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Preparing a Paper for Publication: Help Us Help You Make It Happen

Some of the most enjoyable aspects of being an editor are meeting with prospective authors to discuss ideas for articles, working with authors and reviewers to support manuscript development, and congratulating authors when their papers are accepted for publication. One of the most unpleasant aspects is notifying authors that Critical Care Nurse is not able to consider their paper for publication. When that message is communicated in response to a query letter, the discomfort is fairly minimal because the author’s and CCN’s resource investment is minimal. If that message needs to be conveyed after 1 round of peer review, it pinches considerably more, as the author’s time and effort in preparing the paper and staff time in processing the paper through peer review (preliminary check; identifying, assigning and confirming experts to review the paper; analyzing, summarizing, and forwarding decision and review comments to the author) often represent many hours extended over months. When that message is needed after multiple rounds of peer review, the level of disappointment escalates for the author and CCN as our cumulative time, effort, and expertise are seemingly expended for no return whatsoever. To minimize the chance of a rejection coming your way, I’ll use this editorial to share some time-tested truisms for getting your paper published in CCN. Virtually all of the principles contained in these tips apply to any professional journal, but I will tailor some points so you can tell how they specifically apply to CCN. My goal is to not only encourage you to submit papers for publication, but to persist through the revision stages until your paper is ready for publication. I will organize these tips along major stages in the manuscript development continuum, from selecting an idea for an article to receiving notice of manuscript acceptance.

Selecting an Idea for an Article

In order for a topic to be publishable, it needs to be relevant and timely for readers of that journal. Topic relevance relates to whether the content is consistent with the journal’s mission and purpose. CCN’s mission is to provide critical care, high-acuity care, and progressive care nurses with relevant and useful information related to direct care of critically ill patients. CCN’s purpose is to convey information that benefits the care that readers provide to critically ill patients and their families. When considering a clinical topic for CCN, ensure that it

- Is within the scope of critical care, high-acuity care, or progressive care nursing.
- Can include meaningful coverage of nursing implications.

A brief perusal of CCN’s masthead reveals that in addition to its primary focus on direct patient care, CCN also publishes papers related to academic education, advanced practice, ethical and legal issues, work environments, management, military, safety, and tele-ICU. Topics for these areas can be considered as long as they have overt application to some aspect of critical care nursing. For example, CCN is not
a fitting venue for papers on graduate admissions, but is appropriate for faculty critical care practice partnerships that reduce readmission of heart failure patients.

For CCN, any topic without a patient care focus needs direct application to some aspect of critical care nursing.

Topic timeliness relates to whether the projected publication time horizon (often 9-12 months from acceptance) represents an opportune time to provide that information. In short, how “hot” will that topic be for readers? Whereas some topics (managing patients with Ebola virus) require expedited publication, they quickly descend the priority list after that. Other topics (care of patients with sepsis) become instantly unuseable if based on application of outdated guidelines.

Timing problems are less obvious when the topic is relevant, but has been around long enough to generate an ocean of research and review literature. For those topics to be publishable, its literature needs to be wanting in some aspect, that is, incomplete, obsolete, superficial, or silent on the aspect(s) your paper would cover. Otherwise, there is no justification to publish another paper that simply echoes existing literature (within or outside nursing).

Viable publication topics for CCN fill a need with content that is somehow new or different or unique or at odds with existing literature on that topic within or outside of nursing.

Preparing the Initial Draft

If critical care nursing is your passion and your topic is publishable, but writing is not your forte, consider one of the following 2 approaches: securing assistance from someone with expertise and experience as a published author who is willing to mentor you through the process or acquiring those skills on your own.

Either approach can generate 4 valuable outcomes: a publishable paper, a foundational set of skills that can be refined over your career, minimizing struggles that some authors experience with publication, and developing realistic expectations regarding your capabilities as an author, working with journals, and gaining from reviewers' insights. For most CCN authors, the ideal mentor would be a prolifically published colleague, who understands your writing language, medical terminology, the critical care environment, and the critical care nursing perspective. A less optimal approach is assistance from someone skilled in writing. The major downside here is needing to explain terms and contexts to someone unfamiliar with the field. This type of assistance may be available at local colleges or university writing centers, where access to writing assistance exists for your support.

If you are a self-starter, then learning how to prepare a manuscript for publication represents a prime self-directed learning opportunity with a high likelihood of success. Excellent resources include the following:

- Nurse Author & Editor, a publication providing informative articles on scholarly writing and publishing for nurses, with a website (naepub.com/for-authors) offering access to a compendium of free author resources.
- An informative booklet, Writing for Publication (John Wiley & Sons, Inc, 2014), which lightly covers basic considerations such as identifying your purpose and messages to communicate, your audience, writing different types of articles and different types of information, and mention of ethical and copyright issues.
- A directory of nursing journals
- Writing Basics (naepub.com/category/writing-basics), with papers on Secrets of Successful Writers, Writing Guides, Rules of Writing, Publishing Secrets, Avoid Rejection, Revising a Manuscript, and more.
- The free online course, Writing for Professional Journals, developed by Patricia Gonce Morton, PhD, RN, FAAN (https://utah.instructure.com/courses/306223) to assist nurses in learning the steps of the publishing process. The course comprises 12 modules (including Getting Started, Focusing a Topic, Preparing Outlines & Choosing a Format, Writing the First Draft, Responding to Feedback) and additional resources.

Finalizing the Manuscript

Once the content, format, and presentation are developed, a number of final checks need to be made to ensure consistency with the journal's requirements and to avoid unnecessary revisions. Every professional journal has its own author guidelines, which specify how papers need to be prepared, structured, referenced, and submitted. All authors need to follow these instructions at the outset of writing. CCN’s Author Guidelines (ccn.aacnjournals.org/site/misc/ifora.xhtml) include specifications that facilitate processing of incoming manuscripts; not adhering to them precipitates delays and extra work
for staff and authors. Using CCN’s checklist will help ensure all requirements are met.

As mundane as final proofing may sound, there is nothing more off-putting to editors and reviewers than struggling to read a paper riddled with spelling gaffes, uncorrected typos, subject-verb disagreements, punctuation errors, incomplete or incoherent sentences, and other glaring writing flaws. These reflect poorly on authors and color reviewers’ impressions of your work.

Another suggestion is to obtain preliminary feedback on the paper by asking several colleagues to critique one primary aspect. For example, for a manuscript on medications for managing heart failure, ask a pharmacologist to review for currency and accuracy of pharmaceutical information, ask colleagues in different geographic locations to verify whether patient management practices differ from yours, and ask another to examine for clarity and organization. Your goal is to resolve weaknesses before the journal’s peer review process so the latter can refine the paper, rather than salvage it from rejection.

- Complete a final check before submission to correct problems with spelling, grammar, punctuation, sentence structure, reference accuracy, and formatting
- Use CCN’s checklist for authors to prepare for submission
- Secure preliminary reviews to resolve problems with accuracy, currency, clarity, and organization before submission.
- When an author’s native language is not English, a language editing service may help prepare the paper—see CCN’s Author Guidelines.

**Submitting the Manuscript**

Authors who have followed the preceding guidance typically find the manuscript submission process easy to complete. CCN’s Author Guidelines provide links to a tutorial that illustrates the submission procedure and to the online manuscript management portal at Editorial Manager (www.editorialmanager.com/ccn) and describe how to obtain any additional help needed.

Submit the manuscript according to directions at the journal’s website and/or manuscript management system.

**Responding to Reviewer Critiques in Revising the Manuscript**

The peer review process exists to afford some level of quality assurance before material being published. With
the exception of personal opinion pieces such as editorials, every column or feature that appears in CCN is subject to peer review. Peer review distributes the author’s work to a panel of health care professionals with expertise in the topic area and requests their appraisal of its merits, weaknesses, and suitability for publication. The best reviewers are constructive, specific, and instructive in their comments; others may be critical, caustic, sweeping, and dismissive. Authors who have published extensively have learned to expect, deal with, and learn from the full range of possible reviewer remarks. A few tips for responding to reviewer comments may be helpful:

• It is exceedingly rare for a manuscript to be accepted as is on initial submission. In more than 30 years as editor, perhaps 5 papers sailed through peer review without needing substantive improvements. Your paper could be the sixth, but odds are heavily against it, so best adjust expectations accordingly.
• Reviewer comments are a gift to authors. Reviewers are busy professionals just like you, who volunteer time to offer suggestions for improving your paper. They get nothing except satisfaction from helping a colleague they do not know. Some are the same experts cited in your paper, so appreciating their investment in your work is a useful viewpoint.
• When you receive a request for revision, authors should feel encouraged that their paper is still considered promising, rather than discouraged for revisions still needed.
• Copious reviewer comments may represent the need for substantial revisions, but may also reflect a reviewer suggesting rephrasings, a more verbose communication style, or a point especially important to them. In any case, the volume of comments received may, but does not always, reflect the amount of revision necessary, so perusing them all and responding to each in turn remain the mainstays for manuscript revision.
• Authors do not need to agree with every reviewer comment, but when they disagree, they need to explain their perspective and supply references, as appropriate, for support. Addressing comments in a clear, respectful tone enables rapid consideration of author replies. Quasi-snarky replies, expressions of disagreement without rationale or evidence, or not addressing comments are neither appropriate nor facilitative.

• Respect reviewers’ time and expedite revisions by making it easy for reviewers to locate changes made to improve the paper. When revised papers are resubmitted, authors must provide a direct reply to each reviewer comment and identify where changes were made.
• If you are only submitting a paper to meet an academic requirement or to see if a school paper might get published as is with no intention of ever revising it for publication, then do not submit it to CCN. Our staff and reviewers should not be obligated to waste their time on optimizing a paper when its author is not making that mutual investment with us.

Repeating Rounds of Peer Review and Revision

Less seasoned authors are more likely to experience the need for multiple rounds of peer review and revision because the number and nature of necessary improvements may be greater. As a result, each revision may bring incremental improvement over the prior submission, yet the need for substantive changes persists. CCN attempts to support less experienced authors by offering multiple opportunities at refinement, but even this has limits, so attending to the changes requested is necessary for the paper to remain under consideration. A more frequent reason for revision merry-go-round is an author neglecting to make changes requested in a prior review. An additional opportunity may be offered, but is not guaranteed.

Closing

Issuing acceptance letters to authors is the best part of my job, so I hope that the information provided here offers you the foundation and inspiration to publish in CCN. We are here to help support you on your journey as a CCN author and look forward to receiving your best work very soon. CCN

JoAnn Grif Alspach, RN, MSN, EdD
Editor
Acute Disseminated Encephalomyelitis After Influenza Vaccination: A Case Report
Wei-Ti Chen, RN, CNM, PhD, Yi-Chen Huang, RN, MSN, Meng-Chin Peng, RN, MSN, Ming-Chu Wang, RN, MS, and Kon-Ping Lin, MD

Acute disseminated encephalomyelitis is an inflammatory demyelinating disease of the central nervous system that has been associated with influenza immunization, but only a few cases related to vaccination for influenza have been reported. Acute disseminated encephalomyelitis developed in a 42-year-old woman within 3 weeks of receiving the seasonal influenza vaccine. She had 80% recovery after 3 months of treatment with methylprednisolone. Although cases of acute disseminated encephalomyelitis after vaccination for influenza are rare, enough of them have occurred that critical care nurses should be aware of the possibility. Early treatment can prevent serious residual signs and symptoms; therefore, correct and quick diagnosis is important. Medical history obtained from patients with central nervous system problems should include history of recent vaccinations. (Critical Care Nurse. 2016;36[3]:e1-e6)

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Solid-Organ Graft-Versus-Host Disease After Liver Transplant: A Case Report
Jonathan S. Auerbach, MD, and Christopher K. Schott, MD, MS, RDMS

Solid-organ transplant graft-versus-host disease (SOT-GVHD) is a rare complication of organ transplant that is associated with high mortality. The initial signs and symptoms are vague, so this disease is easily confused with other posttransplant complications. A case of SOT-GVHD occurred after orthotopic liver transplant for liver failure due to hepatitis C in a patient in a Veterans Affairs intensive care unit. The patient had dehydration, acute kidney injuries, rashes, diarrhea, and pancytopenia. Results of skin biopsy, bone marrow biopsy, and cytogenetic studies were consistent with SOT-GVHD. Despite supportive care including antibiotics, antiviral and antifungal therapy, high-dose steroids, antithymoglobulin and neupogen, the patient died of overwhelming sepsis. Owing to the rarity of SOT-GVHD, no evidence-based guidelines or recommendations for treatment exist. Treatment includes high-dose corticosteroids and antibiotic, antifungal, and antiviral prophylaxis. Treatment of liver transplant–related GVHD with anti–tumor necrosis factor α agents has been successful. (Critical Care Nurse. 2016;36[3]:e7-e11)

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Hypoperfusion is the most common event preceding the onset of multiple organ dysfunction syndrome during trauma resuscitation. Detecting subtle changes in perfusion is crucial to ensure adequate tissue oxygenation and perfusion. Traditional methods of detecting physiological changes include measurements of blood pressure, heart rate, urine output, serum levels of lactate, mixed venous oxygen saturation, and central venous oxygen saturation. Continuous noninvasive monitoring of tissue oxygen saturation in muscle has the potential to indicate severity of shock, detect occult hypoperfusion, guide resuscitation, and be predictive of the need for interventions to prevent multiple organ dysfunction syndrome. Tissue oxygen saturation is being used in emergency departments, trauma rooms, operating rooms, and emergency medical services. Tissue oxygen saturation technology is just as effective as mixed venous oxygen saturation, central venous oxygen saturation, serum lactate, and Stewart approach with strong ion gap, yet tissue oxygen saturation assessment is also a direct, noninvasive microcirculatory measurement of oxygen saturation. (Critical Care Nurse. 2016;36[3]:12-19,70)

Alterations in tissue perfusion and oxygenation at the level of the microcirculation can contribute to the development of organ dysfunction and poor outcomes. Insufficient oxygen to meet cellular demands leads to cellular ischemia, bacterial translocation, sepsis, worsening of shock, organ dysfunction, multiple system organ failure, and death. A balance must be maintained between oxygen delivery ($D_O_2$) and oxygen consumption ($V˙O_2$) to minimize anaerobic metabolism, maintain normal metabolic processes, and meet the cellular requirements for the body. High baseline oxygen-extraction organs, such as the heart, are at high risk for ischemia if the $V˙O_2$ just meets the oxygen demand. Adequate physiological oxygen reserves need to be available in order to cope with increases in oxygen demand.
Adverse changes in oxyhemoglobin and deoxyhemoglobin levels in the peripheral tissues, such as during resuscitation in patients with hemorrhagic shock, indicate that peripheral blood flow is being redistributed to the vital organs. Hypoperfusion is the most common event preceding the onset of multiple organ dysfunction syndrome (MODS) during shock resuscitation. Detecting subtle changes in perfusion is crucial to ensure adequate tissue oxygenation and perfusion. Assessments of blood pressure, heart rate, arterial oxygen saturation, central venous pressure, blood gases, urine output, and hemoglobin concentration are used by the trauma team during resuscitation. However, normal values for these physiological parameters do not rule out tissue hypoxia or imbalances between whole-body oxygen supply and demand. As care providers, nurses must always determine if the tissue $DO_2$ is sufficient to meet the oxygen demands at the cellular level.

**Venous Oximetry**

Mixed venous oxygen saturation ($SvO_2$) is the percentage of oxygen remaining in the venous blood returning from the lower part of the body to the right side of the heart. The normal level of $SvO_2$ is approximately 75%. In general, a low or a high $SvO_2$ is critical and an early warning sign. Four main causes of low $SvO_2$ are an increase in $VO_2$, low cardiac output, arterial desaturation, and anemia. Increases in $SvO_2$ can occur if blood is being shunted without releasing its oxygen, the uptake of oxygen by the tissues is decreasing, the $DO_2$ is increasing, or the $VO_2$ is decreasing. Also, inadequate calibration and malposition of the catheter can cause an error in $SvO_2$ measurements.

Central venous oxygen saturation ($ScvO_2$) is the oxygen saturation of venous blood coming from the head and the upper part of the body. $ScvO_2$ is measured by using an invasive central venous catheter placed in the superior vena cava. The superior vena cava drains blood from the head and the upper part of the body to the heart. $ScvO_2$ does not provide an accurate estimate of preload or a measurement of contractility.

The normal cardiovascular response to an increase in $VO_2$ is to increase oxygen extraction and cardiac output. However, this mechanism has its limits. A decrease in $DO_2$ can be induced by anemia, hypoxia, hypovolemia, or heart failure. Fever, pain, and stress can also decrease $SvO_2$ or $ScvO_2$ by increasing the whole-body $VO_2$.

A decrease in $SvO_2$ and $ScvO_2$ indicates an increase in metabolic stress. A decrease in $DO_2$ due to a decrease in arterial oxygen, cardiac output, or both can cause $SvO_2$ and $ScvO_2$ to decrease. In addition, $SvO_2$ and $ScvO_2$ can decrease because $DO_2$ does not increase to cover the increased $VO_2$. Adequate measurement of tissue oxygenation by venous oximetry can occur only if the tissue is still capable of extracting oxygen. During arteriovenous shunting on the microcirculatory level or in cell death, the values of $SvO_2$ and $ScvO_2$ may not decrease or be elevated.

**Serum Levels of Lactate**

When the critical amount of $DO_2$ is decreased because the amount of oxygen extracted can no longer be increased, tissue hypoxia occurs and an increase in the serum level of lactate may ensue. Increases in the serum level of lactate and in lactate clearance are indicators of the severity of tissue hypoxia and the adequacy of resuscitation from shock. The relationship between lactate and pH exists only at higher lactate levels and therefore should be termed lactate-associated acidosis. Yet, lactate increases and base deficits also have several limitations: overresuscitation can occur because hyperlactatemia may persist for hours after anaerobic metabolism is resolved. The values of lactate and base are not continuous and could provide erroneous clinical assurance when the patient’s actual condition is deteriorating, as in shock, thus allowing less severe cases of hypoperfusion to be overlooked.

In a retrospective observational study, prehospital serum levels of lactate were assessed as a predictor of...
Lactate is a natural byproduct of glycolysis. The normal level of lactate present in the blood in unstressed patients is 0.5 to 1 mmol/L.11 Hyperlactatemia (without metabolic acidosis) is defined as a persistent, mild to moderate (2-4 mmol/L) increase in the blood level of lactate.12 Adequate tissue perfusion, intact buffering systems, and adequate tissue oxygenation can occur with hyperlactatemia or lactic acidosis (type B). Type B1 lactic acidosis is associated with systemic diseases such as diabetes mellitus, renal and liver diseases, and malignant neoplasms; type B2 is caused by alcohol (ethanol), epinephrine, thiamine deficiency, biquanides, zidovudine, salicylates, and cocaine; and type B3 is due to inborn errors of metabolism. Types B1, B2, and B3 are among the causes of lactic acidosis when tissue oxygenation is adequate. In the case of type B lactic acidosis, occult tissue hypoperfusion accompanies the primary cause.11

Stewart Approach With Strong Ion Gap

Peter Stewart’s approach to acid-base status of body fluids puts water dissociation at the center of the controversial acid-base issue.12 Mammals are approximately 60% water and follow the acid-base physiological behavior of water, such as the model of water dissociation $\text{H}_2\text{O} \leftrightarrow \text{H}^+ + \text{OH}^-$. According to the law of mass action, even a small dissociation change, such as that caused by temperature, can have a marked effect on pH.12 Stewart designates pH, bicarbonate ($\text{HCO}_3^-$), carbonate, a single anionic form (A), and hydroxide (OH) as dependent variables (passive). The 3 independent variables that are the heart of many subcellular and molecular processes: membrane acid-base transporters, the mechanism of mitochondrial oxidative phosphorylation, and the functioning of ionophores considered to facilitate proton or HCO$_3^-$ transfer along concentration gradients.12 Calculations are complex; thus, new tools are available for clinicians to enter patients’ acid-base and chemistry data online and receive online support for complex acid-base disorders.12

In a study by Gezer et al,13 the results of 409 arterial blood gas analyses of 90 patients were collected retrospectively and evaluated by using the same blood gas analyzer. HCO$_3^-$ level and the anion gap were calculated by using the Stewart method via an online tool.
addition, \( \text{HCO}_3^- \) levels, the anion gap, and the strong ion difference were calculated by using the Stewart method along with incorporating the parameters of age; serum levels of lactate, glucose, and sodium; and pH. The mean \( \text{HCO}_3^- \) level was 22.4 (SD, 7.2) mEq/L and the anion gap was 20.1 (SD, 4.1) mEq/L when the classic Henderson method was used for the calculations. When the Stewart method was used, the mean \( \text{HCO}_3^- \) level was 22.6 (SD, 7.4) mEq/L, and the anion gap was 19.9 (SD, 4.5) mEq/L. The values for all parameters used in blood gas analysis differed significantly \((P < .001)\) according to the method used for the calculations. However, a strong correlation was found between the classic method and the Stewart method for calculating the \( \text{HCO}_3^- \) level and the anion gap.\(^{13}\) Both methods could be used accurately in acid-base disorders. The Stewart method may be a more effective method for evaluating complex metabolic acidosis.\(^{13}\)

**Tissue Oxygen Monitoring Technology**

This technology is based on near-infrared spectroscopy (NIRS), an optical method of illuminating chemical compounds that absorb, reflect, and scatter light directed at the muscle tissue bed. Oxyhemoglobin, deoxyhemoglobin, and total hemoglobin concentrations in the muscle tissue bed are measured.\(^3\)

The near-infrared spectrum includes wavelengths of 700 to 1000 nm, and wave lengths of approximately 650 to 900 nm are used in the clinical application of NIRS technology.\(^3\) Visible light can penetrate tissue no deeper than 1 cm, whereas NIRS can penetrate up to 8 cm.\(^3\) The noninvasive sensor is placed on the thenar eminence (Figure 1). Wavelength analysis of 3 forms of hemoglobin (oxyhemoglobin, deoxyhemoglobin, and total hemoglobin) are the basis of the skeletal muscle tissue oxygen saturation of hemoglobin (\( \text{StO}_2 \)).\(^3\) The sensor illuminates and light scatters into the tissue of the thenar eminence (Figure 2). The light is absorbed by hemoglobin in
accordance with the oxidation state of hemoglobin. Highly oxygenated hemoglobin absorbs less light than does deoxygenated hemoglobin. The sensor then measures the amount of light returning to the spectrometer, which is calculated as $\text{StO}_2$. Unlike pulse oximetry, NIRS and $\text{StO}_2$ can be used to measure perfusion in a pulseless or hypothermic patient. Thus, NIRS is widely used in trauma and emergency departments and for patients in whom therapeutic hypothermia is being implemented.

