey to complete in the family studio during a quiet time. After completing the survey, family members placed the survey into a preaddressed, sealed envelope and gave it to the study investigator. Survey responses were not shared with unit personnel unless requested to do so by the family member. The study investigator was available for the family member while the family member was completing the survey to answer any questions and to assist with survey completion if requested.

Data Analysis
Descriptive statistics were used to summarize responses to the surveys. A rank order listing of family member needs was based on the mean Likert score for each item on the survey, with percentages calculated for how well each family need was met.

Results
A total of 55 family members of patients were invited to participate in the study, with 4 declining participation. Of the 51 consenting family members, 45 completed the survey during the 2-month period of the study. The family members were from 21 to 86 years old (mean [SD], 50.3 [13.8] years). Most of the participants were women (86%), spouses of the patient (40%), and either lived with the patient (62%) or saw the patient frequently (55%) before admission to the neuroscience ICU (Table 1). In the 2 days before completing the survey, 71% of the family members had spent almost all the time in the neuroscience ICU with the patient.

Mean scores for the ratings of individual needs and how well those needs were met are summarized in Table 2 (available online only—www.ajcconline.org). Family member need items were arranged in rank order in the table, with the original item order in the survey tool indicated by the number in parentheses that precedes each item.

Mean (SD) scores for the 43 needs items on the CCNI survey (Table 2, online only) ranged from 4.0 (0.0), which was the highest score possible, indicating that the item was very important, to 2.8 (1.1). The most important needs identified by family members from these items related to information about the patient, visiting the patient, being given hope, talking with a doctor each day, and being assured that the best care is being provided for the patient. Least important items on the list of 43 items related to physical comforts for the family members. Mean scores for how well needs were met during the hospitalization ranged from 1.0 (0.2), where a score of 1 meant that the need was met and a score of 3 meant that the need was not met at all, to 2.2 (1.4).

Mean (SD) scores for the 24 needs items specific to the visiting situation in the neuroscience ICU and developed by the study investigators (Table 2, online only) ranged from 3.9 (0.3), where a score of 4 meant very important, to 2.8 (1.2). The most important needs identified by family members from these items related to information about the patient, being close to or present with the patient, and being able to sleep when staying overnight. Least important items related to physical comforts for the family members and being included on physician rounds. Mean (SD) scores on how well needs were met on the investigator-developed items ranged from 1.0 (0.2), where a score of 1 meant that the need was met, to 2.0 (1.0), where a score of 2 meant that the need was partially met.

Mean (SD) scores for the 12 satisfaction items on the survey (Table 3) ranged from 1.2 (0.5), where a score of 1.0 meant excellent, to 1.8 (1.1). Highest satisfaction scores were for the care provided by nurses and doctors and for courtesy and respect given to the patient and family. The lowest satisfaction score was for frequency of physician communication with the patient’s family.

Fifteen of the 45 family members provided specific suggestions for care improvements, and 18 provided other comments on the survey tool.

Family members noted that getting information about the patient, visiting, and being given hope were most important.
Specific compliments about the care provided by the unit staff far exceeded the number of negative comments about either the staff care or the physical environment of the neuroscience ICU.

**Discussion**

The most important needs identified by family members on the CCNI survey were items relating to information about the patient, visiting the patient, being given hope, talking with a doctor each day, and being assured that the best care is being provided for the patient. Least important items were related to physical comforts for themselves. According to responses to how well individual needs were met on the CCNI, the vast majority of family members rated their needs as being met for all of the items in the survey. According to the survey results, family members’ satisfaction with care was very high.

Compared with prior studies of the needs of adult family members of ICU patients, family members’ most and least important needs have not changed. Prior studies included family members whose loved ones were cared for in a variety of different types of adult ICUs, including medical, surgical, neuroscience, mixed medical-surgical, and coronary care units. The consistency in how family members ranked their needs, particularly the most and least important needs, despite the type of ICU and diagnosis, supports the universal nature of what is important to patients’ family members during a critical illness.

Of the 43 CCNI need statements in our survey, family members had all of their needs met at a very high level. In prior studies, although some needs were met at a high level, some needs identified as very important in the survey were met less than 50% of the time. In Molter’s original research, family members identified needs related to talking with a doctor at least once a day, having knowledge of chaplain services, needing to have a place to be alone in the hospital, and needing to have someone help with financial services. They did not have those needs met at a high level despite the needs being ranked highly. Maxwell et al reported that more than half of the highest ranked need items were not on the list of top ranked needs that were met. Items in that survey that were not well met related to information, comfort, and proximity. Mendonca and Warren reported that 4 out of 10 of the highest ranked needs were not in the top ranked needs that were met. Needs that were not highly met were related to needs for information. In Warren’s study, items related to proximity to the patient had lower scores for being met than other survey items. Prior studies, though, presented limited objective data on how well needs were met, summarizing the data in general statements about the highest needs met.

In addition, all of these studies but one were conducted before the year 2000, at a time when visitation policies in critical care were very limited (ie, 2 or 3 brief periods for visitation each day). Responses by family members about how well needs were met in our study were almost always “met,” with few being “partially met” or “not met at all.” A number of explanations for family members’ needs being met at a high rate in this study could be advanced, including organizational factors, unit culture and communication, and other patient or family satisfaction foci. The high rate of needs being perceived as “met” could also be due to the liberal

### Table 1

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>No. (%) of family members</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sex</strong></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>6 (14)</td>
</tr>
<tr>
<td>Female</td>
<td>37 (86)</td>
</tr>
<tr>
<td><strong>Relationship to patient</strong></td>
<td></td>
</tr>
<tr>
<td>Parent</td>
<td>9 (18)</td>
</tr>
<tr>
<td>Spouse</td>
<td>18 (40)</td>
</tr>
<tr>
<td>Significant other</td>
<td>3 (6)</td>
</tr>
<tr>
<td>Child</td>
<td>10 (22)</td>
</tr>
<tr>
<td>Friend</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Other</td>
<td>1 (2)</td>
</tr>
<tr>
<td><strong>Lived with patient before admission</strong></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>28 (62)</td>
</tr>
<tr>
<td>No</td>
<td>17 (38)</td>
</tr>
<tr>
<td><strong>How often did you see patient before hospitalization?</strong></td>
<td></td>
</tr>
<tr>
<td>&gt; Once a week</td>
<td>25 (55)</td>
</tr>
<tr>
<td>Once a week</td>
<td>11 (24)</td>
</tr>
<tr>
<td>Once a month</td>
<td>6 (13)</td>
</tr>
<tr>
<td>Once every 6 months</td>
<td>1 (2)</td>
</tr>
<tr>
<td>Once every year</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Not even every year</td>
<td>2 (4)</td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>20 (44)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>3 (7)</td>
</tr>
<tr>
<td>African American</td>
<td>20 (44)</td>
</tr>
<tr>
<td>Asian</td>
<td>1 (2)</td>
</tr>
<tr>
<td>Other</td>
<td>0 (0)</td>
</tr>
<tr>
<td><strong>Educational level completed</strong></td>
<td></td>
</tr>
<tr>
<td>Grade school</td>
<td>2 (4)</td>
</tr>
<tr>
<td>High school</td>
<td>11 (24)</td>
</tr>
<tr>
<td>Community college</td>
<td>14 (31)</td>
</tr>
<tr>
<td>College</td>
<td>8 (18)</td>
</tr>
<tr>
<td>Graduate school</td>
<td>10 (22)</td>
</tr>
<tr>
<td><strong>Time spent with patient last 2 days</strong></td>
<td></td>
</tr>
<tr>
<td>Almost all the time</td>
<td>32 (71)</td>
</tr>
<tr>
<td>At least 24 hours</td>
<td>10 (22)</td>
</tr>
<tr>
<td>At least 12 hours</td>
<td>1 (2)</td>
</tr>
<tr>
<td>At least 6 hours</td>
<td>1 (2)</td>
</tr>
<tr>
<td>&lt; 6 hours</td>
<td>1 (2)</td>
</tr>
</tbody>
</table>
visiting policy in the unit, because most family members surveyed had been with the patient most of the time during the 2 days before the survey. Theoretically, a family member’s prolonged physical presence would most likely have improved communication of information about the patient from care providers and made them more aware of care that had been done, both important needs that had not been well met in prior studies.

The response by family members to the survey item developed by the investigators about family members’ being included on physician rounds was remarkable. The scores on that item were lower than the scores on many of the other items, and in particular contrasted with scores on the survey item that dealt with needing to talk to a physician once a day. The seeming incongruence of a strong need to talk to a physician each day but only a moderate need to be included on physician rounds may indicate that rounds are not the best way for family members to have contact with a physician each day. Future research is needed to clarify the value to family members of including them on patient care rounds and/or if their preference is for more individualized and direct communication with the physician.

**Clinical Implications**

Having an unrestricted visitation policy in an ICU did not change the family members’ ranking of the most and least important needs, but their needs were met more often than had been observed in prior studies of patients’ family members. Satisfaction levels with care were also very high. Having a more liberal visiting policy could improve satisfaction levels of family members during the ICU stay.

**Study Limitations**

This study surveyed only family members or significant others who had spent a large amount of time with the patient while in the neuroscience ICU. We did not survey family members who had spent limited amounts of time in the neuroscience ICU, and their needs and views could be different. Another limitation of the study is that the neuroscience ICU was a newly renovated unit, structured to accommodate the open visitation policy of the unit. Results may be different in situations where the

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**Table 3**

Responses by 45 family members of patients in the neuroscience intensive care unit (ICU) to survey questions on their satisfaction with care

<table>
<thead>
<tr>
<th>Questions from Family Satisfaction with ICU</th>
<th>Excellent (1)</th>
<th>Very good (2)</th>
<th>Good (3)</th>
<th>Fair (4)</th>
<th>Poor (5)</th>
<th>Not applicable</th>
<th>Score, mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. (75) How well the ICU nurses have cared for your family member.</td>
<td>36</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>1.2 (0.7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. (77) How well the doctors have cared for your family member.</td>
<td>34</td>
<td>8</td>
<td>2</td>
<td>1</td>
<td>1.2 (0.5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. (69) The courtesy, respect, and compassion your family member has been given by the ICU staff.</td>
<td>36</td>
<td>6</td>
<td>3</td>
<td>1</td>
<td>1.3 (0.6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. (74) The teamwork of the ICU staff that takes care of your family member.</td>
<td>36</td>
<td>6</td>
<td>3</td>
<td>1</td>
<td>1.3 (0.6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. (70) The courtesy, respect, and compassion you have been given by the ICU staff.</td>
<td>34</td>
<td>8</td>
<td>2</td>
<td>1</td>
<td>1.3 (0.7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. (71) How well the ICU staff has assessed and treated your family member’s pain.</td>
<td>36</td>
<td>6</td>
<td>2</td>
<td>1</td>
<td>1.3 (0.7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. (72) How well the ICU staff has assessed and treated your family member’s breathlessness.</td>
<td>27</td>
<td>7</td>
<td>2</td>
<td>1</td>
<td>8</td>
<td>1.4 (0.7)</td>
<td></td>
</tr>
<tr>
<td>8. (73) How well the ICU staff has assessed and treated your family member’s agitation (restlessness).</td>
<td>29</td>
<td>7</td>
<td>4</td>
<td>1</td>
<td>4</td>
<td>1.4 (0.8)</td>
<td></td>
</tr>
<tr>
<td>9. (79) How well you were included in decision making about your family member’s care.</td>
<td>29</td>
<td>7</td>
<td>5</td>
<td>1</td>
<td>6</td>
<td>1.5 (0.8)</td>
<td></td>
</tr>
<tr>
<td>10. (76) How often the nurses communicated to you about your family member’s condition.</td>
<td>32</td>
<td>7</td>
<td>5</td>
<td>1</td>
<td>3</td>
<td>1.5 (0.9)</td>
<td></td>
</tr>
<tr>
<td>11. (80) How well you were supported during the decision-making process.</td>
<td>30</td>
<td>6</td>
<td>4</td>
<td>2</td>
<td>1.5 (0.7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. (78) How often the doctors have communicated to you about your family member’s condition.</td>
<td>26</td>
<td>8</td>
<td>8</td>
<td>1</td>
<td>2</td>
<td>1.8 (1.1)</td>
<td></td>
</tr>
</tbody>
</table>

*a Survey items were from the Family Satisfaction in the ICU (12 items). Items are arranged in descending order of most important needs and satisfaction with care, with original survey item number in parentheses before each item.*
physical environment of the ICU is not as conducive to or supportive of family members’ presence. And finally, another limitation is that this study was focused only on family members’ needs and did not address satisfaction of nursing or medical staff with open visitation.

Conclusions
Results of this survey indicate that patients’ family members rated their needs as being met at a high level in a neuroscience ICU with an open visitation policy. Compared with prior studies with limitations on family visitation, needs were met at a high level for more surveyed items. The higher level of needs being met in our study may be due to the unrestricted nature of the visitation policy as well as the supportive physical environment for family presence in the ICU during prolonged periods. Although needs were met at a very high level, the rank order of the importance of each need in the survey was very similar to the rankings in prior studies in a variety of nonneuroscience ICUs.

ACKNOWLEDGMENTS
Special thanks to Marianne Chulay, RN, PhD, FAAN, for assistance with study design and manuscript preparation; to Susan E. Shapiro, RN, PhD, FAAN, for research review and administrative support; to Pam Cosper, RN, MSN, NEA-BC, Cindi Reynolds, RN, Lisa Reif, RN, MSN, APRN-CCNS, CCRN, and all the nursing staff in the neuroscience intensive care unit for encouragement and support.

Table 4
Examples of comments written by family members on the survey tool completed by 25 family members of patients in the neuroscience intensive care unit (ICU)

Specific accolades for neuroscience ICU staff (30 individual comments)

Keep up the good work!
Great hospital and personnel!—don’t change!
The staff is beyond excellent!
Staff is excellent on listening!
You are the best of the best.
All nurses have been very informative.
I can’t express how pleased I am with care here . . . I pray nothing changes!!!
Love the studio and chance of interaction with other families in the waiting room.
The family-centered care model works well for my family and is much appreciated.
Everyone has been great to us. They answer all questions and provided information needed. We are so very pleased with the hospital and accommodations.
Everything has been wonderful now and for the last 7 years.
Truly impressed thus far of the care my sister has been given by the staff and the amenities available during my stay like shower room, cafeteria, phones, electrical sockets, etc. . . .
We are impressed with the facility and services, as well as the nurses, doctors, and other staff.
The care and efficiency with which we have been treated has impressed us significantly, and [we] hope that this is a model for all future visits. It has been so easy to ask questions and . . . were easily answered, and we were made to feel very comfortable.

Complaints related to care by the neuroscience ICU staff (7 individual comments)
Communication poor when family member transferred from another site.
Poor communication between care providers.
A lot of attention paid to neuro assessment but basic nursing care not being done.
People need to explain who they are.
The day-shift staff needs to exhibit more compassion. The night shift is excellent!
Out of town visitors who drove 2 hours were allowed only short visit—allow exceptions to extra visits after 9 pm.

Complaints about physical environment at the hospital (10 individual comments)
Food not good/inadequate.
Bathroom is too far from ICU—should have been allowed to use the toilet in the patient’s room or closer to unit.
Bathrooms are not clean.
Need a chair inside the room.
More seating for family inside the patient’s room.
So many staff sometimes—confusing.
A heater to keep the family room warmer.

Specific suggestions to improve care (7 individual comments)
Need a better parking arrangement for long-term stay.
The only small suggestion is to allow visits from children under 12 years old when accompanied by an adult. Children and music lift the spirits and head.
More communication by nurses and techs as they come in to provide care without informing patient or family about what was to take place.
of staff involvement in research; and posthumously to Becky Provine, RN, MSN, NEA-BC, for encouraging and supporting bedside nurses to conduct nursing research.

FINANCIAL DISCLOSURES
None reported.

SEE ALSO
For more about family visitation, visit the Critical Care Nurse Web site, www.aconline.org, and read the article by Bishop, “Family Presence in the Adult Burn Intensive Care Unit During Dressing Change” (February 2013).

eLetters
Now that you’ve read the article, create or contribute to an online discussion on this topic. Visit www.aconline.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 Columbus, 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 118-125, consider the questions and discussion points outlined in the “Discussion Points” box. Visit www.ajcconline.org to discuss the article online.

Open visitation in the intensive care unit (ICU) is a recommended practice that holds promise to enhance the outcomes of families of the critically ill. More than 3 decades of research capture the psychological and informational needs of family members of the critically ill. Recent recommendations from professional organizations support open or unrestricted visitation in the adult ICUs. With limited direct evidence on the benefits of open visitation, the authors sought to discern if open visitation in a neurological ICU addresses the needs and enhances the experiences of the family members.

To perform their study, the authors recruited family members 48 to 72 hours after a patient’s admission to a neurological ICU. The Critical Care Needs Inventory, the Family Satisfaction in the Intensive Care Unit survey, and a set of questions to assess the experience related to open visitation was administered to 45 participants at baseline and 2 months after enrollment.

Participants indicated that their needs were mostly met and they were highly satisfied with the care delivered to the critically ill patient. Consistent with previous research, the authors noted that the most important needs identified by participants were related to informational support, access to the patient, and a physical space that accommodated an overnight stay.

Information From the Authors

In this Evidence-Based Review (EBR) column, it is typical to highlight the journey and background of the lead author. The point of sharing the perspectives of the lead author is help to demystify the process of research and publication. This EBR column highlights the journey of a team of staff nurses who were motivated to better understand...
the impact of open visitation on the experiences of family members of critically ill patients admitted to their neurological ICU.

With support from a research mentor, Marianne Chulay, RN, DNSc, this team of clinical nurses sought to better understand how the adoption of an open visitation policy and modifications of the physical environment of their ICU contributed to meeting the needs of family members of the critically ill in their unit. According to the authors, the decision to focus on family presence emerged naturally. “As staff nurses in the neurological ICU, we have long embraced family presence in our unit and recognize the family as integral component of patient care,” they explained.

The results of this study were not a surprise to the authors. “Our research validated what we thought about the care provided to families in our ‘open’ ICU and have similar need priorities as found in published studies involving family members of the critically ill,” they said. They added, “However, unlike prior research, our family members’ need for information and need to be present with their loved ones were met at a very high level.” The authors anticipate that their study results will be used to inform decisions to implement open visitation and family involvement in patient care at other institutions.

Implications for Practice

The authors encourage readers of the *American Journal of Critical Care* to acknowledge the value of open visitation and boldly advocate positive change to enhance the quality of care for critically ill patients and their family members.

The study findings confirm that open visitation, along with thoughtful environment design, has a positive effect on family members of critically ill patients in a neurological ICU. “Our study findings provided us with an opportunity to understand how we were meeting the complex needs of our patients and their family members. We have readily accepted value of the family at the patient’s bedside and hope that our study findings are inspiration for not only our hospital but to others across the nation,” noted the authors regarding the clinical implications of their study.

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.

Discussion Points

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

B. Literature Evaluation
- To what extent has the open visitation been implemented in intensive care units?
- What is the evidence that supports open visitation in the intensive care unit?

C. Sample
- What patients were eligible to participate in this study?
- Why do you suspect family members of patients who had short stays were excluded from this study?

D. Methods and Design
- Given the purpose of this study, were the measures used in this study appropriate and why?
- Describe how the authors obtained data from the participants. Do you suspect that the data collection procedures enhanced participation in the study?

E. Results
- What were the major findings of this project?
- How can you use the findings of this project to improve the quality of your nursing care?
Background. The impact of nursing care on patients’ outcomes has been demonstrated in adult and pediatric settings. However, limited attention has been given to standardized measurement of pediatric nursing care. A collaborative group, the Consortium for Congenital Cardiac Care Measurement of Nursing Practice, was formed to address this gap. The purpose of this study was to assess the current state of measurement of the quality of pediatric cardiovascular nursing in freestanding children’s hospitals across the United States.

Methods. A qualitative descriptive design was used to assess the state of measurement of nursing care from the perspective of experts in pediatric cardiovascular nursing. Nurse leaders from 20 sites participated in audiotaped phone interviews. The data were analyzed by using conventional content analysis.

Results. Each level of data coding was increasingly comprehensive. Guided by Donabedian’s quality framework of structure, process, and outcome, 2 encompassing patterns emerged: (1) structure and process of health care delivery and (2) structure and process of evaluation of care. Similarities in the structure of health care delivery included program expansion and subsequent hiring of nurses with a bachelor of science in nursing and experienced nurses to provide safety and optimal outcomes for patients. Programs varied in how they evaluated care in terms of structure, measurement, collection and dissemination of data.

Conclusion. External factors and response to internal processes of health care delivery were similar in different programs; evaluation was more varied. Seven opportunities for measurement that address both structure and process of nursing care were identified to be developed as benchmarks. (American Journal of Critical Care. 2016;25:128-135)
By 2014, the impact of nursing care on patients’ outcomes had routinely been demonstrated in adult and pediatric settings. Furthermore, evidence had linked specific nursing characteristics to patients’ outcomes of morbidity and mortality across the age continuum. The numerous studies highlighting the effect of nursing care on patients’ satisfaction and outcomes contrast sharply with the limited attention given to measuring nurses’ actions/behaviors in terms of care that is safe, effective, efficient, equitable, timely, and centered on patients and patients’ families.

The paucity of measurement of nursing care is of great concern for pediatric nursing care because most of the available standardized nurse-sensitive outcome indicators are related to adult care. These indicators, such as fall prevalence or failure to rescue, lack validity when applied globally to children or sub-populations of children. It can be argued that high-quality nursing care is especially important in children’s health care because the etiology, epidemiology, and trajectory of illness are often different in children than adults, and these differences have critical implications in the long term. Children born with congenital heart disease exemplify this fact explicitly. In response to this gap in the literature and the documented need for measurement specific to pediatric nursing, we formed a collaborative group named the Consortium for Congenital Cardiac Care Measurement of Nursing Practice (C4-MNP).

The overall aim of C4-MNP is to establish a national collaborative to identify nursing care actions/behaviors for measurement in the highly complex environment of pediatric cardiovascular care. The first step toward accomplishing this broad objective was to learn the current state of measurement of pediatric cardiovascular nursing care (structure, process, and outcome measurement) in 20 freestanding children’s hospitals across the country.

