Critical Care Nurse

The journal for high acuity, progressive, and critical care nursing

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Acute Coronary Syndrome
Alcohol Withdrawal Syndrome
Traumatic Extremity Hemorrhage

Infants With Hypoplastic Left Heart Syndrome

Electronic Patient Education
Palliative Care in Critical Access Hospitals
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WARNING: RISK OF MEDICATION ERRORS AND HEPATOTOXICITY

Take care when prescribing, preparing, and administering OFIRMEV Injection to avoid dosing errors which could result in accidental overdose and death. In particular, be careful to ensure that:

• the dose in milligrams (mg) and milliliters (mL) is not confused;
• the dosing is based on weight for patients under 50 kg;
• infusion pumps are properly programmed; and
• the total daily dose of acetaminophen from all sources does not exceed maximum daily limits.

OFIRMEV contains acetaminophen. Acetaminophen has been associated with cases of acute liver failure, at times resulting in liver transplant and death. Most of the cases of liver injury are associated with the use of acetaminophen at doses that exceed the recommended maximum daily limits, and often involve more than one acetaminophen-containing product.

INDICATIONS AND USAGE

OFIRMEV® (acetaminophen) injection is indicated for the management of mild to moderate pain, management of moderate to severe pain with adjunctive opioid analgesics, and reduction of fever.

IMPORTANT RISK INFORMATION

OFIRMEV® (acetaminophen) injection is proven to reduce acute pain, limit opioid exposure, and improve patient satisfaction1-6

The clinical benefit of reduced opioid consumption with OFIRMEV has not been evaluated or demonstrated.

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In a major abdominal and pelvic surgery study, patients receiving IV acetaminophen 1 g with IV opioids (n=20) reported significantly lower pain scores vs placebo with IV opioids (n=20), \( P < 0.01 \).

The clinical benefit of reduced opioid consumption with OFIRMEV has not been evaluated or demonstrated.

The efficacy of OFIRMEV® (acetaminophen) injection has been proven in multiple settings.¹-⁵,⁷-¹⁶ For more information, visit OFIRMEV.com.

For more information, visit OFIRMEV.com.

Following hip arthroplasty, 85.7% of patients receiving OFIRMEV with PCA morphine (n=30) vs 39.3% of patients receiving placebo with PCA morphine (n=31) reported “good” or “excellent” satisfaction with their pain management at bedtime, \( P = 0.0018 \).

* This study was terminated early due to detection of particulates in some placebo vials.
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**CONTRAINDICATIONS**

- Acetaminophen is contraindicated in patients with:
  - known hypersensitivity to acetaminophen or to any of the excipients in the intravenous (IV) formulation.
  - severe hepatic impairment or severe active liver disease.

**WARNINGS AND PRECAUTIONS**

- Administration of acetaminophen in doses higher than recommended may result in hepatic injury, including the risk of liver failure and death. Do not exceed the maximum recommended daily dose of acetaminophen. The maximum recommended daily dose of acetaminophen includes all routes of acetaminophen administration and all acetaminophen-containing products administered, including combination products. Dosing errors could result in accidental overdose and death.

- Use caution when administering acetaminophen in patients with the following conditions: hepatic impairment or active hepatic disease, alcoholism, chronic malnutrition, severe hypovolemia (e.g., due to dehydration or blood loss), or severe renal impairment (creatinine clearance ≤ 30 mL/min).

- Rarely, acetaminophen may cause serious skin reactions such as acute generalized exanethematous pustulosis (AGEP), Stevens-Johnson Syndrome (SJS), and toxic epidermal necrolysis (TEN), which can be fatal.

- Hypersensitivity and anaphylaxis associated with the use of acetaminophen may have been reported. Clinical signs included swelling of the face, mouth, and throat, respiratory distress, urticaria, rash, and pruritus.

- The antipyretic effects of OFIRMEV may mask fever.

**ADVERSE REACTIONS**

- Serious adverse reactions may include hepatic injury, serious skin reactions, hypersensitivity, and anaphylaxis.

- Common adverse reactions in adults include nausea, vomiting, headache, and insomnia. Common adverse reactions in pediatric patients include nausea, vomiting, constipation, pruritus, agitation, and atelectasis.

**USE IN SPECIFIC POPULATIONS**

- Pregnancy Category C. OFIRMEV should be given to a pregnant woman only if clearly needed.

- Breastfeeding: While studies with OFIRMEV have not been conducted, acetaminophen is secreted in human milk in small quantities after oral administration.

- Pediatric Use: The effectiveness of OFIRMEV for the treatment of acute pain and fever has not been studied in pediatric patients < 2 years of age.

To report SUSPECTED ADVERSE REACTIONS, contact Mallinckrodt Hospital Products, Inc. at 1-800-778-7898 or the FDA at 1-800-FDA-1088 or www.fda.gov/medwatch.

Please see Brief Summary of Full Prescribing Information, including complete boxed warning, on the following page.

**References:**

For doses less than 1000 mg, the appropriate dose must be withdrawn from the vial and placed into a separate container for patient administration. Using aseptic technique, withdraw the appropriate dose (90 mg or weight based) from an intact OFIRMEV vial and place the measured dose in a separate empty, sterile vial or glass bottle, plasmonic intravenous, or syringe for intravenous injection to avoid the inadvertent withdrawal of unmeasured air. Discard any unmeasured contents of the total volume withdrawn into the separate container. A single-use vial and the unused portion must be discarded. Place small volume pediatric doses up to 60 mg in volume in a single-use vial instead of a 15 mL syringe. Monitor the end of the injection in order to prevent the possibility of an embolism, especially in cases where the OFIRMEV injection is the primary infusion.

Once the vacuum seal of the glass vial has been penetrated, or the vial is opened in any other container, administer the dose of OFIRMEV within 6 hours. Do not add other medications to the OFIRMEV solution. Discontinue high concentration hydrochloric acid as a preservative in compatible products to allow compatibility. Therapeutic effects of OFIRMEV may be reduced.

Additional Adverse Reactions Observed During Clinical Studies of OFIRMEV Products

The following additional treatment-emergent adverse reactions were reported by adult subjects treated with OFIRMEV in a multiclinical trial (N=102) that occurred with an incidence of at least 1% and at a frequency greater than placebo (N=525).

- Nervous system disorders: headache

- Hypersensitivity: anaphylaxis

- Serious Skin Reactions

Serious Skin Reactions rarely may occur. Serious skin reactions such as generalized exanthematous pustulosis (GEP), Stevens-Johnson Syndrome (SJS), and toxic epidermal necrolysis (TEN), which can be fatal. Patients should be informed about the signs of serious skin reactions, and use of the drug should be discontinued at the first appearance of skin rash or any other sign of hypersensitivity.

Risk of Medication Error

Take care when prescribing, preparing, and administering OFIRMEV (acetaminophen) injection in order to avoid dosing errors that could result in an accidental overdose and death. In particular, be careful to ensure that:

- the dose in milligrams (mg) and milliliters (mL) is not confused;
- the dose is weight-based on patient weight for pediatric use;
- infusion pumps are properly programmed; and
- the volume of acetaminophen per administration is not exceeded beyond maximum daily limits (see Dosage and Administration).

Allergy and Hypersensitivity

There have been post-marketing reports of hypersensitivity and anaphylaxis associated with the use of acetaminophen. Clinical signs included swelling of the face, mouth, throat, respiratory distress, urticaria, rash, and pruritus. There were infrequent reports of life-threatening anaphylaxis requiring emergency medical attention. Discontinue OFIRMEV immediately if symptoms associated with anaphylaxis are observed. Do not use OFIRMEV in patients with acetaminophen allergy.

ADVERSE REACTIONS

The following serious adverse reactions are described elsewhere in the labeling:

- Hepatic injury (see Warnings and Precautions [5.2])
- Severe Skin Reactions (see Warnings and Precautions [5.7])
- Allergy and Hypersensitivity (see Warnings and Precautions [5.8])

Clinical Trial Experience

Clinical trials conducted under very wide-ranging conditions, adverse reaction rates observed cannot be directly compared to rates in other clinical trials and may not reflect the rates observed in clinical practice.

Asthma Prevention

A total of 160 adult patients have received OFIRMEV in clinical trials with a risk of asthma (N = 180) who received 170 mg (N = 170) who received 160 mg. Most patients had asthma that had been uncontrolled and who were on long-term oral corticosteroids. A total of 131 (N = 131) received OFIRMEV 650 mg every 4 hours.

All adverse reactions that occurred in adult patients treated with OFIRMEV were related to the dosage or placement in dosed, placebo-controlled, clinical trials in an incidence of 2% at a frequency greater than placebo treatment. Table 3 lists the most common adverse reactions in adult patients treated with OFIRMEV (incidence 5% and greater than placebo) were nausea, vomiting, headache, and insomnia.

Table 3. Treatment-Related Adverse Reactions Occurring in ≥ 3% of OFFIRMEV-Treated Patients and at a Greater Frequency than Placebo in Placebo-Controlled, Repeated Dose Studies

<table>
<thead>
<tr>
<th>System Organ Class</th>
<th>Preferred Term</th>
<th>OFFIRMEV</th>
<th>Placebo</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gastrointestinal Disorders</td>
<td>Nausea</td>
<td>138 (44)</td>
<td>118 (21)</td>
<td>0.019</td>
</tr>
<tr>
<td>Gastrointestinal Disorders</td>
<td>Vomiting</td>
<td>126 (28)</td>
<td>114 (21)</td>
<td>0.046</td>
</tr>
<tr>
<td>General Disorders and Administration Site Conditions</td>
<td>Pruritus</td>
<td>21</td>
<td>54</td>
<td>0.114</td>
</tr>
<tr>
<td>Nervous System Disorders</td>
<td>Headache</td>
<td>39 (10)</td>
<td>38 (9)</td>
<td>0.872</td>
</tr>
<tr>
<td>Psychiatric Disorders</td>
<td>Insomnia</td>
<td>38 (10)</td>
<td>31 (7)</td>
<td>0.21</td>
</tr>
</tbody>
</table>

Drug Interactions

Effects of other Substances on Acetaminophen

Acetaminophen is not metabolized by the cytochrome P450 system. It is not metabolized by cytochrome CYP2E1 and is not affected by the metabolism of other drugs. Acetaminophen is a substrate of hepatic cytochrome P450 enzymes and may compete with some of these enzymes.

Antiepileptics

Acetaminophen use at a dose of 6000 mg has been shown to cause an increase in international normalized ratio (INR) in some patients who have been stabilized on antiepileptic therapy. As no studies have been performed evaluating the short-term use of OFIRMEV in patients on antiepileptic therapy, the frequency of use of INR may be appropriate in such circumstances.

INSTRUCTIONS FOR INTRAVENOUS ADMINISTRATION

For doses greater than 42 mg/kg, add 50 mg of OFIRMEV to a single intravenous injection at the rate of 90 mg/6 hours or 12.5 mg/kg every 4 hours, with a maximum single dose of OFIRMEV of 15 mg, a minimum single dose of 5 mg/kg per day, and a maximum daily dose of acetaminophen of 75 mg/kg per day.

Instructions for Intravenous Administration

For doses greater than 39 mg/kg, add 50 mg of OFIRMEV to a single intravenous injection at the rate of 90 mg/6 hours or 12.5 mg/kg every 4 hours, with a maximum single dose of OFIRMEV of 15 mg, a minimum single dose of 5 mg/kg per day, and a maximum daily dose of acetaminophen of 75 mg/kg per day.

Table 2. Dosing for Children

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Single Dose Weight</th>
<th>Weight-Based Dose</th>
<th>Total Daily Dose</th>
<th>Maximum Total Daily Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 year</td>
<td>50 mg</td>
<td>10 mg/kg</td>
<td>50 mg</td>
<td>100 mg</td>
</tr>
<tr>
<td>1 year</td>
<td>50 mg</td>
<td>10 mg/kg</td>
<td>50 mg</td>
<td>100 mg</td>
</tr>
<tr>
<td>1 year</td>
<td>50 mg</td>
<td>10 mg/kg</td>
<td>50 mg</td>
<td>100 mg</td>
</tr>
<tr>
<td>1 year</td>
<td>50 mg</td>
<td>10 mg/kg</td>
<td>50 mg</td>
<td>100 mg</td>
</tr>
</tbody>
</table>

Table 1. Dosing for Adults and Adolescents

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Single Dose Weight</th>
<th>Weight-Based Dose</th>
<th>Total Daily Dose</th>
<th>Maximum Total Daily Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adults and adolescents (17 years and older) weighing &gt; 50 kg</td>
<td>100 mg</td>
<td>2 mg/kg</td>
<td>150 mg</td>
<td>300 mg</td>
</tr>
<tr>
<td>Adults and adolescents (17 years and older) weighing ≤ 50 kg</td>
<td>75 mg</td>
<td>1.5 mg/kg</td>
<td>125 mg</td>
<td>250 mg</td>
</tr>
</tbody>
</table>

Information for Intravenous Use

Ensure that the contents of the intravenous container are clear and that the container is intact. Use the contents transferred to another container, administer the dose of OFIRMEV within 6 hours. Do not add other medications to the OFIRMEV solution. Discontinue high concentration hydrochloric acid as a preservative in compatible products to allow compatibility. Therapeutic effects of OFIRMEV may be reduced.
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When It’s Your Time, Will It Be Your Way?

The Institute of Medicine’s critical report *Dying in America*¹ highlighted the critical needs related to that issue via its subtitle: *Improving Quality and Honoring Individual Preferences Near the End of Life.* The first recommendation in that report defines comprehensive care for individuals nearing the end of life (EOL) and, in part, characterizes that care as “. . . patient-centered . . and consistent with individuals’ values, goals, and informed preferences.”²(p3) For both our patients and ourselves, it is important that we make time to document our preferences for EOL care so our wishes can be shared with those who will be caring for us and making decisions on our behalf.

Our preferences for EOL care are typically documented in an *advance directive,* a legal document consisting of a *living will,* that specifies the types of care and treatments that one does and does not wish to receive under certain conditions (eg, if you were permanently unconscious or had a terminal illness), and a durable power of attorney for health care (ie, health care proxy, medical power of attorney), which identifies who would serve as your surrogate decision maker(s) for health care decisions if you were unable to make those decisions.³ Some states combine the living will and health care power of attorney into a single document, whereas others require these to be separate documents. Some states detailed these preferences in a set of Physician Orders for Life-Sustaining Treatment (POLST) or Medical Orders for Life-Sustaining Treatment (MOLST) documents⁴ intended to cross all care settings with the patient.

Two major obstacles that can thwart the potential effectiveness of an advance directive for improving the quality of EOL care are failure to prepare an advance directive and disregard of an existing advance directive.

**Failure to Prepare an Advance Directive**

I don’t know the degree to which critical care nurses are complicit in failing to prepare these documents, but if we mirror the larger US population, only 25% to 30% of us have completed an advance directive.⁵,⁶ Why a substantial portion of the adult population in the United States has not yet identified their personal preferences for care if they faced a life-ending condition is not known with certainty, though a recent study found that the most frequently cited reasons were not knowing what advance directives are and family already knowing their wishes.⁸ Other plausible explanations include not perceiving its necessity due to youth, current good health, or unease in pondering one’s mortality and unintended legal and procedural consequences that may pose barriers to understanding or completing these documents.⁹

As discomforting as it may be to plan for our own demise, that effort affords us the greatest possibility for ensuring that time is consistent with our deepest wishes. None of us knows when we might need to deal with such unwelcome news, so my suggestion is to thoughtfully consider what would be most important to you at the end of your life and summarize what you want so it can be discussed and shared with those most likely to carry out your wishes.
Inability to Determine Whether an Advance Directive Exists

Even when advance directive documents are prepared, they may not be implemented for any of a number of reasons. For example, the existence of these directives may not be known to health care providers at the time care is needed, patients may be unable to indicate whether these documents exist or to describe their preferences at the time they require care, immediate family members or surrogate decision makers may not be known or available when the patient presents for care, or the documents may be inaccessible due to their physical location or their digital security requiring passwords. In many instances, circumstantial exigencies can make it impossible for health care staff to follow a patient’s wishes relative to treatments they do or do not want. Health care staff have no alternative but to follow established protocols of care to meet the patient’s needs.

Disregard of a Known Existing Advance Directive

Gallup polls in 1992 and 1996 found that 90% of Americans would prefer to be cared for at home if they were terminally ill (6 months or less to live). A decade later, a Pew report reaffirmed that a vast majority of adult Americans (about 80%) would prefer to die at home rather than in a health care facility. One of the vexing realities in EOL care is that despite more Medicare beneficiaries dying in palliative care or home settings since 2000, the frequency of hospitalizations into acute and critical care units and the frequency of transitions across multiple care sites during the EOL actually increased, reflecting persisting emphasis on provision of aggressive, curative care, only punctuated by brief hospice stays immediately preceding death. This dissonance was cogently summarized in an editorial by 2 physicians at Yale: “The focus appears to be on providing curative care in the acute hospital regardless of likelihood of benefit or preferences of patients.” Several studies have attempted to construct an accounting for this disparity between what patients want and what many physicians administer by examining physician attitudes toward EOL and advance directives.

Attitude Toward and Disregard of Advance Directives by Physicians

A survey of 765 physicians who graduated from Johns Hopkins School of Medicine between 1948 and 1964 found that 64% had an advance directive that they had discussed with their spouse or immediate family, although 70% had not discussed it with their personal physician. In addition, more than 80% of these physicians indicated that the EOL care they would select was to receive pain medication, but refuse life-sustaining medical treatments.

In a 2011 essay titled “How Doctors Die,” a retired family practice physician described why physicians administer so much care to patients at the end of their lives that they would not want for themselves. His explanations for their aggressive EOL treatment included patients who have not made their wishes known, overwhelmed families who request that everything be done, expectations of outcomes that may be misguided or unrealistic, physicians attempting to address patient or family wishes or to minimize potential for litigation, as well as possible exploitation to earn higher fees. I would summarize his explanations for why “doctors don’t die like the rest of us” as “they know better,” that is, despite understanding and having access to all possible options for the latest medical therapies, they have also witnessed numerous instances of care they considered futile and recognize the limitations and tradeoffs of what even the best medical care can provide. As a result, when physicians approach their life’s horizon, they prefer to go gently home rather than fight in a hospital.

The question of why physicians choose to forego highly aggressive medical treatments for themselves at EOL, yet administer that care to their terminally ill patients was revisited in a 2014 Stanford University study. In contrast to the Johns Hopkins survey, the Stanford study employed a larger, younger and more demographically diverse sample from 2 academic medical centers, yet found that physician attitudes toward advance directives had not substantially changed and that more than 88% of physicians opted to forgo resuscitation and aggressive treatment if they had a terminal illness. Allowing for the possibility that terminally ill patients might request aggressive care, the study found no data to support that contention, instead citing that the local health system culture and physicians’ personal practice styles were the primary contributors associated with providing intensive treatments to the terminally ill. Because patients receiving such care in the last 6 months of life do not have lower mortality rates compared to those who receive less aggressive care, this begs the question of what biases or incentives may underlie...
“the prevalent national practice pattern of subjecting dying patients to ineffective, burdensome high-intensity treatments” while doctors choose low-intensity EOL treatments for themselves.17(p7)

As if disrespecting a terminal patient’s expressed wishes for care were not sufficiently troublesome, there have also been reports of corrosive interactions and verbal sparring between physicians providing aggressive treatment and those attempting to provide palliative care.18 In a 2012 survey of physician members of a national hospice and palliative medicine society, more than half reported instances when palliative care had been characterized as murder, killing, or euthanasia by a patient’s family member or other health care professionals, including other physicians.19

Attitude Toward and Disregard of Advance Directives by Nurses

Nurses should not erroneously conclude that concerns related to health care professionals disregarding patients’ expressed wishes for EOL care can be leveled only at physicians. Although most of the research in this area has concentrated on physicians, a growing number of studies suggest that nurses in many countries around the world exhibit a comparable dichotomy of assigning more aggressive care for terminally ill patients than patients wish to receive and more aggressive than the nurses want for themselves. Studies have included registered nurses from Scotland, Wales, Canada, and Sweden20; Sweden and Germany21; Korea22; and nearly 1100 nurses from Hong Kong, Ireland, Israel, Italy, and the United States.23 In this study, although patient preferences for care were not known, in each country, nurses chose more aggressive options of EOL care for patients than they would chose for themselves or for their own parent.

Closing

Despite the many obstacles that may arise in living our life as we would like, few are as open to improvement as having it end as we wish. To the extent that we can control our location and ministrations at that point, the least we can do is to identify what we want and do not want, where we would or would not like to be located, and any other aspects that may be important to us. Both nurses and physicians have challenges ahead in getting some of our colleagues to honor and respect patient preferences about their EOL care, but we can take personal responsibility to ensure our own advance directive is updated and distributed.

As critical care nurses, we can also make every effort to encourage patients and families to prepare these documents. Advocating on behalf of patients to ensure their wishes are followed needs handling via institutional policies and procedures rather than verbal battles at the bedside. Encouraging and supporting respect of a patient’s wishes is something we can do right now to improve EOL care. CCN

References


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Corrections

In the October In Our Unit article by Cooper et al, “Against All Odds: Preventing Pressure Ulcers in High-Risk Cardiac Surgery Patients” (Crit Care Nurse. 2015; 35[5]:76-82), there was an error in the reference citation on page 82. At the top of that page, reference 18 cited on the second line should be reference 23, which also should be added to the References list:


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A Bedside Decision Tree for Use of Saline With Endotracheal Tube Suctioning

Erin B. Owen, MD, Charles R. Woods, MD, MS, Justine A. O’Flynn, RN, Megan C. Boone, RN, MSN, CCRN, Aaron W. Calhoun, MD, Vicki L. Montgomery, MD

BACKGROUND Endotracheal tube suctioning is necessary for patients receiving mechanical ventilation. Studies examining saline instillation before suctioning have demonstrated mixed results.

METHODS A prospective study to evaluate whether saline instillation is associated with an increased risk of suctioning-related adverse events in patients 18 years old or younger requiring mechanical ventilation through an endotracheal tube for at least 48 hours when suctioned per protocol using a bedside decision tree.