Detecting subtle changes in perfusion, prompt investigation of the cause, and subsequent treatment may lead to less risk for MODS. The value of $\text{StO}_2$ for prediction of mortality in high-risk patients with trauma to the torso who have hemorrhagic shock was studied at 7 level I trauma centers. The sample population consisted of 383 patients who arrived within 6 hours of injury, had evidence of shock (systolic blood pressure <90 mm Hg or base deficit >6 mEq/L), and had broken bones or trauma to the torso. MODS developed in 50 of the 383 patients. All clinicians were blinded to the data obtained upon arrival and at 24 hours, along with information on other predictors of hypoperfusion. For discrimination of MODS patients, minimum $\text{StO}_2$ was similar to maximum base deficit. Sensitivity for both measures ($\text{StO}_2$ cutoff, 75%; base deficit cutoff, 6 mEq/L) was 78%. Specificity was 34% to 39%. The positive predictive value was 18% to 20%, and the negative predictive value was 88% to 91%. In the first hour, the sensitivity of minimum $\text{StO}_2$ (cutoff, 75%) was significantly greater ($P = .02$) than that of maximum base deficit (cutoff, 6 mEq/L) and significantly greater ($P = .05$) than that of minimum systolic blood pressure (cutoff, 90 mm Hg) for predicting death. The negative predictive value of minimum $\text{StO}_2$ was also significantly greater than that of maximum base deficit ($P = .01$) and minimum systolic blood pressure ($P = .04$). For prediction of mortality, minimum $\text{StO}_2$ had a greater specificity than did minimum systolic blood pressure ($P = .03$). The results indicated that NIRS-derived $\text{StO}_2$ could be used to detect patients within the first hour of arrival to the emergency department who would later experience MODS or die. Of note, $\text{StO}_2$ had the same discriminatory power as base deficit and systolic blood pressure for prediction of both MODS and mortality.

Another study of the correlation between initial $\text{StO}_2$ and the development of MODS was done in an urban, academic, level I trauma center/emergency department and met standardized criteria for activation of a trauma team. Measurement of $\text{StO}_2$ began immediately on arrival and was continued up to 24 hours for patients admitted to the trauma intensive care unit. The results of other resuscitation laboratory measurements and clinical evaluation tools were collected. Descriptive statistical analyses were performed; numeric means, multivariate regression, and rank sum comparison were used. The clinicians had no knowledge of the $\text{StO}_2$ values. A total of 78 patients were enrolled in the study during a 14-month period. The mean injury severity score was 18.5 (SD, 12.9), and 76.9% of the patients had experienced blunt trauma. MODS developed within the first 24 hours in 26 of the 78 patients (33%), who had a mean initial $\text{StO}_2$ of 53.3% (SD, 10.3). Among the non-MODS patients, the mean $\text{StO}_2$ was 61.1% (SD, 10.0%). The difference between the 2 groups was significant ($P = .002$). The mean injury severity score of 29.9 (SD, 11.5) in MODS patients was significantly higher ($P < .001$) than the score of 12.1 (SD, 9.1) in non-MODS patients. The shock index also differed significantly ($P = .001$) between the 2 groups: 0.92 (SD, 0.28) for MODS patients and 0.73 (SD, 0.19) for non-MODS patients. Serum levels of lactate did not differ significantly between the 2 groups. In this study, $\text{StO}_2$ values during initial trauma resuscitation correlated with the later development of MODS.

During active hemorrhage, the $\text{StO}_2$ value should decrease (predictive of imminent hemorrhagic shock). Although external bleeding is easily recognized, internal bleeding is not as obvious. Upon arrival at a trauma center, an initial $\text{StO}_2$ value (measured concurrently with or before vital signs) less than 65% is predictive of hemorrhagic shock, indicating a requirement for early administration of blood. $\text{StO}_2$ can be used as an early predictor of hemorrhage and may be superior to clinical assessments of blood pressure, heart rate, arterial oxygen saturation, urine output, and hemoglobin concentration that may not appear until class III/IV shock has occurred. NIRS technology also has been used by the armed forces during conflicts to detect early states of hypovolemic shock.

Macdonald and Brown used the MeSH terms near-infrared spectroscopy, sepsis, shock, tissue oxygen saturation, and microcirculation to search for relevant
literature on NIRS. They reviewed 286 articles (of which 38 were considered relevant), including 6 observational clinical studies. The published information was examined for use of NIRS at the thenar eminence of the hand. Three studies indicated that StO₂ was significantly lower in patients with severe sepsis (76%) than in healthy control patients (87%) and that the recovery slope for StO₂ was significantly lower after vascular occlusion in sepsis patients.¹⁷ In 6 studies, the mean baseline StO₂ reading was lower among patients with sepsis than among controls and lower in patients with septic shock. All 6 studies were observational and subject to reporting bias.¹⁷

Neto et al¹⁸ did a systematic review and meta-analysis of publications between 1966 and 2013 on the static and dynamic variables derived by using NIRS in patients with sepsis. The association between StO₂, reperefusion slope, occlusion slope, maximum StO₂ value minus basal StO₂ value, and prognosis in patients with severe sepsis or septic shock was evaluated. The search yielded 20 articles with 962 participants: 717 with severe sepsis or septic shock and 245 healthy control patients. Patients with sepsis had significantly lower values than did healthy controls for the following variables: mean StO₂, 78.27% (SD, 4.91%) vs 82.02% (SD, 3.57%), P = .01; reperfusion slope, 2.75% (SD, 0.63%) vs 5.19% (SD, 2.86%) per second, P = .003; and maximum StO₂ value minus basal StO₂ value, 7.86% (SD, 0.11%) vs 12.53% (SD, 2.65%), P = .01.¹⁸

In early goal-directed therapy, a component of the Surviving Sepsis Campaign, ScvO₂ monitoring is an important step. ScvO₂ monitoring is invasive and expensive.¹⁹ A study of 13 patients was performed to determine if a correlation exists between ScvO₂ and StO₂ as indicated by the Pearson correlation coefficient.¹⁹ A high correlation was detected: r = 0.91, StO₂ = 1.00, and ScvO₂ = 2.85. Bland-Altman analysis was also performed: 100% of monitored points fell within the range of the mean plus or minus 1.96 SD. The standard deviation of the difference between the StO₂ and the ScvO₂ was -7.2% to 13.2%. The results indicate that StO₂ can be used for directing clinical treatment, although further research is needed to improve precision.¹⁹

Mozina and Podbregar²⁰ studied use of NIRS for evaluating skeletal muscle StO₂ in patients with left-sided heart failure (cardiogenic shock) with or without severe sepsis, and then compared StO₂ with SvO₂. Patients with left-sided heart failure (n = 24) had lower StO₂ than did healthy volunteers: means, 58% (SD, 13%) and 84% (SD, 4%), respectively; P < .001. Correlation was good between StO₂ and SvO₂ and between SvO₂ and the plasma level of lactate. StO₂ and SvO₂ tracked well together over time, although StO₂ led to an overestimate of SvO₂, with a bias of -2.3% and a precision of 4.6%. Overestimation may be due to use of NIRS, which does not discriminate between compartments and provides a global assessment of oxygenation in all vascular compartments (arterial, venous, and capillary).²⁰ The results confirmed that skeletal muscle StO₂ values in patients with cardiogenic shock could be used for fast noninvasive estimation of SvO₂ and that the trend in the values of StO₂ can be substituted for the trend of values of SvO₂.

Data suggest that in patients in the early phase of septic shock, low StO₂ is predictive of low ScvO₂ and higher mortality rates.²⁰ However, in patients with severe sepsis and severe heart failure, the discrepancy between ScvO₂ and SvO₂ presents a clinically important difference between both variables; mean ScvO₂-SvO₂ was 72% (SD, 8), and the ScvO₂-SvO₂ difference was 9.4% (SD, 7.5).²¹ The skeletal muscle StO₂ deoxygenation rate is inversely proportional to the difference between ScvO₂ and SvO₂.²¹ Dobutamine did not influence this relationship. If ScvO₂ is used as a treatment goal, NIRS may be a useful noninvasive diagnostic method to detect patients who have normal ScvO₂ but also have a potentially abnormal low SvO₂.²¹

Research²² on muscle physiology showed the capability of noninvasive hybrid NIRS–diffuse correlation spectroscopy (DCS) for continuous monitoring of hemodynamic and metabolic parameters, including absolute blood flow, blood oxygenation, and VO₂ rate in local muscle groups during exercise. Healthy volunteers (n = 9) performed a handgrip exercise to increase blood flow and VO₂ in forearm flexor muscles while a hybrid optical probe on the skin was used to directly monitor concentrations of oxyhemoglobin, deoxyhemoglobin, and total hemoglobin; StO₂; relative blood flow, and relative VO₂ rate. The signals for relative blood flow and relative VO₂ rate were calibrated by using absolute baseline blood flow and VO₂ obtained through venous and arterial occlusions. Skeletal muscle function depends
on oxidative metabolism and blood-flow response. Mean blood flow before exercise was 1.76 mL/100 mL per minute (SE, 0.42). The mean plateau value toward the end of exercise was 8.93 mL/100 mL per minute (SE, 2.81). Mean $V_\text{O}_2$ before exercise was 0.11 (SE, 0.03) mL O$_2$/100 g per minute and the mean plateau value toward the end of exercise was 0.57 (SE, 0.13) mL O$_2$/100 g per minute. These results were consistent with previous findings in a systematic review of the literature. Because it can be used to measure blood flow, blood oxygenation, and $V_\text{O}_2$, the hybrid NIRS-DCS technology is relevant to the study of muscle physiology and pathology.  

Relevance of $St_2$ to Care Providers

Clinical manifestations of inadequate $Do_2$ might include tachycardia, tachypnea, prolonged capillary refill time, an increase in temperature, reduced level of consciousness, decreased urine output, diaphoresis, or cool extremities. Familiarity with the application of $St_2$ monitoring could lead to early detection of patients at risk for shock. $St_2$ correlated well with changes in $Do_2$, base deficit, and lactate levels in early clinical testing during active shock resuscitation. $St_2$ monitoring can also provide earlier detection of poor or altered perfusion in elderly patients. Traditionally, the elderly show nonspecific signs and symptoms. A correct diagnosis could be confounded with multiple comorbid conditions in elderly patients. Clinical settings need technology that is fast, noninvasive, and portable and provides results in real time. The NIRS-DCS device is reusable and relatively inexpensive, characteristics that make the technology accessible and affordable.

In the intensive care unit, results of $St_2$ monitoring have been encouraging. For example, during weaning from mechanical ventilation, $St_2$ monitoring could be used during a 30-minute spontaneous breathing trial to discriminate between patients in whom weaning would be successful and those in whom weaning would be unsuccessful. Thus, $St_2$ can be used as a monitoring system for detecting limited cardiovascular reserve.

A multicenter prospective cohort study was designed to identify patients at risk for MODS after trauma. Trauma patients with MODS require more resource-intensive hospitalization than do trauma patients who do not experience MODS. In intensive care, the leading causes of death are multiorgan failure, cardiovascular failure, and sepsis. Multiorgan failure has a mortality rate of 11% to 18%. The mean intensive care unit length of stay was 23 days for MODS patients and 7 days for non-MODS patients. The median hospital charges in 2007 were $312,104 for a MODS patient and $148,384 for a non-MODS patient. Early detection of shock, prompt investigation of the cause of shock, and treatment of hypoperfusion of organs facilitated by technology could have a major impact on cost-effective patient care, could improve patient outcomes, and ultimately could save lives.

Limitations and benefits of the NIRS-DCS technology should be compared with those of alternative measurement techniques (see Table). A definite advantage of the NIRS-DCS method is that it is completely noninvasive and is easier to use and more comfortable for patients than are other methods of measuring. Use of NIRS-DCS is inexpensive compared with the cost of other techniques such as positron emission tomography, perfusion magnetic resonance imaging, and $31P$-magnetic resonance spectroscopy. One concern about NIRS technology is the influence of the thickness of adipose tissue, which can sometimes distort hemodynamic measurements. Gurley et al found that up to 3 mm of adipose tissue affected the sensitivity of the NIRS-DCS signal by less than 10%. In addition, no significant correlation was found between the thickness of adipose tissue and $V_\text{O}_2$ or blood flow. A reasonable assumption is that hemodynamic measurements were not adversely influenced by skin thickness.

Conclusion

Currently, no gold standard exists for diagnosis of shock. NIRS is a noninvasive technology that has shown potential in detecting patients who are at risk for organ dysfunction and that could be used to guide resuscitation. Future research efforts, to include randomized control trials, are required to address the usefulness of $St_2$ in outcome prediction and as a target end point for initial resuscitation. The $St_2$ values could be increasingly more sensitive and specific if coupled with other “traditional” measures of organ perfusion, such as blood lactate levels, in a controlled environment such as an emergency department, a trauma department, or an intensive care unit. On the battlefield or before emergency medical transport to a

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treatment facility, $\text{StO}_2$ has proven to be portable, noninvasive, comfortable for the patient, and easy to use. $\text{StO}_2$ monitoring is becoming a valuable addition to the prognostic care of trauma patients and may be the catalysis for a shift in the management of trauma patients. CCN

Financial Disclosures
None reported.

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dotmore

### Table
Benefits and limitations of measurements used to indicate or detect shock

<table>
<thead>
<tr>
<th>Feature</th>
<th>Lactate</th>
<th>$\text{SvO}_2$</th>
<th>$\text{ScvO}_2$</th>
<th>$\text{StO}_2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct measurement of the adequacy of oxygen available to the tissue?</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Continuous measurement?</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Noninvasive?</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Predictor of bad outcome for patient?</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**Limitations?**
- Hyperlactatemia may persist for hours after anaerobic metabolism is resolved\(^\text{10}\)
- Liver disease causes decreased ability to clear lactic acid\(^\text{11}\)
- Lactate acidosis, in the absence of tissue perfusion, may occur with various causes of type B lactate acidosis\(^\text{11}\)
- Hard to measure in the field\(^\text{5}\)
- A flow-weighted mean of venous saturations from perfused vascular beds\(^\text{2}\)
- Does not reflect the adequacy of transport of oxygen in nonperfused vascular beds\(^\text{2}\)
- Does not mean all tissues are adequately oxygenated if the level is normal\(^\text{2}\)
- Adequacy of perfusion of individual vascular beds is not reflected\(^\text{2}\)
- Hard to measure in the field\(^\text{5}\)
- Central venous pressure monitoring cannot be used to measure cardiac output and does not provide reliable information on the status of pulmonary circulation in the presence of left ventricular dysfunction\(^\text{29}\)
- Hard to measure in the field\(^\text{5}\)
- Adipose tissue affects the sensitivity of signal by <10%\(^\text{22}\)

Abbreviations: $\text{ScvO}_2$, central venous oxygen saturation; $\text{SvO}_2$, mixed venous oxygen saturation; $\text{StO}_2$, skeletal muscle oxygen saturation.

References

Continued on page 70
Comparison of **Head Elevation Protocols** Following Femoral Artery Sheath Removal After Coronary Angiography

Nancy C. Olson, RN-BC, MSN

**OBJECTIVES** To compare 2 standard protocols for head elevation following removal of a femoral artery sheath after coronary angiography and their effects on bleeding complications and reported levels of back pain. One protocol involved flat supine bed rest; the other allowed progressive head elevation.

**METHODS** A prospective comparative study of 80 adult patients undergoing coronary angiography via the femoral approach. The Numeric Rating Scale was used as the measure of reported pain.

**RESULTS** No bleeding complications occurred in either group. Both groups had very low mean pain scores. Repeated-measures analysis demonstrated that the experience of pain differed significantly over time by location ($F_{5,70} = 3.864, P = .004$), with a notable decrease in pain scores more than 1 hour after sheath removal at the location that used the progressive head elevation protocol. Patients’ satisfaction scores after discharge did not differ significantly between the 2 groups. Patients with a history of chronic back pain had consistently higher pain scores, but those pain scores did not differ significantly by location (or protocol).

**CONCLUSIONS** It appears that using a progressive head-elevation protocol within the first 3 hours after diagnostic angiography is not associated with an increased risk of bleeding complications at the access site and warrants further exploration in the mitigation of back pain associated with prolonged supine bed rest. (Critical Care Nurse. 2016;36[3]:20-35)

Wide variations exist in postangiography protocols among institutions and published reports, especially for duration of bed rest and degree of head-of-bed (HOB) elevation allowed.¹² The practice of prolonged supine positioning for patients after angiography, common in many facilities’ protocols, has been based on tradition but not necessarily on evidence.³⁶ Immobilization of the affected leg after removal of a femoral artery sheath was historically assumed to be instrumental in preventing complications after angiography. Rein and colleagues⁷ noted as much in a 1995 study that was conducted under conditions similar to current practice. For a patient recovering from diagnostic angiography, an extended period of restricted bed rest can be frightening and
uncomfortable at best, as anxiety and fear for one’s own life are compounded by immobilization, creating a perception of loss of control.\textsuperscript{5} Urinary discomfort and retention are frequent complaints when patients are restricted to a recumbent position.\textsuperscript{3} At worst, supine positioning at less than 30° head elevation in some high-risk patients can lead to aspiration and impaired oxygenation, especially with the use of sedation.\textsuperscript{8} Perhaps most common among patients’ complaints, generalized back pain has been reported as a problem during the period of immobilization after removal of a femoral artery sheath.\textsuperscript{3,5,6} Pain management is a contributor to patients’ satisfaction with hospitalization, and patients’ satisfaction levels are driving many initiatives in the current competitive hospital environment. For these reasons, the restrictions on patients’ movement and positioning after angiography have been challenged in recent years. Nurses are in a position to mitigate the discomfort associated with the postangiography period, while keeping their patients safe and satisfied in the process. It is vital that these nurses have protocols that are based on valid data.

The background of the inception of this study was the acquisition of a second cardiac catheterization laboratory (CCL) by a regional health care system. Each CCL had a separate protocol regarding HOB elevation after angiography, and staff desired to know which protocol was better for the patient in terms of safety and comfort. Based on the knowledge of the characteristics of the femoral artery, and of the discomfort often associated with the postangiography experience, the idea was conceived. The purpose of this study was to compare 2 standard protocols for HOB elevation after removal of a femoral artery sheath following angiography and their effects on bleeding complications, reported levels of back pain, and patient satisfaction scores in the area of pain management.

**Review of the Literature**

The key areas reviewed in published reports include postangiography protocols, bleeding complications, and postangiography back pain. The appendices summarize the reviewed articles by the following categories.

**Postangiography Protocols on Bed Rest and HOB Elevation**

Variations in protocols for postangiography care abound in the literature, with findings inclusive of expert consensus and randomized controlled trials, some of which are dated yet valuable. The recommendations of the highly respected American College of Cardiology (ACC) regarding bed rest after removal of a femoral artery sheath leave some room for interpretation. In its most current 2012 consensus, the ACC’s recommended guidelines call for 1 to 4 hours of bed rest, depending on femoral sheath size, but offer no guidelines for HOB elevation or other positioning.\textsuperscript{9} Appendix 1 provides a summary of protocols used in studies related to bed rest and HOB elevation in postangiography patients. A specific rationale is not provided in these studies as to why certain HOB elevations or position changes were chosen, but most cite the early works of Coyne et al,\textsuperscript{10} who studied HOB elevation of 15° to 60° and/or Chair et al,\textsuperscript{11} who studied lateral repositioning after angiography.

**Postangiography Bleeding Complications**

Bleeding complications are frequently cited as a primary reason for postangiography restrictions, yet they are noted only rarely in published study findings. In descriptive studies, the most common complications found after coronary angiography were related to the access site, most commonly hematoma, followed by bleeding and pseudoaneurysm.\textsuperscript{4,17,18} Researchers in 1 of these studies found no significant patient-related or practice-related characteristics associated with these complications.\textsuperscript{4} However, in a much larger study of 1000 patients conducted in 2009, 2 characteristics of patients were found to be significantly associated with bleeding complications: elevated systolic blood pressure and female sex.\textsuperscript{19} Female sex was again isolated as a risk factor for bleeding in the study by Park et al.\textsuperscript{20}
factor for bleeding complications in a 2010 study.\textsuperscript{20}

Appendix 2 provides a summary of findings related to bleeding complications after angiography.

Published reports are inconsistent in regard to the definition of bleeding complications. Christenson’s guidelines have provided a working definition for many years, categorizing bleeding as follows: category 1, absence of bleeding; category 2, insignificant bleeding (blood loss <100 mL or hematoma ≤5 cm wide); category 3, significant bleeding (blood loss >100 mL as estimated by saturation of six 4 x 4-in [10 x 10-cm] gauze sponges or hematoma >5 cm or occluding pedal pulses);
and category 4, femoral artery thrombosis requiring intervention. These guidelines were employed by Chair et al in a 2003 study evaluating the effect of hourly position changes after angiography on vascular complications. Alternatively, researchers in a 2006 prospective study categorized bleeding as “minor” (requiring compression but not transfusion or causing instability) or “major” (causing hemodynamic instability or requiring transfusion). In the same study, hematoma is separately defined as a hard, palpable swelling, measured as small (<1 cm), medium (1-5 cm), or large (>5 cm). Ultrasound-confirmed pseudoaneurysm is also listed.
as a potential bleeding complication in that report but is not always mentioned in other reports.