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**Methods**

**Study Design**

A qualitative descriptive design was chosen to assess the status of nursing measurement from the perspective of experts in the field of pediatric cardiovascular nursing. Qualitative description is a distinct method of naturalistic inquiry that uses broad open-ended questions and low inference interpretation to describe the experience in the everyday language of the participants. Participants contribute their insight and understanding of the phenomenon of interest by sharing fresh perspectives and thoughts. After getting approval from the institutional review board, the principal investigator (J.A.C.) initiated the interviews, which consisted of open-ended questions and related probes (Table 1). The co-principal investigator (S.M.) was present during the interview to ask follow-up questions and take field notes.

**Data Collection**

The nurse leader and designated colleagues from each site participated in an audiotaped phone interview that was then transcribed verbatim, omitting any identifying information. Following confirmation of the written transcript, the data were analyzed by using conventional content analysis, a technique widely used in qualitative descriptive research.

**Data Analysis**

The process of data analysis consisted of reading and rereading the data to fully understand the participants’ words and intent. First-level codes materialized directly from the data and were chosen because of emphasis, repetition, significance, or perceptiveness of comment. These codes were continuously reviewed, revised, and modified as new insights and ways of understanding the data emerged.

Next, similar first-level codes were clustered into categories and relabeled. Further work with the categories revealed that they represented 2 major

1. Most of the available standardized nurse-sensitive outcome indicators are related to adult care.
After each interview, the principal investigator and the co-principal investigator did peer debriefing to ensure that the research data analysis remained true to the participant’s words.

During data analysis, detailed quotes from the participants were used to substantiate coding decisions. The quotes also assisted an independent reader in confirming the accuracy of the researchers’ analysis, thus further authenticating the study’s credibility. A group of 6 institutions was selected to carry out member checking, which included reading a direct quote or statement made by the participant followed by the team’s coding of the statement. This process afforded transparency and transferability of the study.

According to Lincoln and Guba, just as there can be no validity without reliability, there can be no credibility without dependability. Dependability and confirmability of this research were established by audit trails. Dependability was achieved through an inquiry audit of the process to certify that the process was acceptable, professional, legal, and ethical. Confirmability was achieved through a confirmability audit, which examined the product (data), findings, interpretations, and recommendations attesting that the findings were supported by the data. In addition, dependability and confirmability were ensured through consultation with an external research methodologist who has extensive experience with qualitative descriptive research.

### Results

In a 6-month period, nursing administrative leaders from 20 pediatric cardiovascular programs were interviewed. The programs’ median annual volume for repair of a congenital heart defect was 279 cases (range, 107-806 cases). Following data analysis, Donabedian’s quality framework of structure, process, and outcome guided the final synthesis of data. Two encompassing patterns facilitated communication of data: (1) the structure and process of health care delivery and (2) the structure and process of evaluation of care (Figure 1). An integral part of each interview was the nurse leader’s review of the local, regional, and national external and internal pressures that influence the quality of care. These were multiple, embedded in the codes, and are specified in Figure 2.

### Structure of Health Care Delivery

Each nurse leader referred to some type of external environmental factor that influenced the quality of care for patients with congenital heart disease. A major external pressure was the demand to grow and be recognized as a program of excellence, such as improving a program’s standing in the US News

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**Table 1**

Guiding questions for interviews

| 1. Please describe your program’s evaluation of quality nursing care. |
| 2. Please describe any cardiac-specific measure of cardiac nursing care. |
| 3. From your experience, please tell me what do you identify as unique about providing quality nursing care for pediatric cardiovascular patients? (What makes it special? How is it different?) |
| 4. Please comment on what aspects of this nursing care make a difference in patients’ outcomes. |
| 5. Which of these aspects might be measurable, and how might that be accomplished? |
| 6. How have you or are you collecting data on these nurse-sensitive measures? |
| 7. Please comment on the resources you have in place (or wish you had in place) to collect and/or support data collection. |
| 8. Is there anything else you would like to share with me regarding providing quality nursing care for pediatric cardiovascular patients? |

**Table 2**

Data analysis coding example

<table>
<thead>
<tr>
<th>Code</th>
<th>Category</th>
<th>Pattern</th>
<th>Framework</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adequate staffing/hires Appropriate education Experienced Staff retention</td>
<td>Nursing workforce</td>
<td>Health care delivery</td>
<td>Structure</td>
</tr>
<tr>
<td>Situational awareness Expansion/growth Merger New technology Increased complexity</td>
<td>New structures</td>
<td>Evaluation of care</td>
<td>Structure</td>
</tr>
<tr>
<td>Nurse-sensitive measures Hospital-wide Adapted to cardiac unit Unique characteristics Nurses, cognitive skills Population of patients</td>
<td>Regulatory requirements Complexities of patients and patients’ families</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

patterns (Table 2). Additional exploration of this discovery and referencing Donabedian’s framework of structure, process, and outcomes and the Institute of Medicine’s quality domains enabled the team to organize and synthesize the data for the final report.

Prolonged engagement, peer debriefing, and member checking were employed to enhance the credibility of the study. Prolonged engagement included interviewing leaders from 20 pediatric cardiovascular programs (medical and surgical cardiac care) to ensure data saturation. Rich data and multiple nuances were shared as the clinically experienced interviewers easily gained a trusting relationship with the participants, which facilitated discussion and reflection about measurements specific to pediatric cardiovascular nursing practice.
and World Report’s rankings of best pediatric hospitals and/or cardiovascular programs. Increases in size and census were the constant response to this demand, as evidenced in transition to a new institution, a new building, a new cardiac-specific unit, merger of cardiovascular programs across organizations, or expansion of existing cardiac units. As one nurse leader remembered,

“We split off from the PICU [pediatric intensive care unit] in 2005... we had to actually onboard a lot of people in order to get up and running... ensuring quality care was a big issue, as far as making sure that things were being done correctly in providing care.

The risk of expansion affecting quality was further echoed by another leader.

One of the things we really noticed in the CVICU [cardiovascular intensive care unit] was that we expanded so rapidly that of course we didn’t have the nursing to keep up. We went from a 12 bed, to 16, to 21, all within a year and a half. That was huge, and I [was] onboarding staff as fast as I could. And that means that there are some deficits in training.

In many interviews, tension related to reorganization of leadership at the hospital, cardiovascular program, or unit level was evident. As stated by one nurse leader,

“We certainly have had challenges over the past year where there are several hospitals which have restructured... We had a major restructuring of the entire nursing department, which really did increase our turnover significantly. And I do think that has an effect on quality.

The continual structural change in the environment led to uncertainty and impinged on patients’ outcomes. Much of the nurse leader’s time was focused on building and retaining the nursing team to ensure quality of care. Many nurse leaders described the need to hire new staff and the stress of finding nurses with a bachelor of science in nursing and experienced nurses. For many, staffing requirements meant taking the risk of hiring new graduates directly into the intensive care environment. One nurse leader described the balance between degree and experience:

“We have some unique challenges... in that there are actually several diploma programs that are up and running and generate many nurses a year. There is a challenge... to hire only bachelor’s-level
nurses. I have been able to hire at the new-graduate level, but have not done as well at the experienced-nurse level. The market is pretty much saturated with associate and diploma degree nurses.

Another nurse leader described the choice between hiring baccalaureate nurses and having enough nurses:

We didn't hire anything but BSN [bachelor's-level nurses] until . . . 7 years ago, when we grew so fast that we just couldn't find a nurse . . . . But, we do really highly encourage them to get their BSN [bachelor of science in nursing], through reimbursement and so forth.

To offset the lack of experience and/or academic preparation, leaders described a number of strategies they put in place such as engagement of leadership, mentoring programs, rotation of experienced staff to nights, longer orientations, cross-training, and enhanced educational programs. As one nurse leader summarized,

We . . . engage them right out of orientation. I meet with the orientees . . . new grad group, orientation up to 6 months . . . experienced group, 4 or 5 months . . . our group started a mentoring program where they'll put an experienced nurse on nights, because that was the deficit shift. And they'll take assignments, but they're just there to be eyes and ears for assessment, and so that the younger nurses can have them on board.

Another leader echoed the importance of a mentorship program.

The mentor program is the key to success. The people who have 20+ years . . . all those critical thinking skills and techniques, and . . . value in those nurses' brains is worth a lot . . . the mentor program has increased the quality of care.

Others also emphasized the importance of leadership and engagement.

The more leadership becomes engaged with the bedside, the better things seem to move. If the communication is better, the understanding becomes better.

In addition, cross-training and certification were identified as strategies to support continued education and ensure high-quality care across cardiovascular programs.

Because we believe that in order to be successful with your outcomes, you need to have a strong foundation, both educationally and in practice.

Certification is a focus . . . something to be said about . . . expanding your knowledge and feeling like you really do know something when you pass the test.

Process of Health Care Delivery

The nurse leaders described key external processes in place to ensure the safety net and stay current with quality care initiatives such as participation in national collaboratives through the Children’s Hospitals Association, National Association of Children’s Hospitals and Related Institutions (NACHRI), and Nursing Database of Nursing Quality Indicators. Internal processes included practice-based activities such as standardized communication and handoffs, use of nursing clinical practice guidelines, and distraction-free areas. As one nurse leader summarized the processes,

Our various handoffs . . . [are under] a lot of scrutiny . . . [we want to] be sure we don’t miss anything . . . we saw medication errors [in] some serious events that took place . . . [so we] created this safety checklist, where the oncoming and offgoing nurse have a checklist that they go through when they give reports, specific to double-checking all the drips [infusions], the rates, the medication, the right concentration, and . . . daily rounds. We look at line [catheter] days and who needs to be extubated . . . We put in place . . . a bar-coding system for breast milk.

Structure of Evaluation of Care

The structure of how care was evaluated varied across institutions from a hospital-level quality program to a cardiovascular program to a unit-level committee. Those reporting at the hospital level verbalized the inability to focus measurement on cardiovascular issues. In most instances, all disciplines collaborated on quality evaluation.

A similarity was noted in measurement concerning infection, pressure ulcer, unplanned extubation, and medication events. Interestingly, when asked about cardiovascular nursing measurement, all reported no specific measurement. Some discussion addressed the attribution of bloodstream infections associated with central catheters and of open chest infections to nursing care.

Nurse leaders gave thoughtful responses when asked to portray the unique attributes of cardiovascular nursing care. Almost all described the cardiovascular nurse as knowledgeable about congenital heart disease conditions and treatment:

Well, certainly there is a different assessment skill set that a cardiovascular nurse
needs. You need that knowledge based on that defect or whatever the disease state is . . . the technology, and understanding how all of that works, the . . . sequence . . . the chronicity of it.

Nurse leaders also characterized cardiovascular pediatric nurses as having a necessary level of assertiveness, confidence; communicating the patient’s clinical status, and skill in educating families.

Understanding the importance of verbalizing subtle changes early . . . nurses that come from the adult cardiac world . . . are almost unnerved being here . . . it is completely different . . . it’s the subtle changes.

Another leader concurred, “Certainly the strong element of critical thinking, strong communication skills, because probably our families need more education and communication [about] what is going on than others [do].”

Nurse leaders emphasized that the cardiovascular nurse had to have a commitment to lifelong learning, as innovation was a constant.

There is so much going on . . . I don’t know of any subspecialty of nursing that is where team members are on the cutting edge . . . particularly . . . with all of the VADs [ventricular assist devices] . . . mobile ECMO [extracorporeal membrane oxygenation], all of these kind of things . . . doing the first thing for the first time ever in an institution.

Pediatric cardiovascular nursing care has expanded to premature infants and also to adults with congenital disease and subsequent morbidity. Providing care for the adult population was a growing issue, and how to address the needs of patients and nursing was not clear.

So, we’ve dealt with the entire spectrum. We have a very big adult congenital population . . . they present themselves with comorbidities . . . that we’re not used to . . . the aging population coming back with different relationships . . . There’s no mom and dad now. It’s a husband or a wife. And children . . . it’s challenging.

Many programs described a growing commitment to quality education onsite.

Well, they are educated in orientation about quality indicators, and what we track . . . and what to report. And we try to do a yearly; I don’t know if you call it competency or education, about quality indicators, about what we’re watching.

Dissemination of quality data occurred in the setting with use of dashboards, electronic boards, and posted displays. New information was routinely presented at staff meetings.

**Process of Evaluation of Care**

The process of how care is evaluated also varied. For many programs, nurse leaders reported a combined effort at the hospital and unit level to support data collection and report generation. Much of the data collection depended on unit leadership and staff. This arrangement provided staff the experience of evaluating the quality of their care.

My standing rule . . . is that the bedside nurses do the audits . . . the staff has to know what is expected of them. Doing the audits is the only way that they know . . . that half of our IV [intravenous] tubings are not labeled.

Some nurse leaders linked quality outcomes to employee performance and evaluation:

One of the things that we have been working on in the NACHRI is our bloodstream infections . . . they did not meet their goal. So, they all received a below in that particular area . . . they’re like, “That’s really not fair.” And I’m like, “Did you hold your peer accountable when you saw them enter a line without doing a scrub for 15 seconds”? . . . That’s how you make an impact. . . . I’m expecting you to hold each other accountable.

A number of opportunities for measurement were identified and were believed to be critical to moving the field of pediatric cardiovascular nursing

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### Table 3

<table>
<thead>
<tr>
<th>Topic area</th>
<th>Type of measure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Structure²</td>
</tr>
<tr>
<td>Nutrition</td>
<td>X</td>
</tr>
<tr>
<td>Pressure ulcers</td>
<td>X</td>
</tr>
<tr>
<td>Work environment</td>
<td>X</td>
</tr>
<tr>
<td>Clinical deterioration</td>
<td>X</td>
</tr>
<tr>
<td>Pain management</td>
<td>X</td>
</tr>
<tr>
<td>Patient- and family-centered care</td>
<td>X</td>
</tr>
<tr>
<td>Adults with congenital heart disease</td>
<td>X</td>
</tr>
</tbody>
</table>

² Measures the organization’s capacity and the conditions in which health care is provided by looking at factors such as staff or facilities.
³ Measures how health care is provided.
⁴ Measures the results of the health care.
⁵ Measures ensuring that if changes are made to one part of the system, they do not have unintended consequences on another part of the system.
forward (Table 3). Included were nutrition, device-related ulcers, clinical deterioration, pain management, care of adults with congenital heart disease, the work environment, and patient- and family-centered care. These 7 areas address both the structure and process of nursing care with linkage to outcomes. All agreed that collaboration is important, especially in a specialty setting; however, no current efforts are specific to pediatric cardiovascular nursing.

Limitations

Although information was garnered from 20 freestanding pediatric cardiovascular programs, we cannot generalize the status of quality measurement to all programs in the United States.

Discussion

Information from this study portrays the current landscape of delivery and evaluation of pediatric care in highly specialized and acute care environments. Similarities across institutions were notable in terms of program expansion requiring hiring of nurses with a bachelor of science in nursing and of experienced nurses to provide safety and optimal outcomes for patients. Nurse leaders verbalized the importance of measurement focused on cardiovascular nursing to help justify optimal staffing models in the current environment of reorganization and growth. Measures encompassing competency, experience, education, and retention were perceived as key for establishing benchmarks. The quality of the work environment, adult-based care, and patient- and family-centered care were additional items highlighted for measurement.

For many nurse leaders, the inability to justify an optimal staffing model was related to the paucity of evidence and measurement linking the process of nursing care to patients’ outcomes. This gap limited their ability to define quality care for their pediatric cardiovascular population, hence their greater attention to structural issues.

Programs varied in how evaluation of care was conducted in terms of structure, measurement, and the collection and dissemination of data. Quality of nursing care was a clear goal, and all nurse leaders agreed that cardiac-specific nursing care measures are essential; however, very few sites had measures, and none had used external benchmarks.

Conclusion

In many instances, the health care delivery experiences of nurse leaders were similar in external factors and response to internal structure and process approaches. How quality was evaluated varied across centers. Potential measures specific to cardiovascular nurses were identified.

A national community of researchers, administrators, and expert clinicians has come together to form a strong network committed to rigorous measurement of quality nursing care to achieve optimal outcomes for children with cardiac disease. Nurses’ ability to identify key performance measures and to articulate the value of those measures in the delivery of care is central to improving quality, establishing benchmarks, and reducing cost.

Next Steps

Information from this study will be used to inform development of measurements and benchmarks. Using the 7 identified target areas for measurement, the C4-MNP members will identify and develop measures and linkages to patients’ outcomes. These measures will then be pilot tested across a smaller number of centers before they are used for setting benchmarks for all participating programs.

FINANCIAL DISCLOSURES

This work was supported by Boston Children’s Hospital Program for Patient Safety and Quality Research Grant Award 2011 and American Association of Critical-Care Nurses (AACN) Impact Research Grant 2012.

eLetters

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REFERENCES


21. Naylor MD. Advancing the science in the measurement of health care quality influenced by nurses. Med Care Res Rev. 2007;64(2):144S-169S.


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  Headache profoundly affects management of spontaneous subarachnoid hemorrhage but is poorly characterized.

Objective  To characterize headache after spontaneous subarachnoid hemorrhage.

Methods  Medical records of patients with Hunt and Hess grades I-III subarachnoid hemorrhage admitted from 2011 to 2013 were reviewed. Demographics, clinical and radiographic features, medications, and pain scores were recorded through day 14 after hemorrhage. Headache pain was characterized on the basis of a numeric rating scale and analgesic use. Severe headache was defined as 2 or more days with maximum pain scores of 8 or greater or need for 3 or more different analgesics for 2 or more days. Univariate and multivariable models were used to analyze factors associated with severe headache.

Results  Of the 77 patients in the sample, 57% were women; median age was 57 years. Severe headache (73% overall) was associated nonlinearly with Hunt and Hess grade: grade I, 58%; grade II, 88%; and grade III, 56% ($P=.01$), and with Hijdra score: score 0-10, 56%; score 11-20, 86%; score 21-30, 76% ($P=.03$). By univariate analysis, patients with low Hijdra scores were less likely to have severe headache (27% vs 57%; $P=.02$). In a multivariable model, younger age and higher Hijdra score tended to be associated with severe headache.

Conclusions  Headache after spontaneous subarachnoid hemorrhage was often severe, necessitating multiple opioid and nonopioid analgesics. Many patients reported persistent headache and inadequate pain control. (American Journal of Critical Care. 2016;25:136-143)
Aneurysmal subarachnoid hemorrhage (SAH) occurs at a rate of 3 to 25 cases per 100,000 population annually, typically requires intensive medical and neurosurgical care, and may result in a fatal or devastating neurological outcome. The ictal headache of SAH is often described as the “worst headache of a patient’s life,” beginning with the “thunderclap” and followed by a chronic headache that may persist for weeks, months, or even years after the hemorrhage. In the initial phase of hospitalization after aneurysmal rupture, headache and its management cloud the neurological assessment, may interfere with the important diagnosis of vasospasm, and may be a risk factor for delirium. Headache that persists in the subacute and chronic phases after SAH is poorly understood and inadequately characterized.

Despite the high prevalence, associated morbidity, and effects on quality of life of SAH-associated headache, epidemiological studies of its timing, severity, characteristics, and usual treatments are lacking. In the MASH-2 trial (magnesium in aneurysmal SAH), patients with higher magnesium levels (>1.0 mmol/L) had slightly lower mean pain scores (4.1 vs 4.9) on a numerical rating scale and lower use of analgesics compared with patients with normal levels of magnesium (≤1.0 mmol/L). In another study, among patients with no angiographic evidence of SAH, 75% experienced severe headache during their inpatient stay, and 25% experienced persistent headache at a mean follow-up of more than 24 months after discharge. The results of a prospective study published in 2013 indicated that headache was the second-leading cause for 30-day hospital readmission after SAH. Long-term follow-up data indicate that headache may persist after SAH for 2 to 9 years. Review articles typically mention headache after SAH without making specific recommendations for managing the headache after the initial episode.

Follow-up data indicate that headache after subarachnoid hemorrhage may last for 2 to 9 years.

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Despite this evidence that SAH-related headache leads to hospital readmissions and causes long-term suffering, current SAH guidelines from the American Heart Association and the Neurocritical Care Society do not offer evidence-based recommendations for managing headache. Furthermore, the exact mechanism of headache pain after subarachnoid hemorrhage remains elusive. Some researchers have postulated that this pain may be caused by inflammatory byproducts of hemolysis, with resulting meningeal irritation in the subarachnoid space. Additionally, central pain sensitization mediated by N-methyl-d-aspartate (NMDA) receptors may cause hyperalgesia after SAH. The lack of a definitive mechanism makes selection of pharmacotherapeutics a marked challenge. On the basis of the need to monitor neurological examinations, avoid oversedation, and alleviate discomfort in SAH patients with headache, we decided that a rigorous evaluation of headache after SAH was warranted. We performed a retrospective review of headache after nontraumatic SAH to assess the prevalence of headache and describe its typical inpatient course, delineate frequently used headache medications, and determine clinical factors associated with headache severity.

Methods

Patients
Consecutive patients were 18 years or older and admitted from January 1, 2011, to March 1, 2013, with nontraumatic SAH of Hunt and Hess grades I, II, or III. Patients were characterized according to the worst Hunt and Hess grade in the initial 24 hours after admission. Patients with Hunt and Hess grades IV and V and those requiring intubation and sedation for more than 24 hours during...
the study period were excluded because the intensity of their headaches could not be assessed.

**SAH Protocol**

Patients with SAH were admitted to a dedicated neuroscience intensive care unit. Symptomatic hydrocephalus was treated with external ventricular drainage. All patients had digital subtraction angiography unless computed tomography angiography showed a culprit aneurysm that required surgery. Aneurysms were urgently secured by endovascular coiling unless surgical clipping was technically necessary. The SAH protocol included standard enteral administration of nimodipine 60 mg every 4 hours, simvastatin or atorvastatin 40 mg/d, intravenous infusion of 0.9% sodium chloride solution at 100 to 150 mL/h, and maintenance of the serum magnesium level at more than 2.3 mg/dL. Transdermal nicotine replacement therapy was provided to smokers of more than 0.5 packs per day.24,25 Transcranial Doppler imaging was performed daily or every other day at the managing physician's discretion, and a neurological examination was performed every 1 to 2 hours by nurses or physicians. All patients were initially treated in a dedicated neuroscience intensive care unit; a few patients with Hunt and Hess grade I to II SAH deemed at low risk for vasospasm were subsequently managed in a neurological intermediate care unit. Results of headache and neurological examinations were recorded by nursing staff as described in the following material.