RESULTS A total of 1986 suctioning episodes (1003 with saline) were recorded in 69 patients. The most common indication for use of saline was thick secretions (87% of episodes). In 586 suctioning episodes, at least 1 adverse event occurred with increased frequency in the saline group (P < .001). Normal saline was more likely to be associated with hemodynamic instability (P = .04), bronchospasm (P < .001), and oxygen desaturation (P < .001). Patient factors associated with adverse events include younger age (P < .001), a cuffed endotracheal tube (P = .01), endotracheal tube diameter of 4.0 mm or less (P < .001), respiratory or hemodynamic indication for intubation (P < .001), underlying respiratory disease (P < .001), and longer duration of mechanical ventilation (P < .001). Saline instillation (P < .001), endotracheal tube size of 4.0 mm or less (P = .03), and comorbid respiratory diseases (P = .03) were associated with an increased risk of adverse events.

CONCLUSIONS Saline instillation before endotracheal tube suctioning is associated with hemodynamic instability, bronchospasm, and transient hypoxemia. Saline should be used cautiously, especially in children with a small endotracheal tube and comorbid respiratory disease. (Critical Care Nurse. 2016;36[1]:e1-e10)
Acute Coronary Syndrome: Focus on Antiplatelet Therapy

Rodel V. Bobadilla, MSN, APRN, CCRN, NP-C, FNP-BC

The American Heart Association/American College of Cardiology in 2014 published a focused update of the 2007 and 2012 guidelines for non–ST-segment elevation acute coronary syndrome (NSTE-ACS). The management of ST-segment elevation myocardial infarction (STEMI) is described in a separate guideline published in 2013. The focused updates to the guidelines contain updated recommendations for dual antiplatelet therapy, including use of the P2Y12 inhibitor ticagrelor, which was recently approved by the Food and Drug Administration. Nurses caring for patients with acute coronary syndrome must have a good understanding of the current treatment guidelines for such patients, to help ensure delivery of evidence-based care. This review article uses a case study–based approach to describe how the new guidelines affect clinical decision making when choosing appropriate antiplatelet therapy for patients with NSTE-ACS or STEMI, depending on the patient’s clinical history and presenting characteristics. (Critical Care Nurse. 2016;36[1]:15-27)

In 2010, there were 1,141,000 unique hospitalizations for acute coronary syndrome (ACS) in the United States. ACS describes any group of clinical signs and symptoms that are compatible with acute myocardial ischemia; thus ACS includes both non–ST-segment elevation acute coronary syndrome (NSTE-ACS; formerly known as unstable angina and non–ST-segment elevation myocardial infarction [NSTEMI]) and ST-segment elevation myocardial infarction (STEMI). It is estimated that, each year, approximately 635,000 new ACS events and approximately 300,000 recurrent events will occur in the United States. ACS is caused by obstruction of blood flow to the myocardium as a result of blockage in the coronary artery. A common cause of such blockage is disruption of an atherosclerotic...
plaque within a coronary artery, often associated with the formation of a clot. The consequent ischemia may cause myocardial damage, and potentially necrosis, which can be detected via cardiac biomarkers (ie, troponins or creatine kinase–MB). ACS therapy is directed toward reestablishing coronary artery perfusion through either invasive therapy with percutaneous coronary artery intervention (PCI) or an ischemia-guided strategy. Because ACS has serious consequences, it is vital that patients be evaluated, given a diagnosis, and treated quickly to optimize outcomes. Major priorities for improving outcomes are better recognition of signs and symptoms and shortening the time to reperfusion. The American Heart Association (AHA) and American College of Cardiology Foundation (ACCF) have recently updated their guidance for the management of NSTE-ACS and STEMI, with a focus on antiplatelet therapy. This review summarizes updated information reflected in the latest AHA/ACC guidelines for the management of NSTE-ACS and STEMI, with a focus on antiplatelet therapy. NSTE-ACS and STEMI case studies are included to illustrate how the current guidelines can be applied to clinical practice.

**Class of Recommendation and Level of Evidence**

An evidence-based approach was taken by the guideline writing groups in analyzing the data and developing recommendations, using methods created by the ACCF/AHA Task Force on Practice Guidelines. Each recommendation includes a class of recommendation (COR), an estimate of the magnitude of a treatment effect, and a level of evidence (LOE), which estimates the probability or precision of the effect (Table 1).

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**Table 1** Class of recommendation and level of evidence in recommendations from the American College of Cardiology Foundation/American Heart Association

<table>
<thead>
<tr>
<th>Class of recommendation</th>
<th>Size of treatment effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Benefit &gt;&gt; risk</td>
</tr>
<tr>
<td></td>
<td>Procedure/treatment should be performed/administered</td>
</tr>
<tr>
<td>IIa</td>
<td>Benefit &gt; risk</td>
</tr>
<tr>
<td></td>
<td>It is reasonable to perform procedure/administer treatment</td>
</tr>
<tr>
<td>IIb</td>
<td>Benefit ≥ risk</td>
</tr>
<tr>
<td></td>
<td>Procedure/treatment may be considered</td>
</tr>
<tr>
<td>III</td>
<td>No benefit or harm</td>
</tr>
<tr>
<td></td>
<td>Procedure/test is not helpful or treatment has no proven benefit</td>
</tr>
<tr>
<td></td>
<td>Procedure/test is associated with excess cost without benefit or is harmful; treatment is harmful to patients</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Level of evidence</th>
<th>Estimate of certainty (precision) of treatment effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Multiple populations evaluated²</td>
</tr>
<tr>
<td></td>
<td>Data derived from multiple randomized clinical trials or meta-analyses</td>
</tr>
<tr>
<td>B</td>
<td>Limited populations evaluated²</td>
</tr>
<tr>
<td></td>
<td>Data derived from a single randomized trial or nonrandomized studies</td>
</tr>
<tr>
<td>C</td>
<td>Very limited populations evaluated²</td>
</tr>
<tr>
<td></td>
<td>Only consensus opinion of experts, case studies, or standard of care</td>
</tr>
</tbody>
</table>

² Based on information from American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines.³

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**Author**

Rodel Bobadilla has been practicing in an interventional cardiology practice for the past 14 years and is an adjunct assistant professor with the South Carolina College of Pharmacy, Columbia, South Carolina.

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

ACS often occurs when a vulnerable plaque in a coronary artery ruptures (Figure 1), exposing the lipid-filled core. Platelets in the blood are activated by coming into contact with the thrombogenic contents (e.g., collagen) exposed by disruption of the plaque’s fibrous cap (Figure 2). Platelets adhere to sites of vascular injury, where collagen and von Willebrand factor in the extracellular matrix interact with the glycoprotein (GP) receptors on the platelet surface. This activates the platelets, causing a shape change and releasing adenosine diphosphate (ADP) and thromboxane A2, which in turn activates surrounding platelets. Platelets express GPIIb/IIIa receptors, which bind adhesive proteins such as von Willebrand factor and fibrinogen, and stimulate the formation of thrombin on their surface to amplify aggregation and support coagulation. A number of platelet receptors are involved in this process, including the P2Y12 receptor. These receptors are activated by ADP, which mediates the release of potent prothrombotic and proinflammatory factors involved in platelet aggregation.

Figure 1 The pathophysiology of acute coronary syndromes. The rupture of an unstable atherosclerotic plaque can lead to an acute coronary event. The clinical severity of the event is influenced by the thrombotic response of the individual.

Figure 2 The process of platelet activation and thrombus formation within a blood vessel. Where the vascular surface is disrupted, collagen and von Willebrand factor (vWF) in the extracellular matrix (ECM) are exposed to the circulating blood and interact with glycoprotein (GP) receptors on the surface of platelets. Platelets then adhere to the site and become activated, changing shape, releasing adenosine diphosphate (ADP) and thromboxane A2 (TxA2), and stimulating the formation of thrombin. These stimuli act on surrounding platelets to accelerate and augment the process. Platelets express GPIIb/IIIa receptors, which bind adhesive proteins such as vWF and fibrinogen. The adhesion of the platelets forms the platelet-rich thrombus.
and the promotion of fibrin cross-linking to stabilize the thrombus. The P2Y$_{12}$ antagonists clopidogrel, prasugrel, and ticagrelor inhibit ADP-induced P2Y$_{12}$ receptor activation, thereby preventing GPIIb/IIIa complex activation and reducing platelet aggregation.\(^9\)

Clopidogrel and prasugrel are both orally administered, thienopyridine-based, irreversibly binding P2Y$_{12}$ inhibitors, which must be converted into an active metabolite to allow binding to the P2Y$_{12}$ receptor.\(^10\) Ticagrelor, an orally administered, reversibly binding P2Y$_{12}$ receptor antagonist, is the first in a new class of agents, cyclo-pentyltriazolopyrimidines, and does not need a metabolic conversion step to become active. In addition to P2Y$_{12}$ inhibition, ticagrelor also increases extracellular adenosine levels by inhibiting the equilibrative nucleoside transporter-1.\(^11\) As well as being an additional mechanism for the antiplatelet effects of ticagrelor,\(^12\) the increase in local adenosine levels enhances adenosine-mediated coronary blood flow.\(^13\)-\(^15\)

**Guideline Update: NSTE-ACS**

The AHA/ACC Task Force on Practice Guidelines has published a 2014 update for the care of patients with NSTE-ACS.\(^6\) This update replaces the relevant parts of the 2007 ACC/AHA guidelines,\(^4\) which were revised during focused updates in 2011\(^16\) and 2012.\(^17\)

NSTE-ACS is characterized by ST-segment depression or prominent T-wave inversion as shown by electrocardiography and/or a positive result for a necrosis biomarker (eg, troponin) without ST-segment elevation and in the presence of other clinically relevant symptoms such as chest discomfort or anginal equivalent.\(^6\)

Patients with unstable angina or NSTEMI are often difficult to distinguish at first, and therefore are considered together in the term NSTE-ACS under AHA/ACC guidance.\(^6\) Unstable angina and NSTEMI have a similar pathogenesis and mainly differ in the degree of ischemia and whether the degree of ischemia is sufficient to cause myocardial damage that releases biomarkers of myocardial necrosis (ie, troponins or creatine kinase–MB).\(^4\) When neither of these biomarkers is detected, a patient is confirmed as having unstable angina; if a biomarker is present, a diagnosis of NSTEMI is established.\(^6\) Around 53% to 71% of patients with ACS have NSTE-ACS diagnosed at first.\(^1\),\(^18\),\(^19\)
although only 0.9% of ticagrelor recipients and 0.1% of clopidogrel recipients discontinued treatment because of dyspnea), \(^{20}\) and ventricular pauses of 3 seconds or longer during treatment week 1 that were not associated with syncope or with pacemaker implantation (5.8% vs 3.6%, \(P < .01\) overall). \(^{20}\)

In the overall PLATO population, ticagrelor efficacy (primary composite end point) was apparently lower in patients weighing less than the median weight (for their sex) and in patients who were not receiving lipid-lowering medication when randomized. \(^{20}\) Ticagrelor efficacy also appeared to be lower in patients from North America, most likely because aspirin doses commonly are higher in the United States, \(^{25}\) although a chance finding cannot be ruled out. Adjusted analyses showed that in patients taking low-dose maintenance aspirin, ticagrelor was associated with better outcomes than was clopidogrel, with statistical superiority in countries

### Table 3

Summary of outcomes from PLATO and TRITON-TIMI 38 trials in patients with non-ST-segment-elevation acute coronary syndromes (NSTE-ACS) or ST-segment-elevation myocardial infarction (STEMI)

<table>
<thead>
<tr>
<th>Outcome</th>
<th>NSTE-ACS(^{21})</th>
<th>STEMI(^{22})</th>
<th>NSTE-ACS(^{23})</th>
<th>STEMI(^{24})</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of patients</td>
<td>11 080</td>
<td>7544</td>
<td>10 074</td>
<td>3534</td>
</tr>
<tr>
<td>Median age, years</td>
<td>64</td>
<td>59</td>
<td>61.2-62.1</td>
<td>58-59</td>
</tr>
<tr>
<td>Prior myocardial infarction, No. (%) of patients</td>
<td>2810 (25)</td>
<td>1014 (13)</td>
<td>2075 (21)</td>
<td>359 (10)</td>
</tr>
<tr>
<td>Prior PCI, No. (%) of patients</td>
<td>1862 (17)</td>
<td>630 (8)</td>
<td>1597 (16)</td>
<td>NA</td>
</tr>
<tr>
<td>PCI on study, No. (%) of patients</td>
<td>5710 (52)</td>
<td>6158 (82)(^{a})</td>
<td>99.1</td>
<td>3425 (97)</td>
</tr>
<tr>
<td>Primary end point (cardiovascular death, myocardial infarction, stroke)</td>
<td>10.0% T vs 12.3% C (P = .001)</td>
<td>9.4% T vs 10.8% C (P = .07)</td>
<td>9.30% P vs 11.23% C (P = .002)</td>
<td>10.0% P vs 12.4% C (P = .02)</td>
</tr>
<tr>
<td>All-cause mortality</td>
<td>4.3% T vs 5.8% C (P = .002)</td>
<td>5.0% T vs 6.1% C (P = .05)</td>
<td>NA</td>
<td>3.3% P vs 4.3% C (P = .11)</td>
</tr>
<tr>
<td>Cardiovascular death</td>
<td>3.7% T vs 4.9% C (P = .007)</td>
<td>4.5% T vs 5.5% C (P = .07)</td>
<td>1.78% P vs 1.83% C (P = .88)</td>
<td>2.4% P vs 3.4% C (P = .13)</td>
</tr>
<tr>
<td>Myocardial infarction</td>
<td>6.6% T vs 7.7% C (P = .04)</td>
<td>4.7% T vs 5.8% C (P = .03)</td>
<td>7.26% P vs 9.46% C (P &lt; .001)</td>
<td>6.8% P vs 9.0% C (P = .02)</td>
</tr>
<tr>
<td>Stroke</td>
<td>1.3% T vs 1.4% C (P = .79)</td>
<td>1.7% T vs 1.0% C (P = .02)</td>
<td>0.97% P vs 0.91% C (P = .75)</td>
<td>1.6% P vs 1.5% C (P = .91)</td>
</tr>
<tr>
<td>Major bleeding(^{b})</td>
<td>13.4% T vs 12.6% C (P = .26)</td>
<td>9.0% T vs 9.2% C (P = .76)</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>CABG-related major bleeding(^{b})</td>
<td>NA</td>
<td>5.1% T vs 5.8% C (P = .30)</td>
<td>NA</td>
<td>18.8% P vs 2.7% C (P = .003)</td>
</tr>
<tr>
<td>Non–CABG-related major bleeding(^{b})</td>
<td>4.8% T vs 3.8% (P = .01)</td>
<td>4.1% T vs 3.7% C (P = .61)</td>
<td>2.16% P vs 1.55% C (P = .02)</td>
<td>2.4% P vs 2.1% C (P = .65)</td>
</tr>
<tr>
<td>TIMI: 2.9% T vs 2.2% C (P = .01)</td>
<td>TIMI: 2.5% T vs 2.2% C (P = .60)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Life-threatening bleeding(^{b})</td>
<td>6.6% T vs 6.5% C (P = .56) (^{c})</td>
<td>4.7% T vs 4.9% C (P = .86)</td>
<td>NA</td>
<td>1.3% P vs 1.1% C (P = .75)</td>
</tr>
<tr>
<td>Fatal bleeding(^{b})</td>
<td>0.3% T vs 0.4% C (P = .37)</td>
<td>0.2% T vs 0.1% C (P = .008)</td>
<td>0.28% P vs 0.06% C (P = .10) (^{d})</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: C, clopidogrel; CABG, coronary artery bypass grafting; NA, not available; P, prasugrel; PCI, percutaneous coronary intervention; STEMI, ST-segment elevation myocardial infarction; T, ticagrelor.

\(^{a}\) During index admission (PCI performed within 12 hours of randomization in 5439 [72%] of patients with STEMI).

\(^{b}\) Trial definitions of bleeding were PLATO (PLATO trial) and TIMI (TRITON-TIMI 38 trial).

\(^{c}\) Includes life-threatening and fatal bleeding.

\(^{d}\) Non–CABG-related fatal bleeding.
Ticagrelor is recommended over clopidogrel for all patients with NSTE-ACS according to the updated AHA/ACC guidelines, irrespective of their initial treatment strategy. In line with the prescribing information for ticagrelor, which states that it should be used only with a low maintenance dose of aspirin (325-mg loading dose then a 75- to 100-mg maintenance dose), the updated guidelines recommend an aspirin loading dose of 162 to 325 mg and a maintenance dose of 81 mg daily for patients receiving ticagrelor, as it is considered to carry a lower risk for bleeding. This recommendation is also similar to the recommendations for patients with STEMI following primary PCI. The guidelines also state the importance of considering the potential for intracranial bleeding in patients who have previously experienced a stroke or a transient ischemic attack (TIA) when considering the addition of ticagrelor to aspirin, because dual antiplatelet treatment (aspirin and either clopidogrel or prasugrel) has previously been associated with an increased likelihood of intracranial bleeding, especially in patients who have previously experienced stroke. In PLATO, ticagrelor was associated with more episodes of intracranial bleeding than clopidogrel was (26 [0.3%] vs 14 [0.2%] respectively, \( P = .06 \)). However, bleeding intracranially was not found to be related to a history of stroke or TIA (interaction \( P = .38 \)); of the 1152 patients in PLATO with a history of stroke or TIA, only 4 patients receiving ticagrelor and 4 patients receiving clopidogrel had intracranial bleeding. It is worth noting that ticagrelor is currently being evaluated as a monotherapy in a trial of “all-comers (unselected)” patients undergoing PCI (NCT01813435), with results expected in 2016.

The guidelines provide recommendations on how long antiplatelet therapy should be stopped before planned cardiac surgery. It is recommended that both ticagrelor and clopidogrel be stopped 5 days before surgery. For prasugrel, the guidelines recommend stopping therapy 7 days before surgery (Table 2—available online).

Guidance on the management of patients with NSTE-ACS with platelet GPIIb/IIIa receptor antagonists (abciximab, eptifibatide and tirofiban) remains the same as that published in the 2007 guidelines, as do the recommendations for anticoagulant support of PCI.

**Case Study 1: NSTE-ACS**

A 65-year-old man arrives in the emergency department complaining of chest pain that has been occurring for the past 6 hours. He has coronary artery disease and had a drug-eluting stent placed 8 years previously. He is currently receiving aspirin (81 mg/d), clopidogrel (75 mg/d), metoprolol (25 mg/d), benazepril/amlodipine (10/5 mg/d), and pravastatin (40 mg/d). (Continuation of a P2Y\(_{12}\) receptor inhibitor such as clopidogrel for longer than 12 months may be possible for patients receiving a drug-eluting stent [COR: IIb; LOE: C].)

Cardiac enzymes are initially negative but reveal a slight elevation on the second test (creatine phosphokinase, 500 \(\mu\)g/L; creatine kinase–MB fraction, 5.2 \(\mu\)g/L; troponin I, 1.03 \(\mu\)g/L), and the 12-lead electrocardiogram shows no ischemic changes. NSTE-ACS (NSTEMI) is diagnosed, and the patient is given a loading dose of clopidogrel (300 mg) in the emergency department and admitted to cardiac telemetry. Coronary angiography is scheduled for the following day.

Coronary angiography reveals a 90% stenosis at the previously stented site in the left anterior descending artery and a 50% stenosis of the mid-left circumflex artery. A drug-eluting stent is placed in the left anterior descending artery, reducing the 90% stenosis to 0% residual.

**Choice of P2Y\(_{12}\) Inhibitor for PCI**

A key question in this case is the choice of P2Y\(_{12}\) inhibitor for antiplatelet therapy. The updated AHA/ACC guidelines recommend clopidogrel or ticagrelor (in addition to aspirin) for all patients with NSTE-ACS managed with either an early invasive strategy or ischemia-guided strategy (COR: I; LOE: B), and state that it is reasonable to use ticagrelor over clopidogrel (COR: IIa; LOE: B). For patients with NSTE-ACS undergoing PCI with stenting, the guidelines recommend clopidogrel, prasugrel, or ticagrelor (COR: I; LOE: B for all 3 P2Y\(_{12}\) inhibitors; Table 2—available online only), with prasugrel recommended over clopidogrel for patients who are undergoing PCI and not at high risk for bleeding complications. The removal of prasugrel from recommended initial therapy in NSTE-ACS patients managed with an ischemia-guided strategy (based in part on the TRILogy-ACS trial results) represents a key update from the
2007 guidelines and is more similar to the approach suggested in the European Society of Cardiology (ESC) NSTE-ACS guidelines, which recommend individual P2Y12 inhibitors for particular patient subgroups. The guidance for patients with NSTE-ACS undergoing PCI is slightly different from the recommendations for anti-platelet therapy in patients with STEMI, where one P2Y12 inhibitor is not endorsed over another. Furthermore, a number of sections in the 2012 ACCF/AHA NSTE-ACS guidelines highlight potential variability in response to clopidogrel associated with its reliance on the CYP2C19 isoenzyme, which converts clopidogrel to its active metabolite. A boxed warning in the prescribing information for clopidogrel acknowledges higher cardiovascular event rates following ACS or PCI among CYP2C19-poor metabolizers taking clopidogrel versus patients with normal CYP2C19 function. The updated 2014 AHA/ACC guidelines for NSTE-ACS do not recommend routine testing of platelet function or genetic phenotype testing, on the basis that such tests have not been associated with a decrease in ischemic complications. It is notable that the ESC guidelines recommend the consideration of these testing approaches for patients who are receiving clopidogrel.

Another consideration in the choice of treatment for this patient is concomitant therapy. Although this patient was not prescribed a proton pump inhibitor (PPI), such agents are often given to prevent gastrointestinal complications in patients receiving nonsteroidal anti-inflammatory drugs plus clopidogrel, where they may reduce the antiplatelet effects of clopidogrel via competition for CYP2C19. The effect of the interaction between PPIs and clopidogrel on cardiovascular outcomes has not been confirmed as clinically important, and the guidelines do not prohibit the use of PPIs in patients taking clopidogrel. (Remember, continuation of a P2Y12 receptor inhibitor >12 months may be possible for patients receiving a drug-eluting stent [COR: IIb; LOE: C].) The guidelines recommend that PPIs be prescribed in patients receiving triple anti-thrombotic therapy with a vitamin K antagonist, aspirin, and a P2Y12 receptor inhibitor who have a history of gastrointestinal bleeding, and that use of PPIs may be considered in patients without a history of gastrointestinal bleeding who are receiving P2Y12 agents.

In case study 1, the interventional cardiologist decides to change the P2Y12 inhibitor to ticagrelor, a decision based on the reduction in vascular death, myocardial infarction, or stroke found for ticagrelor relative to clopidogrel in the PLATO trial. The patient receives a loading dose of ticagrelor 180 mg by mouth and then 90 mg twice a day.