Adding to the confusion of how bleeding complications are operationalized, the ACC has its own definitions of a “bleeding event.” A bleeding event after angiography is entered into the ACC database only if it results in a decrease of at least 3 g/dL in hemoglobin level (OR, 1.47; 95% CI, 0.60-3.64) and hematoma (OR, 0.82; 95% CI, 0.59-1.16) for patients remaining on bed rest longer than 6 h after cardiac catheterization; found evidence of decreased back pain with 2.5 h bed rest versus 4 h bed rest (OR, 4.54; 95% CI, 2.50-8.25). Evidence on the benefit of reducing bed rest to 2 h is inconclusive, mainly because of increased tendency of hematoma to form.

### Appendix 2

**Studies on bleeding complications after angiography.**

Abbreviations: CA, coronary angiography; NA, not available; OR, odds ratio; RCT, randomized controlled trial.
any acute drop in hemoglobin level without any obvious source after angiography is considered as bleeding at the access site.\textsuperscript{21} No consistent standard exists for measurement of bleeding, which may complicate the ability to compare bleeding across studies.

**Postangiography Back Pain**

Although it is more of an aggravation than a complication, back pain is frequently associated with the postangiography experience. Chair et al\textsuperscript{24} reported factors that were significantly associated with back pain after angiography in a secondary analysis of an earlier randomized controlled trial, including higher body weight, younger age, and lack of turning privileges. They proposed the principle of muscle disuse as a factor leading to back pain.\textsuperscript{24} In a qualitative study of coronary angiography patients by Lundén et al,\textsuperscript{5} back pain emerged as a common theme. Numerous randomized controlled trials conducted between 1994 and 2014 have consistently indicated significant differences in back pain between control groups who were immobilized and patients who were allowed changes in position (including HOB elevation) and/or earlier ambulation. These differences are statistically significant and are not necessarily clinically significant. Importantly, complications associated with these advances in mobility were not reported in any of these studies.\textsuperscript{3,6,7,10-15} In a recent randomized controlled trial,\textsuperscript{2} no significant difference in back pain ratings was found between a control group kept flat and an experimental group allowed changes in HOB elevation, although back pain was measured only in the first hour after angiography in that study. Appendix 3 provides an overview of studies specifically addressing back pain after angiography.

**Gaps in Knowledge**

From this review, we know that protocols for positioning after angiography vary widely. It is evident that bleeding complications do occur after angiography, but the absence of a standard definition makes it difficult to quantify them. It has been demonstrated that various position changes and bed rest times have been significant in reducing reports of back pain, without a significant increase in bleeding complications. What is still lacking is a standard protocol for HOB elevation, and justification for early HOB elevation as a means of reducing back pain after angiography. With this in mind, research questions to be answered were as follows:

1. Is there a significant difference in access site bleeding and hematoma between patients whose HOB is gradually elevated beginning 1 hour after femoral artery hemostasis and patients who are kept flat for 3 hours after hemostasis?

2. Is there a significant difference in reported back pain scores, and in patient satisfaction scores as related to pain management, between patients whose HOB is gradually elevated beginning 1 hour after femoral artery hemostasis and patients who are kept flat for 3 hours after hemostasis?

3. Is there a significant difference in the pain experience of patients with a history of chronic back pain between those whose HOB is gradually elevated beginning 1 hour after femoral artery hemostasis and those who are kept flat for 3 hours after hemostasis?

**Methods**

This study employed a prospective comparative design. The first protocol (at location 1, the main hospital campus) involved flat bed rest for 3 hours, with no HOB elevation. The second protocol (at location 2, the free-standing outpatient site) involved bed rest for 3 hours, with the HOB elevated to 30° after 1 hour and to 70° after 2 hours. There was no other specific rationale for employing 70° HOB elevation after 2 hours, other than the current practice at that facility. Because each CCL was functioning under its existing protocol, the current standard of care did not change in either location with this proposed study. It was decided to proceed in this manner by obtaining a nonrandomized convenience sample from each location and conducting a comparative descriptive study, rather than a randomized controlled trial.

**Sample**

The target population included all patients who were electively scheduled to undergo diagnostic coronary angiography via the femoral approach in either the main campus or outpatient CCL at a regional health care system during an 8-month period in 2011.

Because of the constraints of bed rest and sedation that would create difficulty in marking a form, the NRS was delivered verbally in this study.
This population consisted of inpatients (patients already admitted to a hospital bed at the main campus) and outpatients (patients scheduled to arrive the day of procedure, either at the main hospital campus or at the free-standing outpatient CCL). Exclusion criteria were any of the following, which would require a change in duration of bed rest, additional anticoagulation, and/or a higher level of care: emergency coronary angiography, procedures resulting in immediate catheter-based or surgical intervention, use of a vascular closure device, use of a radial or brachial artery, and periprocedural complications that resulted in admission to the cardiovascular intensive care unit. Sample sizes in the literature review varied widely, from 29 to 1000 study participants. The desired sample size for this study was calculated by assuming a moderate effect size of 0.5 with a power level of 80% and significance of .05. It was determined that a minimum of 260 participants would be ideal for this study.

**Approvals**

This proposal was submitted to the health care system’s Nursing Research and Evidence-Based Practice Council for preapproval. The institutional review board...
deemed the project exempt because of the data collection methods. All of the research assistants obtained a certificate for completion of the National Institutes of Health web-based training course “Protecting Human Research Participants.” Data were kept confidential by the primary investigator and stored in a locked cabinet for security.

**Instruments**

The data collection tools consisted of the Numeric Rating Scale (NRS) to score pain and a tool for collecting patient care information. The NRS provides interval-level data with a scale of 11 points, in which the end points represent no pain (“0”) and the worst pain imaginable (“10”). This tool can be delivered graphically by self-completion on a form, or verbally. Because of the constraints of bed rest and sedation that would create difficulty in marking a form, the NRS was delivered verbally in this study. The NRS has demonstrated validity and reliability. In a recent appraisal of pain measures for adults, it was found to have high test-retest reliability in literate ($r = 0.96$) and illiterate ($r = 0.95$) patients with rheumatoid arthritis. It was correlated highly with the Visual Analog Scale (VAS) for construct validity ($r \geq 0.86$) in patients with chronic pain.25

<table>
<thead>
<tr>
<th><strong>Outcome summary</strong></th>
<th><strong>Pain score, mean (SD)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients who were heavier ($P&lt;.001$), younger ($P&lt;.05$), and denied turning privileges ($P&lt;.01$) experienced more back pain after femoral access angiography</td>
<td>NA</td>
</tr>
<tr>
<td>Patient-reported experience during and after angiography was categorized as follows: (1) emotional, (2) bodily sensations, (3) nursing interventions, and (4) personal strategies</td>
<td>NA: qualitative study</td>
</tr>
<tr>
<td>Back pain and narcotic usage higher in control group ($P&lt;.05$) than group with HOB gradually increased from 15° to 60°</td>
<td>NA</td>
</tr>
<tr>
<td>Back pain higher in supine control group with HOB flat ($P&lt;.05$) than groups positioned on side or with HOB elevated</td>
<td>NA</td>
</tr>
<tr>
<td>Back pain higher in supine control group with affected leg immobilized ($P&lt;.001$) than group allowed hourly position changes from supine to sides; no significant difference in puncture site bleeding</td>
<td>Experimental group (SDs not available): T1 (immediately after procedure): 0.2; T2 (2 h after): 0.3; T3 (4 h after): 0.7; T4 (6 h after): 0.8; T5 (next morning): 0.75 Control group: T1: 0.4; T2: 0.75; T3: 1.3; T4: 2.2; T5: 1.75</td>
</tr>
<tr>
<td>Back pain higher in patients not allowed to change position ($P&lt;.05$) than in other groups with various position changes; no significant differences in complications among groups</td>
<td>VAS pain scores at 2, 4, 6, and 8 h compared between groups; mean (SD) of control groups ranged from 3.42 (1.22) to 8.38 (1.21); means (SD) of experimental groups ranged from 1.74 (0.74) to 3.03 (1.17)</td>
</tr>
<tr>
<td>Back pain higher in control group ($P&lt;.001$) than group allowed to move as freely in bed as permitted by a sandbag to femoral site</td>
<td>NA</td>
</tr>
<tr>
<td>Patient comfort and satisfaction higher in experimental group after 3 h ($P&lt;.001$); no significant difference in bleeding ($P=.35$) or hematoma ($P=.94$)</td>
<td>NA</td>
</tr>
<tr>
<td>Back pain lower in experimental group at release of pressure and end of bed rest time ($P&lt;.01$); no significant difference in hematoma formation</td>
<td>NA</td>
</tr>
<tr>
<td>Ambulation 4 h after procedure reduced later back pain ($P&lt;.001$) and urinary discomfort, and increased general well-being; 1 rebleed</td>
<td>NA</td>
</tr>
<tr>
<td>Only first hour after procedure was studied; no significant difference in back pain rating between group kept flat and group allowed HOB changes; no bleeding</td>
<td>NA</td>
</tr>
<tr>
<td>Back pain lower at 2, 3, and 6 h after procedure in group allowed intermittent position changes and reduction in sandbag time to femoral site ($P&lt;.001$) than control group with leg immobilized 6-24 h; no significant difference in bleeding or hematoma</td>
<td>Experimental group: 2 h: 0.52 (1.1) 3 h: 0.25 (0.80) 6 h: 0.05 (0.31) Control group: 2 h: 3.05 (2.62) 3 h: 4.02 (3.11) 6 h: 5.05 (3.11)</td>
</tr>
</tbody>
</table>
Interrater reliability was established by frequent validation of pain score measurements between the primary investigator and the 6 research assistants.

The remaining data collection tool referenced demographic, bleeding complications, HOB elevation, back pain, and patient satisfaction. Bleeding complications (also referred to as delayed bleeding) were defined as any bleeding from the access site after initial hemostasis was obtained, beyond slight oozing. For data collection purposes, complications were further delineated as severe oozing, pulsatile bleeding, or hematoma larger than 5 cm.

HOB elevation in this study was defined as elevation of the head position of the bed or stretcher, with 0° being flat supine positioning, as measured hourly by markings on the bed if available, or by a template provided to the research assistants that indicated a 30° angle. The template could be inserted between the flat (0°) base of the stretcher under the head and the portion that was elevated to guide the nurses to the accurate angle.

Back pain was operationally defined as musculoskeletal pain anywhere in the spinal region (cervical to sacral), reported by the patient after the procedure, either when asked or when the patient summoned the nurse, not associated with referred chest pain or retroperitoneal bleeding. (Back pain associated with retroperitoneal bleeding may be suspected if accompanied by signs of hemodynamic instability, such as decreasing blood pressure with increased heart rate.)

Patient satisfaction scores were defined by use of the hospital’s patient satisfaction survey tool. The measurement used for this study was a question abstracted from the Press Ganey Outpatient Services survey used during the follow-up contact after the procedure. This question provided categorical data by asking the patient to rate how well his or her overall pain was managed on a 5-point Likert-type response scale, with an answer of “very poor,” “poor,” “fair,” “good,” or “very good.” Since the Press Ganey surveys at this facility were mailed out at random, it was likely that not every study participant would receive a survey, nor would the surveys indicate patients participating in the study. To compensate for this limitation, this item of satisfaction with pain management was asked of each patient by interview the day after the procedure, either by phone call or in the patient’s hospital room. The question was worded as follows: “We asked you about your pain at intervals during your recovery. Which of these categories best describes how you felt your pain (if you had any) was managed—very poor, poor, fair, good, or very good?”

Procedure

Informed consent was obtained from patients scheduled for diagnostic coronary angiography before the procedure. When the angiography was completed, the patient was evaluated for exclusion criteria. If the patient remained a candidate for the study, the investigator initiated the data collection tool, as described in the preceding section. Recovery nurses proceeded to care for the patient according to the standard protocol for their facility, which determined the time and degree of HOB elevation, while the investigator or research assistant proceeded with data collection. The location of the patient determined which protocol was used, as each facility had its standard protocol. Location 1 indicated the group at the main hospital campus, which followed a protocol that called for 3.5 hours of bed rest with the first 3 hours flat, followed by 30 minutes with the HOB elevated 30°. Location 2 indicated the outpatient catheterization laboratory, which followed a protocol that called for 3 hours of bed rest, with the first hour flat, the second hour at 30° HOB elevation, and the third hour at 70° HOB elevation.

Initial assessment for back pain occurred when the patient arrived in the recovery area. Length of time on the procedural table was not recorded for this study or factored into bed rest time, but most diagnostic catheterizations at this facility require from 20 to 60 minutes in room time. Following the removal of the arterial sheath and subsequent hemostasis, the patients were instructed to keep the affected leg straight and their head on the pillow. They were also informed of the bed rest and HOB elevation protocol for their location. All patients were instructed on the frequency with which the groin area would be checked (every 15 minutes 4 times, then every 30 minutes 4 times), and on the need to summon a nurse immediately for any wet, warm, sticky sensation at the groin site, or new pain in any location, especially the groin.
chest, and back. If support persons were present, instructions were reviewed with them for reinforcement. At hourly intervals, each patient was asked to report a level of musculoskeletal back pain based on the NRS. Musculoskeletal back pain was also assessed at the end of bed rest time, upon discharge, and at any time during the bed-rest period when a patient self-reported pain or discomfort.

The nursing staff was instructed that if bleeding complications occurred during the monitoring period, the patient was to be treated first, and then the investigator contacted. The monitoring period extended until discharge or up to 24 hours after the sheath was removed, whichever came first. Patients who were being discharged the day of the procedure were instructed to call 911 if bleeding complications developed at home, as per the facility’s standard discharge instructions. Consistent with the definition of bleeding complications, they were taught that any bleeding beyond a slight ooze and/or any swelling greater than the size of a quarter, was to be considered an emergent complication. Patients were taught to apply pressure to the site until the arrival of medical assistance.

Once 24 hours had passed from the time of hemostasis, the patient was contacted either by phone or in the hospital room. If contacted by phone, the patient was asked to self-report bleeding complications. If the patient was seen in the hospital, the site was assessed by the primary investigator and/or the medical record was reviewed for complications. The patient was then asked about satisfaction with pain management according to the Likert-type scale described in the Instruments section. The data collection tool was then considered complete.

Analysis

Data analysis was performed by using SPSS version 19.0 statistical software (IBM SPSS). Descriptive statistics were used to summarize demographic variables. The research questions provided direction for the analysis of study data. Chi-squared analysis was used to compare incidence of bleeding complications between protocols, as well as the categorical patient satisfaction data. Repeated-measures analysis of variance was used to analyze the NRS scores across time intervals. Chi-squared analysis was further used to compare categorical data of pain severity between groups, and between patients with and without a history of chronic back pain. This study assumed a 2-tailed level of significance of .05 with a power of 80%.

Results

Sample Characteristics

The study sample was modified from the planned 260 participants down to 107, as a result of unforeseen circumstances involving the closing of the outpatient facility that used the 1-hour head elevation protocol (location 2). A total of 107 participants provided consent for the study, but that sample was reduced by the previously listed exclusion criteria, most commonly the placement of a closure device, or immediate stenting or surgical intervention, resulting in a final study sample of 80 participants. Forty participants were enrolled from each facility. Most patients were discharged the same day as the procedure (n = 72), although a few were already inpatients (n = 4), or were subsequently admitted for medical or surgical follow-up at location 1 (n = 4).

At location 1, 36 enrollees started the study as outpatients, and 4 were already inpatients at the hospital. Ninety-five percent (n = 38) of these patients spent the entire recovery period in the CCL recovery area. The other 5% (n = 2) were transferred to a room in-house and completed their bed rest recovery period on a nursing unit outside the CCL. All 40 participants at location 2 were outpatients and discharged to home after their recovery time. Both groups were similar in sex (Table 1) and age. Mean age was 71.5 (SD, 12.54) years at location 1 and 74.6 (SD, 8.63) years at location 2. Most participants reported that they had no history of chronic back pain (Table 1).

Procedural sedation was given to 72 of the patients (90%). The most common sedatives administered were a combination of midazolam and fentanyl (n = 43), or midazolam and hydromorphone (n = 22). Table 1 provides a summary of the type and frequency of sedation. The femoral artery sheath was removed in the recovery area by staff with demonstrated competency in sheath removal, and manual or mechanical compression was applied to the groin site for 20 minutes or until hemostasis occurred. Sheath sizes used were either 5 French (n = 17) or 6 French (n = 63). Four patients received intravenous analgesia in the recovery.

Comfort measures, such as positioning a pillow under the knees or in the small of the back, should not be underestimated as vital components of the patient’s recovery.
period because of complaints of back pain, and 4 received oral analgesics. Data on specific dosages were not recorded for this study but were noted in the medical record consistently and reflected standard doses for their respective areas.

**Access Site Bleeding and Hematoma**

*(Bleeding Complications)*

No reportable bleeding complications, including bleeding from the access site and hematoma, occurred in any of the 80 participants. Because no complications occurred among this sample of patients, no further statistical tests were done.

**Pain Scores**

Pain scores were compared by using a patient-reported value from 0 to 10 on the NRS. Pain was assessed at baseline (on admission), immediately after the procedure, at the time of sheath removal, hourly following sheath removal for 3 hours, and at discharge. Mean pain scores are reported at defined intervals and locations (Table 2). Because of the overall low mean pain scores, the clinical significance of the difference in these pain scores was analyzed further. The groups were broken down into

---

**Table 1** Demographic and clinical data (frequencies)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Subset</th>
<th>Whole group (N=80)</th>
<th>By location (n=40)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient’s location</td>
<td>Location 1 (36 outpatient, 4 inpatient)</td>
<td>40 (50)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Location 2 (all outpatient)</td>
<td>40 (50)</td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td>Male</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Location 1</td>
<td>40 (50)</td>
<td>21 (52)</td>
</tr>
<tr>
<td></td>
<td>Location 2</td>
<td></td>
<td>19 (48)</td>
</tr>
<tr>
<td>History of chronic back</td>
<td>Yes</td>
<td>13 (16)</td>
<td></td>
</tr>
<tr>
<td>pain</td>
<td>Location 1</td>
<td>9 (22)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Location 2</td>
<td>4 (10)</td>
<td></td>
</tr>
<tr>
<td>Sedation</td>
<td>No sedation</td>
<td>8 (10)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Location 1</td>
<td>1 (2)</td>
<td>7 (18)</td>
</tr>
<tr>
<td></td>
<td>Location 2</td>
<td>22 (28)</td>
<td>11 (28)</td>
</tr>
<tr>
<td></td>
<td>Midazolam/hydromorphone</td>
<td>43 (54)</td>
<td>21 (52)</td>
</tr>
<tr>
<td></td>
<td>Location 1</td>
<td>11 (28)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Location 2</td>
<td>22 (55)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Midazolam/fentanyl</td>
<td>7 (9)</td>
<td>7 (18)</td>
</tr>
<tr>
<td></td>
<td>Location 1</td>
<td>7 (18)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Location 2</td>
<td>0 (0)</td>
<td></td>
</tr>
<tr>
<td>Disposition</td>
<td>Discharged home</td>
<td>72 (90)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Location 1</td>
<td>32 (80)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Location 2</td>
<td>40 (100)</td>
<td></td>
</tr>
<tr>
<td>Admitted to hospital</td>
<td>(location 1 only)</td>
<td>8 (10)</td>
<td></td>
</tr>
</tbody>
</table>

**Table 2** Comparison of patients’ pain scores at defined intervals by location

<table>
<thead>
<tr>
<th>Time interval</th>
<th>Location</th>
<th>No. of patients</th>
<th>Pain score, mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline (before procedure)</td>
<td>1</td>
<td>39</td>
<td>0.18 (0.68)</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>35</td>
<td>0.80 (1.97)</td>
</tr>
<tr>
<td>1 hour after sheath removal</td>
<td>1</td>
<td>37</td>
<td>0.51 (1.26)</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>40</td>
<td>1.25 (2.26)</td>
</tr>
<tr>
<td>2 hours after sheath removal</td>
<td>1</td>
<td>39</td>
<td>1.38 (2.11)</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>40</td>
<td>0.50 (1.06)</td>
</tr>
<tr>
<td>3 hours after sheath removal</td>
<td>1</td>
<td>40</td>
<td>1.53 (2.63)</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>40</td>
<td>0.20 (0.76)</td>
</tr>
<tr>
<td>At discharge</td>
<td>1</td>
<td>35</td>
<td>0.06 (0.24)</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>40</td>
<td>0.15 (0.95)</td>
</tr>
</tbody>
</table>

*Protocol at location 1 was 3 hours flat and then 30 minutes with the head of the bed elevated 30°. Protocol at location 2 was 1 hour flat followed by 1 hour with the head of the bed elevated 30° and then 1 hour with the head of the bed elevated 70°.*
categories of patients who had minimal pain (NRS score 0-3) and those who had moderate to severe pain (NRS score 4-10) and were compared by using χ^2 analysis. Significant differences were noted between locations for those who had minimal versus moderate to severe pain at the 2-hour (χ^2 = 8.8, n = 79; P = .003) and the 3-hour (χ^2 = 7.3, n = 80; P = .01) time intervals. In both instances, a greater incidence of patients experiencing moderate to severe pain was demonstrated at location 1 (25.6% at 2 hours and 22.5% at 3 hours), which used the flat bed-rest protocol, than at location 2 (2.5% at both time intervals).