**Data Points and Definitions**

Data collected included age; weight; sex; hospital course (date of SAH, admission date, hospital discharge date, in-hospital mortality, discharge disposition); relevant medical and social history (alcohol or tobacco use, headache or migraine, medications used before admission to treat preexisting headache); clinical features (location of aneurysm, maximum daily temperature, development of elevated intracranial pressure [defined as sustained pressure > 20 mm Hg for 2 hours, requiring medication or hyperventilation], hydrocephalus, seizure, meningitis, ventriculitis); Hunt and Hess grade (worst grade I-V in initial 24 hours after admission); Hijdra scores (measure of blood volume in the subarachnoid space; range, 0-30); interventions performed (coiling, clipping, external ventricular drain, shunt, lumbar puncture); radiographic features (transcranial Doppler imaging and angiographic findings); pain scores recorded; and medications used for headache pain.

Analgescic agents, administration times, and doses were obtained and recorded by review of an electronic medication administration record. Total daily dose of each medication was calculated for each day of hospitalization after hemorrhage during the study interval. Each day of the study period was considered the 24-hour period from midnight to midnight, resulting in partial days at the beginning or the end of the study period, depending on times of admission and discharge. Severity of headache was determined via pain scores reported by patients using a numerical rating scale (scores 0-10, with zero meaning no pain and 10 meaning worst pain imaginable). Electronic documentation of pain scores included site of pain; only pain scores related to headache were included. All documented pain scores obtained before administration of medication were recorded; data analysis included daily maximum and median scores. Pain scores obtained after administration of medication were not consistently recorded and therefore were excluded from calculations of maximum and median pain scores. Hunt and Hess grades (I-III) and Hijdra scores (0-30) were calculated by neurointensivist physicians by using the initial head computed tomography scan. The outcome severe headache was defined on the basis of severity (≥ 2 days with maximum pain scores ≥ 8) or refractory nature (requiring ≥ 3 different analgesics on ≥ 2 days). Radiographic evidence of vasospasm was defined as transcranial Doppler velocities of more than 120 cm/s at the middle or anterior cerebral artery in conjunction with a Lindegaard ratio of 3.0 or greater. Discharge medications were determined by reviewing patient discharge summaries in the electronic medical record.

**Statistical Methods**

Daily drug dosing data for each patient were recorded as delivered doses of various types of drugs during the study interval. The study interval consisted of the number of days of hospitalization and was capped at day 14 after hemorrhage. In order to calculate a uniform metric to quantify the daily total opioid dose per patient per day, the recorded doses of the various opioid agents were converted to their intravenous morphine equivalent by using the appropriate conversion factors.26 The total resultant dosage was calculated as the sum of all converted doses for each patient for each day in the study interval and was presented as morphine-equivalent dose. Maximum and median daily opioid dosage was determined by examining these aggregated daily data.

Pain data were recorded as responses on a scale from 0 to 10. Plots of the mean daily maximum and median pain scores were developed. The data were categorized into cohorts according to Hunt and
Hess grade (I, II, III), volume of blood in subarachnoid space (Hijdra score 0-10, 11-20, 21-30), and by severe headache or no severe headache. Mean intercohort differences were compared by using $\chi^2$ tests. Finally, clinical variables considered most likely to be related to headache, including age, sex, Hunt and Hess grade, Hijdra score, radiographic evidence of vasospasm, aneurysmal etiology, hydrocephalus, and presence of an external ventricular drain were used in a stepwise logistic regression model against the occurrence of severe headache. SAS, version 9.3, software (SAS Institute) was used for analyses. A cutoff of $P$ less than .30 was established for inclusion in the model; variables that did not meet this criterion were removed.

**Results**

Of the 126 patients screened, 49 were excluded, resulting in a sample size of 77 patients (Figure 1). The Table gives patients’ demographics, clinical

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>All patients (n = 77)</th>
<th>Severe headache</th>
<th>Overall (%)</th>
<th>Severe headache (%)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, median (IQR), y</td>
<td>57 (48-65)</td>
<td>55 (47-64)</td>
<td>59 (54-68)</td>
<td>.06</td>
<td></td>
</tr>
<tr>
<td>Female sex</td>
<td>44 (57)</td>
<td>33 (59)</td>
<td>11 (52)</td>
<td>.60</td>
<td></td>
</tr>
<tr>
<td>Weight, median (IQR), kg</td>
<td>79 (67.1-90)</td>
<td>79.1 (67-88.7)</td>
<td>75 (68-87.1)</td>
<td>.70</td>
<td></td>
</tr>
<tr>
<td>Active tobacco use</td>
<td>48 (62)</td>
<td>36 (64)</td>
<td>12 (57)</td>
<td>.60</td>
<td></td>
</tr>
<tr>
<td>History of headache/migraine</td>
<td>5 (6)</td>
<td>5 (9)</td>
<td>0 (0)</td>
<td>.40</td>
<td></td>
</tr>
<tr>
<td>Hunt and Hess grade</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>19 (25)</td>
<td>11 (20)</td>
<td>8 (38)</td>
<td>.09</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>40 (52)</td>
<td>35 (62)</td>
<td>5 (24)</td>
<td>.006</td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>18 (23)</td>
<td>10 (18)</td>
<td>8 (38)</td>
<td>.07</td>
<td></td>
</tr>
<tr>
<td>Hijdra score</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-10</td>
<td>27 (35)</td>
<td>15 (27)</td>
<td>12 (57)</td>
<td>.02</td>
<td></td>
</tr>
<tr>
<td>11-20</td>
<td>29 (38)</td>
<td>25 (45)</td>
<td>4 (19)</td>
<td>.07</td>
<td></td>
</tr>
<tr>
<td>21-30</td>
<td>21 (27)</td>
<td>16 (29)</td>
<td>5 (24)</td>
<td>.70</td>
<td></td>
</tr>
<tr>
<td>External ventricular drainage</td>
<td>17 (22)</td>
<td>12 (21)</td>
<td>5 (24)</td>
<td>.80</td>
<td></td>
</tr>
<tr>
<td>Aneurysm identified</td>
<td>51 (67)</td>
<td>37 (66)</td>
<td>14 (70)</td>
<td>.70</td>
<td></td>
</tr>
<tr>
<td>Hydrocephalus</td>
<td>22 (29)</td>
<td>15 (27)</td>
<td>7 (33)</td>
<td>.60</td>
<td></td>
</tr>
<tr>
<td>Radiographic evidence of vasospasm</td>
<td>29 (39)</td>
<td>24 (44)</td>
<td>5 (25)</td>
<td>.13</td>
<td></td>
</tr>
<tr>
<td>Discharged to home</td>
<td>60 (79)</td>
<td>44 (79)</td>
<td>16 (80)</td>
<td>.90</td>
<td></td>
</tr>
<tr>
<td>Discharged to rehabilitation center</td>
<td>15 (20)</td>
<td>11 (20)</td>
<td>4 (20)</td>
<td>.80</td>
<td></td>
</tr>
<tr>
<td>Discharged to skilled nursing facility</td>
<td>1 (1)</td>
<td>1 (2)</td>
<td>0 (0)</td>
<td>.60</td>
<td></td>
</tr>
<tr>
<td>Died before discharge</td>
<td>1 (1)</td>
<td>0 (0)</td>
<td>1 (5)</td>
<td>.60</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviation: IQR, interquartile range.

a Values in second, third, and fourth columns are number (percentage) of patients unless otherwise indicated in the first column.

b Data missing for 1 patient with no severe headache.

c Data missing for 2 patients with severe headache and 1 patient with no severe headache.
Headache pain was common, with high pain scores throughout the hospitalization and minimal decreases during the study period. Maximum and median pain scores are shown in Figure 2; the decrease in median pain scores between days 0 and 14 after the subarachnoid hemorrhage was only 17%. Figure 3 shows use of medications with analgesic effect during the study period. Of note, some postoperative patients were given dexamethasone to prevent or reduce edema, and distinguishing this use from use to decrease meningeal irritation and headache was impossible. The maximum total daily dose of dexamethasone was 16 mg administered as 4 mg every 6 hours. Only a few patients (5%) completed the 15-day study period without receiving any opioid analgesic. The mean opioid use by hospital day, expressed in intravenous morphine equivalents, is shown in Figure 4. Most study patients (75%) required opioid prescriptions for headache pain when they were discharged from the hospital.

Severe headache was experienced by 11 patients (58%) with Hunt and Hess grade I SAH, by 35 (88%) with grade II, and by 10 (56%) with grade III (P = .01). Similarly, severe headache was experienced by 15 patients (56%) with Hijdra scores of 0 to 10, by 25 (86%) with scores of 11 to 20, and by 16 (76%) with scores of 21 to 30 (P = .03). The distributions, while indicative of association with the underlying process, were not sufficiently linear to be used in determining prediction or causality of headache, as indicated in the subsequent multivariate analyses.

Stepwise logistic regression analysis was used to isolate clinical factors independently associated with severe headache. In the final model, Hijdra score (odds ratio, 1.09; P = .06) and age (odds ratio, 0.95; P = .08) had no significant independent associations with headache. A weak but nonsignificant association was found between severe headache and radiographic evidence of vasospasm (P = .30) or hydrocephalus (P = .32). These variables were dropped from the model on subsequent stepwise elimination by using an inclusion cutoff of P less than .30. Severe headache after SAH was not associated with placement of an external ventricular drain, aneurysmal vs nonaneurysmal SAH, or Hunt and Hess grade.

Discussion

Headache after SAH persisted well beyond the initial ictal event. Most patients hospitalized with Hunt and Hess grade I, II, or III SAH (73%) met our criteria for having severe headache during the 15-day study period. Patients often required opioid and nonopioid analgesics; opioid usage peaked at a mean daily morphine-equivalent dose of 18 mg intravenously on days 4 to 5 after the hemorrhage.
Both dexamethasone and butalbital/acetaminophen/caffeine were often administered (Figure 3). Patients with less subarachnoid blood were less likely than those with more blood to experience severe headache ($P = .02$), although the finding was not significant in the multivariable model ($P = .06$). Finally, we noted a trend toward association of severe headache and younger age. Patients reported inadequate pain control during hospitalization, and most required opioid prescriptions at the time of discharge from the hospital.

Previous descriptions of persistent headache in patients with SAH are limited. In 1 study,² rates of severe headache during an inpatient stay were similar to the rates in our study; 74% to 81% of SAH patients with no angiographic evidence of aneurysm experienced severe headaches. In follow-up after discharge, 23% of patients had depression and headache at a mean of 28 months (range, 2-84 months).² In a study³ of long-term neurological and psychological outcomes after SAH, 16.5% of patients reported frequent or severe headache 4 to 7 years after SAH. Headaches were significantly correlated with difficulty in nighttime sleep ($r = 0.28; P = .001$).³ In a study published in 1998, Linn et al²⁷ interviewed SAH survivors and found that all patients with a history of headache rated the SAH headache more severe than usual headaches. In a study⁴ of 149 patients with perimesencephalic SAH admitted to University Medical Center Utrecht in the Netherlands, follow-up interviews conducted at a mean of 7.5 (range, 1-23) years after the hemorrhage revealed that 25% of the study patients had headaches, dizziness, fatigue, forgetfulness, and irritability. Finally, investigators in the 610-patient Aneurysm Screening after Treatment for Ruptured Aneurysms (ASTRA) study²⁸ conducted interviews with patients at a mean of 8.9 years after SAH clipping. Patients widely reported fatigue, headache (12%), and difficulty with concentration.

Our results provide a detailed and comprehensive description of pain severity and headache treatments used in the acute phase of SAH management and indicate opportunities for improved patient care. Although our research was performed at a single center and is subject to biases associated with the study design, we think our findings provide a valuable snapshot of patient care and reveal a pattern of inadequate pain management.

Our study has weaknesses. Because of the retrospective design, omissions and inaccuracies in data collection and preservation are possible. The number of patients in our sample was modest. Nursing records were inconsistent, especially in documentation of pain after administration of analgesic medication. Pain assessment was conducted by several different nurses during the study period. The patient admission and discharge time could have resulted in underreported use of analgesics for patients with partial admission days. Owing to the limitations of the pain scale normally used in patients with SAH, we developed a new definition of severe headache by using a combination of patient-reported severity, persistence of pain, and analgesic requirements. The duration of at least 2 days was included to ensure headache pain was present beyond the initial thundcrclap headache. The pain score threshold of 8 on a numerical rating scale was determined via our informal survey of critical care nurses, who determined that a pain score of 8 or greater indicated severe headache. The threshold of 3 analgesic medications was determined by our informal survey of critical care pharmacists.

Our definition of severe headache has not been used before and should be reevaluated prospectively. Our definition may not be appropriate for detecting severe headache in patients who require high doses of 1 or 2 medications. Furthermore, although a numerical rating scale is widely used in hospitals around the world to describe pain levels, the scale may not be appropriate for patients with SAH because of the patients’ variable levels of consciousness, which might affect the ability to verbalize and rate discomfort. This variability may be the reason that fewer pain scores were reported and documented

![Figure 4](https://www.ajcconline.org/ajcc/article-pdf/2016/3/141/141/ajcc_2502_0160.pdf)
among patients with Hunt and Hess grade III SAH and among patients with the highest amount of blood in the subarachnoid space (Hijdra scores > 21), who had somnolence. The need for a pain scale designed specifically to rate pain in SAH patients is apparent, and these limitations weaken our analysis.

Certain medications used to manage headache pain in our study warrant discussion. Dexamethasone was given to many of patients, at a maximum total daily dose of 16 mg. High-dose corticosteroids are not recommended for patients with acute SAH,16,17 as indicated by the results of the Corticosteroid Randomisation After Significant Head Injury (CRASH) trial,29 which showed that use of high doses of methylprednisolone in patients with head injury was associated with an increased risk of death. The dexamethasone dose used during our study is commonly used for management of cerebral vasogenic edema or meningeal irritation and is equivalent to approximately 85 mg methylprednisolone daily, which is less than 1% of the greater than 10,000 mg/d dose used in the CRASH trial. Additionally, the majority of patients received opioids during our study interval, often at high doses. Owing to their propensity to cause sedation and cloud the neurological examination, opioids are not ideal analgesics for patients with SAH. However, opioids were often used because of the severity of pain and lack of success with alternative, less sedating agents. Nonanalgesic medications with sedating properties and their doses were not recorded.

We found a nonlinear association of SAH severity (determined by Hunt and Hess grade) and volume of subarachnoid blood (determined by Hijdra score) with severe headache. Patients with Hunt and Hess grade II and Hijdra scores of 11 to 20 had the highest incidence of severe headache. The nonlinearity of this association of headache severity with SAH severity is not surprising because higher grade SAH causes obtundation and coma, most likely resulting in underreporting of pain, whereas patients with lower grade SAH may experience less meningeal irritation. The standard Hunt and Hess grading definitions were problematic, because the scale includes headache in its definition; for this reason, the World Federation of Neurological Surgeons grading system for SAH may be more appropriate for further research on SAH-associated headache. Furthermore, the lack of association noted between vasospasm and headache could be due to the small number of patients, the insensitivity of transcranial Doppler imaging to show evidence of vasospasm,40 or to a true lack of association. Finally, we could not distinguish the use of dexamethasone for headache from its use for edema.

Despite these weaknesses, our study is the first in which headache after SAH was quantified, and our results suggest many important topics for prospective study: optimal therapies for headache after SAH, how headaches after SAH should be rated, whether headache control is independently associated with functional and cognitive outcomes, what agents provide the best control of headache after SAH, and whether superior headache control might improve patient-centered outcomes such as quality of life.

Conclusions

Headache after SAH causes marked suffering that persists at a high level of severity for at least 2 weeks and is associated with the volume of blood apparent in the subarachnoid space on the initial head computed tomography. SAH-related headache often requires high doses of opioid analgesics and other sedating and potentially deliriosgenergic medications, which provide incomplete and often inadequate pain relief. Headache after SAH is therefore a major cause of suffering and morbidity and deserves intensified research to develop novel and effective therapies.

ACKNOWLEDGMENTS

This study was performed at Maine Medical Center. We acknowledge the support of the Maine Medical Center Neuroscience Institute and thank the staff of the neuroscience intensive care unit, our patients, and the patients’ families for their contribution.

FINANCIAL DISCLOSURES

None reported.

eLetters

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REFERENCES

FUNCTIONAL STATUS AND DISABILITY IN PATIENTS AFTER ACUTE STROKE: A LONGITUDINAL STUDY

By Fidel López-Espuela, RN, BP, PhD, Juan Diego Pedrera-Zamorano, MD, PhD, Pedro Enrique Jiménez-Caballero, MD, PhD, José María Ramírez-Moreno, MD, Juan Carlos Portilla-Cuenca, MD, Jesús María Lavado-García, MD, PhD, and Ignacio Casado-Naranjo, MD, PhD

Background  Stroke is a major public health problem.  
Objective  To use the Barthel Index to evaluate basic activities of daily living in stroke survivors and detect any predictors of functional outcome at 6 months after stroke.  
Methods  In an observational longitudinal study, data were gathered on consecutive patients admitted to the comprehensive stroke unit at Hospital San Pedro de Alcántara, Cáceres, Spain. Sociodemographic and clinical data were obtained prospectively at hospital admission and during follow-up 6 months later. Information on type of stroke, score on the Barthel Index, findings from the neurological evaluation, and other relevant data were collected.  
Results  Of 236 patients admitted, 175 participated in the study. Mean age was 69.60 (SD, 12.52) years, 64.6% were men, and mortality was 12.8%. Six months after experiencing a stroke, 84.8% of patients had returned to their own homes, 8.0% were institutionalized, and the others were residing at a family member’s home. Scores on the Barthel Index 6 months after stroke correlated with baseline scores on the National Institute of Health Stroke Scale ($r = -0.424; P < .001$) and with depressive mood 6 months after stroke ($r = -0.318; P < .001$). Age was negatively associated with Barthel Index scores at the time of hospital discharge and 6 months after stroke.  
Conclusions  Functional status 6 months after stroke was influenced by age, sex, stroke severity, type of stroke, baseline status, mood, and social risk. Comorbid conditions, socioeconomic level, and area of residence did not affect patients’ functional status. (American Journal of Critical Care. 2016;25:144-151)
Stroke is a major public health problem.\(^1\) In 2010, approximately 10% of all deaths worldwide and about 4% of all disability-adjusted life years were due to stroke.\(^2\) Estimates from the IBERICTUS study\(^3\) (a population-based study of stroke epidemiology) suggest that 80,000 to 90,000 new strokes occur in Spain each year, making stroke the leading cause of disability in Spanish adults. Stroke places substantial burdens on patients and their families and has marked economic and societal costs.\(^4\)

Stroke is a devastating condition that is considered a medical emergency. Because 30% of all stroke patients experience a worsening in their clinical condition in the first 24 hours, many of these patients will need critical care, which may be provided in a designated intensive care or stroke unit with continuous monitoring. Nursing care plays an essential role in the treatment of stroke patients. Evidence\(^5,6\) indicates that care and medical attention, when provided by trained nurses and specialized health care providers in dedicated stroke teams, units, and coordinated care systems, improve clinical outcomes in the acute-care phase of stroke.

Notable therapeutic advances (ie, management in a stroke unit, intravenous thrombolysis, and decompressive surgery for malignant hemispheric cerebral infarction) have contributed to reducing brain damage after stroke and increasing the ability of health care providers to reduce the level of disability after stroke.\(^7\) Some patients benefit from administration of a tissue plasminogen activator up to 6 hours after the onset of an ischemic stroke, and this treatment decreases mortality and dependency rates after stroke.\(^8\) Adopting a systematic approach to patient care during the acute phase of stroke in a hospital stroke unit also decreases mortality and dependence.\(^9\) In the United States, all patients who have intravenous thrombolysis are admitted for at least 24 hours to a critical care unit or stroke unit with intensive monitoring capabilities.\(^10\)

Despite these advances, many stroke patients still experience a level of disability that prevents them from performing basic activities of daily living (BADL) or instrumental activities of daily living independently.\(^11,12\) The repercussions of dependency are increasingly relevant; the estimated mean lifetime cost of ischemic stroke in the United States is $140,048 per patient. This figure includes inpatient care, rehabilitation, and follow-up care needed to treat long-lasting deficits. Recently, the role of the main informal caregiver has been recognized as a key social, political, and economic issue; cost-utility analyses show a positive balance for this type of care. Caregiver burden, stress, and strain are common outcome measures.\(^13\)

Functional evaluation is of paramount importance to research and an essential part of a stroke patient’s overall assessment during the subacute phase. For the initial evaluation, activities of daily living (basic and instrumental) are reliable indicators of the functional status of patients affected by stroke. Assessment of these activities is used by increasing numbers of nursing professionals as a tool for the development of effective care plans for stroke patients.\(^14\)

The Barthel Index is a validated instrument commonly used to measure BADL in patients with stroke.\(^15\) This instrument for assessing functional disability has been used extensively in research on the outcomes of stroke.\(^16\) The primary aim of our study was to use the Barthel Index to evaluate BADL in survivors of an ischemic stroke or spontaneous intracerebral hemorrhage. The secondary aim was to use the index to identify any predictors of functional outcome at 6 months after stroke.

**Methods**

In an observational longitudinal study, data were gathered on consecutive patients admitted to the comprehensive stroke unit at Hospital San Pedro de Alcántara, Cáceres, Spain. In Spain, the government ensures free universal health care for residents via the Spanish national health system. In 2008, a strategy that guaranteed standardized delivery of care for stroke patients was approved for nationwide implementation.\(^17\)
The Barthel Index evaluates a patient’s capacity to perform routine self-care activities necessary for independent living. During the study period from January through December 2010, a total of 236 patients were admitted to the stroke unit. Of these, 26 patients with transient ischemic attacks were excluded, as were 33 who declined to participate or could not commit to the follow-up visit, and another 2 patients who had experienced a stroke mimic. Thus, a total of 175 patients were included in the study. All the patients who participated in the study provided written informed consent, and the clinical research ethics committees at the hospital approved the study.

Measures
Data were collected by the same investigator at 3 different times: within 48 hours of admission (to record baseline functional status in the week before the stroke), at hospital discharge, and 6 months after the stroke.