**Risk Associated With Switching Antiplatelet Therapies**

The patient in this case had received a 300-mg loading dose of clopidogrel before angiography and then was switched to ticagrelor. In the PLATO study, 46.0% of the patients in the ticagrelor study group had received clopidogrel in the hospital before randomization; most received 300 to 375 mg (n = 1921; 20.6%), and a number received 600 to 675 mg (n = 1282; 13.7%). Interestingly, the rate of major bleeding did not differ between patients receiving ticagrelor along with clopidogrel and patients receiving just clopidogrel, and no significant interaction was found between clopidogrel given before randomization or as a loading dose and bleeding events. The other possible choices of P2Y12 inhibitor are continuation of clopidogrel or initiation of prasugrel.

Possible choices of P2Y12 inhibitor are continuation of clopidogrel or initiation of prasugrel.
Guideline Update: STEMI

The 2013 ACCF/AHA Guideline for the Management of STEMI contains a significantly revised version of the recommendations from the 2004 guidelines, for which focused updates were published in 2007 and 2009. The American College of Physicians, American College of Emergency Physicians, and Society for Cardiac Angiography and Interventions (SCAI) participated in a joint initiative to update the guidelines. The update focuses on recent developments in reperfusion therapy, the organization of regional care systems, transfer algorithms, antithrombotic and medical therapies (evidence-based), and approaches in secondary care that may improve patient-centered management. The following sections expand on the updates that are most relevant to critical care nurses, including the use of antiplatelet therapy in patients with STEMI.

Regional Approaches to STEMI Management and Reperfusion Treatment

Primary PCI remains the reperfusion strategy in patients experiencing STEMI, and the 2013 ACCF/AHA guideline recommendations favor the benefits of PCI over fibrinolytic agents, despite the potential for delays associated with transport to a hospital with the capability to perform PCI. Still, several updates to the guidelines emphasize time as a key factor in STEMI outcomes. Current time-to-treatment goals are summarized in Table 4.

### Antiplatelet Therapy

The 2013 ACCF/AHA STEMI guidelines encourage appropriate antithrombotic therapy, including dual antiplatelet therapy and anticoagulants, both during and after reperfusion therapy. Similar to the NSTE-ACS guidelines, the updated STEMI guidelines provide guidance on the use of the newest P2Y12 receptor antagonist, ticagrelor, with the PLATO trial (described earlier) supporting these recommendations. In a planned sub-group analysis of the PLATO cohort limited to the 7544 patients (41%) with STEMI (Table 3), the 13% risk reduction (hazard ratio = 0.87; P = .07) in the combined primary end point (myocardial infarction, stroke, or cardiovascular death) for ticagrelor versus clopidogrel was comparable with that seen in the overall population of the study. The incidence of myocardial infarction alone was also significantly reduced with ticagrelor (4.7% vs 5.8% with clopidogrel) in STEMI patients. The treatment groups did not differ significantly with regard to major bleeding. Similar to the total study population, dyspnea was more frequent with ticagrelor (12.6%) than with clopidogrel (8.4%) in STEMI patients (P < .001), but rarely required drug discontinuation (0.5% of ticagrelor

---

### Table 4: 2013 ACCF/AHA time-to-treatment goals for care of ST-segment-elevation myocardial infarction (STEMI)

<table>
<thead>
<tr>
<th>ACCF/AHA recommendations</th>
<th>Class of recommendation</th>
<th>Level of evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>A 12-lead ECG should be performed by emergency medical services personnel at the site of FMC in patients with symptoms consistent with STEMI.</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>Primary PCI is recommended for STEMI patients with ischemic symptoms for less than 12 hours.</td>
<td>I</td>
<td>A</td>
</tr>
<tr>
<td>It is reasonable to perform PCI in STEMI patients with ECG or clinical evidence of ischemia up to 24 hours.</td>
<td>IIa</td>
<td>B</td>
</tr>
<tr>
<td>For STEMI patients initially transported to a PCI-capable hospital, the ideal FMC-to-device goal is 90 minutes or less.</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>Immediate transfer to a PCI-capable hospital is recommended for patients with STEMI who initially arrive at a non-PCI-capable hospital, with an FMC-to-device time goal of 120 minutes or less.</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>In the absence of contraindications, fibrinolytic therapy should be administered to patients with STEMI at non-PCI-capable hospitals when the anticipated FMC-to-device time at a PCI-capable hospital exceeds 120 minutes because of unavoidable delays.</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>When fibrinolytic therapy is indicated or chosen as the primary reperfusion strategy, it should be administered within 30 minutes of hospital arrival.</td>
<td>I</td>
<td>B</td>
</tr>
</tbody>
</table>

Abbreviations: ECG, electrocardiogram; FMC, first medical contact; PCI, percutaneous coronary intervention.
and 0.1% of clopidogrel recipients discontinued treatment because of dyspnea). Results in the STEMI subgroup of the TRITON-TIMI trial are also shown in Table 3. Between 30% and 40% of patients with ACS in the United States have STEMI. The PLATO study sample reflected this national average, with approximately 38% of patients having STEMI.

The 2013 ACCF/AHA guidelines for antiplatelet therapy to support reperfusion with primary PCI in patients experiencing STEMI are summarized in Table 5. As mentioned previously, the ACCF/AHA STEMI recommendations are slightly different from those for NSTE-ACS in that clopidogrel, prasugrel, or ticagrelor are recommended without a preference for one in particular. From a comparison perspective, the STEMI recommendations are broadly in line with the ESC’s STEMI guidelines, although the ESC recommends prasugrel only in patients who are clopidogrel-naïve and less than 75 years old (in addition to having no history of stroke or TIA) and recommends clopidogrel preferably

<table>
<thead>
<tr>
<th>ACCF/AHA recommendations</th>
<th>Class of recommendation</th>
<th>Level of evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>In STEMI patients undergoing PCI</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aspirin 162- to 325-mg loading dose before procedure</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>81- to 325-mg daily maintenance dose (indeterminate)</td>
<td>I</td>
<td>A</td>
</tr>
<tr>
<td>81 mg daily is the preferred maintenance dose</td>
<td>IIa</td>
<td>B</td>
</tr>
<tr>
<td>A loading dose of a P2Y12 receptor inhibitor should be given as early as possible or at time of primary PCI to patients with STEMI</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>Clopidogrel 600 mg; or</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>Prasugrel 60 mg; or</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>Ticagrelor 180 mg</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td><strong>In patients receiving stents:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P2Y12 inhibitor therapy should be given for 1 year to patients with STEMI who receive a drug-eluting stent or bare-metal stent during primary PCI, using the following maintenance doses:</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>Clopidogrel: 75 mg daily; or</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>Prasugrel: 10 mg daily; or</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>Ticagrelor: 90 mg twice a day</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td><strong>In patients with a drug-eluting stent:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clopidogrel, prasugrel, or ticagrelor can be continued beyond 1 year</td>
<td>IIb</td>
<td>C</td>
</tr>
<tr>
<td><strong>In STEMI patients who are receiving antiplatelet agents and must undergo urgent CABG:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aspirin should not be withheld</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>Clopidogrel or ticagrelor should be discontinued at least 24 hours before urgent on-pump CABG, if possible</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>Urgent off-pump CABG within 24 hours of clopidogrel or ticagrelor administration might be considered, especially if the benefits of prompt revascularization outweigh the risks of bleeding</td>
<td>IIb</td>
<td>B</td>
</tr>
<tr>
<td>Urgent CABG within 5 days of clopidogrel or ticagrelor administration or within 7 days of prasugrel administration might be considered, especially if the benefits of prompt revascularization outweigh the risks of bleeding</td>
<td>IIb</td>
<td>C</td>
</tr>
<tr>
<td>Short-acting intravenous glycoprotein IIb/IIIa receptor antagonists (eptifibatide, tirofiban) should be discontinued at least 2 to 4 hours before urgent CABG</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>Abciximab should be discontinued at least 12 hours before urgent CABG</td>
<td>I</td>
<td>B</td>
</tr>
</tbody>
</table>

* The recommended maintenance dose of aspirin to be used with ticagrelor is 81 mg daily.

* Prasugrel should not be administered to patients with a history of stroke or transient ischemic attack (class of recommendation: III; level of evidence: B).

* Drug-eluting stent should not be used in patients who cannot or will not comply with long-term dual antiplatelet therapy (class of recommendation: III; level of evidence: B).
in cases where prasugrel and ticagrelor are not available or cannot be used (ticagrelor can be used in all patient groups). The ACCF/AHA recommendations for supportive anticoagulant regimens are unchanged from the 2009 update and comprise the use of unfractionated heparin, including bolus doses to maintain therapeutic activated clotting times (as required), with consideration of whether the patient has received a GPIIb/IIIa receptor antagonist (LOE: C) or bivalirudin, with or without prior treatment with unfractionated heparin (LOE: B). They also note that bivalirudin monotherapy is preferred over unfractionated heparin and a GPIIb/IIIa inhibitor in patients who are at a high risk of bleeding. However, the ESC’s STEMI guidelines recommend bivalirudin (with GPIIb/IIIa inhibitors limited to bailout use) or enoxaparin (with or without a GPIIb/IIIa inhibitor) over unfractionated heparin and a GPIIb/IIIa inhibitor in all patients (although the ESC guidelines state that unfractionated heparin should be used in patients not receiving bivalirudin or enoxaparin).

The lack of consensus between the guidelines is part of a larger ongoing debate around the use of heparin versus bivalirudin in patients with STEMI who are undergoing PCI. The recently published UK HEAT-PPCI trial showed that heparin led to a lower incidence of ischemic events and a similar incidence of bleeding compared with bivalirudin, suggesting that heparin might be a more cost-effective treatment on the basis of these results and its lower cost. In addition to a significant reaction to its delayed consent strategy, the trial has generated much debate in the medical community because of the difference in results compared with previous trials of bivalirudin versus heparin, although interestingly, a subsequent US study also yielded similar results. It is not clear whether the current debate will influence the next update to the STEMI guidelines, although it is important for all health care professionals treating cardiology patients to be aware of the potential implications with respect to clinical practice as the discussions and investigations will no doubt continue.

It should be noted that clopidogrel is the only P2Y12 receptor antagonist recommended for supporting reperfusion with fibrinolytic therapy (ie, as adjunctive antithrombotic therapy). Only clopidogrel and prasugrel are recommended in the setting of PCI after fibrinolytic therapy.

Case Study 2: STEMI

A woman aged 67 years has an inferior wall STEMI diagnosed and undergoes emergency coronary angiography. Antithrombotic and dual oral antiplatelet therapies are not started before the coronary angiography because of the possibility of surgical revascularization. Unfortunately, the angiography reveals severe, diffuse 3-vessel coronary artery disease with decreased flow in the right coronary artery, although her left ventricular ejection fraction is normal at 60%. The surgical team determined that the patient was not suitable for bypass surgery. Medical management is recommended.

According to the 2013 STEMI recommendations, the patient should receive β-blockers (COR: I; LOE: B), angiotensin-converting enzyme inhibitors (COR: IIa; LOE: A), and high-intensity statin therapy (COR: I; LOE: B). The patient is currently receiving enteric-coated aspirin 325 mg/d, carvedilol 6.25 mg twice daily, lisinopril 5 mg/d, and atorvastatin 40 mg/d.

Table 5 describes the antiplatelet treatment options for this patient according to the 2013 ACCF/AHA STEMI guidelines. If she had been treated with a fibrinolytic agent and PCI, then there would be an indication for dual antiplatelet therapy with clopidogrel or prasugrel as the P2Y12 inhibitor. However, as neither fibrinolysis nor PCI have been used, a selection of either clopidogrel or ticagrelor would be appropriate to individualize therapy for this patient. Prasugrel should not be considered because the patient did not undergo PCI.

The Nurse’s Role in Facilitating Guideline-Based In-Hospital Care

Critical Care Nurses’ Central Role

A critical care nurse may encounter patients with ACS in emergency departments, intensive care units, cardiac care units, cardiac catheter laboratories, telemetry units, progressive care units, and recovery rooms. Within these settings, nurses have a variety of responsibilities in the management of ACS patients, including explaining what is happening to them, providing comfort to patients and their families, assisting with risk stratification of patients, acting as a conduit of information between different departments or members of the health care team, and assisting with decision making.

Nurses have an important role in the clinical decision process. The interpretation of vital signs, laboratory test results, and electrocardiographic tracings will speed the
triage process and assist with determining which patients require immediate care and transfer from the emergency department to the cardiac care unit. The nurse’s understanding of the current AHA/ACC treatment guidelines for patients with ACS will not only help ensure delivery of evidence-based care, but will reduce time-to-treatment, a critical aspect of ACS response.

Postprocedural Bleeding
An additional key role for critical care nurses is in the early identification of postprocedural bleeding in patients with ACS. Bleeding is the most common noncardiac complication in patients undergoing PCI, due to the number of antiplatelet and anticoagulation therapies patients receive in the acute phase. Monitoring for arterial bleeding is particularly important in high-risk groups such as elderly patients, women, those with renal dysfunction, and those who had a STEMI. Monitoring should include regular assessment of wound or vascular-access sites, pain, peripheral pulses, vital signs, heart rhythm, and fluid intake and output. Bleeding should be suspected in any hypotensive patient who has recently received coronary angiography, PCI, CABG, or other surgery in a background of antiplatelet therapy.

The Nurse’s Role in Posthospital Care Planning

Postdischarge Pharmacotherapy
Nurses also have an important role in planning for discharge and posthospital management. With respect to posthospital care, the guidelines for NSTE-ACS emphasize secondary prevention, including continued use of antiplatelet therapy. Recommendations for maintenance dosing of antiplatelet agents in patients with NSTE-ACS are summarized in Table 2 (available online only). Routine pharmacotherapies recommended for posthospital care include continued use of β-blockers (when no contraindications are present) during and after hospitalization for all patients with STEMI (COR: I; LOE: B). In addition, angiotensin-converting enzyme inhibitors may be considered for all patients with STEMI (and no contraindications; COR: IIa, LOE: A), and all patients with STEMI should receive high-intensity statin therapy if there are no contraindications to its use (COR: I; LOE: B).

New Guideline Recommendations
Although not specifically referred to in the most recent update of the NSTE-ACS guidelines, the 2012 focused update contained a new section on quality of care and outcomes. It was recommended that key stakeholders (health care professionals and institutions) managing patients with NSTE-ACS contribute to a standardized quality-of-care data registry designed to monitor outcomes, including complications and adherence to agreed evidence-based care processes and improvement of quality for NSTE-ACS (COR: IIa; LOE: B). Among the registries listed are the National Cardiovascular Data Registry, the AHA’s Get With The Guidelines (GWTG) quality-improvement program, and the ACTION Registry-GWTG. The goal is to evaluate NSTE-ACS care, identify system problems, and implement improvements.

The 2013 ACCF/AHA STEMI guidelines have added a posthospitalization plan of care section designed to prevent hospital readmissions. It is recommended that all STEMI patients receive cardiac rehabilitation/secondary prevention programs that are exercise-based (COR: I; LOE: B); an evidence-based plan of care that encourages medication adherence (and is easy to understand), prompt follow-up with the health care team, improved diet and level of physical activity, and compliance with secondary prevention measures (COR: I; LOE: C); and smoking cessation support, including avoidance of second-hand smoke (COR: I; LOE: A).

Postdischarge Planning
As an in-hospital patient advocate, the critical care nurse is uniquely positioned to provide invaluable education about posthospital care to patients with ACS and their families. Such education would address medication adherence and titration, medication side effects, meeting promptly with a health care professional, smoking cessation, improved diet, physical activity levels, cardiac rehabilitation, symptom awareness, and the need for ongoing reassessment of risks for arrhythmias and heart failure. Assessment of adherence with medication is vital as evidence suggests that patients often discontinue antiplatelet therapy following hospital discharge, which may contribute to readmission and further complications, such as increased risk of stent thrombosis. Furthermore, patients should continue with a stabilized antiplatelet regimen as an outpatient unless there is a clinical need to change or discontinue treatment. Medication reconciliation is critically important during
hospitalization and at discharge to ensure no errors, omissions, and/or drug interactions occur.\textsuperscript{16,19} The nurse may also be mindful of wider socioeconomic/psychosocial challenges, including increased risk of depression and imbalance in health care provision or access that may necessitate individualization of the care plan.

A recent study by Jorstad et al\textsuperscript{52} provides evidence that nurse-coordinated education and monitoring after ACS improves cardiovascular outcomes. Patients were randomized to a program consisting of 4 outpatient nurse clinic visits within 8 months of ACS (n = 366) or to usual care alone (n = 367). Clinic visits focused on healthy lifestyles, biometric risk factors, and medication adherence and were conducted in addition to a usual-care regimen, which included outpatient cardiologist visits and referral to a 12-week cardiovascular rehabilitation program. After 12-month follow-up, the estimated 10-year cardiovascular mortality risk was reduced by 17% in the intervention group versus usual care alone. The intervention group also experienced a significant reduction in rehospitalizations (86 vs 132 with usual care). Although the intervention used in this study was carried out after discharge, predischarge counseling may have similar benefits in patients with ACS.\textsuperscript{52}

Conclusions

Evidence-based guidelines for patient management in ACS are updated regularly, as novel treatments become available. Critical care nurses need to be familiar with the latest guidelines in order to help deliver evidence-based care, speed time to treatment, and optimize outcomes for patients with ACS. CCN

Acknowledgments

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References


Management of alcohol withdrawal in critically ill patients is a challenge. The alcohol consumption histories of intensive care patients are often incomplete, limiting identification of patients with alcohol use disorders. Abrupt cessation of alcohol places these patients at risk for alcohol withdrawal syndrome. Typically benzodiazepines are used as first-line therapy to manage alcohol withdrawal. However, if patients progress to more severe withdrawal or delirium tremens, extra adjunctive medications in addition to benzodiazepines may be required. Sedation and mechanical ventilation may also be necessary. Withdrawal assessment scales such as the Clinical Institute of Withdrawal Assessment are of limited use in these patients. Instead, general sedation-agitation scales and delirium detection tools have been used. The important facets of care are the rapid identification of at-risk patients through histories of alcohol consumption, management with combination therapies, and ongoing diligent assessment and evaluation. (Critical Care Nurse. 2016;36[1]:28-39)
Withdrawal Assessment for Alcohol Revised (CIWA-ar) in some patients is questioned. In general, the limited research on AWS in critically ill patients limits the development of evidence-based guidelines. We describe the implications for practice due to these challenges and suggest some recommendations for nurses working in the ICU who provide care for patients with AWS.

Search Strategy
A comprehensive search was used to identify relevant articles for review. The EMBASE, PUBMED, and PRO-QUEST databases were searched without date limiters.

Neurobiology of Alcohol Withdrawal
Ethanol affects a variety of neurotransmitter pathways and receptors in the central nervous system. Long-term alcohol consumption creates an adaptive change to both the inhibitory γ-aminobutyric acid (GABA) and the excitatory glutamate systems.6 Specifically, the down-regulation of the GABA pathway results in reduced levels of endogenous GABA, and reductions in the number and sensitivity of GABA receptors.7 In addition, activation

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Table 1  Diagnostic and Statistical Manual of Mental Disorders (5th ed.) criteria for alcohol use disorder (AUD)

<table>
<thead>
<tr>
<th>The severity of the AUD is defined as:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild: The presence of 2 to 3 symptoms</td>
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</tr>
<tr>
<td>Moderate: The presence of 4 to 5 symptoms</td>
<td></td>
</tr>
<tr>
<td>Severe: The presence of 6 or more symptoms</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>The presence of at least 2 of these symptoms indicates an Alcohol Use Disorder (AUD).</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Alcohol is often taken in larger amounts or over a longer period than was intended.</td>
</tr>
<tr>
<td>2. There is a persistent desire or unsuccessful efforts to cut down or control alcohol use.</td>
</tr>
<tr>
<td>3. A great deal of time is spent in activities necessary to obtain alcohol, use alcohol, or recover from its effects.</td>
</tr>
<tr>
<td>4. Craving, or a strong desire or urge to use alcohol</td>
</tr>
<tr>
<td>5. Recurrent alcohol use resulting in a failure to fulfill major role obligations at work, school, or home.</td>
</tr>
<tr>
<td>6. Continued alcohol use despite having persistent or recurrent social or interpersonal problems caused or exacerbated by the effects of alcohol.</td>
</tr>
<tr>
<td>7. Important social, occupational, or recreational activities are given up or reduced because of alcohol use.</td>
</tr>
<tr>
<td>8. Recurrent alcohol use in situations in which it is physically hazardous.</td>
</tr>
<tr>
<td>9. Alcohol use is continued despite knowledge of having a persistent or recurrent physical or psychological problem that is likely to have been caused or exacerbated by alcohol.</td>
</tr>
<tr>
<td>10. Tolerance, as defined by either of the following:</td>
</tr>
<tr>
<td>a) A need for markedly increased amounts of alcohol to achieve intoxication or desired effect.</td>
</tr>
<tr>
<td>b) A markedly diminished effect with continued use of the same amount of alcohol.</td>
</tr>
</tbody>
</table>

Withdrawal, as manifested by either of the following:

a) The characteristic withdrawal syndrome for alcohol (refer to criteria A and B of the criteria set for alcohol withdrawal)

b) Alcohol (or a closely related substance, such as a benzodiazepine) is taken to relieve or avoid withdrawal symptoms.