It is recognized that pain scores at each interval were not independent of one another, as each patient rated his or her pain multiple times. For this reason, a repeated-measures analysis of variance was used to compare differences in pain scores across time by location. The repeated-measures analysis demonstrated that the experience of pain differed significantly over time by location (F_{5,70} = 3.86, P = .004), with a notable decrease in pain scores following the 1-hour time point after sheath removal at location 2. This corresponds to the time point at which the HOB was raised at location 2, whereas the HOB was kept flat at location 1 (see Figure).

Data for patients with and without a history of chronic back pain were then analyzed further.

Chi-squared analysis showed no significant difference between locations in the number of participants reporting a history of chronic back pain. Table 3 describes the differences in pain scores between patients with and without a history of chronic back pain at each interval.

Although the proportion of patients with a history of chronic back pain was similar at both locations, and the NRS scores of those with chronic back pain were consistently higher than the scores of patients without chronic back pain (Table 3), the question of the potential effect of chronic back pain on the experience of pain in this study remained. An additional χ^2 analysis demonstrated that the significant differences between minimal and moderate to severe pain by location did not remain when only the relatively few patients with chronic back pain (n = 13) were considered.

**Patients’ Satisfaction Scores**

Patients’ satisfaction related to pain management was rated on a scale of 1 (very poor) to 5 (very good), and the range reported was 4 to 5. Of those patients who responded to this question on follow-up, 81% (30/37) from location 1 and 90% (35/39) from location 2 rated their satisfaction with pain management as a 5 (very good). Chi-squared analysis of the incidence of these “very good” ratings between locations demonstrated no significant difference. It is worth noting that this question regarding satisfaction was asked only on follow-up the day after discharge, whereas mean pain scores at each location were reported by time interval the day of the procedure (see Table 2).
Discussion

The results of this study hold implications for the safe management of patients’ comfort after coronary angiography. Consistent with published reports, it appears that using a progressive HOB elevation protocol within the first 3 hours after diagnostic catheterization is not associated with an increased risk of bleeding complications at the access site.7,10,14,15

Of interest, the significant differences in mean pain scores found at 2 and 3 hours after sheath removal were not found after only 1 hour. This finding is consistent with results of a recent study that measured pain scores only up to 1 hour after angiography,2 and it warrants further exploration. That study did allow HOB elevation in the first hour, whereas both groups in our study remained flat supine for 1 hour. Furthermore, pain scores differed significantly between patients with and without a history of chronic back pain at every interval except 1 hour after sheath removal. An explanation for this could be that the patient experiences relief that the procedure is over, and any sedatives administered during the procedure may still be circulating in the patient’s system, contributing to a predictable period in which the patient is relatively comfortable. Nurses may wisely choose to limit external stimulation (ie, visitors, noise, lights) of their patients during this time frame as much as possible and encourage rest. Although such interventions are appropriate throughout the entire recovery period, they may facilitate patients’ “getting through” the first hour of flat bed rest.

Correlation of sedatives with pain scores was outside the scope of this study but may warrant further research. Because patients were given sedatives (which may or may not have included an opioid analgesic) with relative consistency at both locations, and most of the procedure may still be circulating in the patient’s system, contributing to a predictable period in which the patient is relatively comfortable. Nurses may wisely choose to limit external stimulation (ie, visitors, noise, lights) of their patients during this time frame as much as possible and encourage rest. Although such interventions are appropriate throughout the entire recovery period, they may facilitate patients’ “getting through” the first hour of flat bed rest.

Particular consideration should be given to patients with a history of chronic back pain. The findings regarding patients with chronic back pain are consistent with those of Coyne et al10 and support the frequent assessment of pain during the recovery period. A detailed assessment of pain history on admission is recommended, including what medications work best for the patient. This information is also helpful to the procedural nurse and physician, who will in tandem make decisions regarding appropriate sedation during the procedure and perhaps regarding adjunctive analgesia. Explanation of the bed-rest protocol before the procedure will encourage patients with chronic pain to share any concerns about back pain, ensure that they know how to use the NRS, and allow the nurse to reassure them that every effort will be made to keep them comfortable. Comfort measures, such as positioning a pillow under the knees or in the small of the back, should not be underestimated as vital components of the patient’s recovery period.5

Patients’ satisfaction scores did not differ significantly between the 2 treatment groups. Scores were high in both areas. The patients who were discharged to home after the procedure may have been relatively pleased to be home and not in need of immediate intervention. Patients’ satisfaction levels were not measured at time of discharge. It is possible that measuring satisfaction levels at discharge would provide a more accurate reflection of the patients’ experience.

Limitations

A major limitation of this study is that the results cannot be generalized to the population of patients who have interventional cardiac procedures, because larger sheaths and more anticoagulation are used in that population. Therefore, the results reported here are limited to patients undergoing diagnostic coronary angiography.

The sample size was reduced for the reasons described earlier. Consequently, the sample size initially indicated by power analysis could not be obtained, increasing the risk of a type II error. Bleeding complications do occur, even though they did not occur in this study, and a larger sample might have provided further insight into these complications relative to HOB elevation. Furthermore, the sample size was not large enough for meaningful correlation of whether sedation (which may or may not include an analgesic) affected pain scores. However, one might anticipate that sedation, especially if it includes an
opioid analgesic, would decrease pain scores, and it is worth noting that the mean score at 1 hour after hemostasis for the patients who had no sedation at all was 1.57 (SD 2.82), compared with 0.83 (SD 1.77) for patients who had sedation. Yet overall, the group (location 2) that had more procedures done with no sedation at all (and also was allowed earlier HOB elevation) had lower mean pain scores.

A few of the patients fell outside the usual protocols. Pain scores were not recorded by data collectors at a few intervals (6 on baseline assessment, 3 at 1 hour after hemostasis, and 1 at 2 hours after hemostasis). Four of the patients were unable to be contacted for follow-up, and 2 were contacted before the 24-hour time frame for follow-up. Two had their bed rest extended to 4 hours because of their physician’s preference. All available results were included, but these variances limit the accurate analysis of the data.

A final limitation to highlight is the measurement of HOB elevation. Although guided by the template as described at the 30° angle, there was still an element of subjectivity at the 70° angle of elevation. For greater accuracy, a simple tool could be used in future studies. Peterlini et al reported that errors in estimation of the head-rest elevation were quite common, with the most common error being overestimation. The implications of the bias of overestimation in this study may limit interpretation of changes in back pain scores and potential bleeding complications. Underestimation, conversely, could expose the patient to a greater degree of flexion too early in the recovery process, although no published reports have suggested an increased risk with early flexion.

**Implications for Future Study**

Further study in this area would be enhanced by a true randomized experimental design, with a larger sample size, in which participants are assigned to groups randomly rather than by the location in which they had the procedure. Because the results of this study support certain findings of other studies done with diagnostic angiography patients, a logical next step may be to conduct research with patients who have had interventional angiography procedures, considering the use of anticoagulation and larger sheaths. The use of a protractor or goniometer would add the necessary reliability and validity to the nurses’ reporting of HOB elevation, which is crucial for expanding this knowledge base. Correlation of reported pain levels with the use of intravenous sedation and other pain medication would add valuable information on the management of back pain. Finally, it would be helpful to increase the sample of patients with chronic back pain, so that further analysis could be performed on this particular and ever-present population of patients.

Facilities reviewing their current protocols and order sets for care after angiography may find this information helpful. On the basis of the results of this study, the CCL location at our facility that had the more restrictive protocol (3 hours flat) adopted a practice change and now allows HOB elevation of 30° 1 hour after the procedure and progressive HOB elevation after 2 hours. This study lent support to the practice change in the interests of patients’ safety and comfort and may be valuable to other facilities seeking to increase patients’ safety and comfort. CCN

**Acknowledgments**
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**Financial Disclosures**
None reported.

**Letters**
Now that you’ve read the article, create or contribute to an online discussion about this topic using eLetters. Just visit www.ccnonline.org and select the article you want to comment on. In the full-text or PDF view of the article, click “Responses” in the middle column and then “Submit a response.”

**dotmore**
To learn more about head elevation, read “Head-of-Bed Elevation and Early Outcomes of Gastric Reflux, Aspiration and Pressure Ulcers: A Feasibility Study” by Schallom et al in the American Journal of Critical Care, January 2015;24:57-66. Available at www.ajcconline.org.

**References**


Comparison of Head Elevation Protocols Following Femoral Artery Sheath Removal After Coronary Angiography

Which head-of-bed (HOB) elevation after angiography protocol is better for the patient in terms of safety and comfort? The purpose of this study was to compare 2 standard protocols for HOB elevation after removal of a femoral artery sheath after angiography and their effects on bleeding complications, reported levels of back pain, and patient satisfaction scores in the area of pain management.

- This study employed a prospective comparative design. The target population included all patients who were electively scheduled to undergo diagnostic coronary angiography via the femoral approach in either the main campus or outpatient cardiac catheterization laboratory at a regional health care system during an 8-month period in 2011.

- Although it is more of an aggravation than a complication, back pain is frequently associated with the postangiography experience. Initial assessment for back pain occurred when the patient arrived in the recovery area.

- The location of the patient determined which protocol was used. Location 1 indicated the group at the main hospital campus, which followed a protocol that called for 3.5 hours of bed rest with the first 3 hours flat, followed by 30 minutes with the HOB elevated 30°. Location 2 indicated the outpatient catheterization laboratory, which followed a protocol that called for 3 hours of bed rest, with the first hour flat, the second hour at 30° HOB elevation, and the third hour at 70° HOB elevation.

- It appears that using a progressive HOB elevation protocol within the first 3 hours after diagnostic catheterization is not associated with an increased risk of bleeding complications at the access site.

- Of interest, the significant differences in mean pain scores found at 2 and 3 hours after sheath removal were not found after only 1 hour.

- The repeated-measures analysis demonstrated that the experience of pain differed significantly over time by location, with a notable decrease in pain scores following the 1-hour time point after sheath removal at location 2. This corresponds to the time point at which the HOB was raised at location 2, whereas the HOB was kept flat at location 1 (see Figure).

- Particular consideration should be given to patients with a history of chronic back pain. A detailed assessment of pain history on admission is recommended, including what medications work best for the patient.

- Explanation of the bed-rest protocol before the procedure will encourage patients to share any concerns and allow the nurse to reassure them that every effort will be made to keep them comfortable.

- Comfort measures, such as positioning a pillow under the knees or in the small of the back, should not be underestimated as vital components of the patient’s recovery period.

- Patients’ satisfaction scores did not differ significantly between the 2 treatment groups. Scores were high in both areas. CCN

![Figure](Representation of pain experience by location and across time.)

Hereditary Hemorrhagic Telangiectasia: A Primer for Critical Care Nurses

Kathleen M. Sacco, MSN, ACNP-BC, CCRN, CHPN
Thomas W. Barkley, Jr, PhD, ACNP-BC

Hereditary hemorrhagic telangiectasia is a rare, autosomal dominant genetic disease that causes abnormal growth of blood vessels and, subsequently, life-threatening arteriovenous malformations in vital organs. Epistaxis may be one of the initial clues that a patient has more serious, generalized arteriovenous malformations. Recommended treatment involves careful evaluation to determine the severity and risk of spontaneous rupture of the malformations and the management of various signs and symptoms. The disease remains undiagnosed in many patients, and health care providers may miss the diagnosis until catastrophic events happen in multiple family members. Prompt recognition of hereditary hemorrhagic telangiectasia and early intervention can halt the dangerous course of the disease. Critical care nurses can assist with early diagnosis within families with this genetic disease, thus preventing early death and disability. (Critical Care Nurse. 2016;36[3]:36-49)

Mr J, a 19-year-old man, was admitted to the critical care unit of a community hospital with an intracerebral hemorrhage. His mother, father, siblings, and extended family visited often and were attentive and concerned. After initial stabilization of his condition, a ruptured cerebral arteriovenous malformation (AVM) was diagnosed. Mr J was subsequently intubated and sedated for 12 days before he had a tracheostomy and placement of a feeding tube. During this time, the critical care nurses had a chance to become acquainted with his family. As the family was grieving about this tragic event, the nurses became aware that several other members of the family had experienced the same tragedy at similarly young ages.
Mr J continued to slowly improve. He regained consciousness and was able to have placement of a T-piece and, eventually, a speaking valve. He had residual left-sided hemiparesis, but he readily partnered with his physical and occupational therapists to decrease his deficits. A few days before his transfer to the telemetry unit, a nurse happened to mention to one of Mr J’s physicians, a pulmonologist, that the family had knowledge of 6 other family members on the father’s side who had had the same fate, and all when they were less than 29 years old. The physician agreed that the situation was unusual and proceeded to investigate. Later that day, the physician spoke with the family and asked them if anyone in the family had experienced epistaxis that seemed unusually frequent or severe. To everyone’s amazement, the patient’s father stated that he had had severe epistaxis since he was an adolescent and that his son also had frequent epistaxis. The father proceeded to explain that 2 of the father’s siblings, several cousins, and his mother and grandmother also had epistaxis. The family members had assumed it was a family trait, much like their propensity for hypertension; however, no one attributed any significance to the nosebleeds. After hearing this information, the pulmonologist asked Mr J’s father if the father or any other family members had noticed any red or pink spots on their mucous membranes or fingers. Again, the father affirmed that he had them, as did the same members who had nosebleeds. The physician examined the father and confirmed the presence of several telangiectasias on the father’s lips and tongue. At that point, the physician spoke with the family and told them that they had sufficient diagnostic criteria consistent with a somewhat rare genetic disorder called hereditary hemorrhagic telangiectasia (HHT).

Mr J was eventually transferred to the telemetry unit and subsequently entered an acute rehabilitation unit. The family was referred to a local tertiary center that specialized in HHT. The family members had genetic tests, and the diagnosis was confirmed. Most important, Mr J’s 13-year-old sister also tested positive for HHT. Because she had intermittent headaches, she had follow-up imaging, which revealed a small cerebral AVM. The tertiary HHT team, the patient, and the patient’s family agreed that watchful waiting was the best strategy for treatment. The patient was relieved that she did not need an embolization procedure and thought that the diagnosis of HHT possibly saved her from future disability or premature death. Approximately 6 months later, Mr J, his parents, and his sister visited the critical care unit to thank the nurses. The patient’s mother was tearful as she hugged the nurses and told them that because of their persistence and the physician’s astute diagnostic skills, the family had received the necessary diagnosis and counseling.

This case study underscores the important contribution of nurses in actively listening, recognizing a potentially dire circumstance, and acting as patient advocates.

HHT, also known as Osler-Weber-Rendu syndrome, is an uncommon disease, yet it has serious and sometimes deadly complications. HHT is easily underdiagnosed, a situation that places patients at increased risk for serious sequelae such as hemorrhage, brain abscesses, and stroke.

Even though the diagnosis is infrequent, patients with HHT complications often require care in critical care units, postanesthesia care units, and other general acute care units. Many family physicians may not be aware of the disease, so nurses may be the first health care providers to fit the diagnostic pieces together to help in the diagnosis. Early recognition of the presence of the disease can have major positive effects on an entire family’s well-being. The purpose of this article is to inform critical care nurses about HHT, diagnosis, treatment, and nursing considerations in caring for patients with HHT and the patients’ families.

### Background and Pathophysiology

Sir John Legg first described HHT in 1876 as a form of hemophilia with nevi and frequent epistaxis. Doctors Osler, Weber, and Rendu were physicians in the 1890s who continued Legg’s work and realized that HHT was not a clotting disorder but a blood vessel abnormality. Osler, Weber, and Rendu later identified a familial
association and continued the research. HHT is an autosomal dominant condition that causes formation of dysfunctional blood vessels and multiple AVMs in various organs of the body. According to estimates, the incidence of HHT is 1 in 5000 to 1 in 8000. The syndrome occurs globally and in all races and ethnic groups. Males and females are equally affected. The common characteristics of the disease are telangiectasias (small, red lines or dots) on the skin, especially the face, naso-oropharynx, and fingers; visceral AVMs; and epistaxis.

HHT can be divided into several genetic types. Each type has dominant features, but many features overlap between types. The pathophysiology of HHT includes gene mutations on the endoglin (ENG) gene (type 1), activin A receptorlike kinase (ALK1/ACVRL1) gene (type 2), and sometimes the SMAD4 (similar to mothers against decapentaplegic) family member genes. The SMAD4 family of genes has been identified as tumor-suppressing genes. Alterations in these genes not only contribute to HHT and neoplasms of the pancreas, head, and neck but also are associated with a syndrome called juvenile polyposis. Families with juvenile polyposis have a high risk for early colon cancer and HHT. The defective HHT genes code for proteins that mediate signaling pathways in vascular endothelial cells. The alteration in the signaling pathways causes abnormal development of blood vessels, such as dilated venules (eg, telangiectasias) and open arteriovenous channels. The current understanding is that some unknown vessel injury causes angiogenic stimulation, which results in the vessels’ inability to mature correctly.

Complications

Telangiectasias, epistaxis, and visceral AVMs are the hallmark signs of HHT. The disease is severe in some patients and extremely mild in others, even among family members who share the same mutation. Some families endure decades of sudden, tragic deaths of young children due to ruptured cerebral aneurysms before the families realize a medical condition is present. Health care providers must recognize the telltale indications of HHT and refer patients for diagnosis before a catastrophic event occurs. Historically, all HHT patients were thought to have similar life expectancies. However, recent studies have indicated that HHT patients have a significantly higher risk for dying of neurological and hemorrhagic complications than do patients without the syndrome.

This difference is especially true for patients less than 60 years old.

**Epistaxis and Telangiectasias**

Epistaxis or nosebleed, the most common sign of HHT, usually does not begin until early adolescence, often making HHT a silent disease in children. According to estimates, 95% of patients will have some degree of epistaxis by age 20 years. Some patients deal with an occasional, annoying nosebleed, whereas others have frequent, debilitating epistaxis that requires hospitalization. The severity and degree of epistaxis correlate neither with disease severity nor with the presence of visceral AVMs.

Most HHT patients also experience characteristic telangiectasias on the mouth, nose, oropharynx, face, lips, and fingers (Figures 1-3). Usually these signs manifest later in life, often developing when patients are in their 30s and 40s. The size of telangiectasias ranges from...
pinpoint to approximately 4 mm, and the abnormalities often increase in number and size over time.\textsuperscript{13}

**Systemic Effects**

**Cerebral and Spinal AVMs**

Cerebral AVMs can cause intracerebral hemorrhage and death (Figure 4). Patients with signs and symptoms of cerebral AVMs need investigation and magnetic resonance imaging to determine a treatment plan. Although approximately 10\% of HHT patients have cerebral AVMs, most cerebral malformations will never bleed and medical management is advised.\textsuperscript{14} Recent findings\textsuperscript{14} suggest that most of the neurological consequences of HHT are related to embolic events caused by pulmonary AVMs, rather than rupture of a cerebral AVM. Furthermore, although spinal AVMs occur more rarely than do cerebral malformations, HHT patients can have spinal AVMs, which are usually diagnosed during childhood.\textsuperscript{11}

**Pulmonary AVMs**

Approximately 40\% to 60\% of HHT patients are affected with pulmonary AVMs\textsuperscript{14} (Figures 5 and 6). When these AVMs are symptomatic, the most common manifestations are related to hypoxemia and dyspnea. However, pulmonary AVMs also are associated with pulmonary hypertension, heart failure, stroke, and cerebral abscesses. Other sequelae include massive hemoptysis and spontaneous hemothorax.

In the general population, 70\% of pulmonary AVMs are related to HHT.\textsuperscript{2} The diagnosis of HHT should be assumed until it is ruled out. Patients may have dyspnea, hemoptysis, or orthodeoxia (ie, decreased oxygen saturation in the upright position and improvement while lying down). Patients may also have migraines and polycythemia due to chronic hypoxemia. Additionally, migraines may be associated with the presence of pulmonary AVMs because of the passage of microthrombi and vasoactive substances from the venous system to the cerebral circulation.\textsuperscript{14} Clubbing and cyanosis are possible in severe cases of pulmonary AVMs.\textsuperscript{11}

In the normal lung circulation, the microscopic capillary vascular bed acts as a filter to trap minute particles of embolic material, clots, bacteria, and air. When a major pulmonary AVM is present (ie, \( \geq 3 \) mm), the particulate matter does not get trapped in the pulmonary vasculature; rather, it flows unimpeded to the systemic circulation in a right-to-left shunt.\textsuperscript{7} This process can cause an embolic stroke or a brain abscess, depending on the shunted material. Pulmonary AVMs can also rupture, causing hemorrhage, hemoptysis, or hemothorax. The increased blood volume during pregnancy can exacerbate pulmonary AVMs, making pre pregnancy assessment beneficial for HHT patients.
Recently, Clark et al\textsuperscript{15} found evidence that pulmonary AVMs are also implicated in angina pectoris and myocardial infarctions. The researchers found that the embolus flows to the coronary arteries, rather than to the brain, a situation that results in coronary artery occlusion. Clark et al postulated that this type of ischemic process might also affect other organs, including the gut and kidneys.

**Gastrointestinal, Hepatic, and Pancreatic AVMs**

Approximately 80% of HHT patients have gastric or small-bowel telangiectasias, but these AVMs can also form in the esophagus and colon. Gastrointestinal telangiectasias are generally asymptomatic until a patient is 50 to 60 years old, when approximately one-quarter of patients have overt gastrointestinal bleeding. The bleeding may be slow and intermittent and also may cause various degrees of anemia. Women have an incidence 2 to 3 times greater than that of men.\textsuperscript{6}

Hepatic AVMs are fairly common (Figure 7). Most patients are asymptomatic, but portal hypertension and high-output cardiac failure occur in some. Most commonly, signs and symptoms of hepatic AVMs occur late in life after the heart has been strained by years of circulating blood through the passive, low-resistance tract of a hepatic AVM while simultaneously supplying blood to the entire body. A state of continuously high cardiac output eventually causes heart failure. Other hepatic complications include biliary duct abnormalities and enlarged hepatic arteries, with or without aneurysms.\textsuperscript{16} AVMs within the hepatic parenchyma contribute to portal hypertension, cirrhosis, bile duct dilatation, and fibrosis that can lead to complete hepatic failure. Increased capabilities of computed tomography (CT) have increased the ability of clinicians to diagnose intrahepatic abnormalities sooner. Of interest in hepatic AVMs is the decreased first-pass effect that occurs in some HHT patients. The first-pass effect is defined as the initial hepatic metabolism of drugs or substances before the drugs or substances reach the systemic circulation.\textsuperscript{17} Candelli et al\textsuperscript{18} found that oral medications primarily metabolized by the liver have increased bioavailability in patients with marked HHT-related hepatic shunting. Altered drug metabolism has implications for the administration of these types of medications to HHT patients who have hepatic AVMs.