The following demographic variables were collected: age; sex; monthly income (in US dollars); and presence of arterial hypertension, diabetes mellitus, dyslipidemia, and cardiac arrhythmia. Comorbid conditions were classified according to the Charlson Comorbidity Index. Additional data included type of stroke, listed as either ischemic (as defined by the Oxford Community Stroke Project) or hemorrhagic; stroke severity according to the National Institutes of Health Stroke Scale (NIHSS) and presence of aphasia, dysarthria, hemiparesis or hemiplegia; location of the stroke; presence or absence of depression diagnosed before the stroke; rehabilitation; and depressive mood at 6 months after the event according to the Hamilton Depression Scale.

Destination of discharge was also recorded and was coded as the patient’s usual residence, a nursing home facility, or a relative’s home. After 6 months, the variables were reassessed.

BADL, as indicated by the score on the Barthel Index, was assessed at 3 times: before the stroke, at discharge, and at 6 months after the stroke. The Barthel Index is used to evaluate an individual’s capacity to perform the routine self-care activities necessary for independent living. This instrument is used in clinical practice to assess baseline abilities, quantify functional change after rehabilitation, and as a source of information for discharge planning. A Spanish-language version of the Barthel Index has been validated for patients with cerebrovascular disease. The index has excellent psychometric qualities, excellent interobserver reliability, and a high predictive validity for mortality, length of hospital stay, and final functional outcome. The index consists of 10 items that are used to evaluate BADL. In order to aid interpretation, total scores are grouped into 5 categories of dependency: total dependency (0-20 points), severe dependency (21-40 points), moderate dependency (41-60 points), mild dependency (61-90 points), and independence (91-100 points).

Comorbid conditions were classified by using the Charlson Comorbidity Index based on the clinical codes from the International Classification of Diseases, Ninth Revision. Each condition was assigned a score of 1, 2, 3, or 6, depending on the associated risk of death. The Hamilton rating scale for depression consists of 17 items and was designed to measure the intensity or severity of depression (higher scores indicate more depressed mood). Use of the scale is recommended by the US National Institute of Mental Health. A Spanish version has been validated.

Data Analysis
BADL in survivors of an ischemic stroke or spontaneous intracerebral hemorrhage was analyzed by using descriptive statistics. Categorical variables were expressed as percentages; ordinal variables, as medians and interquartile ranges; and quantitative variables as means and standard deviations. For measurement of differences, t tests were used for normally distributed quantitative variables, and the Mann-Whitney test was used for variables with a nonnormal distribution. A Wilcoxon signed-rank test was performed to compare the difference in medians between scores on the Barthel Index at discharge and scores at 6 months after stroke.

Categorical variables were assessed by using the χ² test. Correlations between the quantitative variables were estimated by using the Pearson or the Spearman test, depending on the distribution of the variables.

Predictors of functional outcome at 6 months after stroke were analyzed by using multiple logistic regression. Predictors with statistical significance of .20 or less in the model at the univariate level were included in the multivariate analysis.

Statistical significance was established as a P value of .05 or less. The data were analyzed by using SPSS, version 15.0 (IBM SPSS), software.

Results
Originally, 175 patients were included in the study. At 6 months, a total of 152 patients were reevaluated. A total of 22 patients died, and 1 patient was lost to follow-up.
BADL in Survivors of an Ischemic Stroke or Spontaneous Intracerebral Hemorrhage

Table 1 displays the general characteristics of the study group. The mean age of the cohort was 69.60 (SD, 12.52) years for men and 74.20 (SD, 12.15) years for women. The difference between the 2 groups was significant ($P = .02$). Most of the patients were men (64.6%). Total mortality was 12.8% (5.8% during the hospital stay and 7.0% during follow-up). The median NIHSS score at admission was 6 (interquartile range, 3.13).

Scores on the Barthel Index at the time of admission were distributed as follows: independence, 80.6%; mild dependence, 18.9%; and total dependence, 0.60%. These percentages differed in the evaluations performed just after hospital discharge and at 6 months (see Figure). During the study period, 36.6% of the patients received rehabilitation.

At discharge, 70.4% of the patients returned to their own homes, 17.4% moved into a family member’s home, and 12.2% were institutionalized. At 6 months, 84.8% were living in their own homes; 8.0% were living in nursing homes; and all other patients remained in a family member’s home, indicating improvement over time. The patients who were discharged to their own home or that of a family member had a significantly better mean score ($P < .001$) on the Barthel Index (75 points; SD, 28.35) than did those discharged to a nursing home (31.25 points; SD, 25.31). Mean scores on the Barthel Index differed significantly ($P = .001$) between men and women for functional status before the stroke: 99.07 points (SD, 3.24) for men and 95 points (SD, 12.18) for women. Scores 6 months after the stroke were 87.70 points (SD, 23.07) in men and 78.80 points (SD, 28.9) in women ($P = .04$).

Scores on the Barthel Index also differed significantly for different types of stroke (Table 2) at the time of hospital discharge ($P < .001$) and at 6 months after the stroke ($P < .001$).

Patients with hemiparesis had lower scores on the Barthel Index than did patients without hemiparesis at both the time of discharge ($P < .001$) and at 6 months after the stroke ($P = .008$; Table 3). In contrast, aphasia was associated with a lower score at discharge ($P = .008$) but not at 6 months ($P = .11$).

Depression before stroke was not associated with lower scores on the Barthel Index at discharge ($P = .79$) or at 6 months after the stroke ($P = .33$). However, patients who had depressed mood at the 6-month mark showed less progress according to scores on the Barthel Index at the time of discharge, and this finding was related to a lower score on the Barthel Index at 6 months ($P < .001$). Scores on the index did not differ for the affected brain hemisphere, presence or absence of dysarthria, or the patient’s socioeconomic status or area of residence (rural or urban). Finally, patients who received rehabilitation had a lower score on the Barthel Index than did patients who did not receive rehabilitation ($P < .001$).

An analysis of the medians for each item on the Barthel Index at the time of discharge and at 6 months (Table 4) revealed significant improvements for all items over time ($P < .001$), except bladder control ($P = .59$).
Predictors of Functional Outcome at 6 Months After Stroke

According to bivariate correlation analysis, scores on the Barthel Index at the time of discharge were positively related to scores on the index at 6 months \(r = 0.628\); \(P < .001\) and negatively related to the baseline NIHSS score \(r = -0.607\); \(P < .001\) and the length of stay \(r = -0.358\); \(P < .001\). The same bivariate analysis indicated a relationship between scores on the Barthel Index at 6 months and baseline scores on the NIHSS scale \(r = -0.424\); \(P < .001\), length of the hospital stay \(r = -0.254\); \(P = .002\), and depressive mood at 6 months \(r = -0.318\); \(P < .001\). Age was negatively associated with scores on the Barthel Index for time before the stroke \(r = -0.300\); \(P < .001\), at the time of discharge \(r = -0.280\); \(P < .001\), and at 6 months after the stroke \(r = -0.350\); \(P < .001\).

Table 5 lists age, female sex, stroke severity (NIHSS score), social risk, and depression as the baseline variables independently associated with functional disability at 6 months.

Discussion

Scores on the Barthel Index 6 months after stroke indicate that many patients had more losses in BADL performance after a stroke than they did before the stroke. This decline was evident in more than 50% of the patients at any level of dependence. This finding confirms that disability after a stroke can result in deficits in a patient’s functional status.27-29 Of note, an analysis of the total sample and of all categories grouped by scores on the Barthel Index indicated that all patients showed improvement after 6 months. We found that 61.7% of the patients at the time of discharge and 86.7% at 6 months after discharge were independent or mildly dependent. This outcome may be related to technological advances and to specialized care provided by the highly trained nurses and other health professionals in the stroke unit.6,9,30

In our study, older age was associated with a poorer functional status in the medium term. As other investigators27,31,32 have reported, age plays an important role in the functional recovery of patients, both at the time of discharge from the hospital and 6 months after a stroke, because scores on the Barthel Index decrease with age. This finding may indicate that older patients have poorer health status, which would affect their ability to recover and their degree of dependence.

In agreement with other studies,32,33 we found that female stroke victims had a poorer functional status than did male stroke victims, as measured by using the Barthel Index at hospital discharge and at the 6-month follow-up visit.

Other researchers33,34 have observed differences in levels of functional dependence for different

### Table 2
Mean Barthel Index by type of stroke

<table>
<thead>
<tr>
<th>Type of stroke</th>
<th>Barthel Index, mean (SD)</th>
<th>At discharge</th>
<th>At 6 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hemorrhagic (n = 15, 8.6%)</td>
<td>52.67 (35.90)</td>
<td>83.85 (24.90)</td>
<td></td>
</tr>
<tr>
<td>Cerebral infarction</td>
<td>88.75 (20.36)</td>
<td>95.44 (7.82)</td>
<td></td>
</tr>
<tr>
<td>Lacunar (n = 36, 20.6%)</td>
<td>71.67 (29.06)</td>
<td>90.21 (19.27)</td>
<td></td>
</tr>
<tr>
<td>Partial anterior (n = 51, 29.1%)</td>
<td>76.97 (27.38)</td>
<td>88.21 (17.38)</td>
<td></td>
</tr>
<tr>
<td>Posterior (n = 33, 18.9%)</td>
<td>35.38 (34.99)</td>
<td>60.17 (17.38)</td>
<td></td>
</tr>
</tbody>
</table>

*2 Barthel Index was significantly different \(P < .001\) among different types of stroke both at discharge and at 6 months.

### Table 3
Relationship between the health-related variables and Barthel Index at discharge and at 6 months

<table>
<thead>
<tr>
<th>Variable</th>
<th>Barthel Index, mean (SD)</th>
<th>At discharge</th>
<th>At 6 months</th>
<th>(P)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural setting</td>
<td></td>
<td>.07</td>
<td>.13</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>71.02 (33.10)</td>
<td>87.70 (23.57)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>61.60 (36.18)</td>
<td>81.33 (27.45)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monthly income, $US</td>
<td></td>
<td>.12</td>
<td>.55</td>
<td></td>
</tr>
<tr>
<td>&gt; 1000</td>
<td>72.62 (32.79)</td>
<td>87.41 (27.70)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600-1000</td>
<td>66.50 (33.19)</td>
<td>82.06 (26.53)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 600</td>
<td>59.07 (38.20)</td>
<td>83.75 (21.97)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hemiaparesis</td>
<td></td>
<td>&lt; .001</td>
<td>.008</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>55.86 (35.77)</td>
<td>80.27 (29.40)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>83.85 (24.84)</td>
<td>91.47 (15.64)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aphasia</td>
<td></td>
<td>.008</td>
<td>.11</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>55.08 (38.67)</td>
<td>78.63 (29.36)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>72.06 (31.39)</td>
<td>87.40 (23.12)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>History of depression</td>
<td></td>
<td>.79</td>
<td>.33</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>68.00 (30.58)</td>
<td>80.00 (27.17)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>65.97 (35.56)</td>
<td>85.43 (26.19)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depressed mood at 6 months()</td>
<td></td>
<td>.005</td>
<td>&lt; .001</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>65.44 (32.12)</td>
<td>74.85 (30.01)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>79.04 (26.82)</td>
<td>93.43 (15.32)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hypertension</td>
<td></td>
<td>.33</td>
<td>.82</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>64.39 (35.06)</td>
<td>84.90 (23.32)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>69.75 (34.38)</td>
<td>83.93 (29.27)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td></td>
<td>.67</td>
<td>.64</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>64.05 (31.44)</td>
<td>82.66 (22.75)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>66.85 (35.75)</td>
<td>85.04 (26.35)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cardiac arrhythmia</td>
<td></td>
<td>.11</td>
<td>.10</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>57.58 (36.93)</td>
<td>77.22 (32.44)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>68.27 (34.13)</td>
<td>86.14 (23.71)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dyslipidemia</td>
<td></td>
<td>.76</td>
<td>.72</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>65.16 (34.50)</td>
<td>83.57 (26.00)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>66.88 (35.13)</td>
<td>85.10 (25.46)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rehabilitation</td>
<td></td>
<td>&lt; .001</td>
<td>&lt; .001</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>52.62 (31.06)</td>
<td>72.86 (33.11)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>86.46 (20.90)</td>
<td>92.81 (13.56)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*According to t test.

*According to Mann-Whitney test.

*More than 14 points on Hamilton Depression Scale.
subtypes of stroke. We found that both better recovery and increased dependence were related to total anterior cerebral infarctions or strokes with intracerebral hemorrhaging. Better recovery for patients with these 2 types of stroke was determined by comparing patients’ total scores at the time of hospital discharge with their scores 6 months after the stroke (gain of 31 points on the Barthel Index for hemorrhagic stroke and 25 points for total anterior cerebral infarction; P < .001).

In our study, other factors associated with dependence were presence of hemiparesis and more severe stroke as indicated by scores on the NIHSS. Our results are consistent with those of other authors: motor deficits affect BADL performance and therefore have an effect on the Barthel Index score at discharge and at 6 months among patients with or without hemiparesis. Thus, the greater the neurological deficit at admission, the more pronounced results are consistent with those of other authors:

Some studies have indicated that social isolation and social support most likely influence recovery in stroke patients. Our findings also show that social risk is associated with worse recovery.

Access to rehabilitation was associated with a better Barthel Index score at 6 months, and 36.6% of our patients had intensive physical and occupational rehabilitation on an outpatient basis during the study period. This percentage is higher than the 21.4% reported in another study. Although we consider these numbers low, we understand that recovery also occurs, in part, within the family household and is due to care provided by this key patient resource. In accordance with the results of other studies, our data indicate that scores on the Barthel Index were lower in patients who underwent rehabilitation (52.62 points) than in patients who did not (86.46 points) and that the mean net functional gain in the first group was 20 points on the Barthel Index compared with 6 points for patients without rehabilitation. Thus, in agreement with another classic study, our results indicated that rehabilitation plays a fundamental role in the progress and gains made by patients with greater disability. We conclude that functional evolution varies according to initial clinical severity of the stroke and that functional recovery occurs within the first few months after stroke.

### Table 4
Comparison of each activity on the Barthel Index at discharge and at 6 months, difference in medians

<table>
<thead>
<tr>
<th>Activity</th>
<th>z</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feeding</td>
<td>-4.328</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Bathing</td>
<td>-4.529</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Grooming</td>
<td>-3.656</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Dressing</td>
<td>-4.605</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Bowels</td>
<td>-2.440</td>
<td>.02</td>
</tr>
<tr>
<td>Bladder</td>
<td>-0.539</td>
<td>.59</td>
</tr>
<tr>
<td>Toilet use</td>
<td>-3.989</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Transfers (bed to chair and back)</td>
<td>-6.026</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Mobility (on level surfaces)</td>
<td>-5.553</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Stairs</td>
<td>-4.717</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

* According to Wilcoxon signed rank test.

### Table 5
Predictive factors at baseline of a dependent functional status 6 months after stroke

<table>
<thead>
<tr>
<th>Variable</th>
<th>Univariate analysis</th>
<th>Multivariate analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Odds ratio 95% CI</td>
<td>Odds ratio 95% CI</td>
</tr>
<tr>
<td>Female sex</td>
<td>3.770 1.837-7.737</td>
<td>2.895 1.130-7.415</td>
</tr>
<tr>
<td>Age</td>
<td>1.065 1.033-1.098</td>
<td>1.069 1.030-1.110</td>
</tr>
<tr>
<td>NIHSS</td>
<td>1.145 1.073-1.222</td>
<td>1.190 1.099-1.289</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>1.723 0.774-3.836</td>
<td>—</td>
</tr>
<tr>
<td>Cardiac arrhythmia</td>
<td>2.098 0.876-5.027</td>
<td>—</td>
</tr>
<tr>
<td>CCI</td>
<td>1.233 0.962-1.579</td>
<td>1.292 0.973-1.716</td>
</tr>
<tr>
<td>Depression</td>
<td>3.536 1.325-9.436</td>
<td>2.625 0.823-8.370</td>
</tr>
<tr>
<td>Social risk</td>
<td>1.317 1.096-1.583</td>
<td>—</td>
</tr>
</tbody>
</table>

* Abbreviations: CCI, Charlson Comorbidity Index; NIHSS, National Institute of Health Stroke Scale. Dash indicates variable did not remain in the model.

Detailed analysis of each item on the Barthel Index revealed noticeable improvements in all items during the study period except for bladder control, findings in line with previous observations.

In contrast with data in the Berlin Stroke Register, our results showed no differences in scores on the Barthel Index associated with socioeconomic level. This result may be due to the universal and equal access to health care services offered in Spain. Additionally, we found no differences associated with area of residence (rural or urban).

Our study may have a selection bias for the studied cohort because only patients admitted to the stroke unit were evaluated. Some other stroke
patients, including patients with a poorer functional status before stroke and dependent patients, were admitted by the neurology or geriatrics departments.

Conclusions

Our results indicate that age, sex, stroke severity, type of stroke, baseline status, mood, and social risk appear to influence functional status as measured by scores on the Barthel Index. Comorbid conditions, socioeconomic level, and area of residence did not seem to affect patients’ functional status.

In this group of patients, worsening in functional status (manifested as loss of independence for BADL items) was a frequent and consequential adverse effect of experiencing stroke; however, functional status tended to improve in the 6 months following the stroke.

These predictors can help in discharge planning by letting professionals analyze patients’ needs and changes in functional state to ensure smooth transitions in the stroke care chain from the critical care or acute care facility to rehabilitation and community-based primary care.

We understand that Spain’s universal and equal access to health services plays an essential role in our findings. Protocolized care in the acute phase of stroke, during which the role of critical care nurses is decisive, may be a determining factor in acute stroke patients’ short-term outcomes for functional status.

ACKNOWLEDGMENTS

This research was performed in the stroke unit, Hospital San Pedro de Alcántara. We appreciate the participation and collaboration of all patients and their families. Similarly, we are grateful to Dr. J. Zamorano, head of the nursing department, for the support and assistance provided in this project.

FINANCIAL DISCLOSURES

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USE OF A COMPREHENSIVE PROGRAM TO REDUCE THE INCIDENCE OF HOSPITAL-ACQUIRED PRESSURE ULCERS IN AN INTENSIVE CARE UNIT

By Katie Swafford, RN, MSN, CNS-BC, CCRN, Rachel Culpepper, RN, BSN, CCRN, and Christina Dunn, RN, BSN

**Background**
Hospital-acquired pressure ulcers (HAPUs) are a costly and largely preventable complication occurring in a variety of acute care settings. Because they are considered preventable, stage III and IV HAPUs are not reimbursed by Medicare.

**Objectives**
To assess the effectiveness of a formal, year-long HAPU prevention program in an adult intensive care unit, with a goal of achieving at least a 50% reduction in 2013, compared with 2011.

**Methods**
Planning for the prevention program began in 2012, and the program was rolled out in the first quarter of 2013. Program components included use of Braden scores, a revised skin care protocol, fluidized repositioners, and silicone gel adhesive dressings. Efforts were made to educate and motivate staff and encourage them to be more proactive in detecting patients at risk of HAPUs.

**Results**
Incidence of HAPUs in the unit was reduced by 69% (n = 17; 3% of patients in 2013 vs n = 45, 10% of patients in 2011), despite a 22% increase in patient load. The potential cost saving as a result of this decrease was approximately $1 million.

**Conclusions**
A comprehensive, proactive, collaborative ulcer prevention program based on staff education and a focus on adherence to protocols for patient care can be an effective way to reduce the incidence of HAPUs in intensive care units. (American Journal of Critical Care. 2016;25:152-155)
Pressure ulcers, defined as “any area of skin or underlying tissue that has been damaged by unrelieved pressure or pressure in combination with friction and shear,” typically occur on bony prominences in immobilized patients. In a database of 710,626 patients in adult critical care, step-down, medical, surgical, and medical/surgical units, 3.6% of all patients and 7.9% of those considered at risk had hospital-acquired pressure ulcers (HAPUs; ie, pressure ulcers noted ≥ 24 hours after admission) develop. In acute care settings, the estimated incidence of HAPUs varies widely (eg, from 0.4 to 12% and from 3.3 to 53.4%).

In addition to obvious adverse medical outcomes for patients, the National Database of Nursing Quality Indicators (NDNQI) estimates that the average HAPU costs $38,700. Others have estimated that in 2008, the total cost of HAPUs to the US economy was $3.8 billion. Considered as preventable, stage III and IV HAPUs are not typically reimbursed by insurance payors such as Medicare in the United States.

Standard recommendations for prevention have helped to drive down the incidence of HAPUs, but room remains for further improvement. Formal multifactorial prevention programs are an additional tool that reduces the prevalence of HAPUs. It is also important to take advantage of new technology. For example, in the newly released (2014) National Pressure Ulcer Advisory Panel (NPUAP) guidelines, use of prophylactic dressings has been identified as an emerging tool. Although the evidence remains limited, both a consensus panel and a systematic review reached the conclusion that it was sufficient to recommend use of a 5-layer silicone border dressing for prevention of HAPUs in intensive care units (ICUs).

The purpose of this quality improvement study (which was prompted by an analysis of data on HAPUs in our unit and supported by the American Association of Critical-Care Nurses Clinical Scene Investigator Academy), was to assess the effectiveness of a formal, year-long HAPU prevention program in the adult ICU of our hospital, with a goal of achieving at least a 50% reduction in 2013, compared with 2011.

Methods

The HAPU prevention program was planned during 2012, and the following interventions were implemented in a combined medical/surgical ICU (14 beds) during the first quarter of 2013 (with the exception of the Allevyn Life silicone adhesive dressings [Smith & Nephew, Medical Ltd], which were not introduced until the second quarter of 2013):

- Braden scores were grouped into risk categories (at risk, 15-18; moderate risk, 13-14; high risk, ≤ 12), which were used to indicate specific steps for proper management of moisture, nutrition, mobility, friction, and shear in hospitalized patients.
- A revised skin-care protocol, which was based on NPUAP pressure ulcer staging (which itself is based on the type of skin disruption), encouraged more proactive intervention well before any evidence of skin breakdown. The protocol was updated to include current products, with recommendations on what products should be used.
- Fluidized repositioners (Sundance Solutions), which are helpful in repositioning and offloading pressure, particularly for obese patients, were used behind the torso for all patients requiring repositioning or offloading (Braden score ≤ 14).
- Allevyn Life silicone adhesive dressings (sacrum, 6 x 6 and 5 x 5 products) were required for a Braden score of 14 or less and were encouraged to be used at any pressure points. The most common placement was the sacrum, but dressings were also used on heels, elbows, and under cervical collars. When patients were being placed in the prone position, the dressings were used on the patients’ knees and shoulders. Dressings were used for 5 to 7 days if not soiled and were changed if soiled.
- Face-to-face staff education was provided by the quality improvement team before beginning the program by using the teach-back method. After the program began, the team performed weekly skin audits to assess for compliance. Real-time feedback was also provided during the skin audits.