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of the glutamate system occurs. N-methyl-D-aspartate (NMDA) receptors become upregulated, and the concentration of the neurotransmitter glutamate increases.7 When alcohol consumption ceases, these processes all lead to an unopposed neuronal excitation and the autonomic hyperactivity that occur during AWS.6

Clinical Manifestations

The cluster of signs and symptoms that characterizes AWS is classified as mild, moderate, or severe. The diagnostic criteria and classification of AWS by the American Psychiatric Association2(pp499-501) are presented in Table 2. Mild signs and symptoms such as tremor, anxiety, diaphoresis, tachycardia, and sleep disturbances typically occur in the first 24 hours after the last intake of alcohol.8 Progression to moderate and severe AWS may include fever, confusion, clouding of the sensorium, hallucinations, and seizures. The signs and symptoms that occur with moderate and severe withdrawal are the result of neuronal excitation.9 The most severe and feared complication of AWS is delirium tremens, which is usually manifested within 2 to 5 days after the last drink.9 Patients with delirium tremens may have a fluctuating level of consciousness, with attention and cognitive deficits, hallucinations, confusion, and hypertension.9 If delirium tremens is poorly managed, cardiovascular and respiratory collapse, arrhythmias, dehydration, electrolyte imbalances, and multiorgan dysfunction may occur.10 The mortality rate for patients with untreated delirium tremens is high (5%-15%), but with improved recognition and management, mortality has decreased to approximately 1% to 2%.8 According to estimates, delirium tremens may develop in 5% to 20% of patients with AWS.8 However, the true incidence among critically ill patients is hard to measure.8

Identifying ICU Patients at Risk for Alcohol Withdrawal

The key to managing alcohol withdrawal effectively is the early identification of an AUD gleaned from the patient’s medical history. Unfortunately, a patient’s history of alcohol consumption is often poorly obtained, not detailed enough, or not obtained at all.11-14 For example, in a retrospective review12 of approximately 2000 trauma patients, only 7.3% of patients had an adequate history taken that would have highlighted an AUD. In the ICU, alcohol histories may be missed for several reasons. The inability of patients to communicate because of sedation, mechanical ventilation, and delirium is clearly a barrier. In addition, Broyles et al11 found that clinicians either do not question enough about drug and alcohol intake or use selective questioning based on stereotyping of patients. The use of screening tools (Table 3) such as the CAGE questionnaire, the Alcohol Use Disorders Identification Test (AUDIT), the AUDIT-C, the AUDIT-PC, and the Michigan Alcoholism Screening Test improves the identification of an AUD during history taking. Unfortunately none of these tools has been developed or validated in critically ill patients.15-17
Anecdotally, nurses at the bedside are the care providers who often become aware of clues from a patient’s family about a patient’s alcohol use. Critical care nurses quickly establish rapport and relationships with their patients and the patients’ families and are extremely well placed to gain information about alcohol use. Regrettably, only a single study has shown that the completion of alcohol screening by family members could be as effective and valid as patient self-reporting.

The development of a valid and effective tool that nurses could use to glean important alcohol histories from patients or the patients’ families would be of great benefit. If patients at risk are identified at the time of admission, nurses will be able to detect signs and symptoms of an emerging AWS and initiate treatment early. This practice might halt the progression from mild to severe withdrawal and prevent delirium tremens.

Use of Serum Biomarkers to Detect an AUD

A serum laboratory test that could highlight chronic alcohol use would be helpful, especially when an alcohol history is unobtainable. Laboratory tests such as serum ethanol levels only reveal recent alcohol consumption, not the chronic intake of alcohol that predisposes to withdrawal. Other tests such as mean corpuscular volume and serum concentrations of γ-glutamyl transpeptidase and carbohydrate-deficient transferrin have been widely studied in a variety of patient populations. However, the tests have variable predictive value and poor utility. In 2 studies, serum biomarkers, including carbohydrate-deficient transferrin, in trauma patients were evaluated. Although both studies revealed that patients with higher levels of the transferrin had an increased length of stay and complications, the levels were not predictive of which patients would go into withdrawal. Findings such as these continue to reinforce the importance of the alcohol history.

Predicting Alcohol Withdrawal in Critically Ill Patients

Not every patient with an AUD will progress to withdrawal, just as not every patient who undergoes withdrawal progresses to delirium tremens. Thus, being able to predict who is and who is not at greater risk for withdrawal would be advantageous. Multiple risk factors, including a history of withdrawal seizures, structural brain lesions, multiple detoxification episodes, and severe withdrawal or delirium tremens during past withdrawals have been predictive of future severe withdrawal. A process known as “kindling” is postulated to be responsible for the increasing severity of withdrawal with each detoxification episode. Some researchers have taken these prediction factors and devised tools for identifying patients at risk for more severe withdrawal. Maldonado et al recently devised the Prediction of Alcohol Withdrawal Severity Scale; the scale is based on 10 factors identified through the literature. Unfortunately, this scale was validated in medical inpatients only, and so its use in ICU patients is limited. Although research on risk factors in ICU patients is limited, care providers generally accept that patients who have experienced severe withdrawal, delirium tremens, or seizures during past

<table>
<thead>
<tr>
<th>Tool</th>
<th>Development</th>
<th>Description</th>
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<tbody>
<tr>
<td>CAGE</td>
<td>Developed by Ewing et al15 primarily for the primary care setting</td>
<td>A 4-question tool for the detection of alcohol abuse:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1. Have you ever felt you should Cut down on your drinking?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Have people Annoyed you by criticizing your drinking?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Have you ever felt bad or Guilty about your drinking?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. Have you ever had a drink first thing in the morning to steady your nerves or to get rid of a hangover (Eye opener)?</td>
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<tr>
<td></td>
<td></td>
<td>Score of 2 or more indicates alcohol intake should be investigated further</td>
</tr>
<tr>
<td>Michigan Alcohol Screening Test (MAST)</td>
<td>Developed by Selzer et al16 in 1971</td>
<td>A 25-question screening tool to identify drinking behavior, alcohol</td>
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<tr>
<td></td>
<td></td>
<td>dependence, or adverse consequences of alcohol drinking</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Shorter 13-question version developed for hospital use in 1975 (Short MAST)</td>
</tr>
<tr>
<td>Alcohol Use Disorders Identification Test</td>
<td>Developed by the World Health Organization17 in 1992</td>
<td>A 10-question screening tool used to identify 3 aspects of an AUD:</td>
</tr>
<tr>
<td>(AUDIT)</td>
<td>Developed for primary care setting</td>
<td>excessive drinking pattern, hazardous drinking, and harmful consumption of alcohol</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Scores range from 0 to 40 (8 indicates potentially hazardous alcohol intake)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Several shortened variants also developed (AUDIT C, AUDIT PC)</td>
</tr>
</tbody>
</table>

Table 3 Screening tools used in the detection of alcohol use disorders (AUDs)

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withdrawal episodes are most at risk for severe withdrawal. Therefore, asking patients if they have experienced events such as seizures or delirium tremens during past withdrawals or detoxification episodes is important. The information will highlight any signs and symptoms experienced in the past that may be predictive of the manifestations of current and future withdrawals.

**Identifying Critically ill Patients With AWD**

Identifying critically ill patients who are in active withdrawal presents further challenges. Conditions such as sepsis, intracranial hemorrhage, meningitis, stroke, traumatic brain injury, and metabolic derangements may have signs and symptoms similar to those of AWS. For example, tremor, diaphoresis, altered vital signs, fever, and delirium are also evident in critical illness. Differentiating between AWS and the result of disease is thus difficult. A total of 2 older retrospective studies and 1 case series of critically ill patients have described this challenge. Bostwick and Lapid presented 4 cases of critically ill patients who had a diagnosis of AUD and were placed on an AWS assessment protocol. Despite seemingly adequate treatment of AWS, the condition of all 4 patients continued to worsen. Once a thorough workup had been completed, undiagnosed medical conditions, rather than worsening AWS, were revealed as the cause of the signs and symptoms. The important point is that a worsening clinical condition in a patient with AWS should not always be assumed to be related to withdrawal. This point is particularly important in the ICU, where patients are at great risk for adverse changes in clinical condition because of their critical illness. Any patient undergoing withdrawal whose condition worsens despite therapy must undergo a thorough examination and workup to exclude a missed acute medical condition.

**Treatment**

**Benzodiazepines**

Benzodiazepines are considered the first-line therapy in the treatment of AWS. The results of 2 meta-analyses have shown that these drugs are better in the control of signs and symptoms and more effective than placebo in halting the progression to delirium tremens. The mechanism of action is directly related to the interaction of benzodiazepines with brain GABA receptors. This interaction leads to an increase in GABA transmission, which reduces central nervous system excitability and the risk for seizures and prevents the progression to delirium tremens.

Although no evidence indicates that one benzodiazepine is better than another, the choice of a particular drug should be tailored to the patient. For example, rapid-acting benzodiazepines such as diazepam, lorazepam, and alprazolam may be more appropriate in patients when rapid symptom control is needed. Conversely, agents such as chlordiazepoxide and diazepam may be more effective in providing a smoother detoxification course and reducing rebound withdrawal symptoms. Unfortunately, both chlordiazepoxide and diazepam undergo hepatic metabolism. The active metabolite may accumulate in the liver in patients with hepatic disease if the dose of the drug is not adjusted. Instead, alprazolam and lorazepam may be more appropriate for patients with liver dysfunction. Unfortunatel, recommendations and guidelines on the optimum choice and dose of drug for critically ill patients with AWS remain limited. However, administration of benzodiazepines via the intravenous route may be preferable in the ICU because of the rapid onset of action and more predictable bioavailability.

**Symptom-Triggered Therapy and the CIWA-ar Scale**

Administration of benzodiazepines according to symptom-triggered therapy in combination with an alcohol withdrawal assessment scale has been superior to fixed dose scheduling in a variety of community and hospital settings. Evaluations of symptom-triggered therapy in the ICU have predominantly focused on the use of the CIWA-ar scale. The CIWA-ar remains the most widely used scale in clinical practice both inside and outside the ICU.

The CIWA-ar scale is a 10-item scale that can be used to assess a patient every 30 to 60 minutes (Table 4). A score less than 8 indicates mild withdrawal; moderate withdrawal is indicated by scores of 8 to 15, and scores greater than 20 indicate severe withdrawal. Typically, drug therapy is started in patients who have a score greater than 8.
### Table 4: The Clinical Institute Withdrawal Assessment for Alcohol (CIWA-ar) Scale

<table>
<thead>
<tr>
<th>NAUSEA AND VOMITING</th>
<th>ANXIETY</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ask:</strong> “Do you feel sick to your stomach? Have you vomited?”</td>
<td><strong>Ask:</strong> “Do you feel nervous”</td>
</tr>
<tr>
<td>0</td>
<td>No anxiety, at ease</td>
</tr>
<tr>
<td>1</td>
<td>Mildly anxious</td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Moderately anxious or guarded, so anxiety is inferred</td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>7</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TREMOR</th>
<th>AGITATION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Observe:</strong> Arms extended and fingers spread apart</td>
<td><strong>Observation:</strong></td>
</tr>
<tr>
<td>0</td>
<td>Normal activity</td>
</tr>
<tr>
<td>1</td>
<td>Somewhat more than normal</td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Moderately fidgety and restless</td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>7</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PAROXYSMAL SWEATS</th>
<th>TACTILE DISTURBANCES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Observe:</strong></td>
<td><strong>Ask:</strong> “Have you any itching, pins and needles, any burning or numbness, or do you feel bugs crawling under your skin?”</td>
</tr>
<tr>
<td>0</td>
<td>None</td>
</tr>
<tr>
<td>1</td>
<td>Very mild itching, pins and needles, burning or numbness</td>
</tr>
<tr>
<td>2</td>
<td>Mild itching, pins and needles, burning or numbness</td>
</tr>
<tr>
<td>3</td>
<td>Moderate itching, pins and needles, burning or numbness</td>
</tr>
<tr>
<td>4</td>
<td>Moderately severe hallucinations</td>
</tr>
<tr>
<td>5</td>
<td>Severe hallucinations</td>
</tr>
<tr>
<td>6</td>
<td>Extremely severe hallucinations</td>
</tr>
<tr>
<td>7</td>
<td>Continuous hallucinations</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>AUDITORY DISTURBANCES</th>
<th>HEADACHE, FULLNESS IN HEAD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ask:</strong> “Are you more aware of sounds around you? Are they harsh? Do they frighten you? Are you hearing anything that is disturbing to you? Are you hearing things you know are not there?”</td>
<td><strong>Ask:</strong> “Does your head feel different? Does it feel like there is a band around your head?” Do not rate for dizziness or light-headedness.</td>
</tr>
<tr>
<td><strong>Observation</strong></td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>Very present</td>
</tr>
<tr>
<td>2</td>
<td>Very mild</td>
</tr>
<tr>
<td>3</td>
<td>Mild</td>
</tr>
<tr>
<td>4</td>
<td>Moderate</td>
</tr>
<tr>
<td>5</td>
<td>Moderately severe</td>
</tr>
<tr>
<td>6</td>
<td>Severe</td>
</tr>
<tr>
<td>7</td>
<td>Very severe</td>
</tr>
<tr>
<td>8</td>
<td>Extremely severe</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>VISUAL DISTURBANCES</th>
<th>ORIENTATION AND CLOUDING OF SENSORIUM</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ask:</strong> “Does the light appear to be too bright? Is its color different? Does it hurt your eyes? Are you seeing anything that is disturbing to you? Are you seeing things you know are not there?”</td>
<td><strong>Ask:</strong> “What day is this? Where are you? Who am I?”</td>
</tr>
<tr>
<td><strong>Observation</strong></td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>Cannot do serial additions or is uncertain about date</td>
</tr>
<tr>
<td>2</td>
<td>Disoriented for date by no more than 2 calendar days</td>
</tr>
<tr>
<td>3</td>
<td>Disoriented for date by more than 2 calendar days</td>
</tr>
<tr>
<td>4</td>
<td>Disoriented for place/or person</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TOTAL CIWA-ar SCORE (MAX 67 POINTS):</th>
<th>RATERS INITIALS:</th>
</tr>
</thead>
</table>

*Adapted from Sullivan et al.*
Despite widespread use of the CIW A-ar scale in the ICU, only 4 randomized clinical studies\textsuperscript{44-47} and 1 retrospective cohort study\textsuperscript{48} that included use of the scale in patients with AWS have been published. In one of the early studies, Spies et al\textsuperscript{44} used the CIW A-ar scale to assess and guide therapy. Patients were assigned to 1 of 4 groups: clonidine and flunitrazepam, haloperidol and chlormethiazole, haloperidol and flunitrazepam, or ethanol alone. The efficacy of therapy did not differ between the drug regimens, and for most patients, AWS was adequately managed. The rate of tracheobronchitis was increased, however, among patients treated with chlormethiazole, a result of bronchial hypersecretion.

In another study, Spies et al\textsuperscript{45} evaluated the management of 159 critically ill trauma patients who were randomized to treatment with clonidine and flunitrazepam, haloperidol and chlormethiazole, or haloperidol and flunitrazepam. Overall, no regimen was more advantageous than another, and for most patients, therapy was effective (scores on the CIW A-ar scale decreased to \(<20\)). However both early studies\textsuperscript{44,45} included only a narrowly defined cohort of ICU patients, predominantly patients who were young (mainly trauma patients), had low-acuity illness, and were not intubated.

In a third study, Spies et al\textsuperscript{46} reported similar results among 44 trauma-surgical ICU patients in a prospective, randomized double-blind trial comparing bolus versus fixed-dose infusion of flunitrazepam. In contrast to the patients in the earlier studies, the patients in this study\textsuperscript{46} experienced much more complex withdrawal and had higher CIW A-ar scores, indicating a need for multimodal therapy and mechanical ventilation.

In summary, these studies revealed that the CIW A-ar scale can be a useful tool for critically ill patients undergoing AWS. Unfortunately, one drawback of the scale is that it remains unvalidated in this patient group. Although the studies by Spies et al\textsuperscript{44-46} did show effective use of the scale in their selected cohorts of patients (mainly trauma), how the scale might be affected by other patient-related variables such as critical illness (eg, organ dysfunction, sepsis) is still unknown. A theoretical risk exists that signs and symptoms of critical illness might be mistaken for those of AWS, leading to falsely elevated scores on the CIW A-ar scale.\textsuperscript{31,32,49} Such a mistake might lead to the inappropriate or overzealous administration of medications, with the risk of oversedation and other side effects.\textsuperscript{32} To date, only 1 case series\textsuperscript{32} and 1 older retrospective analysis\textsuperscript{49} have alluded to this phenomenon. Still, cognizance of the potential for exaggerated scores on the CIW A-ar scale patients with critical illness is important. If the CIW-ar scale is used, then scores must be analyzed within the wider context of each patient’s signs and symptoms, with careful assessment and evaluation of response to treatment. The CIW-ar scale should not be applied indiscriminately or without careful consideration in critically ill patients.

**Severe AWS and Delirium Tremens**

Evidence\textsuperscript{50} indicates that patients who have a medical or surgical illness in whom AWS develops have a higher predisposition for more severe withdrawal and delirium tremens than do patients who have AWS only. Most likely the situation is the same for patients with a critical illness and AWS. However, in general, little research has been done on the influence of critical illness on delirium tremens and vice versa.\textsuperscript{50} Most recently, Sohraby et al\textsuperscript{48} reported the results of a retrospective cohort study of critically ill patients with severe AWS. The findings indicated that this population of patients may need additional drugs to manage severe withdrawal. Adjuvant therapy with anticonvulsants, neuroleptic agents, sedative-hypnotics, antipsychotics, and \(\alpha\)-agonists may be needed. However, the lack of large high-quality studies generally limits guidance on choice, combination, and recommended doses for these patients.\textsuperscript{31}

Gold et al\textsuperscript{52} performed a retrospective cohort study on patients admitted to the ICU with delirium tremens refractory to benzodiazepines. One group of patients (\(n = 54\)) was treated before the institution of guidelines emphasizing escalating doses of diazepam in combination with lower doses of phenobarbital. The second group (\(n = 41\)) received benzodiazepines and higher doses of phenobarbital. The second group had a significant reduction in the need for intubation, and a trend toward decreased length of stay. In another randomized controlled trial,\textsuperscript{53} treatment with benzodiazepines and phenobarbital in patients in the emergency department reduced the need for ICU admission. The long duration of action of phenobarbital may provide a smoother course of detoxification.\textsuperscript{53} However, further research in critically

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**Dexmedetomidine has become a promising agent in the management of AWS in the ICU in combination with benzodiazepines.**
A drawback of using the CIWA-ar scale is that patients must be able to communicate symptom severity for 7 of the 10 items. Clearly, this requirement is a problem for critically ill patients who are delirious, confused, and unable to communicate. The studies by Sohrab et al\textsuperscript{46} and Mueller et al\textsuperscript{47} are important in identifying how intubated patients with AWS can be assessed in the ICU. These studies\textsuperscript{46,47} were performed in a unique, complex group of patients (intubated for severe withdrawal), a sample often excluded from earlier studies.\textsuperscript{44-46} Both Mueller et al and Sohrab et al used the CIWA-ar scale in alert, communicative, cognitively aware patients and the Riker Sedation-Agitation Scale, the Ramsey Agitation Scale, or the Richmond Agitation-Sedation Scale when patients could no longer communicate. Previously, Weinberg et al\textsuperscript{64} used the 7-item Riker Sedation-Agitation Scale in a study of 50 trauma patients, and Elsing et al\textsuperscript{65} used an adapted 4-item CIWA-ar scale in a study of 26 AWS patients in a medical ICU. Use of these tools\textsuperscript{46,65} has been neither validated nor described elsewhere.

Only 1 tool has been specifically designed for intubated, critically ill patients undergoing alcohol withdrawal: the Minnesota Detoxification Scale. DeCarolis et al\textsuperscript{66} described the development and use of the scale in 36 medical ICU patients. The scale is limited, however, because it is based on only 1 single-center, retrospective study with only 36 patients and it remains unvalidated. Guidelines\textsuperscript{67} and a systematic review\textsuperscript{68} do support titrating medications to scores on a sedation-agitation scale and clinical judgment but do not describe which tool may be the best for patients undergoing withdrawal. Guidelines\textsuperscript{68} on the management of sedation and delirium in critically ill patients not in acute withdrawal suggest using either the Riker Sedation-Agitation Scale or the Richmond Agitation-Sedation Scale.

Delirium detection scales such as the Confusion Assessment Method for the Intensive Care Unit (CAM-ICU) and the Intensive Care Delirium Screening Checklist (ICDSC) are highly sensitive and specific for detection of delirium in general ICU patients.\textsuperscript{69} For the CAM-ICU, sensitivity is 80% (95% CI, 77.1-82.6), and specificity is 92% (95% CI, 86.6-95.5).
95.9% (95% CI, 94.8-96.0). The ICDSC has a sensitivity of 74%, and a specificity of 81% as a diagnostic screening tool for delirium in the ICU.\textsuperscript{69} Compared with the CAM-ICU, the ICDSC was as effective in the detection of delirium but with slightly less specificity. However, neither the CAM-ICU nor the ICDSC have been validated in patients with AWS-related delirium. Nonetheless, Tolonen et al\textsuperscript{59} successfully used the CAM-ICU in the management of 18 patients with alcohol-related delirium in the ICU. This study\textsuperscript{59} was only a prospective series, however, and further studies are warranted.

Finally, the Delirium Detection Score (DDS) developed and validated by Otter et al\textsuperscript{80} was refined from the CIWA-ar scale. The researchers and developers suggest that the DDS can be used in the ICU in patients with either alcohol-related delirium or delirium of different etiology. Paupers et al\textsuperscript{71} suggest that the score could be used with good validity and reliability. However, the DDS is such a recent tool, it requires further multicenter studies to confirm its external validity and generalizability before it can be widely adopted. It remains the only alcohol withdrawal assessment tool currently validated in ICU patients and of use in patients receiving mechanical ventilation. Until more research on delirium detection scales is performed on critically ill patients undergoing alcohol withdrawal, one scale cannot be recommended for use over another. Until more research is performed, nurses can continue to use any of the delirium detection scales together with clinical judgment, assessment, and the evaluation of treatment.

Conclusion

Important challenges are associated with caring for critically ill patients with AWS. The first step in identifying a patient with an AUD is obtaining a history of the patient’s alcohol consumption. However, obtaining this history is poorly executed in clinical practice. Recognizing patients in active alcohol withdrawal is also difficult. The clinical manifestations of critical illness and AWS are often similar. Once AWS is diagnosed, the CIWA-ar scale can be used to assess and monitor response to therapy and the progression of signs and symptoms. Some patients may progress to delirium tremens and require multiple-drug therapies, intubation, and mechanical ventilation. The CIWA-ar scale can then no longer be used in these patients. Sedation-agitation scales and delirium detection tools have been used in AWS patients who are intubated or receiving mechanical ventilation. However, the efficacy and usefulness of the tools in patients with AWS or delirium tremens have not been evaluated. What may be of use is a large, methodologically sound study that provides validation of a tool or scale that can be used for AWS in critically ill patients.