Additional rare complications can occur in HHT patients. For example, involvement of the pancreas has been detected in up to 31% of patients with HHT.\textsuperscript{16}
With the use of 64-slice CT scanners, more information than before can be obtained on the pancreas. A few patients with HHT have median arcuate ligament syndrome, another rare condition. This syndrome causes abdominal pain and a possible pulsatile abdominal mass due to compression of the celiac artery and nerves by the median arcuate ligament.19 Median arcuate ligament syndrome also usually involves multiple changes in abdominal and hepatic vasculature.

**Hematologic Dysfunction**

Bleeding telangiectasias and chronic nasal and gastrointestinal hemorrhages can contribute to blood loss and chronic anemia. In a recent study, Shovlin et al20 elucidated the association between elevated coagulation factor VIII in HHT patients and the possible increased risk for venous thromboembolism. The patients had an independently elevated factor VIII, despite the lack of recent medical intervention. In another study,21 as iron stores were depleted, patients had an associated increase in the levels of factor VIII. Elevation of coagulation proteins is an important risk factor for pulmonary embolus and deep vein thrombosis.21 This association must be considered in any determination of the best strategy for risk mitigation.

**Altered Immune Function**

A lesser-known complication of HHT involves an alteration in immune function and a propensity for severe bacterial infections. Critical care nurses must consider HHT patients at increased risk for sepsis. Guilhem et al22 found that HHT patients have an altered adaptive immunity with decreased T-cell counts, specifically CD4 and natural killer cells. Serum concentrations of immunoglobulins A and G are increased, whereas the concentration of immunoglobulin M is decreased. Patients have a greater incidence of cerebral abscesses and staphylococcal osteoarthritis than do patients without HHT; however, this difference could be attributed to either the embolic shunting related to pulmonary AVMs or to the prolonged presence of nasal packing associated with severe epistaxis.22 Of note, many HHT patients routinely take iron supplements, and researchers have hypothesized that iron is toxic to lymphocytes. The added iron increases oxidative stress, and an overarching lymphopenia results.22

In another recent study, Hosman et al23 proposed that patients with HHT might have different prevalence patterns for several solid tumor cancers than do non-HTT patients. An often cited concern is the effect of repeated exposure to radiation from frequent imaging studies. Surprisingly, compared with prevalences in the general population, prevalence in HHT patients was lower for lung cancers, higher for breast cancer, and about the same for prostate and colorectal cancers.

Last, Massarenti and Yilmaz24 described altered endothelialization in patients with HHT. In an HHT patient treated with a left atrial appendage closure device, no endothelialization had occurred after 10 months. The researchers24 postulated that HHT was involved because the lack of endothelialization of the
device was the first case noted in the literature. Much remains to be learned about the far-reaching, systemic effects of HHT.

**Diagnosis**

**Clinical Diagnostic Criteria**

According to estimates, $90\%$ of HHT-affected persons may not know they have the disease. The diagnosis can be made on the basis of several clinical signs and symptoms but can also usually be confirmed by genetic testing. Clinical diagnosis is based on the Curacao criteria, which were published as an expert consensus model in 2000. The Curacao criteria have 4 aspects: spontaneous and recurrent epistaxis, presence of telangiectasias, family history of the disease, and the presence of visceral AVMs. Of the 4 criteria, 3 must be present for a definitive diagnosis; however, patients with fewer than 3 may still have HHT. Suspected cases require genetic testing to confirm a diagnosis. The results of a more recent validation study by van Gent et al supported the Curacao criteria as having good diagnostic ability with high sensitivity and specificity.

**Genetic Testing**

Genetic testing benefits HHT patients in several ways. Signs and symptoms vary between family members, and genetic penetrance is a function of age, a factor that makes diagnosis more complicated among young patients compared with older patients. Genetic testing is valuable because the results confirm possible cases of HHT and can pinpoint the specific gene mutation causing the disease. In most persons with HHT, the causal mutation is in 1 of the 3 genes previously mentioned. Occasionally, a patient has a new mutation, and, thus, all the patient’s family members would test negative for HHT. When a patient is recognized as having HHT, both the patient and the patient’s family members are highly encouraged to seek genetic testing. The index patient receives a comprehensive DNA sequencing and deletion-duplication analysis of his or her genes. Once the mutation is discovered on the specific gene (eg, ENG, ACVRL1, or SMAD4), the successive family members need only specific testing for that gene. In a small minority of families, approximately $2\%$, HHT is caused by an unknown gene. The diagnosis can be difficult because not all genes that cause HHT have been identified. The abnormalities do not follow universal patterns, although the gene abnormalities are specific to families. Although the occurrence is extremely rare, an individual patient may have a random genetic mutation and be the only person in the patient’s family who has HHT.

Genetic testing has other beneficial results. Because many children do not manifest signs or symptoms of HHT until adolescence, genetic testing can rule out HHT early in life. Early detection not only prevents catastrophic complications but also obviates unnecessary worry, scans, testing, and the anesthetic-related risks associated with imaging in children. Current DNA tests are performed on a small sample of blood or saliva; collection of such specimens is fairly nontraumatic for younger children. The cost of initial DNA sequencing is approximately $2000. Specific analysis for the presence of a known gene ranges from $200 to $400. Many insurance plans cover the testing and hold the patient responsible for only a small sum.

Although differentiating between the genetic types of HHT is not a reason for genetic testing (the recommended treatments and screening are the same except as mentioned in the following material), differentiation can yield additional research and clinical information. Patients with type 1 HHT have a propensity for the formation of pulmonary AVMs, and patients with type 2 HHT have increased rates of hepatic AVMs. Despite these generalizations, all varieties of AVMs are associated with both clinical types. Most patients (approximately $87\%$) have HHT type 1 or type 2, and approximately $2\%$ have the SMAD4 juvenile polyposis form. The juvenile polyposis form of HHT is the only type in which knowledge of the genotype changes the screening recommendations. Patients with the juvenile polyposis form need frequent colorectal screening because of their increased risk for colon cancer. The remaining $11\%$ of patients with HHT have the more rare mutations on chromosomes 3 and 7, which cause HHT 3 and HHT 4, respectively. The mutations causing HHT 3 and HHT 4 have not been as extensively studied as the other mutations, but study of them may increase the breadth of knowledge about HHT and serve to expand the treatment modalities. HHT is almost always a heterozygous disease, and Govani and Shovlin report studies that have indicated that infants of 2 HHT parents (ie, homozygous) often die in utero.
The homozygous form is thought to be almost always lethal. Genetic testing and counseling can help stratify the risk in these rare cases.

Secondary Evaluation

Pulmonary AVM Screening

Once HHT is diagnosed, patients must be referred for further evaluation. Of note, the severity of signs and symptoms does not always correlate with the severity of the disease and rate of serious complications. Contrast echocardiography is the preferred initial screening examination. If a shunt is detected, then chest CT should be done to confirm the presence of an AVM. Patients must understand that initial screening can be accomplished by using a noninvasive, convenient test with no exposure to radiation. Additionally, if CT is required, low-dose CT scanning, with approximately 50% of the standard radiation dose, is diagnostically acceptable.14

National HHT treatment centers also offer transcranial Doppler imaging bubble studies, which are performed much as a cardiac bubble study is. In a transcranial Doppler imaging bubble study, an ultrasound probe is placed over the temporal window to “listen” for bubbles that have been injected peripherally. The presence of bubbles in the temporal window indicates that a pulmonary AVM exists and that material was shunted to the cerebral circulation. Thoracic CT and echocardiograms also allow assessment of pulmonary artery hypertension, which can be a relative contraindication for AVM treatment by embolization.20 Current international consensus guidelines25 suggest subsequent CT scanning at 5- to 10-year intervals because pulmonary AVMs are capable of growing. Pregnancy is a known factor in the evolution of pulmonary AVMs; therefore, pregnant women with HHT need careful observation.1

Neurological AVM Screening

Cerebral hemorrhage from an undiagnosed AVM can have devastating effects. Patients with HHT who are symptomatic (eg, headaches, visual change, or other neurological symptoms) should have magnetic resonance imaging.14 Older recommendations by Faughnan et al6 stated that cerebral angiography was the gold standard for detecting cerebral AVMs, but the method also was associated with a 0.5% risk for causing a permanent stroke. Recently, investigators14 have proposed that the screening strategy is best determined by an individualized approach that includes discussions between the patient and the provider of the risks and benefits related to the particular patient. Providers should remember that most neurological complications of HHT are related to embolism of clots and bacteria via shunting by pulmonary AVMs and are not caused by cerebral hemorrhage. International guidelines6 also mention the use of transcranial Doppler imaging as an additional option in assessment of cerebral AVMs. For adults in whom the presence of a cerebral AVM is excluded, no evidence indicates that new cerebral AVMs will develop as the adults grow older. Spinal AVMs are rare, and the current consensus does not recommend routine spinal screening.

Gastrointestinal Tract Screening

Although most patients with HHT have involvement of the gastrointestinal system, only one-quarter experience symptomatic bleeding, which usually occurs after middle age. An expert international panel8 has made no specific recommendations except for an annual evaluation of hemoglobin and hematocrit levels beginning at age 35 years. Any HHT patient with gastrointestinal bleeding should be referred for endoscopic visualization, just as any non-HHT patient would. HHT patients with elevated liver enzyme levels should be assessed for signs and symptoms of heart failure (eg, dyspnea, orthopnea, edema), portal hypertension (eg, variceal bleeding, ascites), biliary abnormalities (eg, jaundice, fever, abdominal pain), and hepatic encephalopathy. For these patients, simple ultrasound and abdominal CT are recommended and are highly successful for diagnosis of hepatic AVMs. Liver biopsies are strongly discouraged because of the risk for hemorrhage.6 In the small percentage of patients with the SMAD4 genetic type of HHT (ie, juvenile polyposis), early and frequent colonoscopies are recommended to detect malignant neoplasms. The first colonoscopy should be performed when the patient is 15 to 18 years old; thereafter, repeat colonoscopies should be done every 1 to 2 years.

Epistaxis Assessment

Epistaxis, although rarely life-threatening, is a serious threat to an HHT patient’s quality of life. The

Initial screening can be accomplished by using a noninvasive, convenient test with no exposure to radiation.
epistaxis screening scale was developed for objective assessment of the severity of epistaxis and the efficacy of treatment rendered within the preceding 3 months. The scale consists of 6 questions about the frequency, duration, and intensity of epistaxis; the presence of anemia; and the need for medical attention or transfusion because of epistaxis. Practitioners can use this tool to assess epistaxis severity and determine the level of treatment needed. The tool has been validated and can be accessed for free at the HHT Foundation International website.11

**Specialty Center Screening**

In addition to the interventions previously mentioned, one of the most important recommendations for evaluation of HHT patients is follow-up at an HHT Center of Excellence. These centers are associated with tertiary medical centers and are located throughout the United States, Canada, Europe, and Asia. These facilities provide comprehensive, multidisciplinary care that includes pulmonology, neurology, interventional radiology, gastroenterology, social services, insurance coordination, and genetic counseling.6 Providers at HHT Centers of Excellence also assist local practitioners in routine HHT patient management after initial evaluation at a center. Many insurance companies will cover the cost of referral but not the cost of travel. Charities, such as the National Patient Travel Center,27 can assist patients who cannot afford long-distance travel. HHT Centers of Excellence also have administrative personnel who can help arrange travel, insurance authorization, and the logistics of a 1-day evaluation.11 After the initial evaluation, most follow-up care is then accomplished locally.

**Medical Management**

Several complications of HHT, such as liver and heart failure, can be managed medically. A small risk exists that some patients with severe hepatic AVMs will eventually need a liver transplant. Treatment methods that involve manipulation of the liver, such as embolization for the lungs and cerebrum, have been largely ineffective and even harmful for HHT patients. Systemic treatment with bevacizumab, a monoclonal antibody that binds to vascular endothelial growth factor, can lead to improvement in both signs and symptoms associated with hepatic AVMs and epistaxis.14 Medical management is also offered to reduce chronic gastrointestinal bleeding. Hormonal therapy (ie, estrogen-progesterone preparations), antifibrinolytics (tranexamic acid and aminocaproic acid), antihormonal therapy (tamoxifen and raloxifene), angiogenesis inhibitors (thalidomide), and sirolimus have all been used to decrease gastrointestinal bleeding, although only weak evidence supports the use of most of them.6 Combined estrogen-progesterone oral contraceptives may be an option for women of childbearing age and may have a beneficial effect by decreasing bleeding.14 Anemia is also managed medically by administration of blood transfusions and oral iron supplements. Long-term and sufficient repletion of iron stores may obviate transfusions and the associated risks.14 The international guidelines6 do not require the avoidance of anticoagulant or antiplatelet therapy, but a careful risk-benefit assessment is encouraged.

**Epistaxis Management**

Management of epistaxis involves many therapies with various levels of efficacy. Traditional treatments such as nasal packing, argon laser treatments, or
electrochemical cautery have been the mainstays. Some patients have such severe bleeding that they have resorted to the Young nasal closure procedure, in which the nasal passages are sewn shut. However, this procedure is a last resort because it affects taste and smell. Most authorities recommend humidification of the air and lubrication of nasal passages, steps that are moderately effective in reducing the severity of bleeding. Reh et al found that a topical application of sesame-rose-geranium oil significantly decreased the frequency and severity of epistaxis.

In another study with promising results, a new use was found for thalidomide. Known for its antiangiogenic effects, thalidomide was effective in ameliorating bleeding and in increasing the hematocrit and hemoglobin levels of patients with severe, recurrent HHT-related epistaxis. Cantone et al had success in using Surgiflo (a gelatin-thrombin matrix made of sterile, absorbable porcine gelatin paste) instead of traditional packing, because Surgiflo is not known to cause the rebleeding that can occur after removal of traditional nasal packing. Treatment with estrogen and bevacinumab has been successful in small trials. Recently, study results have suggested that HHT patients have higher levels of vascular endothelial growth factor, a characteristic that could explain the patients’ increased tendencies for nasal bleeding. Riss et al recently published the findings of a small, double-blind, placebo-controlled trial in which intranasal injection of bevacinumab led to a significant decrease in epistaxis. In the ELLIPSE study, investigators examined the efficacy of topical bevacinumab (nasal spray) as an easier and less invasive treatment than systemic administration of the drug but found a lack of efficacy with the topical route. Some initial research has been done with the antioxidant N-acetylcysteine to ascertain its effect on epistaxis. In a study of 43 patients with HHT, the results suggested that the antioxidant might decrease the severity and frequency of diurnal epistaxis, but it was most effective in men.

Silva et al found that most treatments were temporary measures and that most therapies needed repetition. They also found that avoidance of fish oils and high-salicylate foods (eg, alcohol, red wine, cayenne pepper, capiscum, chocolate, coffee) was associated with a decrease in epistaxis. Lifestyle modifications may have some benefit and are without risk. Health care providers must be cognizant in assessing the airway and mucous membranes of HHT patients before anesthesia or other procedures that disturb the airway are implemented. Such measures may prevent aggravation of bleeding telangiectasias.

**Nursing Interventions**

Critical care nurses may be involved in several stages of an HHT patient’s care, whether care after a serious vascular event or after a procedure to correct one of the various vascular defects these patients experience. Nurses should know about the pathophysiology and treatment of HHT, as well as the physical and psychological ramifications for the patient and the patient’s family. Nurses should develop a care plan with interventions that support, educate, and empower the patient and the patient’s family.

**Prevention of Air Embolism**

Nurses need to aggressively protect patients from air embolism. Expert opinion suggests the use of in-line air filters on all intravenous equipment, although no empirical evidence indicates that such use is effective in preventing embolism. Nurses are cautioned to be extra diligent in preparing catheters and in teaching HHT patients to educate future caregivers on the importance of reducing the risk of air embolism. Nurses should teach patients to avoid scuba diving because of the theoretical increased risk of decompression sickness if pulmonary AVMs are present or undiagnosed.

**Antibiotic Prophylaxis and Pharmacological Considerations**

Nurses need to know that experts recommend antibiotic prophylaxis for dental and other bacteremic procedures in any HHT patients with current or previous pulmonary AVMs. Patients need education on increased risk for infection. Cerebral abscesses present a significant risk in HHT patients and the consequences are tragic. Current international guidelines recommend the American Heart Association guidelines for choice of antibiotic prophylaxis.

Nurses need to teach patients to avoid aspirin and non-steroidal anti-inflammatory agents, if possible. If needed, anticoagulants and drugs that alter platelet function may be given, but the risk and benefits associated with these agents...
should be discussed thoroughly by the health care team. Some HHT patients may have altered drug metabolism because of a decreased first-pass effect from hepatic AVMs, a situation that may decrease their need for some drugs. Nurses need to be aware of possible altered drug metabolism and to assess patients’ reactions to medications.

Flight-Related Complications

Patients with HHT and pulmonary AVMs often have low oxygen saturation and decreased hemoglobin and hematocrit levels. Traditionally, these parameters have been used to assess readiness for air travel. Mason and Shovlin, recognized experts in HHT and pulmonary medicine, found that flying is safe for most HHT patients. The researchers determined that most patients could fly without adverse events, even if the patients had abnormal oxygen saturation and anemia. The most reported adverse event was epistaxis, but even then the nosebleeding was self-limited. Because HHT patients may be at increased risk for thromboembolism, nurses should teach them the signs and symptoms of this entity. Patients should follow measures to prevent thrombus formation while on long flights.

Pregnancy-Related Concerns

In most women with HHT, pregnancies will be successful. However, data indicate that during pregnancy, women with HHT have a significantly increased mortality rate due to pulmonary AVM hemorrhage, strokes, and myocardial infarction as compared with those without HHT. Diagnosis and awareness of HHT and pulmonary AVMs before pregnancy are associated with increased survival for both mother and infant. When complications do occur, they usually arise in the second or third trimester because of the effects of the hemodynamic changes of pregnancy; namely, increased volume and cardiac output and reduced peripheral vascular resistance. Patients should be considered at high risk for complications and should be educated to immediately seek care if they have any new signs or symptoms, including hemoptysis or sudden dyspnea. If possible, screenings for pulmonary AVMs should be done before an HHT patient becomes pregnant. The only pregnant patients who need to be screened for cerebral AVMs are those with a family history of cerebral hemorrhage or cerebral symptoms. Shovlin et al also recommend that pregnant HHT patients should have magnetic resonance imaging to detect spinal AVMs, because the presence of spinal AVMs could preclude provision of epidural pain management. Last, during delivery, antibiotic prophylaxis is recommended as well as limiting a prolonged second stage of labor in women who have not had imaging to detect cerebral AVMs.

Radiation Concerns

Patients with HHT can be exposed to a high amount of radiation during their lifetimes, and this risk can be mitigated by evaluation at an experienced center where imaging techniques can be optimized. Interventional procedures, such as embolizations and diagnostic CT scans, contribute the largest amount of cumulative exposure to radiation. Measures to decrease the cumulative lifetime dose are important to protect patients’ future health. Strategies to reduce exposure include using low-dose thoracic CTs and ultrasound and magnetic resonance imaging, when appropriate, instead of abdominal CT scans. Patients can be instructed to inform health care providers that the patients have a history of multiple exposures to radiation, thus allowing patients and providers to choose imaging techniques that are the least risky.

Education and Support

Nurses need to know the available resources for HHT families. Nurses have an important role in encouraging HHT patients and the patients’ families to participate in research. Nurses can help accomplish such participation by educating patients and explaining the importance of the research, including evaluations at tertiary centers and participation in clinical trials and other studies. Patients need education and introduction to the HHT International website for resources to share with their future health care providers. Nurses can be instrumental in empowering patients to understand and advocate for the patients’ care, because many providers are not familiar with HHT. Some patients have even received erroneous, frightening diagnoses, such as pulmonary metastasis, after providers had misdiagnosed an AVM.

The severity of epistaxis can have a detrimental effect on quality of life and is associated with depression and anxiety. Nurses need to help patients cope with and lessen the psychological distress of the disease. Teaching
patients how to use the epistaxis screening scale to talk to health care providers will help the patients address threats to the quality of life.

Patients and their families may need resources to understand how to get other family members tested. Reinforcing the need to be evaluated at least once in the patient’s lifetime at an HHT Center of Excellence is imperative. Additionally, patients need support to gain control over their disease process and to realize that adherence to a treatment plan can result in a normal lifespan. Balancing information with encouragement and support is essential, especially when dealing with families who are considering diagnosis and treatment for children. The HHT Foundation can provide lists of local support groups and HHT-friendly health care providers in a patient’s area. See the Table for additional nursing interventions aimed at providing support and education to HHT families.