About the Authors

Katie Swafford is a critical care clinical nurse specialist and Rachel Culpepper and Christina Dunn are staff nurses and shift coordinators in the critical care unit at Eskenazi Health, Indianapolis, Indiana.

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Multifactorial prevention programs help reduce the prevalence of hospital-acquired pressure ulcers.
Incidence of HAPUs was calculated as the percentage of all patients in the ICU who had a HAPU develop.

Table
Patients' demographic data, incidence, and estimated cost of hospital-acquired pressure ulcers (HAPUs) for 2011-2013

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of patients in intensive care unit</td>
<td>461</td>
<td>434</td>
<td>563</td>
</tr>
<tr>
<td>Mean age, years</td>
<td>51.9</td>
<td>50.5</td>
<td>52.2</td>
</tr>
<tr>
<td>Male, % of patients</td>
<td>59</td>
<td>64</td>
<td>59</td>
</tr>
<tr>
<td>Mean length of stay, days</td>
<td>14.0</td>
<td>12.9</td>
<td>10.7</td>
</tr>
<tr>
<td>Patients with HAPUs, No. (%) of patients</td>
<td>45 (10)</td>
<td>19 (4)</td>
<td>17 (3)</td>
</tr>
<tr>
<td>Device-related</td>
<td>9 (20)</td>
<td>3 (16)</td>
<td>2 (12)</td>
</tr>
<tr>
<td>Stage I</td>
<td>2 (4)</td>
<td>1 (5)</td>
<td>1 (6)</td>
</tr>
<tr>
<td>Stage II</td>
<td>24 (53)</td>
<td>12 (63)</td>
<td>8 (47)</td>
</tr>
<tr>
<td>Stage III</td>
<td>3 (6.7)</td>
<td>0 (0)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Stage IV</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Unstageable</td>
<td>11 (24)</td>
<td>3 (16)</td>
<td>3 (18)</td>
</tr>
<tr>
<td>Deep-tissue injury</td>
<td>5 (11)</td>
<td>2 (11)</td>
<td>3 (18)</td>
</tr>
<tr>
<td>Estimated cost, $million</td>
<td>1.7</td>
<td>0.74</td>
<td>0.66</td>
</tr>
</tbody>
</table>

a Denominator for percentages shown in table.
b Based on estimate from National Database of Nursing Quality Indicators of $38,700 per HAPU and not on actual costs at our institution.

Results

Baseline demographics, including number of patients admitted and stage of ulcer, are provided in the Table. Reasons for admission to the adult ICU were varied, with patients having a variety of traumatic injuries, cardiovascular events, and postsurgical complications. Across all years, the majority of HAPUs were stage II.

In 2011, before beginning the prevention program, a total of 45 HAPUs occurred in 10% of patients and cost approximately $1.7 million. In 2013, the overall reduction in incidence of HAPUs to 17 (affecting 3% of patients) represented a decrease of more than two-thirds (69%) compared with 2011, exceeding our original goal of a 50% reduction (see Figure). This decrease in HAPU incidence was achieved despite a 22% increase in the number of ICU patients.

Based on NDNQI average costs, the hospital potentially could have realized a saving of up to $1 million in 2013. An interesting post hoc finding was that the number of HAPUs associated with medical devices decreased from 9 out of 461 patients admitted during 2011 (2%) to 2 out of 563 admissions (0.4%) in 2013. This reduction was in part due to the use of dressings underneath cervical collars.

Discussion

After a comprehensive ulcer prevention program was implemented in the adult ICU, HAPUs were reduced by more than two-thirds and stage III HAPUs were eliminated. We believe that the extensive efforts for staff motivation and education were a critical component of the success. Concerted efforts were made to be more proactive in implementation of prevention strategies, such as encouraging the use of fluidized positioners and use of silicone gel adhesive dressings whenever there were pressure points, depending on the patient’s position. Although it is difficult to isolate the effects of individual program components, previous studies have shown that application of 5-layer, silicone foam dressings can complement an existing pressure ulcer prevention program. It was our understanding that use of dressings contributed to the reduction in device-related HAPUs.

Key challenges of the program included staff compliance and achieving consistency in use of the Braden algorithm and the silicone adhesive dressings. In this retrospective review of this quality improvement program, it was not possible to assess compliance, which may have been less than 100%. In our particular situation, limitations to hiring additional nurses during the first 6 months of 2013 resulted in reliance upon a larger-than-normal number of per diem staff, which increased responsibilities for regular staff. Thus, it is possible that,
without these limitations, even better results could have been achieved.

Our study used historical data for controls and thus is not strictly a comparative trial. However, we do not think that any significant change in the patient population occurred during the period of the intervention that would otherwise explain the reduction in HAPUs. Rather, the patient load increased 22% during 2013. The incidence of HAPUs declined markedly in 2012 compared with 2011, before implementation of the full prevention program. We attribute some of this improvement to the commencement of planning of the intervention program in 2012, which heightened awareness and may have encouraged staff to become more proactive on prevention issues. Fluidized positioners were also introduced during this period. Nevertheless, the incidence continued to decline during 2013, when the prevention program was fully implemented. Actual cost savings is unknown, as a full cost analysis would have to include the cost of products such as the silicone dressings and fluidized repositioners.

Conclusions

The convincing results in the ICU have led to approval of a hospital-wide rollout of the HAPU prevention program, along with a commitment to ensure that prevention of device-related HAPUs remains a priority. Our experience indicates that a comprehensive, proactive, collaborative prevention program based on staff education and a focus on adherence to protocols for patient care can be an effective way to reduce the incidence of HAPUs in the ICU.

FINANCIAL DISCLOSURES

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SERIALS

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A MODEL OF PRESSURE, OXYGENATION, AND PERFUSION RISK FACTORS FOR PRESSURE ULCERS IN THE INTENSIVE CARE UNIT

By Deborah Bly, RN, BSN, Marilyn Schallom, RN, PhD, CCRN, CCNS, Carrie Sona, RN, MSN, CCRN, CCNS, and Dean Klinkenberg, PhD

Background  Although most intensive care patients are at risk for pressure ulcers, not all experience such ulcers. **Objective** To examine a model of variables related to extrinsic and intrinsic pressure on skin and underlying tissues, oxygenation, perfusion, and baseline comorbid conditions to identify risk factors associated with pressure ulcers in critically ill adults. **Method** A retrospective chart review was conducted on patients identified by weekly rounds from January 2010 through October 2010 to determine the prevalence of pressure ulcers. Variables were analyzed via bivariate analysis and logistic regression for unit-acquired pressure ulcers. **Results** Data on 345 patients with 436 intensive care admissions were reviewed. Variables were significant in each model category at \( P < .05 \). In the regression analysis of first admission only \((n = 306)\), the model was significant \((P < .001)\) and yielded correct classification of 86.3\% of patients. For all intensive care admissions \((n = 391)\), the model was significant \((P < .001)\) and yielded correct classification of 83.9\% of patients. In both models, 4 of the same variables were significant: any transport off the unit, number of days to bed change, systolic blood pressure less than 90 mm Hg, and use of more than 1 vasoconstrictor. History of pulmonary disease and presence of a feeding tube were also significant in regression analyses. **Conclusions** Several variables within the model of pressure, oxygenation, and perfusion were significantly associated with development of pressure ulcers. (American Journal of Critical Care. 2016;25:156-164)
Understanding of the causes of and risk factors for pressures ulcers is evolving. The National Database of Nursing Quality Indicators focuses on the prevalence of pressure ulcers as a marker of nursing quality. The prevalence is defined as the number of pressure ulcers within a population. For point prevalence, a specific population of patients, such as patients in an individual intensive care unit (ICU) or hospital, is assessed at a particular moment in time to calculate a rate based on the proportion of patients with a pressure ulcer. Incidence is the rate at which new pressure ulcers are developing.

The premise that all pressure ulcers are preventable is debatable. In 2008, the Centers for Medicare and Medicaid discontinued payment for treatment of hospital-acquired stage III and stage IV pressure ulcers, a decision based on the premise that pressure ulcers are preventable. However, since then, the National Pressure Ulcer Advisory Panel has posited that not all pressure ulcers are avoidable. Langemo and Brown discussed the concept of skin failure related to hypoperfusion and organ failure, which can be acute, chronic, or end stage and may result in pressure ulcers despite optimal nursing care. Evidence is mounting on the association of comorbid conditions and other risk factors with the development of pressure ulcers in critically ill patients.

The Norton, Waterlow, and Braden scales are used in health care settings to determine the risk for pressure ulcers in adults. The majority of ICU patients at Barnes-Jewish Hospital, St Louis, Missouri, are at risk as indicated by scores on the Braden Scale, yet most do not experience a pressure ulcer. Cox stated that modification of the Braden Scale or creation of a risk assessment measure for the development of pressure ulcers in critically ill patients is needed. In 1999, Defloor published a conceptual scheme for prediction and prevention of pressure ulcers that included pressure, shearing force, tissue tolerance for pressure, and tissue tolerance for oxygen as factors. Defloor stated that the risk for pressure ulcers increases with a decrease in oxygen supply or an increase in oxygen demand.

The conceptual model included several factors in each category. Subsequently, research has been focused on additional risk factors observed in ICU patients to develop a new critical care risk scale. In 2 studies, oxygen and perfusion variables were examined as risk factors for pressure ulcers. However as Defloor noted, a conceptual scheme for risk for pressure ulcers is needed to understand how these risk factors interact. Early intervention is required for patients at increased risk for pressure ulcers, yet more research is needed to better identify risk to provide early intervention and validate the costs of preventive therapies, such as use of specialty beds, equipment, and turn teams.

A model of variables related to extrinsic and intrinsic pressure, oxygenation, and perfusion was initially developed by the principal investigator (D.B.). Variables included in the model were chosen on the basis of clinical observation and refined on the basis of published research. The purpose of this study was to examine a model of variables related to pressure on skin and underlying tissue, oxygenation, and perfusion in addition to baseline comorbid conditions to identify risk factors associated with development of pressure ulcers in critically ill adult patients.

Materials and Methods

The study was approved by the human research protection office. The charts of patients in a 19-bed medical ICU and a 21-bed cardiothoracic ICU at Barnes-Jewish Hospital, a university-affiliated facility, were reviewed.

Pressure ulcer rounds in each unit are conducted weekly by the unit’s wound care liaison and unit-based clinical nurse specialist to promptly detect pressure ulcers and determine patient-specific interventions. The staging criteria of the National Pressure Ulcer Advisory Panel are used to identify and stage the ulcers. A list of patients and the detection of pressure ulcers in the patients is maintained. Monthly
Point prevalence rates are calculated the third week of each month.

A retrospective chart review was conducted on all patients listed on the monthly sheets of point prevalence rates from January 2010 through October 2010. Records were verified to ensure that all ICU admissions for the same hospital admission were correctly identified. All ICU admissions were reviewed separately for 41 variables. No patients or admissions were excluded. Pressure ulcers present at the time of hospital admission were not included in the analysis. For patients who were readmitted to the ICU, history of hospital-acquired pressure ulcers was reviewed to determine hospital location at the time of first documentation of each pressure ulcer. Incidence of ICU-acquired pressure ulcers for the sample was used as the outcome measure. Any staged pressure ulcer was included in the analysis.

Some variables were obtained per patient (eg, emergency department visit, hospital length of stay, mortality). The majority of variables were obtained per ICU admission. Tables 1 through 4 list the types of variables (ie, pressure, oxygenation, perfusion, and comorbid conditions) with notation when each type was analyzed per patient only. Initially, all 3 nurse team members (D.B., M.S., C.S.) verified the

### Table 1
Pressure variables as risk factors for pressure ulcers in the intensive care unit

<table>
<thead>
<tr>
<th>Variable</th>
<th>Pressure ulcer developed (per patient: 91 patients on first admission only, per admission: 109 admissions)</th>
<th>No pressure ulcer developed (per patient: 254 patients on first admission only, per admission: 327 admissions)</th>
<th>Data missing</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Admission BMI, per patient, mean (SD)</td>
<td>28.7 (7.5)</td>
<td>30.2 (9.3)</td>
<td>0 (0)</td>
<td>.18</td>
</tr>
<tr>
<td>Admitted through ED, per patient</td>
<td>23 (25)</td>
<td>90 (36)</td>
<td>1 (&lt;1)</td>
<td>.07</td>
</tr>
<tr>
<td>ED time, per patient, mean (SD), min</td>
<td>83.2 (173.8)</td>
<td>136.6 (230.6)</td>
<td>1 (&lt;1)</td>
<td>.04</td>
</tr>
<tr>
<td>Any OR procedure, per patient</td>
<td>62 (68)</td>
<td>148 (58)</td>
<td>0 (0)</td>
<td>.10</td>
</tr>
<tr>
<td>OR procedure time, per patient mean (SD), min</td>
<td>308.5 (316.3)</td>
<td>217.5 (262.1)</td>
<td>0 (0)</td>
<td>.008</td>
</tr>
<tr>
<td>Found down before admission, per patient</td>
<td>5 (6)</td>
<td>8 (3)</td>
<td>1 (&lt;1)</td>
<td>Not tested, 4% overall</td>
</tr>
<tr>
<td>Splints</td>
<td>1 (1)</td>
<td>5 (2)</td>
<td>0 (0)</td>
<td>Not tested, 1% overall</td>
</tr>
<tr>
<td>Endotracheal tube</td>
<td>98 (90)</td>
<td>197 (60)</td>
<td>0 (0)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Tracheostomy</td>
<td>59 (54)</td>
<td>78 (24)</td>
<td>0 (0)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Rectal diversion device</td>
<td>59 (54)</td>
<td>80 (25)</td>
<td>1 (&lt;1)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Feeding tube</td>
<td>106 (97)</td>
<td>225 (69)</td>
<td>0 (0)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Transport off unit for test or procedures</td>
<td>78 (74)</td>
<td>190 (59)</td>
<td>7 (2)</td>
<td>.004</td>
</tr>
<tr>
<td>Paralysis (chemical or mechanical)</td>
<td>4 (11)</td>
<td>19 (12)</td>
<td>238 (35)</td>
<td>.56</td>
</tr>
<tr>
<td>RASS score ≤ -4 at any time during ICU admission</td>
<td>99 (94)</td>
<td>172 (61)</td>
<td>49 (11)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Bed surface at admission</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard</td>
<td>50 (48)</td>
<td>108 (35)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pressure relieving</td>
<td>40 (38)</td>
<td>141 (46)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All others</td>
<td>15 (14)</td>
<td>57 (19)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Days to bed surface change ≥ 2 days</td>
<td>52 (49)</td>
<td>80 (26)</td>
<td>20 (5)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Final surface or bed: bed changed if need identified after initial surface placed on at admission</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard</td>
<td>6 (6)</td>
<td>67 (22)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pressure relievingb</td>
<td>50 (47)</td>
<td>130 (42)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Specialtyc</td>
<td>51 (48)</td>
<td>111 (36)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospital LOS, per patient, mean (SD), days</td>
<td>39.3 (27.1)</td>
<td>19.7 (17.9)</td>
<td>0 (0)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>ICU LOS, mean (SD), days</td>
<td>20.9 (11.7)</td>
<td>7.7 (8.7)</td>
<td>0 (0)</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

Abbreviations: BMI, body mass index, calculated as weight in kilograms divided by height in meters squared; ED, emergency department; ICU, intensive care unit; LOS, length of stay; OR, operating room; RASS, Richmond Agitation-Sedation Scale.

a Values are number (percentage) of admissions unless otherwise stated in the first column. Because of missing data, not all percentages total 100, and denominators used to calculate percentages vary.

b Versa Care Bed, Synergy Mattress (Hill Rom), or Sof Care (Gaymar).

c Envision, Clinitron, Total Care Sport, Total Care Bari, or Excel Bari (Hill Rom).
### Table 2
Oxygenation variables as risk factors for pressure ulcers in the intensive care unit

<table>
<thead>
<tr>
<th>Variable</th>
<th>Pressure ulcer developed (345 patients, 436 admissions)</th>
<th>No pressure ulcer developed (327 admissions)</th>
<th>Data missing</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Svo₂ or Scvo₂ &lt; 60% for 5 min</td>
<td>59 (63)</td>
<td>63 (42)</td>
<td>197 (45)</td>
<td>.002</td>
</tr>
<tr>
<td>Svo₂ or Scvo₂ &gt; 85% for 5 min</td>
<td>21 (23)</td>
<td>35 (24)</td>
<td>197 (45)</td>
<td>.88</td>
</tr>
<tr>
<td>P/F &lt; 200</td>
<td>100 (92)</td>
<td>189 (58)</td>
<td>3 (1)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Cardiac index&lt;sup&gt;b&lt;/sup&gt; &lt; 1.5 or cardiac output &lt; 4 L/min</td>
<td>6 (23)</td>
<td>12 (31)</td>
<td>371 (85)</td>
<td>Not tested</td>
</tr>
<tr>
<td>Spo₂ &lt; 90%</td>
<td>92 (84)</td>
<td>171 (52)</td>
<td>0 (0)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Hemoglobin level, mean (SD), g/dL</td>
<td>7.7 (1.0)</td>
<td>8.4 (1.7)</td>
<td>1 (&lt;1)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Use of inhaled dilators</td>
<td>54 (49)</td>
<td>51 (16)</td>
<td>0 (0)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Lactate level (n = 99), mean (SD), mmol/L</td>
<td>4.0 (3.2)</td>
<td>3.9 (3.9)</td>
<td>337 (77)</td>
<td>Not tested</td>
</tr>
<tr>
<td>Creatine phosphokinase level (n = 101), mean (SD), U/L</td>
<td>3956 (16 176)</td>
<td>970 (5873)</td>
<td>335 (77)</td>
<td>Not tested</td>
</tr>
</tbody>
</table>

Abbreviations: P/F, ratio of PaO₂ to fraction of inspired oxygen; Scvo₂, central venous oxygen saturation; Spo₂, oxygen saturation as shown by pulse oximetry; Svo₂, venous oxygen saturation.<sup>a</sup>

<sup>a</sup> Values are number (percentage) of admissions unless otherwise stated in the first column. Because of missing data, not all percentages total 100, and denominators used to calculate percentages vary.

<sup>b</sup> Calculated as cardiac output in liters per minute divided by body surface area in square meters.

### Table 3
Perfusion variables as risk factors for pressure ulcers in the intensive care unit

<table>
<thead>
<tr>
<th>Variable</th>
<th>Pressure ulcer developed (109 admissions)</th>
<th>No pressure ulcer developed (327 admissions)</th>
<th>Data missing</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood pressure, mm Hg</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean arterial &lt; 60</td>
<td>93 (86)</td>
<td>226 (70)</td>
<td>4 (1)</td>
<td>.001</td>
</tr>
<tr>
<td>Diastolic &lt; 50</td>
<td>98 (90)</td>
<td>263 (80)</td>
<td>0 (0)</td>
<td>.02</td>
</tr>
<tr>
<td>Systolic &lt; 90</td>
<td>98 (90)</td>
<td>222 (68)</td>
<td>0 (0)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Use of &gt; 1 vasopressor</td>
<td>79 (73)</td>
<td>88 (27)</td>
<td>0 (0)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Body temperature, °C</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 36</td>
<td>71 (65)</td>
<td>122 (37)</td>
<td>0 (0)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>&gt; 38</td>
<td>82 (77)</td>
<td>128 (39)</td>
<td>4 (1)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Continuous venovenous hemodialysis</td>
<td>37 (34)</td>
<td>30 (9)</td>
<td>1 (&lt;1)</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

<sup>a</sup> Values are number (percentage) of admissions. Because of missing data, not all percentages total 100, and denominators used to calculate percentages vary.

### Table 4
Comorbidity variables as risk factors for pressure ulcers in the intensive care unit

<table>
<thead>
<tr>
<th>Variable</th>
<th>Pressure ulcer developed (per patient: 91 patients on first admission only; per admission: 109 admissions)</th>
<th>No pressure ulcer developed (per patient: 254 patients on first admission only; per admission: 327 admissions)</th>
<th>Data missing</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albumin level, mean (SD), g/dL</td>
<td>2.4 (0.6)</td>
<td>2.8 (0.7)</td>
<td>49 (11.3)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Blood glucose level, &lt; 50 mg/dL</td>
<td>5 (12)</td>
<td>9 (5)</td>
<td>227 (52.1)</td>
<td>.08</td>
</tr>
<tr>
<td>Blood glucose level, &gt; 180 mg/dL</td>
<td>93 (85)</td>
<td>208 (64)</td>
<td>1 (&lt;1)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Cardiovascular history&lt;sup&gt;b&lt;/sup&gt; per patient</td>
<td>73 (80)</td>
<td>180 (74)</td>
<td>10 (3)</td>
<td>.22</td>
</tr>
<tr>
<td>Pulmonary history&lt;sup&gt;c&lt;/sup&gt; per patient</td>
<td>44 (48)</td>
<td>86 (35)</td>
<td>10 (3)</td>
<td>.03</td>
</tr>
<tr>
<td>Immunological history&lt;sup&gt;d&lt;/sup&gt; per patient</td>
<td>10 (11)</td>
<td>39 (16)</td>
<td>10 (3)</td>
<td>.25</td>
</tr>
</tbody>
</table>

<sup>a</sup> Values are number (percentage) of admissions unless otherwise stated in the first column. Because of missing data, not all percentages total 100, and denominators used to calculate percentages vary.

<sup>b</sup> Coronary artery disease, congestive heart failure or cardiomyopathy, diabetes mellitus, pulmonary hypertension, peripheral vascular disease, and end-stage renal disease.

<sup>c</sup> Cystic fibrosis, chronic obstructive pulmonary disease, pulmonary embolism, and smoking history.

<sup>d</sup> Chronic steroid use, end-stage liver disease, and vascular collagen disease.
location of the source for each data variable from the electronic medical record for data extraction into the data base. After the nurses had completed 10 charts together, 1 nurse manually extracted and entered all of the information from the electronic medical record while a second nurse did random audits for accuracy. Random chart audits were done on every 30th ICU admission and on patients with multiple readmissions. Data were extracted when available.