Implications and Recommendations

A great need exists for further research in almost every aspect of AWS in critically ill patients. An important facet of caring for such patients is obtaining a thorough alcohol history early in their admission. Nurses are perfectly placed to obtain histories of alcohol consumption from patients or the patients’ families. A tool that enables nurses to obtain the alcohol history would be of great benefit. Once AWS is diagnosed in a patient, a treatment plan must be developed. Astute nursing assessment, clinical judgment, and diligent monitoring for subtle changes in the patient’s signs and symptoms are paramount. These steps are important for 2 reasons: first, to recognize the difference between what may be a worsening medical condition and worsening AWS; and second, to ensure worsening AWS is recognized early and use of adjunctive medications is started. A reasonable approach might be to use a severity assessment scale such as the CIWA-ar to guide and assess the response to these therapies. However scores must be viewed in the right clinical context and always in conjunction with excellent clinical judgment. Specific recommendations for sedation-agitation or delirium detection scales for AWS cannot be made at this juncture. However use of the CAM-ICU in conjunction with a sedation-agitation scale may be beneficial in AWS patients who are sedated, being treated with mechanical ventilation, or are delirious. CCN

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Financial Disclosures

None reported.

eLetters

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dotmore

References


Alcohol Withdrawal Syndrome in Critically Ill Patients: Identification, Assessment, and Management

Management of alcohol withdrawal in critically ill patients is a challenge. The alcohol consumption histories of intensive care patients are often incomplete, limiting identification of patients with alcohol use disorders. Abrupt cessation of alcohol places these patients at risk for alcohol withdrawal syndrome (AWS).

- The cluster of signs and symptoms that characterizes AWS is classified as mild, moderate, or severe. Mild signs and symptoms such as tremor, anxiety, diaphoresis, tachycardia, and sleep disturbances. Progression to moderate and severe AWS may include fever, confusion, clouding of the sensorium, hallucinations, and seizures.
- The most severe complication of AWS is delirium tremens, which is usually manifested within 2 to 5 days after the last drink. If delirium tremens is poorly managed, cardiovascular and respiratory collapse, arrhythmias, dehydration, electrolyte imbalances, and multiorgan dysfunction may occur.
- The key to managing alcohol withdrawal effectively is the early identification. In the intensive care unit (ICU), alcohol histories may be missed for several reasons. The inability of patients to communicate because of sedation, mechanical ventilation, and delirium is clearly a barrier.
- Care providers generally accept that patients who have experienced severe withdrawal, delirium tremens, or seizures during past withdrawal episodes are most at risk for severe withdrawal. Therefore, asking patients if they have experienced events such as seizures or delirium tremens during past withdrawals or detoxification episodes is important.
- Benzodiazepines are considered the first-line therapy in the treatment of AWS. The choice of a particular drug should be tailored to the patient. For example, rapid-acting benzodiazepines such as diazepam, lorazepam, and alprazolam may be more appropriate when rapid symptom control is needed. Conversely, agents such as chlordiazepoxide and diazepam may be more effective in providing a smoother detoxification course and reducing rebound withdrawal symptoms.
- However, if patients progress to more severe withdrawal or delirium tremens, extra adjunctive medications in addition to benzodiazepines may be required. Sedation and mechanical ventilation may also be necessary.
- The CIWA-ar scale can be a useful tool for critically ill patients undergoing AWS. However, a theoretical risk exists that signs and symptoms of critical illness might be mistaken for those of AWS, leading to falsely elevated scores on the CIWA-ar scale. Such a mistake might lead to the inappropriate administration of medications, with the risk of oversedation and other side effects.

Although most extremity hemorrhage from trauma can be controlled with direct pressure and/or pressure dressings, the occasional uncontrolled hemorrhage can be life threatening. Tools that may be able to control such life-threatening extremity hemorrhage include hemostatic dressings, tourniquets, and several new devices that have recently become available. Hemostatic dressings, a relatively new concept, incorporate materials that increase coagulation into a dressing that is applied directly to the wound. Although the use of tourniquets has a long history, recent military conflicts have provided numerous studies that supported and refined their use. The novel extremity hemorrhage control devices effectively control bleeding in one of several ways: direct compression, arterial compression above the level of injury, and sealing the wounds’ edges, creating a hematoma. (Critical Care Nurse. 2016;36[1]:40-51)

Blood loss associated with traumatic extremity injuries (eg, open wounds, open fractures, amputations) quickly leads to hypovolemic shock and may be fatal if not rapidly controlled. The military’s experience in recent wars has demonstrated that early control of severe hemorrhage is critical and that extremity hemorrhage is a frequent cause of battlefield death.1,2 The consensus is growing about the use of some of these tools in civilian trauma.3,4 Some of the tools that the military has developed and used for traumatic extremity injuries are crossing over into civilian trauma care.

Basic Extremity Hemorrhage Control
Extremity hemorrhage may be controlled with direct pressure or a simple pressure dressing directly over the wound.5 However, the success of these methods is dictated by the amount of pressure and how long the pressure is exerted over the wound, which should be at least 5 to 10 minutes, the nature of the wound (large vs small, venous vs arterial, gaping vs puncture, simple vs amputation), and the hemodynamic stability of the patient. Various types of dressings made from differing materials have been used, from improvised dressings of whatever materials are at hand to sophisticated dressings used by emergency medical services (EMS) and military forces.6-9 Hemorrhage control using these methods is often successful when enough direct pressure is applied with the dressing, either manually, or in combination with pressure exerted by the bulk, composition, and tightness of the applied dressing. Hemorrhage from open fractures may also be treated with splinting (static or traction), in addition to direct pressure and/or pressure dressings. Partial or complete amputations often present unique challenges to hemorrhage control, but the same principles just described continue to apply.
If direct pressure and/or pressure dressings are not adequate to stop the hemorrhage, compression of an arterial pressure point proximal to the wound has been advocated, although no research has been done to support this technique of hemorrhage control. In addition, pressure point compression is ineffective in occluding distal flow. Continued digital pressure point pressure is difficult to maintain, for example, when a patient is being moved on a stretch or gurney. Other technologies have emerged to assist care providers in obtaining control of extremity wound hemorrhage, if direct pressure and pressure dressings are ineffective.

Hemostatic Dressings

Hemostatic dressings are dressings to which material has been added to enhance coagulation. All manufacturers recommend holding pressure on the wound for 2 to 5 minutes after the hemostatic dressings have been applied. Indications for use include bleeding that is uncontrolled with conventional methods and extremity wounds in areas that are not amenable to conventional dressings or tourniquets (eg, groin or axillary wounds). Because of their ease of use and similarity to standard gauze dressings, these types of gauze hemostatic dressings have been compared with one another in research studies. The gauze bandages (QuikClot Gauze [also known as Combat Gauze; Z-Medica], Celox [Medtrade Products], Chitoflex [HemCon Medical Technology, Inc]) are impregnated with procoagulation materials but retain the characteristics of a standard gauze dressing. Currently, the US military uses Combat Gauze and the NATO nation forces use Celox gauze dressings. No one hemostatic dressing has been identified as consistently superior to the others in either the laboratory or the clinical setting.

Owing to the continued interest and research in hemostatic dressings, the granule-based products have been supplanted by gauze-based dressings that incorporate some or all of the technology that was used to develop the granule-based products. In addition, the newer formulations of the dressings have eliminated the source of exothermic reactions that were a cause for concern with some of the granular products. Table 1 lists the ideal characteristics for hemostatic dressings.

QuikClot Gauze is a nonwoven gauze dressing that is coated with kaolin, an aluminum silicate that initiates coagulation by functioning as a surface activator when it comes in contact with blood. The dressing material (nonwoven rayon and polyester blend) combined with the kaolin promotes the formation of clots. In addition, kaolin activates the XII factor of the coagulation cascade and is dependent upon an adequately functioning coagulation cascade. However, small, ongoing animal research studies have demonstrated QuikClot’s efficacy with both hypothermia and dilutional coagulopathy. Because of its mechanism of action, QuikClot may not provide immediate hemostasis and may cause more initial blood loss. The resulting clots are often disrupted when the QuikClot, which is easily removed, is removed from wounds.

Table 1

<table>
<thead>
<tr>
<th>Characteristics of the ideal hemostatic dressing for tactical applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approved or cleared by the US Food and Drug Administration</td>
</tr>
<tr>
<td>Stops severe arterial and/or venous bleeding in 2 minutes or less</td>
</tr>
<tr>
<td>No toxicity or side effect</td>
</tr>
<tr>
<td>Causes no pain or thermal injury</td>
</tr>
<tr>
<td>Poses no risk to medics</td>
</tr>
<tr>
<td>Ready to use and requires little or no training</td>
</tr>
<tr>
<td>Durable and lightweight</td>
</tr>
<tr>
<td>Flexible enough to fit complex wounds and is easily removed without leaving residues</td>
</tr>
<tr>
<td>Stable and functional at extreme temperatures (-10°C to +40°C) for at least 2 weeks</td>
</tr>
<tr>
<td>Practical and easy to use under austere conditions (low visibility, rain, wind, etc)</td>
</tr>
<tr>
<td>Effective on junctional wounds not amendable by tourniquet</td>
</tr>
<tr>
<td>Long shelf life (&gt; 2 years)</td>
</tr>
<tr>
<td>Inexpensive and cost-effective</td>
</tr>
<tr>
<td>Biodegradable and bioabsorbable</td>
</tr>
</tbody>
</table>

Owing to the continued interest and research in hemostatic dressings, the granule-based products have been supplanted by gauze-based dressings that incorporate some or all of the technology that was used to develop the granule-based products. In addition, the newer formulations of the dressings have eliminated the source of exothermic reactions that were a cause for concern with some of the granular products. Table 1 lists the ideal characteristics for hemostatic dressings.

QuikClot Gauze is a nonwoven gauze dressing that is coated with kaolin, an aluminum silicate that initiates coagulation by functioning as a surface activator when it comes in contact with blood. The dressing material (nonwoven rayon and polyester blend) combined with the kaolin promotes the formation of clots. In addition, kaolin activates the XII factor of the coagulation cascade and is dependent upon an adequately functioning coagulation cascade. However, small, ongoing animal research studies have demonstrated QuikClot’s efficacy with both hypothermia and dilutional coagulopathy. Because of its mechanism of action, QuikClot may not provide immediate hemostasis and may cause more initial blood loss. The resulting clots are often disrupted when the QuikClot, which is easily removed, is removed from wounds.
resulting in profuse bleeding. In a review of the literature on QuikClot, Gegel et al concluded that published reports did not “conclusively demonstrate” that QuikClot was effective in stopping hemorrhage because the research reviewed focused on animal-based studies and lower level human studies. However, the most recent Tactical Combat Casualty Care guidelines recommend QuikClot for hemorrhage control when a tourniquet is not applicable.

Celox (Figure 1) is a gauze dressing that is impregnated with chitosan, a biodegradable compound derived from the shells of marine arthropods. When the positively charged chitosan comes into contact with the negatively charged red blood cells (RBCs) and platelets, a strong cross link is established that adheres strongly to the wound surface, sealing the wound with mucoidhesive activity. It is not dependent upon a functioning coagulation cascade to be effective. Chitoflex is another gauze dressing that is impregnated with chitosan and has a hemostatic effect similar to that of Celox. Littlejohn et al noted that because of the mucoidherent properties of Chitoflex, the roll had a tendency to be adherent to itself when it came into contact with blood and recommended completely unrolling the roll before insertion. The animal and human studies done to evaluate hemostatic dressings are summarized in Tables 2 and 3, respectively.

Although kaolin is an inert material that is not absorbed into the body, Baldrick’s exhaustive review of the safety of chitosan noted that any chitosan absorbed is converted to naturally occurring glucosamine derivatives that are then used in the amino sugar pool or excreted. Given that chitosan is derived from the shells of marine arthropods, there is a reasonable concern about its interactions within the body. Waibel et al studied the possibility of allergic reactions to chitosan in patients with known allergies to shellfish and noted that no cases of allergic reactions in military personnel who were treated with this type of dressing and had a concurrent shellfish allergy have been reported.

Although a significant amount of research on the various hemostatic dressings has been done, Rall et al stated that “Despite their different compositions and sizes, the lack of clear superiority of any agent suggests that contemporary hemostatic dressing technology has potentially reached a plateau for efficacy.”

Table 2 Animal studies that used hemostatic dressings

<table>
<thead>
<tr>
<th>Reference</th>
<th>Dressings evaluated</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Causey et al</td>
<td>QuikClot vs standard gauze</td>
<td>Standard gauze failed 100% with first dressing and 83% with second dressing QuikClot was 93% successful with first dressing and 100% successful with second dressing</td>
</tr>
<tr>
<td>Littlejohn et al</td>
<td>Celox vs QuikClot vs Chitoflex vs standard gauze</td>
<td>No significant differences between the dressings used in failure to achieve hemostasis, incidence of rebleeding, survival and mortality, and blood loss Standard gauze performed similarly to Celox, QuikClot, Chitoflex in all outcome measures</td>
</tr>
<tr>
<td>Sambasivan et al</td>
<td>Chitoflex vs standard gauze</td>
<td>No significant differences between Chitoflex and standard gauze in dressing failures, posttreatment blood loss, or fluid resuscitation requirements</td>
</tr>
<tr>
<td>Watters et al</td>
<td>QuikClot vs Celox vs standard gauze</td>
<td>No significant difference between QuikClot, Celox, and standard gauze in survival, dressing success, or total blood loss</td>
</tr>
<tr>
<td>Rall et al</td>
<td>QuikClot vs Celox vs Chitoflex</td>
<td>No significant difference between the 3 dressings in hemostasis or survival No significant differences in blood loss at 30 minutes and 150 minutes Blood loss at 10 minutes was significantly higher with QuikClot than with Celox (P = .046)</td>
</tr>
</tbody>
</table>
Dressings are used to control extremity hemorrhage, but another method of treating extremity wound hemorrhage has literally been around for centuries. Unfortunately, that time frame has allowed perpetuation of some myths that more current research has put to rest.

**Tourniquets**

Tourniquet use to stop extremity hemorrhage was described by the ancient Greeks. In the 18th century, Petit improved on an earlier screw design and is credited with coining the term “tourniquet,” from the French “to turn” (*tourner*). The use of tourniquets was decried by the physicians of both the Crimean (British) and American Civil wars. However, many of the complications that these physicians accredited to tourniquet application can actually be attributed to several other factors: (1) extended times from injury to initial physician evaluation (in many cases, up to days), (2) lack of a standardized tourniquet design (most were improvised), and (3) lack of knowledge regarding tourniquet application (inadequate pressure).

During World War I, physicians’ negative opinion of tourniquets continued, with both the British and French suggesting that a tourniquet be removed as soon as it is encountered, even though the patient may have been many hours from the time of injury. These admonitions had been gradually displaced by World War II; however, it was still thought that a tourniquet equaled amputation, despite the fact that tourniquets were recommended to be available for patients with known vascular injuries as they were being transferred. A seminal study of tourniquet application in more than 200 servicemen during World War II revealed no cases of gangrene attributable to the use of a tourniquet alone. In addition, they noted that not a single case of thromboembolic events, excessive edema, or skin or nerve damage was documented in these patients. World War II also heralded the shift from releasing the tourniquet every 30 minutes to allow collateral perfusion to leaving it in place until other means are available to stop the bleeding. The Korean War expanded on experiences from World War II and, in conjunction with improved vascular surgical techniques and rapid evacuation, provided more evidence that tourniquets were not inevitably linked to amputations. More current research regarding tourniquet use is summarized in Table 4.

Although many myths are associated with tourniquet use, research from the recent wars in both Iraq and Afghanistan show that tourniquets have few complications and are effective in both adults and children. The implementation of tourniquets is “one of the most significant medical breakthroughs of the war.”

The goal of care in using a tourniquet is simply to stop arterial bleeding distal to the application point where other methods are ineffective or not appropriate. The tourniquet should be wide enough (at least 2 inches [51 mm]) to compress the artery and stop the bleeding, without causing an inordinate amount of tissue damage from the compression. The wider the tourniquet, the less pressure is required to stop distal arterial blood flow. In addition, the tourniquet should be of an inelastic material, such as woven cloth, that will not stretch over time, thus decreasing the compression. A tightening mechanism that can be secured when the appropriate compression is reached is extremely important.

<table>
<thead>
<tr>
<th>Reference</th>
<th>Dressings evaluated</th>
<th>Results</th>
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<tbody>
<tr>
<td>Trabottoni, et al</td>
<td>Standard dressings vs QuikClot</td>
<td>Mean (SD) time to hemostasis was significantly shorter with manual compression with QuikClot compared with manual compression with a standard dressing: 5.4 (1.5) vs 25 (15) min (<em>P</em> &lt; .001)</td>
</tr>
<tr>
<td>Ran et al</td>
<td>QuikClot</td>
<td>Eleven of 14 cases (79%) had hemorrhage successfully controlled with QuikClot Three failures were related to Aortic injury Gluteal injury with femur and iliac wing fracture and penetrating rectal trauma Extensive degloving thigh injury</td>
</tr>
<tr>
<td>Tan and Bleeker</td>
<td>Celox</td>
<td>Six of 7 cases (86%) had hemorrhage successfully controlled with Celox One failure was related to hemorrhage from a skull fracture</td>
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</table>
Table 4  Modern tourniquet research

<table>
<thead>
<tr>
<th>Reference</th>
<th>Study scenario</th>
<th>Results</th>
<th>Complications</th>
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<tbody>
<tr>
<td>Dorlac et al33</td>
<td>5½ years of data from 2 level I trauma centers in Houston</td>
<td>Eight of the 14 patients could have survived if they had been treated with tourniquets</td>
<td>Not evaluated</td>
</tr>
<tr>
<td></td>
<td>Evaluated 14 patients who had positive vital signs in the field and arrived with cardiopulmonary resuscitation in progress</td>
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<td>Lakstein et al2</td>
<td>Evaluated 550 patients treated by Israeli Defense Force (IDF) for use of tourniquets from 1997 to 2001</td>
<td>Fifty-eight tourniquets applied for appropriate situations (failure to control bleeding with bandaging, wound characteristics, tactical considerations)</td>
<td>Five patients experienced extremity paralysis, but only those with documented tourniquet times from 109 to 187 minutes</td>
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<td>Ninety-one patients had a total of 110 tourniquets applied</td>
<td>Tourniquets were effective in 78%</td>
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<tr>
<td></td>
<td>Evaluated 550 patients treated by Israeli Defense Force (IDF) for use of tourniquets from 1997 to 2001</td>
<td>Fifty-two tourniquets were placed when they were not indicated</td>
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<td>Ninety-one patients had a total of 110 tourniquets applied</td>
<td>Fifty-two tourniquets were placed when they were not indicated</td>
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<tr>
<td>Beekley et al34</td>
<td>Evaluated 165 patients treated at the 31st Combat Support Hospital, Iraq, from January 1 to December 31, 2004</td>
<td>Of the 7 deaths without tourniquet application, 4 were potentially preventable with the effective use of tourniquets</td>
<td>Not evaluated</td>
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<td></td>
<td>Admitted with traumatic amputation, major extremity vascular injury, or documented prehospital tourniquet placement</td>
<td>A total of 80 tourniquets were placed on 67 of the study’s patients</td>
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<td>No bleeding on arrival in 83.3% of the patients with tourniquets and 60.7% in patients without tourniquets (Fisher exact test, ( P = .03 ))</td>
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<td>With patients with an Injury Severity Score (ISS) greater than 15, no bleeding was noted on arrival in 85% of the patients with tourniquets and 17% of patients without tourniquets (( P &lt; .001 ))</td>
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</tr>
<tr>
<td>Kragh et al35</td>
<td>Evaluated tourniquet use in 1462 casualties treated from March 19 to October 4, 2006, at a combat support hospital in Baghdad, Iraq</td>
<td>415 (97%) applications of tourniquets were indicated by either medical or tactical situation</td>
<td>Four patients (1.7%) had transient nerve palsy whereas 6 patients had palsies at the wound level</td>
</tr>
<tr>
<td></td>
<td>Two hundred thirty-two patients had 428 tourniquets applied to 309 injured limbs</td>
<td>One tourniquet was effective in 167 of 203 (82%) applications and 2 side by side tourniquets were effective in 97 of 106 (92%) applications</td>
<td>No amputations were exclusively attributed to tourniquet use</td>
</tr>
<tr>
<td>Kragh et al36</td>
<td>Evaluated tourniquet use in 1462 casualties treated from March 19 to October 4, 2006, at a combat support hospital in Baghdad, Iraq</td>
<td>Nine of 10 patients who were in shock when the tourniquet was applied died (90%) compared with 22 of 222 patients who were not in shock when the tourniquet was applied who died (10%; ( P &lt; .001 ))</td>
<td>Four nerve palsies at the level of the tourniquet were identified and only 1 of the 4 had mild persistence of the palsy at day 6 of follow-up</td>
</tr>
<tr>
<td></td>
<td>Two hundred thirty-two patients had 428 tourniquets applied to 309 injured limbs</td>
<td>22 of 194 patients with prehospital-applied tourniquets died (11% mortality) compared with 9 of 38 patients who died after tourniquet was applied in the emergency department (24% mortality) (( P = .05 ))</td>
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<td>In 5 patients in whom tourniquets were indicated but not used, the survival rate was 0% compared with 87% survival in patients who had tourniquets applied (( P &lt; .001 ))</td>
<td></td>
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<tr>
<td>Kragh et al37</td>
<td>Further evaluated tourniquet use in 238 patients in the study above35</td>
<td>Data regarding mechanism of injury, use site, survival rates, and morbidity rates were similar in both studies</td>
<td>Rate of nerve palsies at the level of the tourniquet was 1.7% for the first study and 1.4% for the second study</td>
</tr>
<tr>
<td></td>
<td>Evaluated an additional 267 patients in a combat support hospital in Baghdad, Iraq</td>
<td>Survival was 90% when tourniquet was applied before shock compared with an 18% survival rate if the tourniquet was applied after the onset of shock</td>
<td>Major limb shortening occurred in 0.4% of cases for both studies</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tourniquet use in absence of shock was associated with survival (( P &lt; .001 ))</td>
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<tr>
<td></td>
<td></td>
<td>Tourniquet use in prehospital setting was associated with survival (( P = .02 ))</td>
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*Continued*
is reached is also important. A number of commercial tourniquets are available\(^{42}\) (see Figures 2 and 3). Although pneumatic tourniquets are available, one concern is that they are more likely to fail in austere environments, so the remainder of this section will apply to the more commonly used tourniquets shown in Figures 2 and 3.