**Summary**

Providing care to patients and families who may have experienced a life-threatening event can be challenging, yet rewarding. HHT patients and their families require expert physical care, emotional support, and teaching to promote their future health. Critical care nurses must establish rapport and be compassionate and supportive, while simultaneously reinforcing the patient’s and the family’s coping and self-care skills. Because HHT can affect multiple family members, nurses have an excellent opportunity to facilitate a beneficial change for not only the patient, but also for the extended family. Many resources exist for the continuity of care after discharge. However, nursing skill is required to help patients and patients’ family members make the transition to the community setting and restoration of functional capacity. CCN

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**Table** Nursing interventions and considerations for patients with HHT across the lifespan

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<th>Population</th>
<th>Intervention</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>General</td>
<td>Teach patients that the worst complications of HHT can usually be prevented; most patients can live a normal lifespan after diagnosis and treatment</td>
<td>Patients have control over their disease process, and positive outcomes are related to follow-up</td>
</tr>
<tr>
<td></td>
<td>Teach patients the signs and symptoms of HHT and encourage family members to get tested</td>
<td>Reinforces positive coping skills and gives hope</td>
</tr>
<tr>
<td></td>
<td>Provide age-appropriate explanations; encourage involvement of adults important in the child’s life (teachers, coaches, friends)</td>
<td>Fosters follow-up and mitigates family tragedies, thus increasing quality of life</td>
</tr>
<tr>
<td></td>
<td>Help the child anticipate needs, such as having tissues ready for dealing with sudden epistaxis</td>
<td>Decreases the child’s stress when the child has been emotionally prepared and has the resources available</td>
</tr>
<tr>
<td>Adults</td>
<td>Encourage a visit to an HHT Center of Excellence every 5 years for follow-up</td>
<td>Ensures complete evaluation for the formation of new AVMs and complications that could otherwise be missed</td>
</tr>
<tr>
<td></td>
<td>Instruct adults to watch for and report signs and symptoms of iron deficiency</td>
<td>Reminds patients that iron deficiency can cause them to feel generally ill, possibly affecting their quality of life</td>
</tr>
<tr>
<td></td>
<td>Encourage adults to join a local support group and become involved in patient support groups, if desired</td>
<td>Can help empower an HHT patient, possibly increasing subjective quality of life</td>
</tr>
<tr>
<td>Adolescents</td>
<td>Teach this group how to handle epistaxis and strategies for explaining their condition to peers</td>
<td>Allows the adolescent a sense of control over his or her symptoms, can decrease feelings of powerlessness and encourages socialization</td>
</tr>
<tr>
<td></td>
<td>Involve teachers, coaches, and other leaders, if student agrees</td>
<td>Helps prevent shock in others at the frequency or severity of epistaxis, thus not calling attention to the teen’s situation, which can be uncomfortable for adolescents</td>
</tr>
<tr>
<td></td>
<td>Teach teens to carry a small bottle of hydrogen peroxide for use in removing blood stains from clothing during epistaxis</td>
<td>Can help decrease a teen’s stress because teens frequently can be self-conscious about personal appearance</td>
</tr>
<tr>
<td>Elderly</td>
<td>Teach geriatric HHT patients that they may have an increased risk of gastrointestinal bleeding, telangiectasias, and liver AVMs that can increase the risk of heart failure</td>
<td>Gives aging patients with HHT support and helps them adapt to their developmental level</td>
</tr>
<tr>
<td></td>
<td>Screen for depression; elderly HHT patients are at risk for depression</td>
<td>Increased symptoms, anemia, decreased oxygen saturation levels, and migraines can contribute to elderly HHT patients not feeling well, which can contribute to their risk for depression</td>
</tr>
</tbody>
</table>

Abbreviations: AVM, arteriovenous malformation; HHT, hereditary hemorrhagic telangiectasia.
Acknowledgments
The authors thank Justin McWilliams, md, director, UCLA HHT Center of Excellence, for providing photographs from his personal collection.

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Hereditary Hemorrhagic Telangiectasia: A Primer for Critical Care Nurses

Hereditary hemorrhagic telangiectasia (HHT) is a rare, autosomal dominant genetic disease that causes abnormal growth of blood vessels and, subsequently, life-threatening arteriovenous malformations (AVMs) in vital organs. Critical care nurses may be involved in several stages of an HHT patient’s care, whether care after a serious vascular event or after a procedure to correct one of the various vascular defects these patients experience. Nurses should develop a care plan with interventions that support, educate, and empower the patient and the patient’s family.

Prevention of Air Embolism

Nurses need to aggressively protect patients from air embolism. Nurses are cautioned to be extra diligent in preparing catheters and in teaching HHT patients to educate future caregivers on the importance of reducing the risk of air embolism. Nurses should teach patients to avoid scuba diving because of the theoretical increased risk of decompression sickness if pulmonary AVMs are present or undiagnosed.

Antibiotic Prophylaxis and Pharmacological Considerations

Nurses need to know that experts recommend antibiotic prophylaxis for dental and other bacteremic procedures in any HHT patients with current or previous pulmonary AVMs. Patients need education on increased risk for infection.

Nurses need to teach patients to avoid aspirin and non-steroidal anti-inflammatory agents, if possible. If needed, anticoagulants and drugs that alter platelet function may be given, but the risk and benefits should be discussed thoroughly by the health care team. Some HHT patients may have altered drug metabolism because of a decreased first-pass effect from hepatic AVMs, a situation that may decrease their need for some drugs.

Flight-Related Complications

Patients with HHT and pulmonary AVMs often have low oxygen saturation and decreased hemoglobin and hematocrit levels. Traditionally, these parameters have been used to assess readiness for air travel. Because HHT patients may be at increased risk for thromboembolism, nurses should teach them the signs and symptoms of this entity. Patients should follow measures to prevent thrombus formation while on long flights.

Pregnancy-Related Concerns

In most women with HHT, pregnancies will be successful. Diagnosis and awareness of HHT and pulmonary AVMs before pregnancy are associated with increased survival for both mother and infant. When complications do occur, they usually arise in the second or third trimester because of the effects of the hemodynamic changes of pregnancy; namely, increased volume and cardiac output and reduced peripheral vascular resistance.

Radiation Concerns

Patients with HHT can be exposed to a high amount of radiation during their lifetimes, and this risk can be mitigated by evaluation at an experienced center where imaging techniques can be optimized. Patients can be instructed to inform health care providers that the patients have a history of multiple exposures to radiation, thus allowing patients and providers to choose imaging techniques that are the least risky.

Education and Support

Nurses need to know the available resources for HHT families. Nurses have an important role in encouraging HHT patients and the patients’ families to participate in research. Nurses can help accomplish such participation by educating patients and explaining the importance of the research, including evaluations at tertiary centers and participation in clinical trials and other studies. Patients need education and introduction to the HHT International website for resources to share with their future health care providers. Nurses can be instrumental in empowering patients to understand and advocate for the patients’ care, because many providers are not familiar with HHT.
Uncontrolled hemorrhage and exsanguination are the leading cause of preventable death due to trauma. Hemorrhage, in turn, quickly leads to hypoperfusion, or “shock,” and coagulopathy. Death due to hemorrhage occurs soon after trauma, usually within the first 6 hours of hospital admission. US hospital data on trauma patients indicates that coagulopathy, which is associated with early mortality, occurs in 28% of hospital admissions. Determining which patients are at risk of shock and coagulopathy developing and applying resuscitation strategies to prevent these processes directly improve survival. In various combinations, fresh whole blood (FWB), blood component therapy (BCT), colloids, and crystalloids have all been staples of trauma care. Therefore, our aim is to review the current use of blood therapy for trauma resuscitation and the US military’s approach to FWB.
Hemorrhage Transfusion Practices

Transfusion practices for hemorrhage have evolved in the past 100 years. This transformation has included the use of FWB, which began around World War I and since has been approved by the US Food and Drug Administration, followed by modified whole blood, and the current use of BCT and crystalloid solutions. Whole blood and its components, such as platelets, fresh frozen plasma (FFP), and cryoprecipitate are cornerstones of resuscitation. For instance, whole blood transfusion was considered the most important medical advance of World War I.

When the fractionation of blood products was developed around World War II, treatment with BCT became the standard primarily because of the ease of storage and the ability to elicit specific effects (eg, packed red cells for low hematocrit). This change to component therapy occurred without robust research aimed at comparing health outcomes between FWB and BCT.

Additionally, guidelines from the Food and Drug Administration regarding blood storage are based on red blood cell (RBC) membrane integrity and adenosine triphosphate levels within the cell and not on oxygen delivery to the tissues. These concerns regarding the safety and effectiveness of transfusing older blood products as well as the lack of clinical outcomes to demonstrate the superiority or even equivalence of BCT to whole blood has resulted in a renewed interest in FWB therapy.

Blood Component Therapy

Historically, FWB was used to treat exsanguinating trauma. However, by the late 1980s, BCT became the normal practice. Component therapy is purported to reduce infectious disease transmission and improve resource utilization by tailoring blood component therapy to laboratory values. This BCT approach based on laboratory results was conveyed into the guidelines for massive transfusion. Trauma transfusion guidelines were extrapolated from the elective surgery setting, and recent publications suggest that this practice might not be best practice given the acidosis and hypercoagulability associated with hemorrhagic shock. Recent reports now indicate that use of a 1:1:1 ratio (ie, equal units of FFP, RBCs, and platelets) of component therapy, mirroring the naturally occurring physiological ratios in whole blood, leads to improved outcomes. Achieving the rapid administration of a 1:1:1 ratio is challenging for even the most experienced staff in trauma centers and all the more arduous in a mass casualty or disaster situation.

Component therapy, however, becomes a logistical challenge in austere environments, such as when blood-banking capabilities are not proximal to the hospital or basic services are markedly disrupted (eg, natural disasters). First, “cold chain” storage with precise environmental control is required regardless of distance or time. Additionally, the short shelf life of platelets (4 days) can easily cause a disruption in supply any time that minor delays in blood banking occur.

Fresh Whole Blood: Forward Deployed Settings

Transfusion of FWB in US civilian care has declined markedly since the late 1970s. The fractionation of blood into components led to precise quality control and allowed a tailored approach to resuscitation. FWB has continued, however, to be used in the US military—especially in challenging environments where collection of platelets by apheresis is impractical. Termed the “walking blood bank” (WBB), a prescreened pool of donors who are immediately available to provide blood for others is a well-established military trauma model. Every US military operation in the past 100 years has used FWB for resuscitation after hemorrhage. Table 1 lists the advantages and disadvantages of FWB transfusion. Current guidelines limit the collection and administration of FWB to situations when BCT is unavailable at a rate...
Despite these limitations, FWB remains an important factor in military trauma resuscitation. The Department of Defense Trauma Registry (DoDTR), a central repository of US military data, has been collecting statistical information on use of FWB and BCT since 2003.25 According to a DoDTR query by the authors, a total of 1607 units of FWB were used in Afghanistan from 2010 to 2013 (Figure 1). A comparison of the use of FWB and blood components (Figure 2) indicates that although FWB use is lower than RBC use from 2010 through 2013, FWB is consistently used in military trauma resuscitation.

**Fresh Whole Blood: Aircraft Carriers**

Aircraft carriers are “floating cities,” home to 5000 crew members working in a heavily industrialized environment that weighs 97,000 tons and rises 10 stories high. These are dangerous settings where planes loaded with explosive ordnance are launched and recovered day and night in all weather and sea conditions. Hazards include heavy machinery or fuel and steam pipes. The danger for crush and blast injuries, falls, burns, and countless other perils is ever present. A culture of safety helps to mitigate episodes of major trauma, and extensive medical screening reduces the incidence of preexisting conditions that could require transfusion therapy. Despite these efforts, aircraft carriers are dangerous places, and the scope of medical care is limited to a small medical team capable of performing damage control surgery and postoperative care.26

The short shelf life of platelets and blood component storage requirements that limit BCT availability for US military ground units also affect US Navy ships. In addition to the remote settings at sea, ships are always on the move, traveling thousands of miles from reliable blood banking services. The time-consuming, resource-intensive process entailed multiple flights to and from the ship, linking it with blood banking hubs in order to keep usable blood products on standby. This put aircrew and equipment in jeopardy exclusively to maintain a blood supply that was seldom used (S. Simien, oral communication, May 2014). When one considers the cost, storage challenge, risk to air crew, and diminished value of being limited to only RBCs and crystalloid, FWB becomes the only reliable, realistic, and clinically beneficial blood product option for ships at sea.

**The Walking Blood Bank**

**Indications**

The use of FWB in military settings is reserved for casualties who are anticipated to require massive...
transfusion (≥10 units RBCs in 24 hours) or have clinically significant shock despite optimal component therapy (ie, apheresis platelets and FFP). FWB may also be used when BCT will not adequately resuscitate a patient with immediate life-threatening injuries and in mass casualty scenarios when the volume of casualties will outstrip available blood inventory. The decision to activate FWB collection is a medical decision that must be made by a provider who is fully aware of both the clinical situation and current availability of blood components. During the current Afghanistan military operations, a WBB program has been established on the basis of risk assessment and predicted casualties, and that program is coordinated through a joint blood program officer.

**Forward Deployed Settings**

Planning and prescreening are the most critical elements for a successful WBB. Prescreened WBB donors are preferentially those currently on active duty, in the active reserve, or the active National Guard because these personnel are screened annually for infectious diseases. Current policy states that Coalition (multinational) forces and foreign nationals will not be routinely used as donors because of the lack of medical infrastructure and resources required to track blood recipients for 6 months.

**Aircraft Carrier Procedures**

Aircraft carriers use a volunteer WBB registry that is routinely updated by a variety of scheduled events. A typical ship in the preparation phase of deployment might solicit volunteers monthly during new arrival indoctrination and through quarterly registry events while at sea. A minimum of 300 registrants are maintained at all times by the ship’s laboratory technicians.

The ship’s senior medical officer can activate the WBB on an aircraft carrier in consultation with the ship’s surgeon. The ship’s public address system is used to request that WBB donors report to the screening location. This announcement is broadcast to all 5000 personnel on
These techniques and procedures are subject to change. Follow all manufacturers’ recommendations for screening of whole blood products for infectious agents.

**Abbreviation:** RPR, rapid plasma reagin.

### Table 2 Procedures for testing transfusions for transmissible infections

<table>
<thead>
<tr>
<th>Steps</th>
<th>EldonCard (ABO typing)</th>
<th>Oraquick HIV</th>
<th>HBV (hepatitis B virus)</th>
<th>HCV (hepatitis C virus)</th>
<th>Malaria</th>
<th>RPR (syphilis)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Blood tube</strong></td>
<td><strong>EDTA (purple) tube</strong></td>
<td><strong>Yellow tube</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Using pipette provided, add 1 drop of water on each of 4 pretreated test circles</td>
<td>Using the specimen collection loop provided, put the rounded end of the loop into the blood tube, make sure loop is completely filled</td>
<td>Using the pipette provided, collect blood from the EDTA tube</td>
<td>Using the pipette provided, collect blood from the EDTA tube</td>
<td>Draw up whole blood from the EDTA tube using a capillary tube; fill it all the way up to the capillary tube line (15 μL)</td>
<td>Using a dispensstir pipette provided, draw up serum from the yellow tube</td>
</tr>
<tr>
<td>2</td>
<td>Immediately insert the blood-filled end of the loop all the way into the vial that is in the pouch</td>
<td>Dispense 75 μL or approximately 1 drop of whole blood into the sample well of the cassette</td>
<td>Dispense 75 μL or approximately 1 drop of whole blood into the sample well of the cassette</td>
<td>Slowly apply blood from the capillary tube to cover the entire PURPLE sample pad on the right side of the device by holding the capillary tube vertically, touching the end of it to the middle of the purple sample pad</td>
<td>Squeeze dispensstir pipette vertically and directly over the first circle, allowing 1 drop to fall onto the card</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Dip each of the cupped-end Eldon stick on each test circle containing water; stir and spread blood and water to the borders of the circular fields</td>
<td>Remove the flat pad from the pouch; insert the flat pad into the vial containing the “pink” solution that has blood; result window of the flat pad should be facing toward you</td>
<td>Immediately dispense 1 free-falling drop of HBV buffer into the sample well of the cassette</td>
<td>Immediately dispense 1 free-falling drop of HCV buffer into the sample well of the cassette</td>
<td>After blood is absorbed by the pad, take reagent A and hold it vertically just below the purple pad and where the white pad is; apply 2 free-falling drops of reagent A</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Place the card onto the rotator, wait 60 seconds and read the results</td>
<td>Start timing the test and read the result after 15 minutes</td>
<td>Start timing the test and read the result after 15 minutes</td>
<td>Just before blood sample reaches the base of the white absorbent pad at the top of test strip, add 4 free-falling drops of reagent A on the top left-hand side of the test device</td>
<td>Place the card onto a mechanical rotator at 100 rpm for 8 minutes to help differentiate nonreactive from reactive results</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Test is negative if the control (C) line is present and the test (T) line is absent; it is positive if both control (C) and test (T) lines appear</td>
<td>Test is negative if the control (C) line is present and the test (T) line is absent; it is positive if both control (C) and test (T) lines appear</td>
<td>Test is negative if the control (C) line is present and the test (T) line is absent; it is positive if both control (C) and test (T) lines appear</td>
<td>Remove the adhesive liner from the right edge of the device, close it; read the results after 15 minutes</td>
<td>Reactive: Agglutination or clumping is present Nonreactive: Absence of clumping or agglutination</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviation: RPR, rapid plasma reagin.

*These techniques and procedures are subject to change. Follow all manufacturers’ recommendations for screening of whole blood products for infectious agents.*
The ship. A unit of FWB can be ready to hang within 60 minutes from the point of donor identification to conclusion of testing. ABO typing, complete blood counts, and rapid infectious disease screenings are completed in all donors before transfusion (Table 2). Critical to the success of any WBB program is training to ensure that registrants' response times will yield the FWB needed when the registrants are called upon. Aircraft carriers are required to test the notification system regularly during mass casualty training events. Arranging transport of patients begins early in the process, usually by the time the call for donors occurs.

**Military Nursing Implications**

The primary goals of patient care before, during, and after FWB infusion include proper blood typing and screenings of donors and recipients, ensuring that negative results are achieved on all rapid testing cards, and monitoring for hemolytic reactions. Obtaining and infusing FWB during a patient emergency can be a tense and chaotic experience. Coordination of phlebotomy and blood collection while simultaneously processing and interpreting test results from multiple donors carries a high risk for error. Figure 3 is a FWB flow sheet for trauma teams and nurses to use as a visual reference of the order and steps involved in FWB collection. Table 3 lists the key personnel and supplies required for each step outlined in Figure 3.

Importantly, nurses need to think independently regarding the coordination and completeness of ABO/Rh and infectious disease testing for every potential donor. Blood testing should be based on current evidence and knowledge of complications, given the blood recipient’s clinical status and the circumstances surrounding FWB donation. Nurses are in a good position to be the team leader coordinating the collection efforts and are also well suited to promptly recognize clinical complications, such as hemolytic reactions, should they occur.
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Civilian Nursing Implications

Fresh whole blood collection in the US civilian setting has declined significantly since the late 1970s. However, many circumstances can lead to a renewed need to collect FWB. The terrorist attacks in 2001 made it clear that we are living in a world filled with risk. On September 11, 2001, the Red Cross stopped blood product distribution from its regional centers and announced that it did not know how long the supply disruption would last, sending hospitals in the New York and Washington-Baltimore regions in search of new sources of blood. Hurricane Katrina, the category 3 hurricane that killed 1300 people and left thousands stranded, demonstrated how fragile our medical infrastructure is during a catastrophic emergency. In response to these events, the US Department of Health and Human Services Advisory Committee on Blood Safety recognized the need to improve the US domestic blood system. In turn, a Task Force on Domestic Disasters and Acts of Terrorism and the Centers for Disease Control now emphasize the importance of blood supply infrastructure, including the possibility of whole blood collection.
Military use of FWB has significant implications for humanitarian assistance or disaster relief personnel working far from urban centers. These difficult situations are similar in many respects. Unreliable, unsafe, or cost-prohibitive supply chains leading to an inadequate supply of blood components (as with the example of US Navy ships) would seem particularly suitable for additional research into addressing the challenges of providing transfusion options in remote or postdisaster civilian health care operations.

Conclusion

With hemorrhage remaining the leading cause of preventable death due to trauma, the use of FWB for trauma resuscitation in combat environments and aboard deployed Navy ships is a well-established practice that improves survival rates. Clinical practice guidelines for whole blood administration provide a comprehensive guide for the establishment of WBBs that are often nurse driven. These WBBs are the only source of cryoprecipitate, platelets, and plasma in austere environments credited with saving the lives of hundreds of US and Coalition service members. The use of FWB in the civilian sector is far less established because of the availability of fractionated components, which mimic whole blood when given in a 1:1:1 ratio. Access to these components requires a robust supply chain that is vulnerable to disruption via terrorist attack and natural disaster. In the event of such disruption, it may become necessary for civilian hospitals to rapidly enact an FWB program.

The merits of FWB over BCT are open for debate. What remains clear, however, is that rapid resuscitation with whole blood when given in a 1:1:1 ratio. Access to these components requires a robust supply chain that is vulnerable to disruption via terrorist attack and natural disaster. In the event of such disruption, it may become necessary for civilian hospitals to rapidly enact an FWB program.

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Acknowledgments

The views expressed are those of the authors and do not reflect the official policy or position of the US Navy, the Uniformed Services University of the Health Sciences, the Department of Defense, or the US Government.

Letters

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References

BACKGROUND  The presence of patients’ families during resuscitation has been an important practice issue. An American Association of Critical-Care Nurses (AACN) practice alert “Family Presence During Resuscitation and Invasive Procedures” supports family members of patients undergoing resuscitation being given the option of bedside presence. Parent Advocacy Group for Events of Resuscitation (PAGER) is an interdisciplinary collaborative in the pediatric intensive care unit.

OBJECTIVES  To ensure that patients’ families are provided the option of being with their child during cardiopulmonary resuscitation.

METHODS  Resuscitation data were collected for 12 months by using the AACN practice alert audit tool. The Family Nurse Caring Belief Scale was administered to 150 pediatric intensive care unit nurses. PAGER nurses received crisis education.

RESULTS  Pediatric intensive care unit nurses were supportive of providing the option of family presence during resuscitation. Family Nurse Caring Belief Scale data revealed areas for improvement in family caring practices. PAGER was implemented with positive outcomes for 2 families.