For some variables, any value that met the threshold value during that ICU admission was recorded as yes. Many patients were placed on pressure-reduction mattresses or surfaces at the time of ICU admission according to the hospital-bed decision tree, which provides bed choices for a variety of clinical reasons. As a patient’s condition changed (eg, hypotension, need for vasopressors, continuous renal replacement therapy), the patient was moved to a low air loss, low-pressure redistribution surface. Additionally, some patients required placement on a bariatric specialty bed or a rotation specialty bed. Of note, the window for moving a patient to the specialty surface because of critically unstable status was sometimes lost. Therefore, some patients had a delay in movement to the specialty surface. Time to surface change was recorded.

Data on comorbid conditions were extracted from the electronic medical record and placed into categories of cardiovascular, pulmonary, and immunological. Cardiovascular comorbid conditions included coronary artery disease, congestive heart failure or cardio-myopathy, diabetes mellitus, pulmonary hypertension, peripheral vascular disease, and end-stage renal disease. Pulmonary comorbid conditions included a diagnosis in the medical record of cystic fibrosis, chronic obstructive pulmonary disease, pulmonary embolism, or a history of smoking. Immune comorbid conditions included chronic steroid use, end-stage liver disease, and vascular collagen disease.

### Statistical Analysis

SPSS 22 software (IBM Corporation) was used for all analyses. Frequencies for categorical data and means and standard deviations for continuous data were calculated. A series of bivariate comparisons (analysis of variance for continuous data and $\chi^2$ analysis for categorical data) was performed on selected variables. Bivariate analysis was not used with variables that had more than 70% missing data or less than 5% yes responses overall. Two logistic regression models were run that included any variable with a $P$ less than .05 in bivariate analysis.

Because of missing data on some variables, some patients were excluded from the regression analyses. The first model was used to test significant variables for a patient’s first admission only (hospital length of stay, sex, race, and comorbid conditions) plus variables that were significant in the bivariate analyses; all variables were entered in a single block. The same process was used in the second model to test significant variables for all ICU admissions and thus excluded variables that were fixed from ICU admission to ICU admission as described earlier.

### Results

Charts from 345 patients with 436 admissions were reviewed: 227 admissions (52%) from the cardiothoracic ICU and 209 (48%) from the medical ICU. The sample included 189 men (55%) and 156 women (45%); 251 patients were white (73%), and 91 were African American (26%). Patients’ mean age was 60.5 (SD, 15.8) years. The mean hospital length of stay was 24.9 (SD, 22.4) days, with a mean ICU length of stay of 11.0 (SD, 11.1) days. A total of 91 patients had more than 1 ICU admission (range, 2-6). Not included in the analysis were pressure ulcers identified in 58 patients at the time of hospital admission (17%) and in 107 admissions to an ICU (25%).

An ICU-acquired pressure ulcer was identified in 106 patients (31%); a new unit-acquired pressure ulcer developed in 109 of all ICU admissions; 71 among the 227 cardiothoracic ICU admissions (31%) and 38 in the 209 medical ICU admissions (18%). A total of 159 unit-acquired pressure ulcers were detected: 70 admissions had 1 pressure ulcer, 28 had 2 ulcers, and 11 had 3, for a total of 109 admissions with a pressure ulcer. Mean number of days to develop was 9.3 (SD, 7.2) for a first pressure ulcer, 13.6 (SD, 7.8) for a second pressure ulcer, and 15.6 (SD, 8.7) for a third ulcer. The sacroccygeal area was the most frequent location: 54 patients (50% of patients with pressure ulcers) and 34% of the pressure ulcer sites (see Figure). In 9 locations, accounting for 49 pressure ulcers, the ulcers were device related. Device-related sites included tracheostomy; ear, from pulse oximetry and nasal cannula; mouth, from endotracheal or oral gastric tubes; rectum, from fecal containment devices; nose, from nasogastric tubes or noninvasive ventilation masks; forehead, from forehead oximetry sensors; penis, from urinary catheter; and posterior part of the neck and the chin, from cervical collar.

A total of 81 patients died (24%): 58 in the medical ICU (72%) and 23 in the cardiothoracic ICU (28%). Compared with patients without a pressure ulcer, patients with a pressure ulcer were more likely to die: 36 of 106 patients (34%) with a
pressure ulcer and 45 of 239 (19%) without a pressure ulcer ($\chi^2 = 9.36; P = .002$). The odds ratio for dying if a pressure ulcer developed was 2.22 (95% CI, 1.32-3.72). Lists of variables screened, with frequencies or descriptive results and bivariate results, are presented in Tables 1 through 4 according to model category.

In the pressure, oxygenation, and perfusion models, several variables were significant in the bivariate analyses. In the pressure category (Table 1), devices, transport off the ICU, need for a switch to specialty bed, delay of 2 or more days before switch to a specialty bed, and deeper sedation score on the Richmond Agitation-Sedation Scale were significantly associated with development of pressure ulcers. Longer hospital and ICU lengths of stay were both associated with development of a pressure ulcer. For oxygenation variables, $SvO_2$ or $ScvO_2$ less than 60% for 5 minutes, a ratio of $Pao_2$ to fraction of inspired oxygen ($Fio_2$) less than 200, oxygen saturation by pulse oximetry less than 90%, low mean level of hemoglobin, and administration of inhaled dilators were all significantly associated with development of pressure ulcers (Table 2). Most of the variables in the perfusion category were associated with development of pressure ulcers, including low systolic, low diastolic, and low mean arterial pressure and administration of more than 1 vasopressor (Table 3). Comorbid conditions associated with development of pressure ulcers included lowest level of albumin, any blood glucose level greater than 180 mg/dL, and a history of pulmonary disease (Table 4).

In the regression analysis of first admission only (n = 306; Table 5), the model was significant ($\chi^2 = 156.66; P < .001$; Cox and Snell $R^2 = 0.40$), and 86.3% of patients were classified correctly. Five variables were significant. For all ICU admissions (n = 397), the model was significant ($\chi^2 = 162.40; P < .001$; Cox and Snell $R^2 = 0.34$), and 83.9% of patients were classified correctly. In the second model, 4 of the same variables were significant: any transport off the unit, number of days to bed change, systolic blood pressure less than 90 mm Hg, and use of more than 1 vasopressor (Table 6).

### Discussion

The purpose of this study was to examine variables related to extrinsic and intrinsic pressure, oxygenation, perfusion, and baseline comorbid conditions.
conditions to determine complex risk factors associated with the development of pressure ulcers. Current scales for determining the risk for pressure ulcers do not accurately indicate the complexity of the patient’s risk, life-saving devices, and comorbid conditions that lead to the development of pressure ulcers.6,16,17,20,21 Multiple studies of various risk factors for development of pressure ulcers in critically ill patients have been done. In a systematic review, Coleman et al20 found that no single factor explained the development of the ulcers. However, an interaction between multiple variables most likely explains why a pressure ulcer develops in some patients but not in other patients at risk.1,18,20 The variables we examined were significantly associated with the development of pressure ulcers, and 4 variables were significant predictors in both regression models.

In our study, a delay of 2 days or more in placement of patients who needed a specialty bed was associated with development of pressure ulcers. Thomas25 reported that the first preventive action is to reduce the effect of pressure, friction, and shear forces. Preventive interventions include offloading pressure via turning, repositioning of pressure points, and use of pressure-relieving devices. The results of previous research support the timely placement of at-risk patients on low air loss and pressure-relieving or pressure-redistribution mattresses23-28 or air-fluidized beds.29 Low air loss mattresses help control the skin microclimate to reduce skin moisture and temperature, thereby reducing injury of tissue surfaces that interface with the mattress.28 The National Pressure Ulcer Advisory Panel19 recommends use of an alternating-pressure air mattress or overlay for patients at high risk who cannot be turned regularly. Cox17 found that the first 6 days in a medical-surgical ICU were the most vulnerable time for development of pressure ulcers and suggested aggressive implementation of preventive strategies. Previous research and our findings highlight the importance of timely placement of at-risk critically ill patients on surfaces to help prevent pressure ulcers.

During transport of patients, an overlay pressure-redistribution mattress may deflate, leading to inadequate pressure relief. In addition, during the procedure or examination (eg, computed tomography), the patient has no pressure redistribution surface. During movement to the examination table or bed, a patient can experience friction and shear, important factors in the development of pressure ulcers.18,30,31

Use of vasoressors and low systolic blood pressure were significant variables in our study. Unstable hemodynamic status was broadly defined by the National Pressure Ulcer Advisory Panel as “global or regional perfusion that is not adequate to support normal organ function, including the skin,” and when unstable hemodynamic status is “exacerbated by movement, unavoidable pressure ulcers can develop.”9 Critically ill patients often require hemodynamic support, either pharmacological, mechanical, or both, placing the skin and other organs at risk for hypoperfusion. Hemodynamic status was identified as a coadjuvant factor that favors decreased tissue tolerance and development of pressure ulcers.18 Lower mean arterial pressure12,14 or diastolic pressure13,32 was a predictor of pressure ulcers. In some studies,17,33 lower blood pressure in patients in whom a pressure ulcer developed was not a significant predictor in the ICU or intraoperatively. Boyle and Green34 used a classification of cardiovascular stable or unstable without specific blood pressure or inotropic support. Unstable cardiovascular status was a risk factor for pressure ulcers. Other investigators16,17,35 reported that vasoressor infusion was a risk factor. Vasoressors are most often administered to patients who have an unstable cardiovascular status. Thus, the concept of organ failure and decreased perfusion seems to play a crucial role in the development of pressure ulcers. The increased risk associated with decreased blood pressure and need for a vasoressor should prompt critical care nurses to implement interventions to prevent pressure ulcers. We collected data on type and dose of vasoressor; however, for simplification of vasoressor categories, we chose to stratify them into 1 or no vasoressors and more than 1 vasoressor. Studies on the impact of specific vasoressors are needed.

Venous and arterial oxygen saturations and a PaO2/FIO2 ratio less than 200 were associated with the development of pressure ulcers. In previous prospective studies of 40 patients12 and 30 patients,13 decreased PaO2 or arterial oxygen saturation were not associated with the development of pressure ulcers. The large number of patients in our study may explain the difference in results. A prospective study with a sufficient sample size is needed to confirm our findings.

Pressure from devices presents a challenge. Patients in our study had a multitude of devices that were associated with the development of pressure ulcers. The association between the devices and pressure ulcers also may indicate the prolonged need for critical care such as need for artificial airways and feeding tubes. Our results are consistent with those of Black et al,35 who found that pressure ulcers of any kind were 2.4 times more likely to develop in patients with a medical device than in patients with no devices.
Lower albumin level was significant in the bivariate analysis, similar to findings in other studies. Albu
min has been viewed as a marker of nutrition and as a marker for decreased oncotic pressure. How-
ever, albumin level is affected by the inflammatory response and by fluid replacement. Nution plays a cru-
cial role in the risk for pressure ulcers, however, currently no marker is available to bedside clinicians
for evaluation of nutrition risk. Research is needed to expand understanding of nutritional markers of
relevance in critically ill patients and the role of the markers in risk for pressure ulcers. Decreased oncotic
pressure due to low levels of albumin affects distribution of total body fluids. The Association between
low levels of albumin and increased risk for pressure ulcers may be due to a change in tissue tolerance, with
redistribution of fluid and formation of edema. The presence of a feeding tube might have been a significant
predictor for several reasons. A feeding tube may indicate prolonged ICU stay, poor nutrition, or
device-related risk for pressure ulcers. Perhaps in future studies, the presence of a feeding tube as a
risk factor can be examined in more detail.

In general, pulmonary comorbid conditions have not been examined as a risk factor for pres-
sure ulcers. However, 1 pulmonary condition included in our study has been examined: smoking. In 2
studies in Indonesia, smoking history was identified as a risk factor in ICU patients. The
researchers found that smoking more than 10 cigarettes per day increased the risk for pressure ulcers.
Research is needed to determine the effect of other pulmonary comorbid conditions on the
development of pressure ulcers.

Our results indicated the high mortality of patients in whom pressure ulcers developed.
Although pressure ulcers are not the cause of mor-
tality, the association between death and pressure ulcers has been revealed in previous studies. The
increased risk for pressure ulcers in critically ill patients who are dying lends support to the
notion of skin failure and that not all pressure ulcers are preventable at the end of life.

Limitations

Our study was retrospective and thus depended on the accuracy of input of data by a variety of
clinicians and the accuracy of manual extraction of the data. The possibility for error existed for both
extraction and input. Also, because of missing data, several variables could not be tested. Last, our sam-
ple population was limited to patients from a med-
cal ICU and a cardiothoracic ICU at a single site. Our findings may not be generalizable to other
specialty ICU patients. The pressure, oxygenation,
and perfusion model needs to be examined pro-
spectively to validate the findings, eliminate the
problem of missing data, assess reliability for nurses
measuring the variables, and examine the predictive
validity of the model.

Conclusion

Many patients are at risk for pressure ulcers upon ICU admission. A new risk assessment model
is needed. Several variables within the model of pres-
sure, oxygenation, and perfusion had a significant
relationship with the development of pressure ulcers and
were significant in the logistic regression models.
A prospective study on these variables is needed to
refine the model. Additionally, an understanding of
how these variables interact and lead to unavoidable
development of pressure ulcers is necessary.

ACKNOWLEDGMENTS

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Ningying Wu, PhD, Institute for Clinical and Translation
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FINANCIAL DISCLOSURES

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A patent is pending on the risk scale application in the
name of Deborah Bly.

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For more about preventing pressure ulcers, visit the
Critical Care Nurse website, www.ccnonline.org, and
read the article by Cox and Rasmussen, “Enteral Nutri-
tion in the Prevention and Treatment of Pressure Ulcers
in Adult Critical Care Patients” (December 2014).

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Objective. Evidence-based guidelines have resulted in decreases in bloodstream infections associated with central catheters (CLABSI) in hospital intensive care units. However, relatively little is known about CLABSI incidence and prevention in long-term acute care hospitals (LTACHs).

Methods. A central catheter maintenance bundle was implemented in 30 LTACHs, and compliance with the bundle was tracked for 6 months. CLABSI rates were monitored for 14 months before and 14 months after the bundle was implemented.

Results. The pooled mean CLABSI rate (No. of infections per 1000 days with a central catheter) was 1.28 before the bundle and 0.96 after the bundle (repeated measures general linear model; $F_{1,58} = 6.973; P=.01$; partial $\eta^2 = .11$). From 14 months before to 14 months after the bundle was implemented, the mean number of CLABSI per LTACH decreased by 4.5 (95% CI, 1.85-7.15). Time series modeling showed a significant decrease in the mean hospital CLABSI rate after the bundle was implemented (-0.511 CLABSI/1000 catheter days, SE = 0.050), indicating an immediate effect of the bundle. The mean hospital CLABSI rate was decreasing slightly before the bundle was implemented and continued to decrease at a reduced rate after the bundle was implemented.

Conclusion. The bundle resulted in a significant and sustained reduction in CLABSI rates in 30 LTACHs for 14 months. These results encourage the development and implementation of similar bundles as effective strategies for infection reduction in LTACHs. (American Journal of Critical Care. 2016;25:165-172)
Many patients admitted to long-term acute care hospitals (LTACHs) are colonized or infected with multidrug-resistant bacteria that could contribute to the incidence of "central line–associated bloodstream infections" (CLABSIs). Despite the heightened risk of CLABSIs in LTACH patients, few studies have addressed the long-term incidence of CLABSIs in LTACHs. In studies on the impact of changes in central catheter procedures on CLABSIs, researchers have examined a single intervention (the effects of chlorhexidine gluconate bathing and port placement) in a single hospital. In contrast, the use of CLABSI prevention bundles and checklists in intensive care units has been extensively investigated.

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Methods
Study Setting
A total of 39 out of 110 Select Medical LTACHs (as of the date of the study) volunteered to implement process improvement initiatives aimed at infection reduction through controlled venous catheter maintenance. The results from 30 hospitals were analyzed; 3 hospitals that volunteered already had a central catheter protocol and/or team and...
therefore did not have appropriate retrospective baseline data, and 6 hospitals were not able to complete the training program within the time frame required for the study. Data from all consecutively admitted patients who were admitted with a central catheter were used in the study. About 65% of patients admitted during the study period were admitted with a central catheter. A total of 6660 patients were discharged from the study LTACHs before the bundle was implemented, and 6559 patients were discharged after the bundle was implemented. The number of patient days was 178,191 before and 181,001 after the bundle was implemented. The number of central catheter days was 120,137 before and 119,412 after the bundle was implemented.

Central Catheter Bundle

At the core of this study was the development and implementation of a clinically relevant, evidence-based bundle for central catheter maintenance and the systematic education of the clinical staff in the execution of the bundle through an interactive webinar. In addition to the CDC guidelines, the bundle protocol included education on the protocol, mandatory use of alcohol-based central catheter caps (which have since been added to the CDC guidelines), chlorhexidine gluconate dressings, and formation of a central catheter team of nurses who demonstrate competency in maintaining and following the protocol. Before the start of the initiative, each hospital’s chief nursing officer organized a team of registered nurses who had previously successfully demonstrated competency in the care of central catheters and verified that their hospital had alcohol-based central catheter caps and chlorhexidine gluconate dressings available. The chief nursing officer also communicated with staff that each patient who was admitted to the LTACH with a central catheter or who had a central catheter placed in the LTACH during the study period would be evaluated for central catheter maintenance in accordance with the bundle. For the purposes of this study, patients qualified if they had, as defined by the CDC, a central venous catheter whose tip terminates in a great vessel, including short- and long-term central venous catheters and peripherally inserted central catheters.

All members of the central catheter teams at participating hospitals attended a training webinar at the beginning, middle, and end of the study and completed an online quiz on the components of the central catheter maintenance bundle. Compliance with the bundle was assessed at each LTACH by a nurse director of quality management who, once a week, at random times, inspected every patient who had a central catheter and completed a checklist to capture data on the degree of adherence to the bundle. A clinical trial manager also reviewed each LTACH’s checklist data weekly and conducted an on-site compliance visit to each LTACH. The bundle compliance checklist contained information on whether (1) the central catheter dressing was intact and 100% occlusive, (2) a date was present on the dressing, (3) initials were present on the dressing, (4) nongauze dressings were changed within 7 days, or if gauze, within 48 hours, (5) daily assessments of the dressing sites were made by a nurse or catheter team, (6) a sterile cap was in place on all intravenous/stopcock ports, and (7) a chlorhexidine sponge or dressing was in place at the catheter insertion site. The major components of the overall central catheter maintenance bundle are shown in Table 1. The bundle did not include changes to standard practices for central catheter removal.

The bundle also did not change the standard method used at each hospital for identifying CLABSI. The only difference between hospital staffing before and after implementation of the bundle was the creation of a central catheter maintenance team. The process of identifying CLABSI did not change. No new staff changes, beyond a normal level of attrition, were made to address CLABSI reporting. The standard protocol, which was in place both before and after bundle implementation, was for physicians at each hospital to make the final identification of a hospital-acquired CLABSI.

The quasi-experimental study was designed to compare the effects of implementation of the bundle by using a 6-month pretest baseline measurement of CLABSI rate (number of CLABSI per 1000 central catheter days). Baseline data were collected retrospectively for the period immediately preceding implementation of the bundle. The impact of the bundle on CLABSI rates was monitored during the implementation period, and overall results were reported to the individual hospitals midway through and at the conclusion of the study. Bundle compliance data were collected as part of the standard of care for central catheter maintenance, as specified in the CDC’s published guidelines. Data collection did not include any protected health information or patient identifiers and was determined to be exempt by the institutional review board.

Data Analysis

The consistency of competency of each hospital’s chief nursing officer was examined at the beginning and end of the study by using a paired-samples t test.
Adherence to the bundle over time was measured by comparing scores at the beginning of the study with scores 5 weeks into the study by using a $r^2$ test. Changes in CLABSI rates were operationally monitored with control chart functions throughout the study time window (Figure 1). Two analyses were conducted on CLABSI rates before and after the bundle was implemented: (1) repeated-measures general linear model and (2) autoregressive integrated moving average (ARIMA) time series analysis ($\alpha$ was set at .05 for both models). Because a separate control group was not available, the level and trend of the CLABSI rate before implementation became the control for the CLABSI rate after implementation.

We hypothesized that the central catheter maintenance bundle would reduce the CLABSI SIRs at the start of the program and that the reduction would persist over time. In order to test this hypothesis, we chose to analyze the bundle’s impact on CLABSI SIRs by using an interrupted time series analysis. Time series analysis was used to examine the temporal sequence of correlations between measured events because uncorrected correlation between observations over time could result in overestimation of the significance of the intervention.

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An interrupted time series model examines multiple

---

Table 1
Components of the central catheter maintenance bundle and strength of evidence

<table>
<thead>
<tr>
<th>Content</th>
<th>Strength of evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>A trained central catheter team of nurses who follow the regimented bundle protocol</td>
<td>I</td>
</tr>
<tr>
<td>Competency testing before being certified for the team</td>
<td>II</td>
</tr>
<tr>
<td>Education on the bundle protocol</td>
<td>II</td>
</tr>
<tr>
<td>Knowledge assessments on the evidence-based practices of central catheter maintenance</td>
<td>II</td>
</tr>
<tr>
<td>Documented daily review of the necessity of the central catheter and checklists</td>
<td>II</td>
</tr>
<tr>
<td>Hand hygiene and aseptic technique</td>
<td>II</td>
</tr>
<tr>
<td>Gloved dressing changes</td>
<td>II</td>
</tr>
<tr>
<td>Sterile gauze or sterile, transparent, semipermeable dressing</td>
<td>II</td>
</tr>
<tr>
<td>Replacement of transparent dressing at least every 7 days</td>
<td>II</td>
</tr>
<tr>
<td>Gauze dressing if patient is diaphoretic or if site is bleeding or oozing, replaced every 48 hours</td>
<td>II</td>
</tr>
<tr>
<td>Catheter site assessed every shift for redness, tenderness, pain, or exudate</td>
<td>II</td>
</tr>
<tr>
<td>Alcohol-based central catheter caps</td>
<td>I</td>
</tr>
<tr>
<td>Change of dressing if compromised, loose, or damp</td>
<td>II</td>
</tr>
<tr>
<td>Application of a chlorhexidine-impregnated sponge dressing</td>
<td>I</td>
</tr>
</tbody>
</table>

---

*a* Adapted from published recommendations of the Centers for Disease Control and Prevention.