Adequate training is essential to the successful placement of a tourniquet. Ideally, the tourniquet should be placed before enough blood has been lost for shock to occur, so recognition of when to place a tourniquet is important, as noted in the shift from A, B, C to \(<\text{C}\>\) A, B, C to immediately stop uncontrolled hemorrhage.\(^{43}\)

The initial and primary use of a tourniquet may bypass the use of direct pressure and pressure dressings by providing the most effective hemorrhage control.\(^{41}\) The limb should have no clothing between the tourniquet and the skin because such clothing might allow the tourniquet to slip during movement of the patient.\(^{35}\)

Once the tourniquet is appropriately positioned, it is tightened until the arterial blood flow distal to the wound ceases and the distal pulse is no longer palpable. If the tourniquet is not tightened to the point of stopping the distal arterial flow, it will create a venous tourniquet effect, which allows arterial blood to perfuse the limb while preventing venous outflow and thus engorges the limb. This engorgement then leads to increased distal limb compartment pressure or expanding hematoma formation and the possible development of compartment syndrome and potential exsanguination.\(^{41}\)

In the rare situation where a correctly applied tourniquet does not stop the arterial blood flow from the wound, applying more compression to the tourniquet will more likely cause significant tissue damage without stopping the arterial blood flow distal to the wound.

In this situation, a second tourniquet may be applied proximal to the first tourniquet.\(^{6}\)

Successful tourniquet use in a patient who is conscious will most likely cause marked pain. This pain does not indicate that the tourniquet is incorrectly applied or too tight. The pain must be treated appropriately and should not induce the health care provider to release the tourniquet. Once applied, the tourniquet is left in place and not loosened until a physician is available to assess its utility and effectiveness and definitively treat the source of the bleeding. Every time the patient is moved, the tourniquet should be reexamined to make sure it is still effective.

The limb should have no clothing between the tourniquet and the skin because such clothing might allow the tourniquet to slip during movement of the patient.
SURE THAT IT HAS NOT BECOME LOOSE. WHEN A TOURNIQUET IS APPLIED AND WHEN IT IS REMOVED SHOULD BE DOCUMENTED TO HELP THE PHYSICIAN UNDERSTAND HOW MUCH TIME THE TISSUE DISTAL TO THE TOURNIQUET WAS ISCHEMIC. ONE TECHNIQUE USED IN THE PREHOSPITAL SETTING IS TO USE AN INDELIBLE MARKER TO PLACE A “T” ON THE PATIENT’S FOREHEAD WITH THE TIME THE TOURNIQUET WAS APPLIED. IN ADDITION, THE TOURNIQUET MUST BE READILY IDENTIFIABLE AND SHOULD NEVER BE COVERED UP BY BLANKETS OR DRESSINGS. ALTHOUGH DRESSINGS AND TOURNIQUETS ARE EFFECTIVE, THERE ARE SOME SITUATIONS WHERE A DIFFERENT APPROACH MAY BE APPROPRIATE, SUCH AS WHEN THE WOUND IS OVER A COMPRRESSIBLE OR JUNCTIONAL SPACE.

**Novel Hemorrhage Control Devices**

Junctional (axilla, groin, neck) hemorrhages are especially difficult to control because of their unique anatomic locations that are too proximal to apply tourniquets, even though they are considered compressible spaces. Eastridge et al evaluated “potentially survivable” deaths, using data from the 2 recent conflicts (Iraq, Afghanistan), and reported that 19% of deaths evaluated were caused by this type of wound. In another study published in 2013, Kragh et al evaluated the rate to be 17%. Those authors further noted that no means of controlling such hemorrhage was available (at the time of their publication). However, several devices have recently become available to treat these potentially fatal wounds. All of these devices are used with a gauze or hemostatic dressing between the wound and the device. Kragh et al evaluated a number of these devices and reported that they all have similar effectiveness in stopping junctional bleeding and preventing blood loss in a mannequin model.

**Junctional Clamp**

The Combat Ready Clamp (Combat Medical Systems; Figure 4) provides direct pressure over a junctional wound. The effectiveness of the Combat Ready Clamp was demonstrated in a swine model of a femoral artery wound, where the authors reported that the device was effective in controlling hemorrhage. Both Doppler and computerized tomography revealed that once the device was applied, no arterial flow was visible distal to the device. As the device was approved by the Food and Drug Administration only in 2010, no data on the long-term effects of use of the device are available. Other devices also have been developed for treating junctional wounds.
Junctional Tourniquets

Unlike the Combat Ready Clamp, the various junctional tourniquets involve a belt that tightens around the area of the wound. Each device has a unique method of providing direct compression of the wound.

One such device is the Junctional Emergency Treatment Tool (North American Rescue; Figure 5). Using a perfused cadaver model, Gates et al reported that the Junctional Emergency Treatment Tool could be applied in 10 seconds and provided immediate occlusion of the common femoral artery. In addition, thanks to the compressive design of the device, it also acted as a pelvic binder, which could be helpful with concurrent pelvic fractures.

As with the Junctional Emergency Treatment Tool, the SAM Junctional Tourniquet (SAM Medical Products) includes a belt that is placed around the pelvis, but instead of using a T-handled screw, this tourniquet uses a target compression device that is inflated with the use of an attached hand pump. The belt is placed under the patient, with the target compression device positioned over the wound. The two ends of the belt are then connected by using a buckle. The brown strap handles are then pulled in opposite directions until an audible click is heard and the strap handles are secured with Velcro (hook and loop connectors). The target compression device is then inflated, using the attached hand pump, until the bleeding stops or the distal pulse is no longer palpable. A second device may be placed on the opposite side if necessary. This tourniquet is approved for use in the inguinal and axillary area and is the only device approved for use as a pelvic binder.

The abdominal aortic junctional tourniquet (Compression Works) is a belt-like device that is applied over the wound or arterial compression point (Figure 7). Lyon et al reported that blood flow through the common femoral artery was eliminated in 7 of 9 healthy volunteers and significantly reduced in the other 2. Taylor et al reported that blood flow through the common femoral artery was eliminated in 15 of 16 healthy volunteers. The one failure was in a volunteer who was above average weight, height, abdominal girth, and body mass index. A recent journal article described the first use of the abdominal aortic junctional tourniquet to treat junctional hemorrhage in the axilla.

As all of these devices are relatively new, not enough research has been done for one device to be
recommended over another. However, ongoing research may eventually winnow the field down to 1 or 2 devices.

**iTClamp**

A new device, the iTClamp (Innovative Trauma Care), provides an alternative to hemostatic dressings and other novel hemorrhage control devices in the extremities but also in junctional or compressible spaces such as the groin, axilla, and scalp (Figure 8). The initial study of the iTClamp’s effectiveness was completed on 2 cadavers that were perfused with pulsatile sterile water to simulate blood flow. Wounds were then made in multiple arteries of the thigh, groin, neck, arm, and scalp. One cadaver was used as a control, with no intervention, while the second cadaver’s wounds were closed with the iTClamp. When the fluid loss from the similar wounds was compared, the iTClamp significantly reduced the fluid loss from all wounds. In addition, movement of the cadaver did not cause any movement of the iTClamp.

One study has been published that compared the iTClamp with standard gauze and a control in a swine model of groin injury. Those researchers reported a statistically significant increase in survival when the iTClamp was used and a statistically significant decrease in external blood loss when an iTClamp was applied early compared with when gauze was used.

The first use of the iTClamp in the United States was recently documented. A 64-year-old man had a 7-inch-long (18 cm), 1-inch-deep (2.5 cm) chainsaw wound to the left upper arm. A medical flight crew responded to a referring hospital, where personnel were unable to control the bleeding from the patient’s wound. The medical flight crew applied 2 iTClamps and the bleeding was under control within 2 minutes (for photos of the wound and its treatment, see Clark).
Nursing Implications

The key message regarding extremity hemorrhage control is to stop the bleeding, using the simplest methods as soon as possible to prevent shock and the worsening of shock. Direct pressure and pressure dressings are the most common and effective tools in preventing extremity hemorrhage. However, in situations where these methods are not successful, having access to, and knowledge of, additional tools can potentially save lives. Although tertiary trauma centers may not use these devices, they are being used by EMS and may be encountered by nurses working in such centers. Nurses working in the prehospital environment may be required to use these devices and they may be beneficial in small rural health care facilities, which usually do not have extensive surgical capabilities. Therefore, nurses need to be aware of these devices and how they control hemorrhage. However, each of the technologies discussed in this article has its own particular issues.

Hemostatic Dressings

The current generation of hemostatic dressings are simply gauze with an added agent to increase coagulation at the wound. The most important concern regarding the use of these dressings is to ensure that the wound is not disturbed until the surgical capability to repair the damage is immediately available. Which type of dressing to use is unclear: multiple studies have shown the superiority of one type over another and other studies have shown no superiority of one over another. As Rall et al noted, it is possible that we have reached the theoretical limit of technology in these dressings. However, given their low cost and probable marked effectiveness, it makes intuitive sense to use them when necessary.

Tourniquets

A tourniquet should be applied in any situation where the health care provider determines that the patient is actively losing blood from an extremity wound, sometimes as the initial hemorrhage control method. The US military has adopted this strategy and provides both entry level and ongoing training regarding the use of tourniquets.

Given the potential for complications related to tourniquet use, nurses must be provided with the training necessary to apply the tourniquet correctly and to monitor it while it is on the patient. It is imperative that the device not be released until the surgical capability to control the bleeding is immediately available. If the patient is awake, pain control related to the tourniquet will be a major concern, but pain control must be considered in the context of the patient’s entire injury pattern.

Novel Hemorrhage Control Devices

Although little research on these devices has been done, the design and potential effectiveness of these devices are intriguing. When the devices are used by either EMS or a health care facility, it is important for the nursing staff to be aware of the device’s potential use and that it may appear on a patient for whom they are providing care. It is especially incumbent upon the EMS agencies to notify their trauma centers when these devices are introduced into the prehospital setting. As with hemostatic dressings and tourniquets, it is imperative that the wound and devices are not disturbed until the surgical capability to repair the damage is immediately available.

Implications for Research

Given that the majority of research in this article is from combat simulations and situations, it is prudent to ask what relevance it has for civilian trauma care. When one looks back over the years, multiple instances of changes in trauma practice have come from prior military experience, starting with the advent of use of ambulances in the Napoleonic wars, progressing through the identification of DaNang lung (adult respiratory distress syndrome [ARDS]) from the Vietnam war, to the extremity wound care from the recent experiences in Iraq and Afghanistan.

War unfortunately provides an opportunity to evaluate trauma practice specifically because a large number of relatively healthy persons are traumatically injured and treated in a consistent, tiered trauma system. Fortunately, civilian trauma systems do not have to deal with the large numbers of trauma patients that our military colleagues are trained and equipped to handle. In addition, the number of civilian patients that would be needed to fulfill the statistical power to generate reliable data is, in the author’s view, insurmountable.
Given those facts, we must be grateful to our military colleagues for providing us with data and research that can potentially be used to guide civilian trauma care. Although we may not have the health care organizational structure or access to the number of patients needed to do valid statistical comparisons, we can publish animal research and case studies that could provide further information about the wound care techniques described in this article.

Of the devices described in this article, the novel hemorrhage control devices have little animal or patient research to support their use. However, Filips et al recognized this deficit and suggested further research in jagged wounds, compared with hemostatic dressings, and in coagulopathic patients.

**Conclusion**

Wound extremity hemorrhage is often easily treated with direct pressure and pressure dressings. However, most seasoned trauma nurses have had the experience of dealing with a patient whose extremity hemorrhage was uncontrolled by these methods. Understanding how the myths regarding “old” technology, such as tourniquets, have been proven to be just that; how a standard dressing may be improved by the addition of a hemostatic agent; and how a new device may be used quickly and effectively may save a life. CCN

**Financial Disclosures**

None reported.

**Letters**

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**References**

Pediatric Cardiovascular Surgery

Preoperative Stabilization of Infants With **Hypoplastic Left Heart Syndrome** Before Stage I Palliation

Amy Donnellan, RN, DNP, CPNP-AC
Lindsey Justice, RN, DNP, CPNP-AC

Hypoplastic left heart syndrome (HLHS) is a severe form of congenital heart disease that results in single-ventricle physiology. Single-ventricle physiology requires complete intracardiac mixing of pulmonary venous and systemic venous blood that is then supplied to parallel pulmonary and systemic circuits. HLHS persists throughout a patient’s life. Palliative treatment options are available, but the syndrome has no cure. Management of HLHS requires a series of 3 staged surgical palliation procedures. Over time, survival rates for patients with HLHS have increased because of improvements in surgical technique, postoperative management, and perfusion strategies. Despite these improvements, patients with HLHS have substantial morbidity and a decreased life expectancy. For patients who have a modified Blalock-Taussig shunt, transplant-free survival is 61% at 3 years and 60% at 5 years. For patients who have a right ventricle to pulmonary artery shunt, the survival rates are 67% for 3 years and 64% for 5 years.

This article has been designated for CE contact hour(s). The evaluation tests your knowledge of the following objectives:
1. Identify prenatal and perinatal factors that affect single ventricle management
2. Describe strategies of perioperative stabilization and management
3. Define 3 major causes of desaturation in single ventricle physiology

To complete evaluation for CE contact hour(s) for test #C161, visit www.ccnonline.org and click the “CE Articles” button. No CE test fee for AACN members. This test expires on February 1, 2019.

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Although a palliative approach for HLHS is widely agreed on in practice, variation occurs in both surgical and medical management. In this article, we review current understanding and practice of preoperative management for infants with HLHS, including perinatal factors that affect management, postnatal stabilization of the infant’s clinical status, and management strategies for balancing single-ventricle physiology and optimizing systemic oxygen delivery.

**Perinatal Factors That Affect Preoperative Management**

The preoperative management of neonates with HLHS is markedly affected by the timing of the diagnosis (prenatal or postnatal) and perinatal factors, such as the HLHS subtype and the infant’s birth weight, gestational age, and genetic abnormalities. These factors generally contribute to the stability of the infant’s clinical status, whether or not the patient is in extremis, and overall survival.

Prenatal diagnosis of patients with HLHS allows better planning of perinatal care and is strongly associated with superior preoperative clinical status. Studies have indicated that although prenatal diagnosis may not have a marked effect on mortality, it is related to an improvement in morbidity, specifically with regard to neurodevelopmental outcomes. Neonates in whom HLHS is not diagnosed prenatally are more likely to have shock, more severe preoperative lactic acidosis, and a need for inotropic support, which further increases the risk for right ventricular dysfunction and tricuspid regurgitation, both of which are important risk factors for survival of stage I Norwood palliation.

Prenatal diagnosis has clear advantages, such as providing time for counseling and educating the infant’s parents and allowing a delivery plan with immediate initiation of prostaglandins and prompt transport to an appropriate care setting. Additionally, prenatal diagnosis of HLHS allows further and more precise delineation of the anatomy, and conditions such as an intact or restrictive atrial septum can be monitored so that plans can be made for prompt balloon atrial septostomy immediately after delivery as needed. Finally, prenatal diagnosis offers the opportunity for fetal interventions such as balloon dilation of the aortic valve or atrial septostomy, which may improve outcomes.

During the perinatal period, delineating the anatomical details and clarifying the HLHS subtype are crucial. HLHS can be due to mitral atresia with aortic atresia, mitral stenosis with aortic stenosis, or mitral stenosis with aortic atresia. The specific subtype of HLHS markedly affects surgical planning (Norwood procedure vs hybrid procedure with stenting of the patent ductus arteriosus and placement of pulmonary artery bands) and may necessitate heart transplant. Some investigators have reported a diminished survival rate of only 79% for patients with mitral stenosis with aortic atresia compared with the other subtypes for stage I Norwood palliation. Furthermore, recent studies have indicated that HLHS with mitral stenosis and aortic atresia is associated with ventriculocoronary connections (sinusoids), which adversely affect outcomes and survival. HLHS with an intact or highly restrictive atrial septum is associated with extremely poor outcomes, with a survival rate of only 68% to 70% before discharge from the hospital after the Norwood procedure for patients deemed to be surgical candidates. However, fetal intervention can increase the survival of this subgroup from 38% to 69%. Furthermore, the Single Ventricle Reconstruction trial indicated that anatomical factors such as the degree of atrioventricular valve regurgitation and ascending aortic diameter are associated with increased morbidity and mortality.

Perinatal factors, such as low birth weight, younger gestational age, and genetic abnormalities play a substantial role in an infant’s predicted course and were associated with an increased risk of morbidity and mortality in the Single Ventricle Reconstruction trial. In a retrospective cohort study, Costello et al evaluated neonates admitted to Boston Children’s Hospital, Boston, Massachusetts, during the period 2002 to 2009 who had critical congenital heart disease and a known gestational age. The results indicated that gestational age of 37 to 38 weeks, compared with gestational age of 39 to 40 weeks, was associated with more than 2-fold greater adjusted odds of mortality during hospitalization and
significantly greater morbidity. More recently, Costello et al18 analyzed information in the Society of Thoracic Surgeons Congenital Heart Surgery Database to determine the relationship between gestational age and outcomes for neonates undergoing cardiac surgery. The authors focused on neonates born at early term and concluded that birth during the early term period of 37 to 38 weeks’ gestation was associated with worse outcomes after neonatal surgery. This finding suggests the importance of avoiding early delivery when possible.

Balancing Circulations to Optimize Systemic Circulation

Preoperative management of patients with HLHS depends on balancing parallel circulations, which entails maintaining adequate but not excessive pulmonary blood flow while ensuring optimal systemic perfusion. However, the key to management of HLHS patients is optimal systemic perfusion, which can occur in patients with excessive pulmonary blood flow so long as total cardiac output is sufficient. Ineffectively balanced parallel circulation may result in impairment of oxygen delivery, which increases the risk for ischemic injury and contributes to marked infant morbidity and mortality.19

Desaturation in single-ventricle physiology can be attributed to 1 of 3 overall causes: diminished pulmonary blood flow; a low mixed venous oxygen saturation due to a high ratio of total pulmonary blood flow to total systemic blood flow (Qp:Qs ratio), low overall cardiac output, or reduced hemoglobin level; or pulmonary venous desaturation. Astute nursing assessment and ongoing monitoring are necessary to detect these conditions, because the management strategies used are based on the underlying physiology.

Diminished pulmonary blood flow before surgery is a rare occurrence. Generally, even before neonatal pulmonary vascular resistance (PVR) begins to decrease, the PVR is lower than the systemic vascular resistance (SVR) and patients are prone to pulmonary overcirculation. Of note, patients with hypoxia may not have poor blood pressure or metabolic acidosis because of adequate, although hypoxic, systemic tissue perfusion. The primary cause of diminished pulmonary blood flow is an intact or highly restrictive atrial septum; thus, the atrial septum must be evaluated first and ruled out as the cause. Infants with an intact or highly restrictive atrial septum do not respond to oxygen and require prompt evaluation via echocardiography. Early intervention is necessary, with a balloon atrial septostomy, but patients may require venoarterial extracorporeal membrane oxygenation to stabilize their condition before transition to the cardiac catheterization laboratory. In infants with a nonrestrictive atrial septum, physiological and anatomical causes of low Qp:Qs ratio before surgery include elevated PVR related to pulmonary infection and obstruction of pulmonary venous egress due to pulmonary venous obstruction. Management of a low Qp:Qs ratio includes inducing systemic vasoconstriction with medications such as vasopressin or phenylephrine; ensuring functional residual capacity with adequate, but not excessive, positive end-expiratory pressure; and manipulating the PVR by using oxygen, inhaled nitric oxide, sodium bicarbonate, or aggressive sedation. Because a low Qp:Qs ratio is an atypical state before surgery, these therapies should be initiated after acquisition of thorough data and monitoring.

Low mixed venous oxygen saturation with an arteriovenous oxygen difference greater than 25% indicates inadequate cardiac output. Clinical signs may include elevated arterial oxygen saturation with poor perfusion, a wide pulse pressure, oliguria, lactic acidosis, pulmonary edema, and high atrial pressure. Additionally, diminished right ventricular function may be evident on echocardiography. Anatomical and physiological causes of a low mixed venous oxygen saturation include high Qp:Qs ratio related to decreasing PVR, elevated SVR, or systemic outflow obstruction, as with aortic arch obstruction or ductal constriction. Additionally, overall low cardiac output related to diminished ventricular function or tricuspid valve regurgitation will result in reduced mixed venous oxygen saturation. Management of a high Qp:Qs ratio is aimed at optimizing total cardiac output, increasing PVR, and decreasing SVR. Systemic vasodilation with milrinone or sodium nitroprusside may be necessary, and agents such as milrinone, epinephrine, or calcium chloride can be used to optimize cardiac output. Additionally, maximizing oxygen delivery in cyanotic patients by keeping the hemoglobin level in the range of 13 to 16 g/dL is beneficial. Furthermore, in patients with left to right shunting, an increased concentration of hemoglobin increases mixed venous and arterial oxygen saturation.
The ultimate goal for HLHS preoperative management is to optimize systemic oxygen delivery. The difference between arterial oxygen saturation and mixed venous oxygen saturation must be evaluated; a difference greater than 25% may indicate low cardiac output. If a patient does not have appropriate intravenous access for measuring mixed venous oxygen saturation, monitoring via near-infrared spectroscopy can also be used as an adjunct to preoperative management. This spectroscopic monitoring is a noninvasive way to determine trends in a patient’s mixed venous oxygen saturation, which will diminish as oxygen delivery decreases or demand increases. Furthermore, near-infrared spectroscopy can be useful in detecting hypoxic-ischemic conditions. Blood lactate levels are also evaluated regularly to ensure that tissue hypoperfusion is not present; lactate levels are expected to increase as tissues are forced to make the change to anaerobic metabolism.

Vasoactive Infusions and Inotropes

One key to preoperative management is maintenance of ductal patency with a prostaglandin infusion. Patients with single-ventricle physiology are dependent on a patent ductus arteriosus for either systemic or pulmonary blood flow. Nearly all infants (with or without the syndrome) have physiological closure of the ductus arteriosus by the fourth day of life, but 20% have functional ductal closure during the first day of life, and more than 80% have ductal closure during the second day of life. For patients in shock with suspected ductal closure or a restrictive ductus arteriosus, the initial prostaglandin dose is 0.05 to 0.1 μg/kg per minute; once ductal patency is achieved, the infusion can be decreased to an effective dose of 0.01 to 0.02 μg/kg per minute. Using the lowest effective prostaglandin dose to maintain ductal patency is important to minimize the most common dose-dependent side effects of the medication. Hypotension requiring volume replacement and respiratory depression requiring mechanical ventilation may occur. In order to...
mitigate the respiratory depression and reduce the need for mechanical ventilation, administration of caffeine can be started with a loading dose of 20 mg/kg and then maintenance dosing of 5 to 10 mg/kg daily.28

Vasoactive medications may be necessary for treatment of cardiogenic shock or support of diminished right ventricular function. For patients whose Qp:Qs ratio is elevated and systemic perfusion is compromised, addition of milrinone might be necessary to increase cardiac output and reduce afterload. However, milrinone may also reduce pulmonary vascular resistance and is associated with a potential undesired risk of increasing the Qp:Qs ratio in excess of total cardiac output.19 Additionally, epinephrine can be used to increase contractility to augment total cardiac output. In neonates, who have an immature sarcoplasmic reticulum, a calcium chloride infusion may be beneficial to improve hemodynamic status, because neonates are highly responsive to exogenous calcium.29 Because infants with HLHS often have elevated heart rates due to low cardiac output, calcium chloride may be the preferred choice because it will increase contractility without further provoking tachycardia. However, monitoring blood levels of calcium and ionized calcium is necessary to avoid supranormal levels. The dose of the vasoactive drug used should be titrated to increase total cardiac output and favorably modify the balance of blood flow between the pulmonary and systemic circulations.