CONCLUSIONS  PAGER has improved the care of families whose children experience cardiopulmonary resuscitation and should be implemented in pediatric critical care units. PAGER nurses are prepared to serve as role models in providing family-sensitive care during crisis. (Critical Care Nurse. 2016;36[3]:58-64)

A young child is experiencing cardiopulmonary resuscitation in a pediatric intensive care unit. The parents are in a waiting room nearby. A nurse asks the care team, “May I bring the parents to the bedside?” No one from the care team replies. Again, the nurse asks, “Do you think it is time to bring the parents to the bedside?” No one from the care team replies. The family is not provided with the opportunity to be present with their child during 5 hours of resuscitation efforts, arriving at the bedside only minutes before their child dies.

~This scenario contains details that are real and fictional.

The advantages and disadvantages of family presence during resuscitation have been argued since it was first proposed in 1987. The presence of patients’ families during resuscitation is a relevant practice issue, yet it remains somewhat controversial. The acute vulnerability of the family during resuscitation has been at the core of nurses’ concerns that witnessing such an event may be detrimental rather than helpful to patients’ families. For example, if their child dies, will the parents’ happy memories of their child be overshadowed by the final images of chest compressions? Will the
sight of providers’ intense actions and the sounds of frightening medical terms and equipment negatively affect grieving? Physicians and nurses have expressed concerns about patients’ families hearing inappropriate bedside conversations that can be spawned by stress (eg, medical jargon, profanity). Additionally, providers with various degrees of experience have feared that parental presence will impede the performance of invasive procedures and resuscitation, thereby affecting the outcome for the patient. In 2000, the American Heart Association endorsed recommendations for parents to be given the option of being present during their child’s resuscitation.6 And, despite providers’ differing opinions about parental presence during resuscitation and the practical implications of offering it, parents prefer to have a choice to be with and to support their children.7,9 Currently, major evidence-based international guidelines for resuscitation support families witnessing it.4 Perhaps most importantly, family presence during resuscitation may aid in parents’ understanding that everything possible has been done to save their child’s life and foster the start of healthy coping and bereavement when resuscitation fails.4,10

Background

Patient and family-centered care (PFCC) is “an approach to care that is respectful of and responsive to the preferences, needs, and values of individual patients and their families.”11 Innovation and mutually beneficial partnerships among patients, patients’ families, and health care providers are the foundation of pediatric PFCC policy.12 Indeed, a prominent PFCC focus in pediatric critical care research and practice has been family presence during invasive procedures and cardiopulmonary resuscitation (CPR). An American Association of Critical-Care Nurses (AACN) practice alert titled “Family Presence During Resuscitation and Invasive Procedures” supports family members of all patients undergoing resuscitation being given the option of presence at the bedside.13 Furthermore, the practice alert calls for patient care units to have guidelines that reinforce family presence as an option during pediatric resuscitation.13 Understanding health care providers’ perceptions of family presence during resuscitation combined with a staff education program, a dedicated core group of providers, and guidelines have improved family presence experiences.14,15 An appraisal of the status quo in one pediatric intensive care unit (PICU) revealed opportunity for improved fulfillment of the recommendations in the evidence specific to parental presence during CPR, inclusive of the recommendations in the AACN practice alert.

Project Aims

The Parent Advocacy Group for Events of Resuscitation (PAGER) is an interdisciplinary PFCC collaborative in the PICU at Children’s Hospital of Pittsburgh University of Pittsburgh Medical Center. The primary aim of PAGER is to ensure that patients’ families are provided with the option of being with their child during CPR and are supported throughout the experience with skilled and sensitive care. Specifically, PAGER is intended to fulfill a need for critically ill children and their families during off-shifts and weekends and in situations when clinical social work resources are limited or exhausted (eg, multiple children requiring CPR during a shift with several parents in crisis). The collaborative is consistent with the hospital’s care delivery model and a critical care strategic goal to align priority initiatives with those of national nursing organizations.

Methods

Ethics

The critical care leadership team, the hospital’s evidence-based practice council, and the quality review board at Children’s Hospital of Pittsburgh approved PAGER. The critical care medicine division is apprised of the project at performance, quality, research, and safety or “PQRS” meetings.
Setting and Preliminary CPR Data

The setting is a 36-bed PICU in a university-affiliated level I trauma center. CPR data were collected for 12 months during all shifts using the audit tool from the AACN practice alert on “Family Presence During Resuscitation and Invasive Procedures.” Data revealed a total of 8 events, all of which involved CPR. One event involved both CPR and an invasive procedure (ie, initiation of extracorporeal membrane oxygenation). Families were offered the option of being present for 6 CPR events. Six of the families who were offered the choice of being present during their child’s CPR accepted. Situations varied in that 1 mother chose to leave her child’s bedside during CPR, while another mother was present at the onset of CPR and chose to stay with her child for the duration.

The 6 families who were given the option to be present during CPR had at least 1 provider to facilitate the experience. Four families were supported by a clinical social worker; 1 family had a physician facilitator; a nurse supported 1 family and another family had a physician, care coordinator, and 2 nurses as cofacilitators. The family of the child receiving extracorporeal membrane oxygenation was not offered the option of being present because of the “sterile nature of the procedure.” Another child experienced 2 CPR events and the parent was present only during the second. Audits did not explain the details of the circumstances around the lack of parental presence for this child’s first CPR event.

Evaluation

The Family Nurse Caring Belief Scale (FNCBS) was developed to measure nurses’ attitudes toward providing family-sensitive care to families who are in crisis. The premise of the FNCBS study was that nurses’ attitudes and behaviors regarding family-sensitive care in a stressful setting such as a PICU may be influenced by experts serving as role models at the bedside with subsequent reflection on nursing practice. The authors of the FNCBS tested the specific construct of family-sensitive care that was defined as “a systems perspective of nursing that is sensitive to both the unique experiences of the family and interactions between nurse and family capable of reducing family stress in a health care crisis.”

We posited that FNCBS scores would guide meaningful PAGER curriculum development.

FNCBS was pilot tested with a convenience sample of 60 PICU nurses to estimate initial content validity from a relevant population.

The FNCBS is a 25-item Likert-type instrument. Respondents indicate the degree to which they agree or disagree with each of the statements on a scale of 1 to 5. An undecided response (score of 3) is useful as it demonstrates lack of support for family-sensitive care. The possible score range is 25 to 125 with lower scores reflective of nurses who are least family-sensitive care oriented. Completion of the FNCBS takes approximately 10 minutes. The FNCBS demonstrates sound psychometric properties with a child-rearing population. Cronbach $\alpha$ was estimated at 0.81, indicating that the FNCBS has acceptable internal consistency and reflects fine discriminations in family-sensitive care construct levels. The 163 participants in the FNCBS study were representative of neonatal intensive care unit and PICU nurses who were sampled by randomization from the AACN membership list population of PICU and neonatal intensive care unit nurses in 2003.

Factor analysis revealed 4 factors: factor I (ethical caring practices), factor II (orientation to family), factor III (child advocacy), and factor IV (normalizing milieu). Some weaknesses in establishing concurrent validity related to the finding that nurses with advanced degrees in nursing had higher sum scores on the FNCBS than did nurses with a 2-year prelicensure education ($P < .05$), suggesting that nurses with higher degrees in nursing may have had more exposure to some of the complex concepts measured by the instrument.

Data Analysis

Permission to use the FNCBS was obtained from Sonja J. Meiers, RN, PhD. We sought to gain a rich understanding of the PICU nurses’ caring beliefs because the family-sensitive care construct may provide the foundation for how they think when caring for families in crisis. We posited that the evaluation of the PICU nurses’ FNCBS scores would reveal the current family caring culture and therefore guide meaningful PAGER curriculum development.

The FNCBS was administered electronically to 150 PICU staff nurses at Children’s Hospital of Pittsburgh. Nurse demographic data (eg, education level) were not collected. In the past, nurses have expressed skepticism that electronic survey data are anonymous, and we believed...
that omitting demographic data might eliminate that concern while enhancing participation. Also, we noted that Meiers and colleagues described nurses with advanced degrees as having higher FNCBS sum scores than nurses without advanced degrees when concurrent validity was established. Practically speaking, nurses with all degree types care for children who may require CPR, and the call to support a family of a child in cardiopulmonary arrest does not discriminate according to nurse education level. Forty-two percent (n = 63) of the staff nurses responded, and all 63 who responded answered all of the items. The PAGER leaders defined most oriented toward family-sensitive care as items with 90% or greater as the sum of “strongly agree and agree” or the sum of “strongly disagree and disagree” depending on whether a reverse scoring format was used for the items. Ten items (40%) had responses less than 90% as the sum of “undecided” and “strongly agree and agree” and “strongly disagree and disagree” depending on the scoring format and indicated least oriented toward family-sensitive care (Table 1).

A section at the end of the FNCBS provided for free-text comments. Qualitative data yielded the following comments from staff nurses:

We do a good job of supporting families . . . could do better with more resources and support . . . if someone could assist families with their well-being it would help everyone as a whole, including the patient.

The more the family is involved with care, the more input the family has and the more the family trusts the nurses.

**PAGER Education and Launch**

A clinical nurse leader and clinical nurse specialist serve as the PAGER innovators and leaders. They sent an electronic message to PICU staff nurses inviting those who are passionate about supporting parental presence and PFCC to participate. Those who responded formed the first PAGER (Table 2). Additionally, a critical care medicine physician who is an advocate for family presence during CPR serves as a liaison between PAGER and the critical care medicine division.

The PAGER leaders and a clinical social worker codeveloped the crisis education curriculum to prepare nurses for their role and to target the areas for improvement identified from the FNCBS data, specifically the items that revealed low scores regarding the provision of family-sensitive care (Table 3). For example, the FNCBS item “Explaining technology to the family will not increase their involvement in the child’s care” is discussed within the context of the PAGER nurse’s role. The PAGER nurse prepares the family for the sight of technology upon entering their child’s room, explains the equipment as it relates to supporting their child’s life, and assists the family with navigating the machines.
to get closer to their child to perhaps whisper “I love you” in a tiny ear. A father—an engineer by trade—who designs, tests, and calibrates technology everyday described brief explanations about equipment as “comforting.” The commonality with hospital technology and his field was something he could relate to and it was important for him to know his child was safe during CPR. Discussion of the scale item “I am not obligated to take care of the family” generates ideas about how PFCC aligns with CPR situations and how the role of the PAGER nurse supports the role of the bedside nurse. It will not be possible for PAGER nurses to serve in their role when they are the primary providers for patients receiving CPR, a key point of clarification that emerged during role-play exercises.

A hospital-wide self-defense course that is currently sponsored by the hospital police was the second part of the PAGER curriculum (Table 4). The PAGER leaders collaborated with the PICU self-scheduling committee for support with nurses’ attendance at the classes. All of the nurses described the education as valuable. They reported feeling better prepared to offer families the option of being present during their child’s CPR and possessing a clear understanding of balancing the PAGER role and their usual responsibilities. Specifically, nurses appreciated a “fresh look into” or understanding of the family process during CPR events.

### Table 3

**Parent Advocacy Group for Events of Resuscitation (PAGER) curriculum, part 1: “Assisting Families During a Medical Crisis”**

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objectives</td>
<td>The learner will: 1. Review the meaning of the data from the Family Nurse Caring Belief Scale 2. Define the state of “crisis” 3. List 1 characteristic of each of the 3 crisis stages; 4. Describe 2 major tasks of crisis intervention theory; 5. Model 1 style of communication for each task (cognitive, emotional, problem solving); 6. Describe how a family’s coping style may be supported by using crisis intervention theory 7. Describe individualization of families’ coping styles within the context of intervention</td>
</tr>
<tr>
<td>Didactic content</td>
<td>American Association of Critical-Care Nurses practice alert “Family Presence During Resuscitation and Invasive Procedures” Crisis intervention theory Resource management</td>
</tr>
<tr>
<td>Role play</td>
<td>The clinical social worker creates scenarios; the learners enact roles of a parent and a PAGER nurse in a simulated family waiting area; The leaders and clinical social worker provide verbal feedback and lead discussion about how the roles felt for the learners; The learners identify positive aspects of role play and opportunities for improvement (eg, body language, communication style)</td>
</tr>
<tr>
<td>Duration</td>
<td>2 h</td>
</tr>
</tbody>
</table>

### Table 4

**Parent Advocacy Group for Events of Resuscitation (PAGER) curriculum, part 2: “Comprehensive Crisis Management”**

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Didactic content</td>
<td>Communication techniques Anxiety Verbal intervention goals Stress management resources for staff</td>
</tr>
<tr>
<td>Role play</td>
<td>Defensive tactics instruction</td>
</tr>
<tr>
<td>Duration</td>
<td>8 h</td>
</tr>
</tbody>
</table>
facilitating parental presence during CPR events that were prolonged and particularly tragic. The nurses each wrote and distributed an electronic summary of their respective experiences to the PICU staff, reflecting on challenges and emphasizing positive feedback from their peers and the affected families. Physician and nurse leaders responded to the electronic summaries with additional comments that contained themes of serving as role models, compassion, teamwork, and dedication. The consensus for both events was (1) family presence did not impede the workflow of the providers and (2) families appreciated the option of being present with their child.

We admitted a child who quickly decompensated. The family was present at the bedside and we facilitated them staying during their daughter’s 6 hour-long resuscitation. We included the family in her care. When chest compressions began, we brought the family in closely, helping them lie with their child until we stopped compressions and she died. I believe the family needed that moment... they appreciated the opportunity to say goodbye while their daughter was still alive and to see that everything possible was done for her.

Discussion

A staff nurse is responsible for specific PAGER work items, and they count toward the nurse’s professional advancement project. For example, the nurse developed the first evidence-based PICU guideline for family presence during CPR at Children’s Hospital of Pittsburgh. The guideline—an adaptation of one currently used in the hospital’s emergency department—is available on the PICU’s shared drive and in bedside reference binders. It includes (1) a brief review of the number of family members recommended in the child’s room during CPR, (2) the process for directing questions and concerns to the most appropriate provider, (3) the process for assessing the family’s coping, (4) the process for assessing family behaviors and how they may affect medical care of the child, and (5) elements recommended by Curley and colleagues regarding the responsibilities of PAGER members as parental presence facilitators.

The clinical nurse director of critical care has recommended an increased number of PAGER nurses in the PICU and the expansion of PAGER to the neonatal and cardiac intensive care units as goals. The PAGER leaders will share current evidence with the PAGER nurses and facilitate continuing education and research opportunities (eg, participation in relevant studies that are marketed in AACN publications such as Critical Care eNewsline). PAGER nurses’ responsibilities and compliance will be evaluated annually through 1-on-1 discussions with PAGER leaders and critical care medicine physicians, annual performance reviews, and audit data. The PAGER leaders may consider administering the FNCBS again with some periodicity to ensure that the culture of the PICU staff remains aligned with this vital PFCC care initiative.

Currently, there are sporadic debriefing sessions for PICU staff following the death of patients, but there is no process in place for debriefing that is specific to PAGER nurses and their role experiences—including situations wherein children survive CPR. We plan to seek input from the PAGER nurses as to whether debriefing about their role would be beneficial. If they believe it would, we will collaborate with them to provide the best way to accomplish PAGER role debriefing.

Based on the results of the FNCBS data and CPR audits, the culture of the PICU staff was generally supportive of providing the option of family presence during CPR, yet data revealed areas of nurse caring that could improve. Early implementation of the PAGER role has met with positive outcomes for families and staff. Currently, PAGER implementation is limited to when patients require CPR alone or in combination with invasive procedures. Efforts to improve parental presence during invasive procedures when CPR is not performed may be undertaken in the future.

Nurses typically learn about ethics- and culture-related topics via traditional education methods (eg, new employee...
orientation classes, web-based tutorials). Although these are efficient and adequate venues to deliver required didactic content for large numbers of individuals, role modeling is a more powerful means to achieve and sustain culture change. Beyond facilitating family presence during resuscitation, PAGER nurses are uniquely positioned to model PFCC and care that is reflective of the factors born out of the FNCBS analysis during times of family crisis in a PICU: ethical caring, orientation to the family, child advocacy, and normalization of the environment. Supporting family presence during CPR preserves parental roles relative to the care they would normally provide to their child during times of wellness. If a family cannot get close to the bedside initially, simply holding a hand or stroking a foot and telling their child, “Mommy and Daddy are here” can be extremely important. Families may retain a sense of control when they would be deprived of it otherwise. Changing diapers, repositioning, wiping tears, and kissing a cheek are examples of nurturing behaviors that may help a family feel like they are still caring for their child during a terrifying and uncertain time when they believe they have nothing else to offer.

When a family is present at the bedside during CPR, the care team may gain a deeper appreciation for the meaning of the crisis and its impact on the family unit. Recommendations from the critical care medicine division are that a formal and deliberate effort be made by PAGER nurses to announce when the family has arrived to the bedside so sensitive care is enhanced and to create a culture shift from permission to a diligent expectation.

Conclusion
Technology in a PICU is overwhelming to families on a daily basis let alone during resuscitation events. PAGER nurses are prepared to explain complex technology to families who are stressed, thereby enabling them to feel comfortable being near their child during CPR and, if necessary, to be empowered to make difficult decisions about stopping lifesaving efforts. During times when CPR is futile, PAGER nurses may play a crucial role in a family’s grieving process that begins at the pivotal time when the family is united with their child—if that is their choice—and the child, the child’s family, and the care team experience the crisis of resuscitation together.

Acknowledgments
The authors thank CCRN-certified nurses Becca Lavezoli, Cheri Cigna, Kylie Kostie, Nicole May, Abby Mysels, Karla Persia, and Alicia Duss; Gwen Harcar, ucv, and Joseph Carcillo, sm, for their compassionate dedication at a vulnerable and frightening time in the lives of children and their families. Thank you to Officer Glenn Kopp and Sergeant Keith Kulwik.

Financial Disclosures
None reported.

References
The cases, and the process used in the book to teach diagnostic reasoning, are perfect to use in virtual simulations for my students across the state!

—Tonja Hartjes, DNP, ACNP-BC, CCRN, CSC / University of Florida College of Nursing
Certification Test Prep

Critical Care Nurses Cannot “Phone It In”

In this highly technical, cyberspace/cloud-driven world in which we now live, human interaction is minimized and sometimes completely eliminated. Many professionals have no face-to-face contact with their clients, colleagues, or the community in which they serve. Critical care nursing is a notable exception to this modern trend. Nurses cannot “phone it in.” To skillfully navigate the seven Cs of certified practice (competence, critical thinking, collaboration, consultation, communication, continuity, compassion), we must be truly present, persistent, professional, and passionate. The waters are unpredictable, and truly being present is essential.

Reference

Adult CCRN Practice Questions

1. A patient with multisystem organ dysfunction has an acute kidney injury. The central venous pressure is 16 cm H2O, and the patient is receiving a norepinephrine infusion. What therapy should the nurse anticipate for this patient?
   A. Hemodialysis
   B. Continuous renal replacement therapy (CRRT)
   C. Peritoneal dialysis
   D. Kidney transplant

2. Nursing care for a patient with an intraventricular catheter open to drain cerebrospinal fluid includes leveling the transducer at or above the
   A. Phlebostatic axis, opening the transducer to obtain the intracranial pressure reading, and noting the cerebrospinal fluid volume hourly
   B. Foramen of Munro, opening the transducer to obtain the intracranial pressure reading, and noting the cerebrospinal fluid volume hourly
   C. Phlebostatic axis, closing the transducer to obtain the intracranial pressure reading, and noting the cerebrospinal fluid volume hourly
   D. Foramen of Munro, closing the transducer to obtain the intracranial pressure reading, and noting the cerebrospinal fluid volume hourly

Contributors

Carol Rauen, RN-BC, MS, CCRN, PCCN, CEN, the department editor, is an independent clinical nurse specialist in The Outer Banks of North Carolina and a staff nurse in the burn trauma intensive care unit at Sentara Norfolk General Hospital in Virginia. She wrote adult CCRN question 5. Carol welcomes feedback from readers and practice questions from potential contributors at rauen.carol104@gmail.com.

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Reference
end-expiratory pressure (PEEP), which of the following findings indicate that he is tolerating a spontaneous breathing trial?

A. Tidal volume of 200 mL, respiratory rate of 16/min
B. Tidal volume of 300 mL, respiratory rate of 20/min
C. Tidal volume of 450 mL, respiratory rate of 26/min
D. Tidal volume of 550 mL, respiratory rate of 30/min

Test plan topic: Pulmonary, 17% of the CCRN questions

4. A patient with a temporary transvenous pacemaker has the following rhythm

![Heart Rhythm Image]

A. This is failure to pace; check the wire for fracture
B. This is failure to capture; check the battery for failure
C. This is oversensing; decrease the sensitivity
D. This is undersensing; increase the sensitivity

Test plan topic: Cardiovascular, 18% of the CCRN questions

5. When performing a pulmonary assessment on a nonintubated bariatric patient, the critical care nurse must remember that

A. Hypoventilation syndrome is common
B. Auscultating crackles is common
C. Obstructive sleep apnea is uncommon
D. Respiratory alkalosis is uncommon

Test plan topic: Multisystem, 14% of the CCRN questions

Correct Answers and Rationales for Adult CCRN Practice Questions

1. Correct Answer: B
Rationale

Continuous renal replacement therapy (B) removes small amounts of volume from a patient to prevent labile hemodynamics related to fluid shifts. Patients requiring hemodynamic support from vasopressors might not be able to tolerate hemodialysis (A) or peritoneal dialysis (C) because of the large fluid shifts associated with those therapies. Kidney transplant (D) is not an option until the patient has recovered from the acute event and chronic kidney disease has been diagnosed.