---

Figure 1 Central catheter–associated bloodstream infections before and after implementation of the central catheter maintenance bundle. The control chart is based on the exponentially weighted moving average (EWMA), which uses exponential smoothing by taking a weighted average of past observations with progressively smaller weights over time. The contribution of a value to the test statistic decays exponentially by time or by the number of new observations. EWMA was applied separately to data from before and after implementation. The Institute for Healthcare Improvement’s Stability Analysis Rules were used to delineate open diamond points as “special cause variation” and filled diamond points as “random variation.”

Abbreviations: CL, confidence limit; LCL, lower confidence limit; UCL, upper confidence limit.

---

1.80
1.60
1.40
1.20
1.00
0.80
0.60

**EWMA rate of infection**

<table>
<thead>
<tr>
<th>Before bundle</th>
<th>After bundle</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td>2012</td>
</tr>
<tr>
<td></td>
<td>1.67</td>
</tr>
<tr>
<td></td>
<td>1.06</td>
</tr>
</tbody>
</table>

**Figure 1** Central catheter–associated bloodstream infections before and after implementation of the central catheter maintenance bundle.
time points before and after an initiative in order to detect whether or not the initiative had a significantly greater effect than any underlying long-term trend.

The time trends before and after the bundle implementation were statistically compared in the interrupted time series data by using an ARIMA model. ARIMA models estimate the effects of the initiative while taking into account the time trend and autocorrelation among the observations (the extent to which data collected close together in time are correlated with each other). In the ARIMA (3,1,0) model, estimates for regression coefficients corresponding to standardized effect sizes are obtained: a change in overall level and a change in trend before and after the initiative. A change in overall level occurs when the observed level at the first postinitiative time point differs from the level predicted by the preinitiative time trend, and a change in trend occurs when the slopes are different before and after the initiative. A negative change in level and slope would indicate a reduction in CLABSI SIRs. A total of 14 months before implementation (June 2011 through July 2012) and 14 months after implementation (August 2012 through September 2013) of the bundle were used in the model.

Results

Competency

All nurses selected for the central catheter team were required to have passed a competency assessment on central catheter maintenance. The competency assessment was available for use at the hospitals as a standard tool for evaluating nurse performance. Each hospital’s chief nursing officer attended an initial training webinar on central catheter maintenance at the beginning of the initiative, a review webinar 3 months into the initiative, and a webinar at the end of the study. At the end of the initial training webinar, the chief nursing officers completed a 4-item quiz on the frequency of central catheter maintenance and assessment, and on the materials used in a central catheter dressing change. The quiz was repeated at the beginning of each of the subsequent review webinars. The mean proportion of correct responses increased from 83% (before bundle implementation) to 86% (6 months after bundle implementation); however, the difference was not significant (paired samples test; $t_{18} = -1.065$, $P = .30, d = -0.346$).

Compliance

Although compliance was more than 90% for each checklist measure during the first week of the bundle initiative, bundle compliance increased significantly during the first 5 weeks following implementation (Table 2). The high level of compliance continued throughout the course of the study.

Central Catheter–Associated Infections

According to the National Healthcare Safety Network’s definition, CLABSI SIs were defined as a primary bloodstream infection in a patient with a central catheter in place within a 48-hour period before blood cultures indicated an infection.20 All study hospitals routinely detected CLABSI SIs on the basis of CDC surveillance algorithms to determine the specific source of the infection, which may or may not be attributed to the central venous catheter.25 The mean LTACH central catheter utilization decreased slightly from before (67%) to after (66%) implementation of the bundle; however, use of CLABSI SIs mitigated the difference. In the 6 months before the bundle was implemented, the CLABSI SIR was 1.28 (95% CI, 1.11-1.46). Six months after the bundle was implemented, the CLABSI SIR was 29% lower than the previous CLABSI SIR, at 0.96 (95% CI, 0.82-1.12; general linear model repeated-measures design for monthly CLABSI rates; $F_{1.54} = 6.973$, $P = .01$; partial $\eta^2 = .11$; Figure 2). From 14 months before to 14 months after bundle implementation, a mean

### Table 2
Mean central catheter team observation for compliance checklist scores from implementation to 5 weeks

<table>
<thead>
<tr>
<th>Measure</th>
<th>Compliance, %</th>
<th>Test results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central catheter dressings intact and occlusive</td>
<td>97.8</td>
<td>$\chi^2 = 11.1, P = .03$</td>
</tr>
<tr>
<td>Date present on dressing</td>
<td>95.3</td>
<td>$\chi^2 = 21.6, P &lt; .001$</td>
</tr>
<tr>
<td>Dressings initialed</td>
<td>91.0</td>
<td>$\chi^2 = 11.8, P = .02$</td>
</tr>
<tr>
<td>Dressing changed in less than 7 days</td>
<td>98.7</td>
<td>$\chi^2 = 9.6, P = .048$</td>
</tr>
<tr>
<td>Daily assessment of dressing site</td>
<td>98.7</td>
<td>$\chi^2 = 15.1, P = .005$</td>
</tr>
<tr>
<td>Chlorhexidine dressing in place</td>
<td>96.8</td>
<td>$\chi^2 = 13.1, P = .01$</td>
</tr>
</tbody>
</table>

*Measured by related-samples Friedman 2-way analysis of variance by ranks (n = 17).
Application of similar bundles is an effective strategy for infection reduction.

Following implementation and maintenance of the bundle in LTACHs, the CLABSI rate was reduced significantly (29%), from a SIR of 1.28 to a SIR less than 1.0 and no different from the expected CLABSI rate, because the mean 95% CI of the CLABSI SIR includes the expected value of 1.0. During the time of this study, the Centers for Medicare and Medicaid Services’ National Action Plan to Prevent HAIs set a national 5-year goal for CLABSI SIR reduction at 25%.8 Although the goal was set for short-term acute care hospitals and not LTACHs, results of the current study indicate that this goal was exceeded after the central catheter maintenance bundle was implemented in LTACHs. A mean reduction of 4.5 CLABSIs per LTACH occurred for the LTACHs studied for 14 months after the bundle was implemented. This infection reduction could translate to a savings of approximately $3.7 million annually for the 30 LTACHs studied and could have potentially saved 20 patients’ lives, assuming a 15% mortality rate from CLABSIs.30

Overall, implementation of the bundle had an immediate effect on CLABSI rates; in a within-hospital interrupted time series analysis, there was no time lag between bundle implementation and reduction in the number of infections. The bundle was developed from the CDC’s infection prevention guidelines, which include specific central catheter maintenance processes ranked according to their effectiveness as reported in prior studies. Components of the bundle were chosen on the basis of the strength of evidence for their effectiveness, implementation feasibility, and relevance to LTACH patients’ clinical requirements. Although the number of CLABSIs was significantly reduced after the bundle was implemented, because the bundled protocol contained many different processes, it cannot be determined which components of the bundle were most effective in contributing to CLABSI reduction. In addition, other processes or factors could have contributed to the observed CLABSI reduction. For example, operational change and increased focus on central catheters could have influenced the results irrespective of specific components of the bundle.30-32 Overall compliance may also have contributed to the positive results observed because compliance-reinforcement strategies can produce substantial results when implementing best-practice initiatives,33 although the high level of compliance observed prevented correlating variance in compliance to CLABSI rates. Although compliance data collection and structured bundle reinforcement processes ended 6 months after the central catheter maintenance bundle was implemented, CLABSI rates remained low 8 months after the study ended.

Conclusions

An estimated 20% of all hospital-associated infections (HAIs) have been attributed to the use of central venous catheters,26 and interventions to prevent CLABSIs could save as much as $32,000 per patient in adjusted variable costs attributable to CLABSIs (as estimated in 2010).37-39 More importantly, CLABSI prevention can reduce morbidity.30
In the LTACHs studied, before the bundle was implemented, it is likely that nurses used many of the processes associated with the bundle when maintaining central catheters. However, no formal, comprehensive, standardized protocols for central catheter maintenance were in place, nor were there central catheter teams of nurses, alcohol-impregnated end caps in use, or compliance checklists; use of chlorhexidine-impregnated dressings also was intermittent. The results of this study are consistent with others’ experiences with bundles, where the bundle as a whole was more effective than individual components.34

Further study to elucidate specific components of the bundle that are effective in reducing CLABSIs should include (1) identification of the primary source of CLABSIs before and after the bundle was implemented15; (2) examination of the time between central catheter insertion and infection16; in the present study, most patients had their central catheters inserted before admission to the LTACH and insertion date data from the short-term acute care hospital was not available15; (3) determination of the type(s) of CLABSI pathogen(s) present before and after bundle implementation; (4) calculation of the proportion of patients with multiple central catheters; and (5) identification of the type and degree of physician involvement in the insertion, maintenance, and removal of central catheters.

Results from the present initiative indicate successful implementation of a central catheter maintenance bundle for an extended period in multiple LTACHs. Application of the bundle resulted in a significant and sustained reduction in CLABSI rates in LTACHs for 14 months. These results encourage the development and implementation of similar bundles as effective strategies for infection reduction in LTACHs.

ACKNOWLEDGMENTS
We thank all the directors of quality management, chief nursing officers, nurses, and other practice staff who have kindly assisted us by participating in this initiative and providing compliance data.

FINANCIAL DISCLOSURES
None reported.

REFERENCES
Correction

In the OnlineNOW article by Mealer et al, “Feasibility and Acceptability of a Resilience Training Program for Intensive Care Unit Nurses,” Am J Crit Care, 2014;23(6):e97-e105, the data in Table 2 were reported incorrectly. The error did not affect the Results section of the article and was limited to the data reported in Table 2. The corrected table is published below with the corrected figures expressed in bold type. We regret the error.

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Table 2
Repeated measures before and after the intervention

<table>
<thead>
<tr>
<th>Category</th>
<th>Intervention group (n = 13)</th>
<th>Control group (n = 14)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before</td>
<td>After</td>
</tr>
<tr>
<td>HADS: anxiety scores, median score (25th-75th quartiles)</td>
<td>12 (10-13)</td>
<td>11 (10-13)</td>
</tr>
<tr>
<td>Positive for symptoms of anxiety on HADS, %</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>HADS: depression scores, median score (25th-75th quartiles)</td>
<td>10 (8-13)</td>
<td>9.0 (7-10)</td>
</tr>
<tr>
<td>Positive for symptoms of depression on HADS, %</td>
<td>69</td>
<td>54</td>
</tr>
<tr>
<td>MBI: emotional exhaustion, median score (25th-75th quartiles)</td>
<td>23 (11-35)</td>
<td>13.0 (8-28)</td>
</tr>
<tr>
<td>Positive for emotional exhaustion, %</td>
<td>69</td>
<td>38</td>
</tr>
<tr>
<td>MBI: depersonalization, median score (25th-75th quartiles)</td>
<td>13.0 (6-18)</td>
<td>9 (5-16)</td>
</tr>
<tr>
<td>Positive for depersonalization, %</td>
<td>69</td>
<td>62</td>
</tr>
<tr>
<td>MBI: lack of personal accomplishment, median score (25th-75th quartiles)</td>
<td>35 (31-39)</td>
<td>37 (30-42)</td>
</tr>
<tr>
<td>Positive for lack of personal accomplishment, %</td>
<td>77</td>
<td>69</td>
</tr>
<tr>
<td>PTSD symptom score, median score (25th-75th quartiles)</td>
<td>11.0 (5-18)</td>
<td>2.0 (3-10)</td>
</tr>
<tr>
<td>CD-RISC, median score (25th-75th quartiles)</td>
<td>73 (67-75)</td>
<td>78 (68-90)</td>
</tr>
</tbody>
</table>

Abbreviations: CD-RISC, Connor-Davidson Resilience Scale; HADS, Hospital Anxiety and Depression Scale; MBI, Maslach Burnout Inventory; PTSD, posttraumatic stress disorder.
No Decrease in Early Ventilator-Associated Pneumonia After Early Use of Chlorhexidine

By Terrence Wong, BA, Adam B. Schlichting, MD, MPH, Andrew J. Stoltze, MD, JD, Brian M. Fuller, MD, MSCI, Amanda Peacock, RN, DNP, ANP-C, GNP-C, CCRN, Kari K. Harland, MPH, PhD, Azeemuddin Ahmed, MD, MBA, and Nicholas Mohr, MD

Background  Oral chlorhexidine prophylaxis can decrease occurrence of ventilator-associated pneumonia. However, the importance of timing has never been fully explored.

Objective  To see if early administration of oral chlorhexidine is associated with lower incidence of early ventilator-associated pneumonia (within 5 days of admission to intensive care unit) in intubated air ambulance patients.

Methods  A single-center, retrospective cohort study of intubated adults transported by a university-based air ambulance service and admitted to a surgical intensive care unit from July 2011 through April 2013. Primary exposure was time from helicopter retrieval to the first dose of oral chlorhexidine in the intensive care unit. Early chlorhexidine was defined as receipt of the drug within 6 hours of helicopter departure. The primary outcome was clinical diagnosis of early ventilator-associated pneumonia. Patients who were less than 18 years old, died within 72 hours of admission, or had pneumonia at admission were excluded.

Results  Among 134 patients, 49% were treated with chlorhexidine before 6 hours, 84% were treated before 12 hours, and 11% were treated for early pneumonia. Early chlorhexidine (before 6 hours; 15%) was not associated ($P = .21$) with early pneumonia (8%). Furthermore, median times to chlorhexidine did not differ significantly ($P = .23$) between patients in whom pneumonia developed (5.2 hours) and patients with no pneumonia (6.1 hours).

Conclusions  Early administration of oral chlorhexidine in intubated patients was not associated with a reduction in the incidence of ventilator-associated pneumonia in a surgical intensive care unit with high rates of chlorhexidine administration before 12 hours. (American Journal of Critical Care. 2016;25:173-177)
Ventilator-associated pneumonia (VAP) is a major cause of morbidity and mortality in critically ill and injured patients.1 VAP is one of the most common intensive care unit (ICU)–acquired nosocomial infections; it affects 4.8% to 7.5% of patients intubated longer than 24 hours and has an estimated overall attributable mortality of 9%. VAP is associated with longer hospital stays, with a resultant attributable cost of approximately $40 000 per case.1-3 Several studies have indicated the effectiveness of oral chlorhexidine in preventing pneumonia among intubated patients, and in 2010 the Institute for Healthcare Improvement recommended routine chlorhexidine prophylaxis to prevent VAP.4-10 Patients who are critically ill and intubated emergently have the highest risk for pneumonia,5,10-13 and in a recent trial,14 a single dose of chlorhexidine early in the care of trauma patients significantly reduced subsequent VAP. Interestingly, use of chlorhexidine before intubation did not reduce the incidence of VAP.15

Oral care varies across ICUs.12,16 Although some researchers have advocated routine application of chlorhexidine before ICU admission to reduce VAP,4 little is known about the importance of the time of prophylaxis in clinical outcomes. We conducted a study to test the association between timing of chlorhexidine prophylaxis and VAP incidence.

Methods
Design, Setting, and Sample
This retrospective cohort study was conducted at University of Iowa Hospitals and Clinics, Iowa City, Iowa, a 711-bed university hospital, and involved all intubated adult patients (age ≥ 18 years) transferred to the 36-bed surgical ICU by an air ambulance service during the period July 2011 through April 2013. Patients were excluded if they died within 72 hours of hospital arrival, had evidence of pneumonia or infiltrates on chest imaging at the time of admission, or had been admitted to inpatient care at another hospital before transfer to our ICU. The study is reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology statement17 and was approved by the appropriate institutional review board under waiver of informed consent.

Procedures
The primary exposure was time to chlorhexidine (if given), and the primary outcome was early pneumonia (diagnosed within 5 days of admission).18,19 Application of oral chlorhexidine is the standard procedure in the ICU; however, no protocol exists for administration of chlorhexidine before arrival at the hospital, in the emergency department, or before intubation. Time to chlorhexidine was defined as the time from helicopter departure from the scene or the transferring hospital to administration of chlorhexidine in the ICU. The definition of early prophylaxis was derived from the median time to chlorhexidine administration, but quartiles were used for sensitivity analysis.

Pneumonia was defined as clinical findings suggestive of pneumonia during examination by a board-certified intensivist, with initiation of antibiotic treatment and with subsequent culture of a respiratory specimen indicating a pathogenic organism. Standard descriptive and comparative analyses were used for reporting data, and significance was defined as \( P \) less than .05 for 2-tailed tests.

Results
The sample consisted of 134 intubated patients. Among these, 128 (96%) were treated with chlorhexidine, and 113 (84%) were treated before 12 hours...
were not treated experienced pneumonia. Neither baseline characteristics nor outcome differ-
ated patients can prevent VAP,4,6,8,9,12,14 but few is associated with development of pneumonia. The effects of prehospital intubation on patient-oriented factors predispose some patients to infection. The Clinical Pulmonary Infection Score has been criticized for its test character-
istics,25-31 perhaps because of the lack of a true gold-standard diagnosis for VAP. The definition of VAP of the Centers for Disease Control and Prevention has also been criticized as being too insensitive for clinical practice.22-24 Stringency of diagnosis for VAP is highly variable among published diagnostic criteria for VAP; in one study,55 the diagnosis of VAP varied from 4% to 42%, depending on which of 6 diagnostic criteria (including those of the Centers for Disease Control and Prevention and the CPIS) was used, with a resultant delay of 4 to 8 days in diagnosis of VAP. Not surprisingly, the more stringent the diagnostic algorithm, the higher the mortality was, which ranged from 50% to 80%. A clinical outcome as used in our analysis may provide a more meaningful patient-oriented event, and early initiation of antibiotic treatment can reduce mortality.36,37

In addition to early chlorhexidine prophylaxis, our institution has standardized oral care that includes elevation of the head of bed 30° or more, tooth brushing and subglottic suctioning twice daily, and chlorhexidine and oral suctioning every 4 hours. Similar oral care resulted a 46% decrease in VAP at other institutions.38 Separating the effect of chlorhexidine from the effect of standard oral care is challenging, so for institutions striving for early VAP prophylaxis, nursing

Discussion

Hospital-acquired infections are important markers of the quality of health care, yet in some instances, patient-oriented factors predispose some patients to infection. The effects of prehospital intubation on subsequent pneumonia are controversial,20-22 but most investigators19,23,24 agree that severity of illness is associated with development of pneumonia.

Administration of oral chlorhexidine to intubated patients can prevent VAP4,6,8,9,12,14 but few studies have defined a clear goal for the time treatment should be started. Munro et al15 recently reported that treatment with chlorhexidine immediately before endotracheal intubation does not reduce the Clinical Pulmonary Infection Score (CPIS). Our study is now the second one to indicate that early prophylaxis does not decrease the incidence of VAP (of note, we used a different, clinical definition of VAP).

The CPIS has been criticized for its test character-
istics,25-31 perhaps because of the lack of a true gold-standard diagnosis for VAP. The definition of VAP of the Centers for Disease Control and Prevention has also been criticized as being too insensitive for clinical practice.22-24 Stringency of diagnosis for VAP is highly variable among published diagnostic criteria for VAP; in one study,55 the diagnosis of VAP varied from 4% to 42%, depending on which of 6 diagnostic criteria (including those of the Centers

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Present (n = 15)</th>
<th>Absent (n = 119)</th>
<th>P*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>11 (73)</td>
<td>71 (60)</td>
<td>.40</td>
</tr>
<tr>
<td>Age, mean (SD)</td>
<td>47.9 (21.4)</td>
<td>51.8 (19.6)</td>
<td>.47</td>
</tr>
<tr>
<td>APACHE II score, mean (SD)</td>
<td>25.6 (8.9)</td>
<td>22.3 (10.2)</td>
<td>.24</td>
</tr>
<tr>
<td>BMI, mean (SD)</td>
<td>27.5 (6.4)</td>
<td>28.1 (5.6)</td>
<td>.73</td>
</tr>
<tr>
<td>Scene flight</td>
<td>0 (0)</td>
<td>13 (11)</td>
<td>.37</td>
</tr>
<tr>
<td>Interfacility transfer</td>
<td>15 (100)</td>
<td>105 (88)</td>
<td>&gt; .99</td>
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</table>

Diagnoses (not mutually exclusive)

<table>
<thead>
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<th>Diagnosis</th>
<th>Present (n = 15)</th>
<th>Absent (n = 119)</th>
<th>P*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trauma</td>
<td>6 (40)</td>
<td>45 (38)</td>
<td>&gt; .99</td>
</tr>
<tr>
<td>Cerebral hemorrhage</td>
<td>5 (33)</td>
<td>49 (41)</td>
<td>.78</td>
</tr>
<tr>
<td>Brain injury</td>
<td>4 (27)</td>
<td>33 (28)</td>
<td>&gt; .99</td>
</tr>
<tr>
<td>Respiratory failure</td>
<td>3 (20)</td>
<td>18 (15)</td>
<td>.70</td>
</tr>
<tr>
<td>Pulmonary contusion</td>
<td>3 (20)</td>
<td>7 (6)</td>
<td>.08</td>
</tr>
<tr>
<td>Spinal cord injury</td>
<td>2 (13)</td>
<td>12 (10)</td>
<td>.66</td>
</tr>
<tr>
<td>Rib fracture</td>
<td>2 (13)</td>
<td>13 (11)</td>
<td>.68</td>
</tr>
<tr>
<td>Sepsis</td>
<td>1 (7)</td>
<td>3 (3)</td>
<td>.38</td>
</tr>
</tbody>
</table>

Timing of chlorhexidine among recipients

<table>
<thead>
<tr>
<th>Hours to chlorhexidine, median (IQR)</th>
<th>Present (n = 15)</th>
<th>Absent (n = 119)</th>
<th>P*</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 3</td>
<td>2 (13)</td>
<td>8 (7)</td>
<td>.31</td>
</tr>
<tr>
<td>&lt; 6</td>
<td>10 (67)</td>
<td>56 (47)</td>
<td>.18</td>
</tr>
<tr>
<td>&lt; 12</td>
<td>14 (93)</td>
<td>98 (82)</td>
<td>.46</td>
</tr>
<tr>
<td>&lt; 24</td>
<td>14 (93)</td>
<td>104 (87)</td>
<td>&gt; .99</td>
</tr>
<tr>
<td>≥ 24</td>
<td>1 (7)</td>
<td>9 (8)</td>
<td>&gt; .99</td>
</tr>
<tr>
<td>No chlorhexidineb</td>
<td>0 (0)</td>
<td>6 (5)</td>
<td>&gt; .99</td>
</tr>
</tbody>
</table>

Outcomes

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Present (n = 15)</th>
<th>Absent (n = 119)</th>
<th>P*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Days in hospital, mean (SD)</td>
<td>19.5 (10.4)</td>
<td>11.1 (9.3)</td>
<td>.002</td>
</tr>
<tr>
<td>Death</td>
<td>3 (20)</td>
<td>13 (11)</td>
<td>.39</td>
</tr>
</tbody>
</table>

Abbreviations: APACHE, Acute Physiology and Chronic Health Evaluation; BMI, body mass index, calculated as weight in kilograms divided by height in meters squared; IQR, interquartile range (25th-75th percentile). *P* values derived from t tests or Mann-Whitney tests for continuous variables and x² tests for categorical variables. b No difference in baseline characteristics, diagnoses, or outcome in recipients vs nonrecipients of chlorhexidine.
Figure Proportion of patients treated with chlorhexidine by time, stratified by early pneumonia status.

education should stress chlorhexidine as a component of overall oral care.