Mechanical Ventilation

Respiratory support may be necessary because of respiratory insufficiency or failure, as well as for low systemic output to reduce oxygen demand. Stabilizing the clinical status of infants with excessive pulmonary blood flow contributing to inadequate systemic blood flow and oxygen delivery before surgery can be a challenge. Previously, mechanical ventilation was used for excessive tachypnea and high oxygen saturation, but in current practice, mechanical ventilation is reserved for patients with respiratory insufficiency or failure or low systemic output.30,31 Spontaneous breathing is preferable, but if necessary, noninvasive ventilatory support can be used to reduce work of breathing and oxygen consumption.

When additional respiratory support is necessary, multiple strategies can be used to increase PVR and thus reduce pulmonary blood flow. Supplemental oxygen decreases PVR and leads to pulmonary overcirculation; thus, avoiding supplemental oxygen is a simple strategy to prevent excessive pulmonary blood flow. Historically, inspired carbon dioxide (to induce hypercarbia) in patients receiving mechanical ventilation and inspired nitrogen (to induce hypoxia) in both spontaneously breathing patients and those receiving mechanical ventilation have been used to increase PVR. For inspired nitrogen, the prevailing thought is that the decrease in oxygen saturation is predominantly due to pulmonary venous desaturation.

Although both hypoxia and hypercarbia can decrease the Qp:Qs ratio, only hypercarbia increases cardiac output.30,31 In current practice, permissive hypercarpnea is used and is well tolerated, but inspired carbon dioxide is not used. Finally, noninvasive positive pressure ventilation or invasive positive end-expiratory pressure can be used to achieve lung volumes that exceed functional residual capacity. At higher lung volumes, the pulmonary vasculature is compressed, thus increasing PVR and diminishing pulmonary blood flow.20 Positive pressure ventilation decreases afterload on the ventricle by decreasing transmural wall stress. Therefore, intubating a patient has 2 benefits: it decreases oxygen consumption by reducing the work of breathing and decreases afterload, which subsequently increases cardiac output. Patients can benefit from these effects if intubation is necessary because of respiratory failure or low systemic output, but spontaneous breathing remains preferable in the absence of these conditions.

Nutrition

Preoperative enteral feedings may improve nutritional status and thus improve outcomes. Preoperative enteral feeding in neonates with single-ventricle physiology is controversial and varied. Preoperative enteral nutrition has historically been avoided in patients with single-ventricle physiology and ductal-dependent systemic blood flow because of variable SVR, decreasing PVR, and the potential for systemic hypoperfusion.19 Central venous access may be obtained to provide total parenteral nutrition for adequate caloric intake and volume administration. In general, these neonates require volumes 10% to 20% higher than do healthy neonates to account for the capillary leak that occurs with prostaglandin therapy and additional calories because of the elevated cardiac work imposed by single-ventricle physiology.19 However, clinicians speculate that preoperative enteral feeding may improve...
nutritional status and thus improve outcomes, such as decreased length of hospital stay and better neurodevelopmental outcomes. Recent findings indicated that compared with no feeding, preoperative trophic feedings before Norwood palliation were safe and were associated with shorter duration of mechanical ventilation, more stable postoperative hemodynamics, less fluid overload, and earlier postoperative feeding tolerance.

According to a recent survey of medical providers in the United States and Europe, routine preoperative feeding is prescribed by 56% of US providers and 93% of non-US providers. Two-thirds of the respondents who were willing to enterally feed a prostaglandin-dependent neonate did not base their decision on the direction of ductal flow. The majority of providers who preoperatively feed patients who have ductal-dependent lesions offer the infants either breast milk or formula via oral feedings, and some providers prescribe a maximum intake. Feeding tolerance in prostaglandin-dependent neonates given feedings was monitored by using clinical assessment, arterial blood gas analysis, measurement of diastolic blood pressure, and measurement of serum levels of lactate. Some clinicians empirically obtained abdominal radiographs. Intestinal hypoperfusion was one of the primary concerns for withholding enteral feedings, but the relationship of enteral feeding to preoperative necrotizing enterocolitis is unclear.

The incidence of necrotizing enterocolitis is far greater in patients with congenital heart disease than in the general population. Infants with congenital heart disease who are receiving high-dose prostaglandin therapy or who have experienced shock or low cardiac output are at highest risk. In a study on the role of enteral feedings in the development of necrotizing enterocolitis in infants with congenital heart disease, Iannucci et al found that the disease developed in 45 infants (3% of infants studied), 8 (18%) of whom had not undergone cardiac surgery. Obviously the state of the science of preoperative feeding for patients with ductal-dependent single-ventricle physiology is evolving, and thus if enteral nutrition is provided, monitoring is required to evaluate systemic perfusion and signs of feeding intolerance, such as abdominal distention and bloody stools.

**Nursing Considerations**

The goal of preoperative HLHS care is optimizing oxygen delivery and ensuring adequate total cardiac output. Assessment and monitoring of oxygen saturation, peripheral perfusion, urine output, and feeding intake will inform a nurse if a patient begins to have signs of low cardiac output syndrome. Indications of the syndrome include decreased interest in feedings or feeding intolerance, poor peripheral perfusion, oliguria, and ongoing metabolic acidosis. Additionally, a difference between arterial oxygen saturation and mixed venous saturation greater than 25% may also indicate low cardiac output. Low cardiac output syndrome is difficult to distinguish from a high $Qp:Qs$ ratio because patients with high arterial oxygen saturation may have adequate systemic output, or may have diminished systemic output as a result of increased pulmonary blood flow occurring at the expense of systemic blood flow. Therefore, astute assessment by nurses and effective communication with the medical providers about subtle clinical changes are crucial. See the Table for management strategies for low pulmonary blood flow, low mixed venous saturation, and low pulmonary venous saturation.

**Table Management strategies to optimize oxygen delivery**

<table>
<thead>
<tr>
<th>Issue</th>
<th>Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low pulmonary blood flow</td>
<td>Echocardiogram to assess atrial septum May require atrial septostomy Systemic vasoconstriction Vasopressin, phenylephrine Optimize hemoglobin level Ensure functional residual capacity with adequate positive end-expiratory pressure Manipulation of pulmonary vascular resistance Oxygen Inhaled nitric oxide Sodium bicarbonate Aggressive sedation Address underlying anatomical and physiological causes Optimize total cardiac output Hypercarbia Systemic vasodilatation Milrinone Sodium nitroprusside Inotropic support Epinephrine Calcium chloride Maximize hemoglobin level Lung recruitment Positive end-expiratory pressure Consequences of ventilatory maneuvers must be assessed cautiously by determining the ventilatory effect on the arterial and mixed venous saturation and global end-organ perfusion</td>
</tr>
</tbody>
</table>
Conclusion

Preoperative management of infants with HLHS is complex and requires multiple complementary strategies. The management and outcomes of these infants are markedly affected by prenatal diagnosis, HLHS subtype, anatomical factors, birth weight, gestational age, and genetic abnormalities. Preoperative management involves complete evaluation, stabilization of the infant’s hemodynamic status, respiratory support, and optimal nutrition strategies. Continued advancement of these strategies is the key to improving outcomes for this complex population of infants. CCN

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Financial Disclosures
None reported.

to comment on. In the full-text or PDF view of the article, click “Responses” in the middle column and then “Submit a response.”

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Poor education-related discharge preparedness for patients with heart failure is believed to be a major cause of avoidable rehospitalizations. Technology-based applications offer innovative educational approaches that may improve educational readiness for patients in both inpatient and outpatient settings; however, a number of challenges exist when implementing electronic devices in the clinical setting. Implementation challenges include processes for “on-boarding” staff, mediating risks of cross-contamination with patients’ device use, and selling the value to staff and health system leaders to secure the investment in software, hardware, and system support infrastructure. Strategies to address these challenges are poorly described in the literature. The purpose of this article is to present a staff development program designed to overcome challenges in implementing an electronic, tablet-based education program for patients with heart failure. (Critical Care Nurse. 2016;36[1]:60-70)

Although many factors contribute to high rates of hospital readmission for patients with heart failure, inadequate educational preparation for discharge is one factor that is largely avoidable and predominantly managed by nurses.\textsuperscript{1,2} New electronic, tablet-based patient education platforms, designed to address predischARGE gaps in education, are increasingly accessible and linked to electronic health records.\textsuperscript{3,4} Yet, integrating these tools into nursing workflow is challenging. Staff development initiatives to facilitate adoption of electronic tablet-based patient education in the acute care setting are needed.
To illustrate the gravity of the prevalence and high cost of preventable readmissions, the Agency for Healthcare Research and Quality sponsored work to identify contributing factors. Of the 9 million Medicare hospitalizations yearly, 1 in 5 patients is readmitted within 1 month of discharge.\(^5\) The cost of hospital readmissions is estimated to be $26 billion per year, of which $17 billion is considered preventable.\(^5\) Notably, inadequate educational preparation was identified as a common contributor to avoidable readmissions and was established as a target for care redesign.\(^6,8\) In 2009, providing written instructions and educational materials at discharge became a critical performance measure in the heart failure clinical practice guidelines for the American College of Cardiology and American Heart Association.\(^9\) The Joint Commission and the Centers for Medicare and Medicaid Services also require that discharge instructions include information on medications, worsening symptoms, diet, activity, weight monitoring, and follow-up appointments.\(^10,12\) Although clinical practice guidelines and regulatory requirements support the need for more effective education before discharge, the challenges of redesigning traditional paper-based educational content and patient education workflow processes in inpatient care settings are substantial.

For nurses, classroom education is shifting to include more contemporary, pedagogically appropriate approaches, moving from static text-based methods to more interactive visual and skill-based modes of education available on electronic platforms.\(^13\) Increasingly, education for patients is also following these trends, gradually incorporating audiovisual content and more interactive technology-based modes of delivery.\(^14\) Using electronic platforms, or mobile technology, to deliver patient education in the predischarge phase of care provides a new opportunity to improve predischarge educational preparedness by evaluating the learning that takes place during hospitalization. Electronic platforms improve the interactive capabilities of standard patient education, and some web-based electronic platforms allow nurses to support patients’ ongoing educational needs beyond the inpatient setting, communicating needs with nurses in the clinic and even in the home.\(^4\)

Because of these advantages, mobile technologies, defined for the purpose of this article as electronic tablet–or smart phone–based platforms, are quickly becoming a more accepted approach for patient education.\(^15\) Studies have explored the potential for e-learning and mobile technology to improve educational outcomes, particularly in patients with chronic illnesses such as cancer, asthma, and diabetes.\(^16,17\) These studies have shown that the use of mobile technologies has improved patient engagement,\(^18\) decreased postdischarge complications,\(^19\) and improved communication.\(^20\) Technology-based applications have demonstrated the potential to change the approach for teaching self-management by equipping patients with the knowledge and tools to better manage chronic illness.\(^21\) Traditional patient-teaching

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materials used by health care providers can be print-heavy with few graphics or illustrations, but technology-based approaches are more engaging. A growing number of studies are exploring the advantages and roles of mobile technologies, yet challenges to initiating the use of mobile technology to teach patients in acute and progressive care clinical settings remain.

The purpose of this article is to present our experience teaching staff nurses to incorporate an electronic tablet–based patient education tool into the clinical workflow in acute and progressive care settings. We address challenges that were encountered specific to tablet adoption, including communicating the value of using mobile technology, training staff for role responsibilities, and ensuring device-related safety, including unit construction and infrastructure for storage as well as patient safety issues such as preventing cross-contamination and limiting access to protected health information. Because our experience of initiating the use of electronic tablets for patient education was stymied by these adoption challenges, many of which required resolution before we could conduct a patient outcomes focused quality improvement study, we present these lessons learned as a critical precursor to using tablets in the clinical setting.

**Approach for Implementation**

Our approach for preparing staff to implement iPad-based patient education began from a shared governance perspective. Our administrative leadership team was aware that, despite evidence supporting tablet use, the most commonly reported barriers to making evidence-based change included insufficient time and lack of administrative support.

To address these concerns head-on, nurse leaders engaged in the implementation efforts for tablet-based patient education from the start. Unit nurse managers and the clinical operations director used this opportunity to create a practice environment that supported professional nursing practice and high-quality care through the implementation of the iPad (Apple Inc) as an innovative method of delivering patient education. The leadership team took steps to ensure that staff would have the necessary time and tools to incorporate evidence-based iPad education as standard practice and to integrate this new approach into existing workflows.

As a first step, unit-based committee leaders from the education and quality improvement committees identified staff to engage in the “iPad unit champion” role. These nurse champions participated in preliminary training sessions with the research team to gain an understanding of the expectations of the role and their responsibility for creating cohesive staff nurse teams or “work groups.” Next, the champions led their respective teams through the implementation process using a structured approach, described in detail later, that included communicating the value of the project, training staff on workflow integration using a competency-based approach, and managing the logistics of iPad device care by using process standards and developing operating procedures. Throughout each of these steps in implementation, the involvement of leadership conveyed an intimate understanding of the challenges faced by front-line staff regarding the implementation process and the time involved to implement a practice change successfully. This level of involvement allowed nursing leaders to create a consistent, supportive, and positive message throughout the course of the all-staff roll out. The message coming from the leadership team contributed to the culture of engagement necessary to support adoption of evidence-based educational approaches and was instrumental in securing the frontline nurses’ view of the importance of their contribution to the implementation of the new patient education process.

In addition to strong, visible leadership support, staff development for tablet implementation was designed with 3 major aims: (1) to establish the value of iPad educational delivery for patients and providers; (2) to formulate the roles, responsibilities, competencies, and workflow integration for all members of the care team; and (3) to develop the processes and procedures for safety, including device protection, cleaning, storage, charging, and software version maintenance of the iPads. The overall goal for implementation was to ensure a high level of staff competency for use of the device and to integrate iPad-based education into the usual unit workflow.

**Defining the Value**

Although nurses on the iPad-based education platform design team had participated in 2 years of research,
development, and feasibility testing, the majority of unit and clinic staff had not participated in this preimplementation phase. As a result, most were not aware of the value and advantages of the new approach for delivery of patient education. To prepare for changes in clinical practice patterns, the implementation team focused first on defining the value of iPad-based education for patients with regard to educational outcomes,3 second on defining the value for the health system with regard to regulatory and quality outcomes,24 and last on defining the added value for staff with regard to continuing education and professional development opportunities (Table 1). The implementation team worked first with unit champions to describe and discuss the advantages of the iPad-based education method25,26 for patients, families, nurses, and the health system’s quality improvement initiatives. Through these discussions, common questions from the staff were addressed and answers to key questions were found before the full staff rollout. Process questions, such as how the documentation interface would work with the electronic health record and how the staff incentives for patient enrollment and participation would be distributed among the team, were clarified and answered. The value message was then condensed into clear, concise, and easily communicated content and was delivered using a series of combined approaches.

Communicating the Value

Implementation teams leaned heavily on change theory27,28 and our shared governance model to formulate and disseminate the value message across clinical areas to staff, ancillary support personnel, and the broader health system leadership team. The first role of unit-based champions was development and presentation of the value message. Nurse champions worked with nurse managers, ancillary staff, student nurses, and members of the iPad-based patient education research team to design, evaluate, and revise the presentation of materials for the all-staff rollout. Using a PowerPoint presentation format allowed multiple educational team members to “show” and discuss the value points and implementation process with various audiences across different units, affiliated hospital settings, and in clinics, without losing the key points of the message. The presentation was split into 2 parts for brevity, given the time constraints of the audience and busy clinical practice environment. Practice presentations were done first within

| Table 1 Constructing a value message for patients, health system, and staff |
|---------------------------------|---------------------------------|---------------------------------|
| **Patient**                     | **Health system**               | **Staff**                       |
| Centralizes documentation for improved communication across patient care transitions | Centralizes documentation for improved communication across patient care transitions | Centralizes documentation for improved communication across patient care transitions |
| Standardizes educational options across the health care system using guideline-based content for heart failure | Meets requirements for The Joint Commission accreditation for patient-centered education | Saves time for documentation of learning outcomes; content is on touch screen and nurse can focus on self-management skills |
| Increases opportunities for engagement of patients and their families through skill-based learning | Meets regulatory (Centers for Medicare and Medicaid Services) requirements for evidence-based care metrics | Streamlines documentation for regulatory and accreditation purposes |
| Establishes individual-level learning priorities to develop and carry out education plan | Assesses and documents primary care provider and transition of care to home | Provides performance review incentives for participation in dissemination of reports |
| Creates opportunity for communication between inpatient and outpatient care settings | Assesses and documents risk for readmission; assesses educational precursors to readmission | Recognizes peer recognition and individual incentives offered through Team Challenge |
| Improves care team’s awareness of baseline self-care knowledge and new priorities for learning | Provides skill-based learning tool for improved medication reconciliation (a unique innovation and test case) | Measures and evaluates patients’ learning outcomes (not simply delivery of education materials) |

Defining and communicating the value message was key to success of the project: improving patients’ educational outcomes, health system quality and satisfaction measures, and staff opportunities for professional development.
the team, so that all members felt comfortable sharing the value of the iPad-based educational program, and then across acute and progressive care nurse groups.

Staff incentives were designed to add to the intrinsic value of improved patient care and to smooth the change process during implementation of the innovation. We developed an tablet team challenge, using incentives to reward nurses’ educational assessment and teaching skills, and expertise in the use of the iPad system. Shared accountability for patient and health system outcomes was established between nurse leaders and frontline staff to ensure that adoption of the evidence-based practice project would be supported and rewarded by the nurse manager team and the director for nursing operations on the unit. To ensure wide dissemination and to provide nurses opportunities for professional development, nurse champions presented monthly updates and quarterly reports about the iPad patient education program.

Formulating Roles and Competencies

The responsibility for educating patients and preparing them to manage a complex medical regimen following discharge falls not only to the nurse but also to other members of the health care team. New Joint Commission Standards for educational documentation emphasize this fact, and yet while “all” are responsible, those actually accountable often narrows down to only a few. To ensure that responsibility for delivery, documentation, and evaluation of learning outcomes for discharge preparedness was dispersed to the multidisciplinary care team, the implementation goals included development of competency-based skills for each role and caregiver discipline represented in the workflow. In addition, the design of the workflow itself represented an integration of all members of the multidisciplinary team (Figure 1).

We defined roles and responsibilities for all members of the multidisciplinary team who contribute to the patient education process, including staff nurses, advanced
practice nurses, pharmacists, dieticians, ancillary support staff, patient resource managers, physicians, and patients and families. We asked each discipline, including patient advocates, for implementation responsibilities specific to their role in heart failure education. As shown in Table 2, the content for predischarge patient education was based on input from each discipline and was reviewed for approval by the team.

The role of care nurses for initiating patient access and entry into the predischarge education program is supported throughout the inpatient stay by nursing assistants, unit secretaries, charge nurses, and all members of the care team. After accessing the system using secure log-ins, a health literacy evaluation (REALM31) and a measure of patient activation, or the self-reported confidence to engage in self-management health behaviors (PAM-1332), is completed. These scores are generated by the system and displayed for the provider to use to tailor subsequent education to the patient’s learning preferences and needs. Providers can then start survey pages so that patients can navigate the iPad independently, completing surveys to assess likelihood for medication nonadherence, symptom presentation patterns, and self-management skills. Following completion of assessments, the educator logs back in to the system to launch the education modules.

The role of patients and families is to engage in self-paced, self-directed learning using the iPad program; however, the extent of engagement is patient-dependent and highly variable. Actual use of the program and extent of engagement with the skill-based tools and educational content is evaluated using the “check your knowledge” questions at the end of each topic segment. As a result of the scoring mechanism for each content area, the care team is aware of areas that need reinforcement before discharge. Even if patients are hesitant to communicate openly about learning needs or weaknesses, the responsibility of the care team is to interpret the patient scores on learning checks, and provide supplementary content, support, and encouragement for eventual adoption of evidence-based self-management skills and behaviors.

Throughout the admission or clinic visit, the role of the nurse and multidisciplinary care team is to offer the patient multiple opportunities to complete education modules and assessments. Immediately before discharge, the patient completes surveys to assess satisfaction with the education received and confidence for implementing these skills at home. The iPad system generates a report of the aggregate as well as individual-level learning goals, goal achievement, and medication management skills. The report is included in the medical record and also used in aggregate to evaluate program participation and outcomes. Individual-level information is available to guide care across settings, including hospital, clinic, community, and home.

The role of physicians in patient education has traditionally been reactive rather than proactive. That is, physicians are comfortable answering patient or family questions about a care plan, but only recently have physicians initiated the educational process. The rationale

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### Table 2 Educational content

<table>
<thead>
<tr>
<th>Topic</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medications</td>
<td>Virtual pill-box-filling exercise</td>
</tr>
<tr>
<td>Symptoms</td>
<td>Symptom recognition links from the American Association of Heart Failure Nurses</td>
</tr>
<tr>
<td>Activity</td>
<td>Learning checks for safe activity progression; links to the American Association for Cardiopulmonary Rehabilitation</td>
</tr>
<tr>
<td>Diet</td>
<td>Learning checks for managing sodium and sugar in the diet; nutrition label reading skill exercises; links to American Heart Association’s dietary modification for cardiovascular disease</td>
</tr>
<tr>
<td>What to report</td>
<td>List of symptoms and symptom changes that should be reported, as well as urgency for notifying the provider</td>
</tr>
<tr>
<td>Whom to contact</td>
<td>Heart Center central communications phone number; primary care provider number; and cardiology nurse practitioner</td>
</tr>
<tr>
<td>Additional information</td>
<td>Website links offered to professional organizations, patient advocacy groups and social networking sites such as “Patients Like Me”</td>
</tr>
</tbody>
</table>
for this is multifactorial, but likely stems from a combination of (1) a perceived lack of time, (2) the absence of instruction received by a physician on the importance of patient education in his or her own medical training, and (3) the presumption that the responsibility of patient education typically resides with other caregivers.