Source

2. Correct Answer: D
Rationale

Intraventricular catheters need to leveled at or above the foramen of Munro, not the phlebostatic axis (A). When an intraventricular catheter is ordered to be open to drain, the transducer must be closed to obtain the intracranial pressure (B). Cerebrospinal fluid volume should be assessed every hour (C).

Source

3. Correct Answer: C
Rationale

Predictors of a successful spontaneous breathing trial are a spontaneous tidal volume greater than 5 mL/kg and a spontaneous respiratory rate equal or less than 30/min. For a 70-kg patient, the spontaneous tidal volume should be at least 350 mL. The tidal volume is too low for adequate ventilation for answers (A) and (D). Answer (B) has adequate tidal volume but the respiratory rate is too high.

Source

4. Correct Answer: D
Rationale

Undersensing (D) occurs when the pacemaker fails to sense the QRS complex appropriately. The device fails to detect existing cardiac depolarizations and therefore competes with the native rhythm. Oversensing (C) occurs when the pacemaker detects noncardiac events and interprets them as cardiac depolarizations. Failure to pace (A) is evident when there are no spikes at appropriate times. Failure to capture (B) occurs when the pacemaker spikes are visible in appropriate locations, but no pacer-generated QRS complex follows.
5. Correct Answer: A

Rationale

The pulmonary changes that accompany morbid obesity include increased incidence of hypoventilation syndrome (which could lead to hypoxia and respiratory acidosis), increased incidence of obstructive sleep apnea, increased work of breathing, increased oxygen demand, pulmonary hypertension, and increased afterload on the right ventricle.

Source


Pediatric CCRN Practice Questions

1. A toddler who has ingested “multiple tablets of her grandfather’s medication” is awake, alert, and agitated. The pupils measure 5 mm bilaterally and react briskly to light, mucous membranes appear dry, and skin is warm to touch and flushed. Axillary temperature is 38.4°C, heart rate (HR) is 152/min, blood pressure (BP) is 101/72 mm Hg, and respiratory rate (RR) is 27/min. Based on this assessment, the patient’s symptoms are most likely caused by what classification of medication overdose?
   A. Cholinergic
   B. Anticholinergic
   C. Opioid
   D. Sympathomimetic

Test plan topic: Multisystem, 14% of the pediatric CCRN questions

2. A 5-year-old with acute lymphoblastic leukemia reports abdominal pain, vomiting, and dysuria approximately 12 hours after receiving induction chemotherapy. Abnormal laboratory findings include potassium 6.4 mEq/L, phosphate 10.5 mg/dL, calcium 4.2 mg/dL, and uric acid 12.0 mg/dL. These findings are indicative of which of the following?

A. Urinary tract obstruction
B. Dehydration
C. Tumor lysis syndrome
D. Chemotherapy-induced nephrotoxic effects

Test plan topic: Hematologic with Endocrine, GI, Renal, and Integumentary, 19% of the pediatric CCRN questions

3. A 9-year-old receiving plasmapheresis reports new onset of leg cramps and tingling of hands and feet. These symptoms are most likely related to which of the following?

A. Hypophosphatemia
B. Hypokalemia
C. Hyperkalemia
D. Hypocalcemia

Test plan topic: Renal with Endocrine, Hematologic, GI, and Integumentary, 19% of the pediatric CCRN questions

4. A child has progressive respiratory distress with coughing, inspiratory stridor, and anxiety after consuming a brownie. The appropriate initial response is to

A. Perform a blind finger sweep to dislodge a potential foreign body
B. Administer abdominal thrusts
C. Administer back slaps
D. Call for help; allow the child to continue coughing

Test plan topic: Pulmonary, 16% of the pediatric CCRN questions

5. In addition to maintaining the head of the bed positioned at 30° to 45°, what additional care component should be performed to decrease ventilator-associated pneumonia in adults and children?

A. Daily interruption of sedation and assessment of extubation readiness
B. Scheduled complete blood cell count (CBC) with differential and bronchial washings
C. Change in mechanical ventilation circuit every 3 days
D. Scheduled endotracheal suctioning

Test plan topic: Multisystem, 14% of the pediatric CCRN questions
Correct Answers and Rationales for Pediatric CCRN Practice Questions

1. Correct Answer: B

Rationale
The association of a constellation of findings on physical examination and vital signs associated with ingestion of a particular substance is referred to as a toxidrome. Ingestion of anticholinergic agents (B) typically produces antimuscarinic properties such as tachycardia, hypertension, fever, mydriasis, agitation, dry mouth, or warm, flushed skin. Cholinergic (A) toxins mimic the effect of the cholinergic nervous system and can manifest bradycardia or tachycardia, hypertension, agitation or lethargy, diarrhea, urinary incontinence, miosis, emesis, and salivation. Opioid (C) ingestion causes respiratory depression, bradycardia, hypotension, lethargy/coma, and miosis. Sympathomimetic (D) adrenergic agents can result in tachycardia, hypertension, fever, mydriasis, agitation, diaphoresis, pallor, and cool skin.

Source

2. Correct Answer: C

Rationale
Tumor lysis syndrome (C) is a potentially life-threatening metabolic disturbance caused by the rapid destruction of tumor cells. Chemotherapeutic agents or radiation therapy causes rapid cell death, resulting in the release of cellular contents into the blood. This syndrome is characterized by hyperkalemia, hyperphosphatemia, hypocalcemia, and hyperuricemia and typically occurs within 48 hours of initiation of therapy. Tumor lysis syndrome is associated with tumors characterized by a high growth rate or sensitivity to chemotherapy. Urinary tract obstruction (A) due to tumor burden is unlikely in acute lymphoblastic leukemia. Renal calculi can cause obstruction, but obstruction is associated with an acute rise in serum urea nitrogen (BUN) and creatinine. Dehydration (B) may cause progressive electrolyte anomalies. Alterations in levels of BUN, creatinine, bicarbonate, and sodium increase with severity of dehydration over time. Acute moderate dehydration is unlikely to cause the electrolyte disturbances described. Chemotherapy-induced nephrotoxicity (D) can occur after administration of nephrotoxic chemotherapy agents and is characterized by an acute elevation in BUN and creatinine levels. Generalized electrolyte anomalies may be present; hyperuricemia will not be present.

Sources

3. Correct Answer: D

Rationale
Anticoagulation of the extracorporeal plasmapheresis circuit is often achieved by using sodium citrate. Sodium citrate exerts an anticoagulant effect by reversibly binding to ionized divalent cations, including calcium. Physiological signs of hypocalcemia (D) range in severity and can include muscle weakness; paresthesias or numbness of the hands, feet, or perioral area; muscle spasms; tremors; seizures; or arrhythmias. Phosphorus levels are generally not affected by plasmapheresis, as it is not a main component of exchange or replacement fluids (A). Administration of anticoagulants and replacement fluids may cause minimal electrolyte imbalances including hypokalemia (B), which is not manifested as leg cramps. Administration of older blood products may increase serum potassium levels, but hyperkalemia (C) is unlikely to occur.

Sources

4. Correct Answer: D

Rationale
If you suspect an incomplete foreign body airway obstruction and a child is able to breathe, cough, and make sounds, do not intervene. Call for help and allow the child to attempt to clear the obstruction (D). If a complete airway obstruction is suspected and the child is unable to breathe, cough, or make any sounds, abdominal thrusts, or back slaps followed by chest thrusts may be administered to the conscious infant or child. A blind finger sweep should not be performed because of the risk of causing airway trauma or pushing a foreign body further into the airway.

Source
Chameides L. Pediatric Advanced Life Support. Dallas, TX: American Heart Association; 2016:52.
Ventilator-associated pneumonia (VAP [now ventilator-associated event, VAE]) is one of the most common hospital-acquired infections in both children and adults. Preventative care is the key to management. The Institute for Healthcare Improvement developed a VAP prevention bundle for adults that includes elevation of the head of bed between 30° and 45°, daily oral care with chlorhexidine, daily interruption of sedation and assessment of extubation readiness, stress ulcer prophylaxis, and deep venous thrombosis prophylaxis. Many centers have implemented a modified pediatric version of the VAP bundle. Although active surveillance is recommended, routine laboratory testing (B) is not indicated in the absence of fever or detrimental change in respiratory status. Ventilator circuits are recommended to be changed on an as-needed basis (C), and oral and hypopharyngeal suctioning is recommended before repositioning the patient or the endotracheal tube (D).

**Sources**


AACN Certcorp publishes a study bibliography that identifies the sources from which items are validated. The document may be found in the AACN Certification exam handbook. The contributor of each question written for this column has listed the source used in developing each item. CCN
Ask the Experts

Best Practices in Caring for Patients Infected With Clostridium difficile

Q What is the isolation protocol for patients infected with Clostridium difficile? How long should routine cultures be done once a patient has a confirmed diagnosis? Any special nursing interventions or treatment for this diagnosis? What is best practice in caring for these patients?

A Susan Smith, APRN, DNP, ACNS-BC, and Jennifer Taylor, RN, MSN, reply:

The number of C difficile infections (CDIs) has doubled from 2000 to 2009, and C difficile now rivals methicillin-resistant Staphylococcus aureus as the most frequent cause of health care–associated infection in the United States.1 It is the most common cause of health care–associated diarrhea and accounts for 15% to 25% of antibiotic-associated diarrhea.2,3 Costs are estimated to be more than $1.3 billion per year.2 For many reasons, CDI has captured the interest of both insurers and the public. Beginning in 2017, the Centers for Medicare and Medicaid Services will include CDI in the reimbursement metrics for its value-based purchasing program.1

Characteristics of CDI are watery diarrhea, fever, anorexia, nausea, and abdominal pain, which can lead to serious illnesses such as pseudomembranous colitis, toxic megacolon, colon perforation, sepsis, and even death. A new, more virulent strain of C difficile, BI/NAP1/027, emerged in 2003.3 Resistant to the usual metronidazole treatment, it has caused a dramatic increase in health care–associated infections, morbidity, and mortality.4

Isolation Protocol

To understand which are the best isolation protocols for prevention of CDI, it is important to know that transmission of C difficile occurs via the fecal-oral route through ingestion of spores usually transmitted from other patients. Transmission most likely occurs from the hands of health care providers to a patient.5

Recommendations for isolation include an emphasis on a standardized protocol that focuses strongly on environmental control. Contact precautions, including use of gloves, gown, and single-patient room with dedicated care equipment (if possible), should be initiated as soon as CDI is suspected to prevent spread of the organism from patient to patient. Reduction of CDI rates is strongly associated with the use of gloves. Gloves prevent spores from adhering to health care workers’ hands.5,6 Recommendations are for health care workers to exclusively wash their hands with soap and water when caring for patients with CDI during an epidemic.5 Alcohol hand rubs do not kill C difficile spores.3

Cultures

To increase the probability of accurate diagnosis of CDI, inappropriate testing should be minimized. As many as 7% to 21% of hospitalized patients can be colonized with...
C difficile. The role of these patients in transmission to other patients is not well understood. For this reason, active surveillance for carriers among asymptomatic colonized patients is not recommended. Testing should be performed only on unformed, diarrheal specimens and on patients with clinically significant diarrhea. Although not validated, the criteria for clinically significant diarrhea include 3 or more diarrheal stools in a 24-hour period or less or 6 diarrheal stools in the past 36 hours. Because current available tests for C difficile are accurate and reliable, there is no need for repeat testing and tests for cure should be discouraged. Automatic, consecutive repeat testing for C difficile leads to false-positive results and does not improve patients’ outcomes.

Nursing Interventions
Nurses play an important role in prevention of CDI. They should be included in the multidisciplinary antibiotic stewardship committee to ensure that use of antimicrobial agents is evidence based because exposure to antibiotics plays a major role in CDI. Protocols should be developed so that nurses can implement contact precautions as soon as CDI is suspected, even before testing confirms the patient’s CDI status. Nurses must provide education to patients and visitors regarding CDI transmission and prevention strategies.

Best Practices
Best practices for the care of patients with CDI focus on prevention of transmission and include the following:

- Judicious use of antibiotics and antibiotic stewardship to reduce use particularly of cephalosporin, macrolide-lincosamide, and fluoroquinolone antibiotics.
- Treatment with metronidazole for initial or first-time CDI. Vancomycin should be reserved for more severe CDI and to prevent vancomycin resistance of enterococci.
- Restriction of use of gastric acid suppressants such as proton pump inhibitors because these are implicated in the development of CDI.
- Consider use of probiotics, as these are effective primary prophylaxis against CDI. Many patients have contraindications to probiotics, so more research is needed on this topic.
- Implement early contact precautions for patients with known or suspected CDI. Patients testing positive should remain in isolation at least until asymptomatic and possibly throughout the entire hospitalization. Alerts should be set up to identify patients who have had CDI and are being transferred or readmitted.
- Conduct routine surveillance to determine CDI rates. These data should be used to assess effectiveness of CDI prevention efforts and shared in the organization to improve adherence with CDI prevention efforts. The success of isolation protocols depends on the use of a streamlined process that involves each discipline interacting with the patient or patient’s environment.

Prevention of CDI is complex and requires a multidisciplinary approach. Nursing is an essential key stakeholder in effective strategic planning for CDI prevention. CCN

Financial Disclosures
None reported.

References
4. Roth VR. Clostridium difficile: the more we learn, the less we know. Infect Control Hosp Epidemiol. 2015;37(1):16-18.
Acute & Critical Care Nurse Practitioner: Cases in Diagnostic Reasoning

Reviewed by Linda Bell, RN, MSN

The first part of the title of this book describes the primary audience for the book: acute and critical care nurse practitioners. However, case studies in any format can have application to all levels of nursing, and this book is of interest to a wider audience. The beauty of reading cases in a diagnostic reasoning format is the insight that can be gained by following the steps and thinking through the process.

Written and edited by acute care nurse practitioners for nurse practitioner students, the format of diagnostic reasoning has been consistently followed throughout the book. The editors Burns and Delgado describe their thinking in developing this format in the first chapter, Diagnostic Reasoning: An Overview. They believe this method could allow the student (or reader) to hear the authors “think out loud” as they discuss each case.

Acute & Critical Care Nurse Practitioner includes 2 tables of contents, allowing the reader to delve into the content either by a listing of diagnoses or by a listing of symptoms or a collection of symptoms that would be found during physical examination. The 71 individual cases do not provide the diagnosis in advance; the reader must follow the process in each case to evaluate the patient in a consistent manner to arrive at the diagnosis.

Each case begins with the chief complaint, lists differential diagnoses, and provides case information such as present illness and medical history. The reader is asked to determine the pertinent positives and significant negatives to help derive a simple problem statement for the patient. With that statement in mind, the reader is asked to consider changing the list of potential causes. Additional information is then given in the review of systems and physical examination. Again, the positives and negatives must be added to the respective lists and an updated list of potential causes must be developed. The appropriate order of diagnostic testing is determined to achieve the working diagnosis. The final diagnosis, treatment, and patient outcome are then shared with the reader.

This book could be a textbook for a class, a support review for acute care nurse practitioner certification examinations, or just an addition to a library of resources. It makes for interesting reading for experienced nurses who may not be enrolled in nurse practitioner programs to see how the process of deriving a medical diagnosis differs from developing the list of nursing needs for individual patients.

This book has been endorsed by the American Association of Critical-Care Nurses.

Linda Bell is a clinical practice specialist at the American Association of Critical-Care Nurses in Aliso Viejo, California.

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Pocket Guide to Diagnostic Cardiac Catheterization

*Pocket Guide to Diagnostic Cardiac Catheterization* truly would fit into a laboratory coat pocket. This guide is filled with pictures, diagrams, tables, and illustrations that describe the different types of catheters and approaches for diagnostic purposes. Although certainly not exploring the topics in depth, this book gives nurses an overview of what is happening to their patient in the cardiac catheterization laboratory. Chapters address care both before and after catheterization. This pocket guide is a good reference book for the nurse working in a cardiology setting.

The Painless Guide to Mastering Clinical Acid-Base

Dr Abelow wrote this book for both learning and review. The beginning chapter gives a quick overview of the chemistry behind the acid-base processes in the system, and he describes the “normal” process before delving into the abnormalities that can occur. Acid-base is a difficult topic that bears repeated study. This book’s focus on the topic helps make the subject relevant to daily practice. There are many diagrams, tables, and footnotes that provide additional insight for the reader. This guide would be a great book for anyone just learning about acid-base, as well as anyone reviewing for certification examinations to brush up on the subject. CCN

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California
Sacramento
Care of the Complex Cardiac-Medical Surgical
Date: September 15-16, 2016. Place: Sacramento, CA. Keynote Speaker: Cheryl Herrmann. Sponsor: Sacramento Area Chapter of AACN. Contact: Laura Tobin. Phone: (916) 781-1651. E-mail: tobs4@hotmail.com. Fee: $150

District of Columbia
Washington
Certification in Legal Nurse Consulting (5-Day Seminar and Online)

Kentucky
Louisville
Annual Chapter Symposium
Nursing in the New Millennium: Basing Your Practice on the Evidence
Date: October 14, 2016. Place: Baptist Health Louisville. Address: 4000 Kresse Way, Louisville, KY 40207. Keynote Speaker: Kathleen Vollman. Sponsor: Greater Louisville Chapter of AACN. Contact: Deb Tuggle. Phone: (502) 500-5010. E-mail: deborahjtuggle@gmail.com. Fee: Member, $60; nonmember, $75; student (pre-licensure), $25. Credits: 7.5 CEUs

Minnesota
St Louis Park
CCRN/PCCN Renew
Date: June 23-24, 2016. Place: Methodist Hospital. Address: 6500 Excelsior Blvd St. Louis Park, MN 55426. Keynote Speaker: Nicole Kupchik. Sponsor: Greater Twin Cities Area Chapter of AACN. Contact: Lainey Sunborg. E-mail: info@gtcac.org. Fee: Member, $229; nonmember, $249. Credits: 18.3 CEUs

South Carolina
Charleston
CURRENTS 33rd Annual Nursing Conference
Date: October 23-26, 2016. Place: The Francis Marion Hotel. Address: 387 King St, Charleston, SC 29403. Sponsor: MED-ED, Inc. Address: 1911 Charlotte Dr, Charlotte, NC 28203. Contact: Catherine Grey. Phone: (800) 763-3332. Fax: (704) 333-5020. E-mail: customercare@mededseminars.net. Fee: 3-day attendance, $440; pre-conference session, $195. Early bird (if registered by Oct 3), active military, and group discounts available. Credits: Up to 30.7 CEUs and up to 7 total Pharmacology hours

Texas
Houston
CCRN/PCCN Review
Date: June 23-24, 2016. Place: Methodist Hospital. Address: 6500 Excelsior Blvd St, Louis Park, MN 55426. Keynote Speaker: Nicole Kupchik. Sponsor: Greater Twin Cities Area Chapter of AACN. Contact: Lainey Sunborg. E-mail: info@gtcac.org. Fee: Member, $229; nonmember, $249. Credits: 18.3 CEUs

Cruise - Western Mediterranean
Rome to Barcelona
7th Annual ED & Critical Care Update Cruise
Date: October 27-November 3, 2016. Place: Royal Caribbean Rhapsody of the Seas. Keynote Speaker: Cheryl Randolph. Sponsor: Paragon Education. Contact: Continuing Education Travel, Inc. Phone: (800) 422-0711 or (727) 526-1571. E-mail: contactus@continuingeducation.net. Website: www.ParagonRN.com. Fee: Conference $350 (cruise and travel fees NOT included). Credits: 14 CEU
I Am a Critical Care Nurse

Why did you become a nurse?
My mother was a psychiatric nurse for more than 20 years. She brought me to work with her, and I saw how she interacted with the patients and how much they respected her. I graduated high school and became a certified nursing assistant to test the waters, and I never looked back. I got into nursing school immediately and paid for it with my nursing assistant wage.

What about your job as a nurse makes you happy?
I adore new minds so I love precepting and working with new nurses. I work part time at the local community college as a senior practicum clinical instructor along with being in the trauma/neuro/medical intensive care unit (ICU). I enjoy the families that I meet on a daily basis. Families are at their lowest points when they come into the ICU, but they still say thank you and give me hugs.

Tell us about an extraordinary experience you’ve had as a critical care nurse.
I cared for an unfortunate young woman in her 20s who came to our ICU after being shot 3 times (in each lung and her pericardial sac), placed in a trunk, and left for dead. She was found in time and she walked out of our ICU many weeks later. She thanked everyone and left us a card. Caring for her was a rewarding experience.

What are the challenges you encounter and how do you overcome them?
As the community around our hospital becomes increasingly diverse, cultural challenges arise in our unit, requiring skill, cultural sensitivity, and patience. Another challenge is that staffing is becoming leaner and, in many ways, more burdensome. To counteract this challenge, my coworkers and I support each other and focus on working as a team to keep our patients safe from harm during these stressful financial times.

What has your journey as a nurse been like?
I have been enriched by the discovery of my love for teaching. As a clinical instructor, I get away from the bedside and I get to witness and interact with new ways of thinking by new nurses.
In the short 12 years I have been a nurse, I have seen the evolution of the RotoProne bed, palliative care, and ethics committees. Now I am embarking on a new journey as I pave my way to a master’s degree in leadership and management. I’m excited to bridge the gap between management and bedside nursing.

At the end of a busy day, how do you find balance in your life?
I love international travel, charity work with children and animals, relaxing with my 2 dogs, and spending time with family and friends.

What would we be surprised to know about you?
I was in Dubai and witnessed a huge city-engulfing sandstorm from the largest building in the world, Burj Khalifa. Also, I’ve received 2 scholarships through the Ebony Nurses Association of Tacoma.

How has AACN played a role in your career?
I became a member in 2004. I appreciate what NTI and continued education can do for my career: they bridge the knowledge gap and give me a sense of empowerment. I always look forward to the journals when they come in the mail, because I know they will be thought-provoking and enrich my career. CCN

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do: http://dx.doi.org/10.4037/ccn2016739
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