Our study has several limitations. First, because it is a retrospective study, only data recorded in the medical record were available. We selected variables that most likely are recorded accurately and used standardized data abstraction. Second, separating oral chlorhexidine from other prophylactic oral care delivered in the ICU is difficult. Third, our center has relatively short times to ICU admission, and most patients (84%) were treated with chlorhexidine within 12 hours of admission. Therefore, the lack of effect in our cohort may not be replicable in centers where chlorhexidine treatment is less routine or rapid.

Finally, our clinical definition of VAP, which combined the treating clinician’s suspicion that a patient had pneumonia and bacteriological evidence of infection for diagnosis, differs from the definition in previous studies in which the CPIS was used, making direct comparison difficult. Use of a retrospective dataset prevented our use of CPIS values; however the test characteristics of the CPIS for prediction of VAP are not ideal. Use of our clinical diagnosis of VAP, however, indicated a lack of protective effects of early chlorhexidine against VAP similar to the findings of a recent study in which the CPIS was used as an outcome.

Conclusions

Oral chlorhexidine prophylaxis administered within the initial 12 hours of treatment is not associated with a decreased incidence of early VAP in intubated surgical ICU patients. The role of VAP prevention, with respect to timing of interventions and the interventions themselves, should be explored further.

ACKNOWLEDGMENTS

This research was performed in the Department of Emergency Medicine, University of Iowa Carver College of Medicine.

FINANCIAL DISCLOSURES

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eLetters

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REFERENCES

A 35-year-old woman came to her obstetrical clinic at 33.5 weeks of gestation in August 2014. A productive cough, headache, and increasing dyspnea had developed 4 days earlier. She reported close contact with family members who had signs and symptoms suggestive of an upper respiratory tract infection. She had no nausea, vomiting, diarrhea, subjective fever, or chest or abdominal pain. She had no history of asthma but regularly used cigarettes. She had a known diagnosis of preeclampsia, gestational hypertension, and a protein to creatinine ratio of 0.4.

Because she was hypoxic, she was sent to the emergency department. Vital signs included blood pressure 170/108 mm Hg, heart rate 126/min, respirations 36/min, and body temperature 37.1 °C. Oxygen saturation was 86% on room air. Physical examination revealed diffusely rhonchorous breath sounds with wheezes throughout the lung fields. Laboratory data included white blood cell count 8900/μL, with 78% polymorphonuclear leukocytes, 4% band cells, 6% lymphocytes, and 10% monocytes. With regard to the known preeclampsia, she had no qualifying evidence of end-organ dysfunction, platelet count was 210 000/μL, serum level of aspartate aminotransferase was 41 IU/L (less than twice the upper limit of the reference value; to convert to microkatals per liter, multiply by 0.0167), and creatinine concentration was 0.65 mg/dL (to convert to micromoles per liter, multiply by 88.4).

Because of the concern that she might have pulmonary embolism, a computed tomography angiogram of the chest was obtained, which showed diffuse, patchy alveolar infiltrates in multiple lobes

**Abstract** The first confirmed US case of severe respiratory tract infection caused by enterovirus D68 in an adult occurred in a pregnant woman with no history of asthma in August 2014. Before she came to the hospital, she had a productive cough, headache, and increasing dyspnea. At the hospital, she was hypoxic and required admittance to the intensive care unit and management with noninvasive bilevel positive pressure assistance. Analysis of a nasopharyngeal swab sent to the Centers for Disease Control and Prevention for a viral respiratory panel of tests confirmed enterovirus D68 infection. She eventually had an uneventful vaginal delivery, was discharged without oxygen supplementation, and has resumed normal activities. This case suggests that pregnant women may be a sentinel group infected with this pathogen, similar to what has been described for influenza virus infection. (American Journal of Critical Care. 2016;25:178-180)
Enterovirus D68 can cause severe respiratory tract infection in adults.

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The patient had marked respiratory distress and required an increase in supplemental oxygen. She was given betamethasone, prednisolone, azithromycin, vancomycin, and ticarcillin/clavulanic acid and then transferred to the medical intensive care unit.

On arrival in intensive care, she was tachypneic and hypertensive and required 100% oxygen via face mask to keep her oxygen saturation greater than 95%. She said she had a headache, and she was in respiratory distress. Chest examination revealed bilateral high-pitched wheezing and scant, fine crackles suggestive of bronchiolitis. She was treated with noninvasive bilevel positive pressure. Specimens, including a nasopharyngeal swab for a respiratory viral panel, were sent to the microbiology laboratory. The antibiotics were changed to ceftriaxone and azithromycin. Albuterol was administered via nebulizer. The prednisolone dose was increased to 60 mg intravenously every 8 hours. Blood pressure was controlled with labetalol; magnesium sulfate was also administered. Results of fetal monitoring were reassuring.

A rapid influenza test was negative for influenza virus. Another nasopharyngeal swab specimen was obtained for testing in a respiratory viral panel (xTAG Luminex; Luminex Corp). The results were considered positive for entero-rhinovirus on the basis of broadly reactive primers that amplify RNA from human rhinoviruses and enteroviruses. Because of concerns that the patient might have an enterovirus D68 infection, the specimen used for respiratory panel testing was sent to the Centers for Disease Control and Prevention. Enterovirus D68 was diagnosed on the basis of reverse transcription–polymerase chain reaction testing that targeted the 5’-nontranslated region, followed by partial sequencing of structural protein genes. The results indicated that the patient had enterovirus D68 infection.

The patient’s clinical status improved during the next 48 hours. A chest radiograph on day 2 of her stay in the intensive care unit revealed bilateral patchy air space disease that was worse at the lung bases. She was weaned off noninvasive ventilation, and oxygen supplementation was reduced to 40% by face mask. Wheezing continued. The hypertension resolved. Repeat white blood cell count was 7800/μL. Blood cultures had no growth. Urine tests were negative for legionella antigen. Mycoplasma serology was positive for immunoglobulin G and negative for immunoglobulin M. Treatment with antibiotics was discontinued; administration of steroids was continued.

The patient was transferred back to the obstetrical service. Labor was induced because of her known diagnosis of preeclampsia with severe features. She had an uneventful vaginal delivery of twins. Weight and Apgar scores of the 2 infants were 1588 g, 8/9 and 1740 g, 8/9 after breech extraction. The patient and infants were discharged without oxygen supplementation. Sixteen days after discharge, the patient reported feeling well and had resumed normal activities.

Discussion
This patient had the first reported US case of severe enterovirus D68 infection in an adult. Although viral cultures were not done, reverse transcription–polymerase chain reaction testing performed at the Centers for Disease Control and Prevention documented evidence of enterovirus D68 in the patient’s nasopharynx. Enterovirus D68 was initially isolated in 1962. The respiratory tract is the primary target tissue of this virus. Additionally, enterovirus D68 can produce infectious progeny in leukocyte cell lines with granulocyte, monocyte, T-cell, and B-cell characteristics. Until recently, the virus has been an uncommonly reported cause of human disease.
partly because of difficulties in identifying this pathogen. Surveillance studies in Japan, China, and the Netherlands revealed that enterovirus D68 was responsible for less than 1% of acute viral respiratory infections and that the incidence of infection peaked between September and November.1,4 In a US enterovirus surveillance report of cases between 1970 and 2005, enterovirus D68 was identified in only 26 of 49,637 cases.6 A total of 68 cases of enterovirus D68 infection were reported among clusters of infection in Asia, Europe, and the United States between 2008 and 2010.7 These cases peaked within or later than the typical enterovirus season, and the peak age group affected was newborn to 4 years old. However, the Dutch study5 revealed that the highest prevalence of patients with enterovirus D68 infection were 50 to 59 years old. Patients infected with enterovirus D68 have significantly more dyspnea and bronchitis and less fever than do patients with some other acute respiratory infections.5 In the study by Lu et al.,7 of 9 patients with enterovirus D68 infection had pneumonia. Of interest, 100% of pregnant women in Finland were seropositive for enterovirus D68.2

Our case is reminiscent of severe disease recognized during the 2009 influenza pandemic in pregnant women. Although our patient had a known diagnosis of pre eclampsia, this condition appeared to be unrelated to the severity of the viral illness. She received supportive care for the viral illness, did not require treatment for pulmonary edema, and recovered before induction of labor because of the pre eclampsia. If her respiratory illness had been related to pre eclampsia, improvement in the respiratory problem before delivery would not be expected. Indeed, an association exists between pregnancy and severity of infection due to influenza virus and other viral pathogens.8

The modulated immunological condition during pregnancy is complex. Changes in adaptive immunity later in pregnancy may explain in part the increased severity of illness we observed in our patient. Infants born during maternal hospitalization for influenza are more likely to be preterm and have lower birth weights than are infants of women without influenza.9,10 In addition, prompt treatment of pregnant women with severe influenza has been associated with fewer deaths.11 In patients with influenza, comorbid conditions such as asthma and tobacco use increase risk for admission to intensive care during pregnancy.11 Although enterovirus infection may primarily cause severe disease in children, our case highlights that pregnancy may be an important risk factor for severe disease in patients with enterovirus D68 infection. Currently, management of pregnant women with enterovirus D68 infection is supportive care, and this viral infection should be included in the differential diagnosis of respiratory illness in adults. As is the case with influenza, pregnant women may be sentinel individuals at particular risk for enterovirus D68 infection. It is hoped that future developments in antiviral therapy and vaccinology will mitigate future risk to pregnant women and other populations infected with enterovirus D68.

REFERENCES

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

By Rebecca Shaw, RN-BC, BSN, BSW, MA

Adequate sleep is a critical component of illness recovery. Inadequate sleep contributes to a myriad of physiological problems, including impaired immune response, decline in wound healing, greater insulin resistance, increased perceptions of pain, and an increase in mortality. Sleep problems exacerbate the healing process during hospitalization and can endure beyond hospitalization. Researchers in one study documented that sleep difficulties may endure beyond hospitalization: 50% of respondents reported moderate to severe sleep problems 1 week after discharge. Other studies have offered evidence that sleep problems experienced during hospitalization increase the risk for development of chronic insomnia.

Acutely ill patients experience difficulty falling asleep, sleep fragmentation, decreased rapid-eye-movement (REM) sleep, and sleep perceived as poor quality. In hospitals, many factors can interfere with patients’ sleep. Environmental noise (e.g., noisy equipment, alarms, staff interaction) is a pervasive problem. The Environmental Protection Agency recommends that noise levels not exceed 45 decibels during the day and 35 decibels at night. Numerous studies in acute and intensive care settings have documented noise levels regularly exceeding the recommendations. Other sleep disruption factors include lighting that interferes with sleep-wake cycles, pain, anxiety, and symptoms related to patients’ underlying illness. Many of these sleep-disrupting factors are amplified in intensive care units.

Pharmacological interventions, such as sedatives, are often the first response to promoting sleep in hospitalized patients. However, use of sedatives has been linked to such adverse effects as memory loss, disorientation, increased fall risk, and daytime fatigue. In recent years, growing emphasis has been placed on exploring the effectiveness of non-pharmacological interventions to promote sleep, such as minimizing nighttime disruptions, decreasing noise and light, increasing meaningful daytime activity, and using relaxation techniques (e.g., aromatherapy, massage, guided imagery, ear plugs, and eye masks).

Music is another previously studied technique for promoting sleep. Music is hypothesized to have psychological and physiological effects on the body, including potentially sleep-promoting influences. The PICO (patient/problem, intervention, comparison, outcomes) question that this review addresses is, What effect do interventions using music, compared with other methods, or usual care, have on promoting sleep in hospitalized adults?

Methods

The literature search strategy included searching Cochrane Library, Joanna Briggs Institute’s Evidence-Based Practice (EBP) Database, PubMed, EMBASE, and CINAHL Plus. Key words included music, sleep, hospital*, lab*, and patient*. (Asterisks indicate that truncated versions of those words were used in the literature search). No limitations were placed on publication date so as to identify the largest number of relevant studies possible. Reference lists of identified articles were also searched by hand.

Results

Twenty-eight articles were retrieved by using the search strategy. The following inclusion criteria were then applied: studies involved only adult participants, measured specific sleep outcomes, and were performed in an inpatient setting or sleep laboratory. Studies performed in community settings, such as participants’ homes, were excluded because of concerns over inadequate control of the test environment and data validity and reliability. After these criteria were applied, 11 articles were reviewed. Table 1 presents the major findings of these articles.

The majority of studies showed at least 1 positive and statistically significant effect on the sleep-related outcomes that were measured. The studies were conducted in a range of settings, including sleep laboratories, acute care units, and intensive care units. Most studies fell within the B and C levels of evidence according to the American Association of Critical-Care Nurses’ evidence-leveling system (Table 2). Two meta-analyses are included in this review, and both reported positive significant effects on patients’ subjective perceptions of sleep quality.
<table>
<thead>
<tr>
<th>Reference</th>
<th>Design, intervention, and sample description</th>
<th>Intervention effects on sleep outcomes</th>
<th>Level of evidence</th>
</tr>
</thead>
</table>
| Chang et al⁹       | Randomized controlled trial  
Music only  
Volunteers with chronic insomnia in hospital-based sleep laboratory  
(N = 50)                                      | + Feeling rested after sleep  
0 Total sleep time  
0 Sleep onset latency  
0 Number of awakenings                                      | C                                                                                                           |
| Chen et al¹⁰       | Randomized controlled trial  
Music only  
Healthy volunteers in sleep laboratory  
(N = 24)                                                      | + Reduced stage 2 sleep in baseline short and long sleep latency groups  
+ Participants with baseline longer sleep latencies spent a larger percentage of sleep time in sleep stages 3 and 4  
0 Duration of stage 1, stage 3, or REM sleep                     | C                                                                                                           |
| de Niet et al¹¹    | Meta-analysis  
Music only  
Volunteers with primary sleep complaints with and without comorbid conditions (N = 5 randomized controlled trials) | +  
+                                                                                                    | A                                                                                                           |
| de Niet et al¹²    | Pre-post, quasi-experimental (nonrandomized)  
Music-assisted relaxation vs cognitive behavioral therapy vs sleep hygiene education  
Inpatient psychiatric unit patients  
(N = 171)                                                     | Condition:  
+ Music-assisted relaxation  
0 Cognitive behavioral therapy  
0 Sleep hygiene                             | B                                                                                                           |
| Kamdar et al¹³     | Observational, pre-post quasi-experimental (nonrandomized)  
Multiphase intervention: stage 1—daytime/nighttime environment modifications; stage 2—earplugs, eye masks, soothing music; stage 3—pharmacological sleep aids  
Intensive care unit (N = 300)                                 | 0                                                                                                        | C                                                                                                           |
| Lazic and Ogilvie¹⁴| Pre-post test (nonrandomized)  
Music vs audio tones  
Healthy volunteers in sleep laboratory  
(N = 10)                                                           | + Sleep onset latency                                                                                       | C                                                                                                           |
| Levin¹⁵            | Quasi-experimental, pretest/posttest  
Brain music vs placebo brain music  
Adults with insomnia, setting unknown  
(N = 58)                                                                      | + Sleep onset latency  
+ Duration of sleep  
+ Intrasleep awakenings  
+ Sleep quality                                                                                              | B                                                                                                           |
| Ryu et al¹⁶        | Randomized controlled trial  
Music vs ear plugs  
Percutaneous transluminal coronary angiography patients in cardiac care unit  
(N = 58)                                                      | + Total sleep time                                                                                         | B                                                                                                           |
Sleep outcomes were measured by using a variety of methods. Sleep perceptions were measured through subjective self-reported validated tools, primarily the Richards-Campbell Sleep Questionnaire (RCSQ) and the Pittsburgh Sleep Quality Index (PSQI). The RCSQ subjectively measures 5 domains of sleep quality: sleep depth, falling asleep, awakening, returning to sleep, and quality of sleep. The PSQI includes 19 subjective questions about perceptions of sleep quality in the past month. Aspects of sleep quality were measured through tools that provided quantitative physiological data, primarily polysomnography. Polysomnography uses a combination of electroencephalography, electromyography, and electrooculography to provide objective data on measures including total sleep time, sleep onset latency, nighttime awakenings, and percentage of time spent in sleep stages 1 through 4 and REM sleep.

Subjective perceptions of sleep were more commonly used in these studies, but results for both subjective and objective measures tended to trend in the same direction. In only 2 studies where both subjective and objective measures were used, findings of positive significant effects on all subjective sleep perceptions were not supported by statistically significant results for objective measures.

### Recommendations for Practice

Despite mixed results and methodological concerns (eg, high reliance on self-reported data, large variation in observation period and experimental setting), the evidence supports the potential value of music in promoting sleep. To implement music as a sleep-promotion tool in hospitals, several questions must be considered; first of all, what music should be played.

Most of the studies reviewed used music with soothing or sedating qualities. Commonly agreed upon characteristics of this type of music are a tempo of 60 to 80 beats per minute, no dramatic changes in volume and rhythm, and played at a volume of 30 to 40 decibels. Preferences for the music played may be a more important factor than specific characteristics of the music. Chang and colleagues reported that when study participants...
listening to music selected by researchers were compared with study participants who listened to their own preferred music, no difference in sleep quality was apparent between these groups. Therefore, any type of music, as long as it is preferred by the listener, may promote sleep.

A second question to consider is how to deliver the music to patients. The infrastructure to broadcast music in patients’ rooms already exists in many hospitals through closed circuit television systems with channels devoted to playing different music genres. In these cases, providing music to assist patients to sleep would not involve additional cost. Considerations would need to be made for patients in semiprivate rooms to provide headphones. Also, it would be necessary to be able to turn off, or cover, the television screen so the light would not interfere with sleep. If this amenity is not available, Chlan and Tracy’s offer guidance for developing a library of music to be played on portable music players.

The studies reviewed here provided the music through headphones or speakers and primarily through portable music players. When music is provided via these methods, infection control issues must be addressed. For example, disposable headphones might need to be purchased, and methods for disinfecting portable music players must be established.

A sleep assessment should be used in conjunction with any sleep-promoting intervention. Conducting a sleep assessment at admission allows providers to identify underlying sleep disorders and gather information about a patient’s preferences for his or her sleeping environment, bedtime routines (eg, typical sleep-wake times), and use of pharmacological sleep aids.

Providing music to hospitalized patients is potentially inexpensive and feasible to implement across a variety of hospital settings. Additionally, no evidence of negative side effects for this practice have been reported. Although the researchers in the studies reviewed here acknowledge some limitations to generalizability and strength of evidence, adequate evidence exists to continue pursuing music as a possible effective intervention for promoting sleep.

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FINANCIAL DISCLOSURES

None reported.

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**SYMPTOMATIC BRADYCARDIA IN A HEALTHY OLDER ADULT**

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

Scenario: This electrocardiogram (ECG) is from a 78-year-old woman who arrived at the emergency department complaining of lightheadedness, dizziness, exertional dyspnea, and generalized fatigue for the past 3 weeks. Her blood pressure was 80/40 mm Hg and respirations were 20/min. Her only medical history was hyperlipidemia and gastroesophageal reflux disease, and she is currently taking gemfibrozil, aspirin, and omeprazole.

**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

Junctional escape rhythm with atrioventricular (AV) dissociation due to complete AV block, with P waves from both the sinus node (upright) and an ectopic location from a lower atrial region (arrows).

Rationale

AV block refers to an abnormality in the electrical conduction between the atria and ventricles. The location and severity of AV blocks can be identified by examining ECG features. For example, first degree AV block describes impulses originating from the SA node that are conducted but delayed (> 0.2 seconds), and are typically benign. Second degree AV blocks occur when some impulses are dropped and therefore are not conducted from the atria to the ventricles. These rhythms can be benign or require treatment based on patient symptoms and vital signs. Third degree, or complete AV block, occurs when conduction between the atrial and ventricles is disassociated, which is the overall rhythm seen in this example. As seen at the end of the rhythm strip (lead II), the sinus node is firing at an atrial rate of 80 beats/min (brackets), however, the P waves have no relationship to the QRS complexes. The P waves denoted by the arrows have a morphology suggesting origination from the low atrium because of the negative P-wave morphology, and are labeled as low atrial ectopic beats. Escape rhythms (junctional or ventricular) in complete AV block originate from an area distal to the site of the block. In this example, because the QRS complex is of normal duration (<0.12 seconds), the impulse travels down the conduction system via the normal pathway, which confirms the origin of the block to be at the level of the AV junction rather than the ventricles. When the block is at the level of the AV junction, the rate of the escape rhythm is typically between 40 to 60 beats/min.

Management

Complete AV block is a medical emergency. Since this patient was unstable, emergent temporary pacing should be initiated to increase the heart rate, and thus, cardiac output. If the cardiac catheterization laboratory is not available, external pacing should be initiated until a transvenous pacemaker can be inserted. Causes of complete AV block include various pathological states that produce infiltration, fibrosis, or loss of connection in portions of the conduction system. A common cause to also consider are medications (ie, beta-blockers, calcium channel blockers, antiarrhythmics, and digoxin), which when discontinued can reverse this condition. In this case, potential reversible conditions were ruled out; hence, the patient had a permanent pacemaker implanted and was discharged home in stable condition.
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