Medical students, in contrast, occupy unique positions in the medical team in that they are “grouped” within the physician sphere but are actively learning as students. Relative to their physician counterparts, they have fewer patient responsibilities and therefore greater amounts of time to dedicate toward direct patient interaction. The patient education process is also likely to be of significant educational interest and value to the student, and it could reinforce disease pathology, symptoms, clinical presentation, and course, along with treatment methods.

**Integrating iPad Education Into Usual Care Workflow**

Integrating the iPad technology into the workflow for usual care delivery posed challenges. Traditional written educational materials were replaced with iPads to deliver patient education, and, as a result, each step in the workflow for patient education, from ordering educational materials from hospital procurement (materials management services) to completion of patient learning checks for each specific content area, was redesigned (Figure 1). Our team no longer defined “education notebook given to the patient” as a sufficient criterion for completion of educational objectives. Instead, the workflow reflected assessment of the patient-reported learning priorities, evaluation of the patient’s literacy level and competencies, and integration of skill-based learning techniques into the course of daily patient care. Although the change represented significant advances in implementing evidence-based practice for patient education, the change required effort and ingenuity on the part of the implementation team and champions to be successful.

As outlined in Figure 1, each member of the care team had a role in the workflow change. Nurses and physicians as well as nutritionists, pharmacists, and physical therapists were responsible for identifying patients who required new or additional skill reinforcement for self-management of the heart failure regimen. A review of patients’ status toward achievement of educational goals was integrated into charge nurse report and bedside report among all staff.

The skills competency checklist (Figure 2) and its accompanying training video and slide presentations were used to reinforce the workflow integration and highlight opportunities for time savings and education documentation efficiencies. For example, the time previously spent by nurses distributing flat, noninteractive written instructions in the education workbook transitioned to time spent facilitating patient engagement with interactive skill-based tools and picture-driven videos on the iPad. The scope and breadth of educational information available from credible professional organizations and patient advocacy groups in literacy-appropriate format was also an advantage, allowing patients to browse selected links for additional information of their choice. As noted by nurses, house officers, and ancillary staff colleagues, the entire care team learned something from the online information available and accessible to patients through the iPad education links.

Importantly, the workflow was not seen as “ending at discharge,” but was phased into patient care processes that continued throughout the acute stay and into the care transition period to home, the follow-up phone call, and later to the 1-week and 1- to 3-month clinic visits. The team developed a recognition and appreciation for the extent and complexity of the work required for patients to learn and adopt new self-care behaviors—an extension of the change in the medical record documentation from “educational materials given” to “self-management skills mastered” and all the way to “self-management skills adopted.”

**Developing Safe Processes and Procedures for Device Use**

Integrating the iPads into the workflow of the unit required defining processes and standard procedures for safe care and storage of the devices themselves. Device storage and charging instructions, including infection control measures, were addressed in a written process standard that was submitted by the implementation team and reviewed for approval by the department’s
### Figure 2  Nurse competency checklist for iPad education.

Abbreviation: VK, verbalized knowledge.

<table>
<thead>
<tr>
<th>Category</th>
<th>Performance criteria</th>
<th>Preceptor evaluation (date/initials)</th>
<th>VK Validation completed (date/initials)</th>
<th>Comments</th>
</tr>
</thead>
</table>
| Components of training/skill validation     | 1. View skill-based learning slides (1 and 2)  
2. View Agency for Healthcare Research and Quality video on performing teachback  
3. Check off by trainer on the iPad test site                                                                                                                   | 1. _______                           | 2. _______                          |          |
|                                             |                                                                                                                                                                                                                       |                                      | 3. _______                          |          |
| Assessment of patient                       | 4. Perform patient learning assessment  
5. Engage patient/family in assessment  
6. Perform health literacy evaluation (REALM)                                                                                                               | 1. _______                           | 2. _______                          |          |
|                                             |                                                                                                                                                                                                                       |                                      | 3. _______                          |          |
| Planning for procedure                      | 1. Obtain iPad from secure charging box  
2. Input patient’s name, medical record number, birthdate, admission date, and room number                                                                                                             | 1. _______                           | 2. _______                          |          |
| Interventions/skills                        | 1. Log patient in to Heart at Home using iPad  
2. Register patient in iPad and complete the following:  
• Risk assessment  
• Medical Home  
3. Assist patient with survey completion  
• Initial assessment  
• Predischarge assessment  
4. Provide education using video and slides, including check-your-knowledge questions  
5. Discharge patient from system  
6. Print reports and send to medical records                                                                                                             | 1. _______                           | 2. _______                          |          |
| Patient safety                              | 1. Ensure that patient has the skills and knowledge for self-care  
2. Ensure that nurse is logged out before handing iPad to patient                                                                                                                                                  | 1. _______                           |                                      |          |
| Evaluation                                  | 1. Assess learning using teach-back. Key: Open-ended questions, patient repeat in own words, clarify misunderstanding  
2. Formulate and communicate plan for meeting additional learning needs based on teach-back assessment                                                                                                       | 1. _______                           | 2. _______                          |          |

Clinical practice council. The process standard was written to facilitate the change from delivery of written educational materials and television video options to iPad technology and integration of hand-held device use into the workflow for patient care in the clinical areas. Comprehensive, simple instructions for care and use of the devices were included in a process standard so that anyone in the specified roles could access instructions and use the devices safely.

**Tracking and Security**

Using iPads in hospital and outpatient clinic settings for patients presented challenges for security and safety of the devices. Protecting the investment in devices was an important consideration to ensure the long-term viability and sustainability of the program. In partnership with the local campus police department, each iPad was engraved in an area where it could be seen through the protective case that had been purchased and applied to protect the equipment. The serial numbers for each iPad were registered with the police department. This step proved to be important in reducing confusion between hospital-owned iPads and privately owned iPads. In addition, tracking capability for each device was put in place by activating the “find my iPad” function, available in any area in which the technology was used. Within the clinical
The patient risk for cross-contamination from shared iPad use was addressed in 3 ways: (1) requesting protocols from oncology clinical areas with previous experience using iPads in immunocompromised patients, (2) meetings with infection control, and (3) review of the literature. Though definitive research was not available, expert consensus after these steps indicated that topical cleaners were effective in reducing microbial colonization and that the use of occlusive baggies was effective in the case of patients on isolation precautions. The iPad implementation team found that the iPads functioned properly within a clear plastic, sealable bag. A rubber-tipped stylus or the eraser of a pencil could be used with the iPad’s touch screen, either with or without the plastic bag protector. Sani-cloth disinfectant wipes (Sani Professional) were

**Table 3** Protocol for cleaning and storage of iPad

<table>
<thead>
<tr>
<th>Responsible personnel</th>
<th>Process and procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nursing assistant</td>
<td>Before beginning each shift, complete iPad checklist: Verify the charge is 100%. Check the cleanliness and adhesive of the screen protector. Verify the secure closure of the drop-resistant case to the back and front of iPad. Preload new patient names and room numbers for patients ready to participate in education, as indicated from rounds.</td>
</tr>
<tr>
<td>Any team member conducting an iPad educational session</td>
<td>Before each patient interaction: Clean your hands with gel, foam, or soap and water before and between each patient’s interaction with the iPad. Using a disinfectant wipe, clean the outside of the iPad device from top to bottom, then from left to right. Use a second disinfectant wipe if the device is grossly contaminated, making sure all crevices are wet. After all visible surfaces and crevices are wet, allow iPad to air dry before beginning the interactive session. For patients on isolation precautions, place the iPad in a plastic baggie and ziplock the baggie before use. Remove after each patient contact and clean as above. Remember to provide a stylus for patients on isolation who are using the iPad.</td>
</tr>
</tbody>
</table>

areas, the iPads were assigned each day to a care nurse. In ambulatory areas, a sign-in/out log was used to track which nurse and patient were currently using the device.

**Charging and Storage**

A checklist for cleaning and appropriate nightly storage was developed to ensure that the iPads were ready and available for patients to use each day (Table 3). Nurses collaborated with the pharmacy department to repurpose an empty compartment in the Omnicell secure drug distribution system to securely store and electronically log iPad access. Although the Omnicell offered advantages in security and electronic tracking, a barrier was encountered in that the Omnicell units did not allow for proper venting or for electrical access for charging the iPads. The long battery life and resting power function of the iPads allowed night-charging only, and a locked charging station was designed that could be easily managed by the charge nurse on day shift. Wide file racks were purchased from a local office supply store to separate the iPads and to protect the iPads from damage (Figure 3). Nursing assistants facilitated the iPad counts at shift change and verified the charge status of each iPad, ensuring that devices were properly stored each night in the power station lockbox.
used between patients to minimize cross-contamination risk (Table 3). In the hospital units, nursing assistants took responsibility for leading device cleaning and working in collaboration with the infection control committee to conduct intermittent audits of cleanliness.

Evaluating Implementation Processes

Nurses’ acceptance of the implementation of electronic health record systems has been studied, but nurses’ acceptance of Internet technology being used by patients in a health care setting has not been reported. In evaluating iPad-based education, both the nurse and the patient must be considered as users. Unlike the traditional technology acceptance model,33,34 which evaluates a single user, tablet-based patient education has 2 types of users who must be concentrically evaluated, the nurse and the patient. For our project, the Davis model15 more aptly focuses on “perceived usefulness” and “perceived ease of use” for both users. Therefore, using stem questions similar to those from Davis’s model, a Likert and open-text type of survey was developed and administered to nurses on the unit before they worked with their first patient on the iPad. The preimplementation 10-question survey was collected anonymously by using SurveyMonkey and included 9 questions asking nurses how the iPads fit into their workflow and how they thought their patients would receive the technology. An initial response rate of 62% (n = 28) was obtained. A majority of the nurse responses were positive regarding “perceived ease of use”; however, more neutrally divided responses were received to the “perceived usefulness” questions on productivity. The implementation team responded by creating a clearer, more comprehensive presentation of the value message for the full staff rollout.

At the end of the survey, a free-text field allowed for written suggestions and concerns. Of those who responded, concerns were raised regarding acceptance of the technology by patients, capabilities of patients using the technology, and the stamina of patients to complete “lengthy” questionnaires. Apprehensions about time to teach the technology and interruptions of care also were conveyed. To address these anxieties, the implementation team incorporated existing evidence on acceptance by elderly users of the technology into the staff development training materials.

Limitations of the evaluation included the timing of the preimplementation surveys and the short window of time allowed for the pretest evaluation. The preimplementation survey was distributed on a rolling basis as nurse users were available for training and before working with their first patient. Revisions to the staff development training program were then integrated before the full staff rollout. A final limitation of the evaluation was the design of comparisons of survey results from before to after implementation. To facilitate truthful responses, the respondents were blinded; only an Internet provider address, date, and time were captured for each survey completed. With the normal staff changes that occur on a unit, and because of the confidential nature of the survey, comparing the same respondents’ responses to the preimplementation and postimplementation surveys was not possible. However, both the preimplementation and postimplementation surveys offered valuable feedback for the team to evaluate the general perceptions that nurses had about using the iPads and how integration affected workflow and patient care.

Conclusions

Technology-based learning tools, such as tablet applications, may be used in acute and progressive care settings to improve patients’ readiness for hospital discharge. However, integrating these devices into usual care delivery processes and workflows presents challenges for nurses. Staff development initiatives that prepare staff to use tablets by engaging leadership in “on-boarding” staff, establishing the value of iPad educational delivery for patients and providers, formulating the roles, responsibilities, competencies, and workflow integration for all members of the care team, and developing the processes and procedures for safe device use may improve the experience of adopting tablets. CCN

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References
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The United States has 1332 critical access hospitals. These hospitals have fewer than 25 beds each and a mean daily census of 4.2 patients. Critical access hospitals are located in rural areas and provide acute inpatient services, ambulatory care, labor and delivery services, and general surgery. Some, but not all, critical access hospitals offer home care services; a few have palliative care programs. Because of the millions of patients living with serious and life-threatening conditions, the need for palliative care is increasing. As expert generalists, rural nurses are well positioned to provide care close to home for patients of all ages and the patients’ families. A case report illustrates the role that nurses and critical access hospitals play in meeting the need for high-quality palliative care in rural settings. Working together, rural nurses and their urban nursing colleagues can provide palliative care across all health care settings. (Critical Care Nurse. 2016;36[1]:72-78)
CAHs are required to provide 24-hour emergency services, with medical staff on site or on call and available on site within 30 minutes (60 minutes if certain frontier area criteria are met). If a physician is not on site 24/7, the facility must post a public notice stating that a registered nurse will provide initial treatment until a physician, physician assistant, or nurse practitioner arrives. Additional criteria for CAHs include maintaining an annual mean length of stay of 96 hours or less, having a maximum of 25 beds, and having established patient referral and transfer agreements in place with other acute care hospitals. Rural CAHs may apply to use some of their beds as “swing beds,” a status that allows these beds to be used as needed for either acute nursing beds or skilled nursing beds. This flexibility provides benefits to rural residents, who can receive acute and postacute care services in their local community. The CAH is not just a safety net for health care, it also provides a sense of pride for rural communities.

According to the 2010 US Census, approximately 59.5 million people, or 19.3% of the US population, live in rural areas. Many rural residents are elderly and are living with 1 or more serious or life-threatening illnesses, increasing the need for palliative and end-of-life care for this vulnerable population. All health care professionals, especially nurses, are well prepared to provide palliative care in rural and remote settings where distances to

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specialty health care services are great and human and fiscal resources are limited.

Case Report

Mr J, an 88-year-old man, lived independently with his wife in a rural farming area; their 4 children lived in different parts of the United States. Mr J’s primary care physician was located in town near a CAH with 10 acute care beds and 15 swing beds. A 200-bed hospital with level II trauma certification was 160 miles away. Mr J’s medical history included diabetes, 2 strokes, renal insufficiency, and back surgery 8 years before. Mr J’s medications included insulin, warfarin sodium, potassium chloride, hydrochlorothiazide, simvastatin, and amlodipine benazepril. After a fall in the barn that injured his left hip, Mr J limited his activity for 1 week before scheduling an appointment with his physician; a radiograph showed no broken bones. Physical therapy was available at the local CAH, and Mr J attended 6 sessions of therapy during a 3-week period. Persistent pain in the left groin and buttocks continued; Mr J was scheduled for magnetic resonance imaging the next time the mobile magnetic resonance imaging truck, which provided imaging services for several CAHs across the state, was in town.

The imaging revealed avascular necrosis of the head of the left femur, and a repeat radiograph showed a crushed femur. An appointment was scheduled with an orthopedic surgeon located 165 miles away. Mr and Mrs J were not familiar with any specialists and were challenged to navigate the complex health care system in the urban center. Appointments and preoperative visits had to be rescheduled as initial times were not conducive to long-distance travel. Initially, Mr J considered surgery but reconsidered that decision when his wife expressed fears about potential complications and her ability to care for him after the surgery. Mr J’s family physician assured Mr and Mrs J that surgery was necessary to meet the goal of remaining active and to prevent further disability. A nurse at the local CAH, who attended the same church as the family, provided positive feedback about the hospital where surgery was scheduled. She also encouraged Mr and Mrs J to ask 1 of their children to join them for the numerous preoperative appointments that were necessary.

Once medical clearance was obtained from a cardiologist and a nephrologist, Mr J was scheduled to have his left hip replaced. Because of his advanced age and frequent cardiac arrhythmias during surgery, Mr J was admitted to the intensive care unit after surgery, a step that optimized his recovery and allowed him to meet his goal of returning to live in his rural farming community.

Critical care nurses focused their care on pain management; pulmonary function; and monitoring cardiac rhythm, blood sugar level, and anticoagulant status. At night Mr J became confused, and his wife became anxious about this change. The nursing staff assured Mr J’s family members that confusion was common in hospitalized elders. The nurses implemented strategies to keep him safe and provided his family with emotional support. Physical therapy started on postoperative day 1 as Mr J began to learn how to walk with his new hip. From the intensive care unit, Mr J went to a surgical step-down unit, and a social worker assisted with discharge planning when everyone became aware that Mr J would not be ready to return home to the farm directly from the hospital. Plans were made for a transfer to the local CAH for postacute nursing care.

The nurses at the urban hospital provided the CAH nurses with a well-developed plan of care for a smooth transition from one setting to another. The nursing staff at the CAH consisted of 1 registered nurse who was assisted by a licensed practical nurse and a certified nursing assistant. The director of nursing was available to provide coverage for meal breaks or when patient acuity or periods of increased census necessitated an extra nurse. While caring for Mr J, nurses at the CAH were also responsible for patients admitted to the emergency room and for delivery of medications in the adjoining long-term care unit.

In the CAH, nurses conducted ongoing pain assessments and managed medications to keep Mr J physically active; they also assessed and monitored his renal function and anticoagulant status. Mr J’s family was involved in goal setting and communicated well with the nurses. Because the nurses personally knew Mr J, they encouraged him to contact his church pastor and facilitated visits with his grandchildren and his faithful best friend Scout, a border collie. The transfer to a CAH near his home community was helpful for Mrs J, who was relying on neighbors to keep up with chores at the farm while she was staying in the city to be close to her husband after surgery.

After surgery, Mr J spent 10 days recovering at the CAH and then went home and did well for several years.

Registered nurses working in CAHs must be “expert generalists.”
Inevitably his advancing age led to a time when Mrs J was no longer able to care for him without assistance. The family consulted with their local physician and the single nurse practitioner in town to set up in-home and hospice services available from the local CAH. Mr J and his family were reassured that they would be receiving services from health care professionals who lived in the family’s rural community. The family personally knew the home health nurse assigned to work with Mr J, a situation that enabled the quick development of a trusted relationship. Together the family and the home health nurse established a plan of care that focused on comfort care, specifically pain control and management of signs and symptoms. Mr J clearly expressed that he wanted to die at home, and his family members were in agreement. The home health nurse discussed the family’s fears and concerns as Mr J approached the end of his life. Local health care professionals and an extended network of neighbors and friends allowed the family to keep Mr J at home until his death at age 95. In the ensuing months, Mr J’s wife received bereavement support through local agencies, including a community grief support group and a rural-based mental health professional.

Rural Nurses

Registered nurses working in CAHs must be “expert generalists”; they need expertise in a wide range of general nursing areas to provide care to patients of all ages with a variety of medical conditions and different health care concerns.9 For example, during the course of a shift in a CAH, a nurse may be responsible for stabilizing the status of a client with an acute myocardial infarction for transfer to an urban hospital, preparing a patient for surgery, administering medications to patients in skilled nursing swing beds, and caring for a mother in labor ready to deliver a first baby.

When Mr J was admitted to the CAH, he knew his nurse. In sparsely populated communities, a nurse’s patients are often the nurse’s friend, relative, or neighbor. Rural nurses lack anonymity; they are easily identified as “the nurse” at the clinic or hospital when at the grocery store or local high school football game. Rural nursing practice is distinctively different from specialized urban nursing practice such as critical care, as aptly described by Scharff.10(p243)

Being rural means being a long way from anywhere and pretty close to nowhere. Being rural means being independent or perhaps just being alone. Being a rural nurse means that when a nurse saves a life, everyone in town recognizes that she or he was there; and when a nurse loses a life, everyone in town recognizes that she or he was there. Being rural means turning inward for answers, because there may be nobody to turn to outward. Being rural means that when a nurse walks into the emergency room, it may be her or his spouse or child who needs a nurse, and, at the moment, being a nurse takes priority over being anyone else. Being a rural nurse means being able to deal with what he or she has got, where she or he is, and being able to live with the consequences.

Palliative Care

Palliative care is a form of specialized care for patients with serious, life-threatening, or incurable conditions. Signs and symptoms are managed, pain is relieved, quality of life is improved, and grief and bereavement are supported.11 In contrast to the belief that palliative care is used only when a patient is dying, palliative care actually has a broader application and is ideal for patients with serious and incurable illnesses and the patients’ family members. Palliative care is recognized as a national priority by several health professional organizations, including the American Association of Critical-Care Nurses,12 which recognizes that critical care and palliative care should no longer be viewed as polar opposites. The “science and skills of both disciplines are needed to provide optimal care for critically ill or injured patients and their families.”13(para 4)

Palliative care includes providing relief of physical and emotional distress, facilitating communication and decision making with health care providers, and coordinating care across health care settings.14 The most common model of palliative care delivery is the consultative model.15 Specialists in palliative care are called in to consult on cases that require management of complex signs and symptoms, have challenging decision-making needs, and/or are characterized by unusual family dynamics.
This model is consistent with secondary (medical specialists) or tertiary (advanced level care) levels of palliative care. Because of the tremendous increase in the number of patients living, and dying, with multiple serious and life-threatening illnesses, health care providers now recognize the need to move away from only using the consultative model of care. Ideally, palliative care should be provided by frontline staff, including physicians, nurses, and others (social workers, chaplains, and so on), who are involved in the routine care of patients with serious and life-threatening illnesses, reserving consultations with palliative care specialists for the most complex cases. In either instance, health care providers are challenged to implement palliative care in rural settings such as the one where Mr J lived.

The Clinical Practice Guidelines for Quality Palliative Care were recently updated to emphasize continuity, consistency, and quality of care (see Table). Although some CAHs provide palliative care services to patients and patients’ family members, the hospitals often face challenges in meeting national guidelines, such as having a multidisciplinary palliative care team available around the clock or providing bereavement services to surviving families for up to 1 year after a patient’s death. In

### Table  
**Palliative care: definition, domains, clinical implications, and tenets**

<table>
<thead>
<tr>
<th>Domains of care</th>
<th>Clinical implications</th>
<th>Tenets</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Structure and processes</td>
<td>Palliative care occurs across health care settings; care includes physical, psychological, and social aspects of care; best practices are used; and health care providers engage in quality and performance improvement activities</td>
<td>Patient and family centered</td>
</tr>
<tr>
<td>2. Physical aspects</td>
<td>Compassionate care is provided by health care providers; pain and symptoms of patients and patients’ families are managed to promote quality of life</td>
<td>Comprehensive palliative care with continuity across health care settings</td>
</tr>
<tr>
<td>3. Psychological and psychiatric aspects</td>
<td>Assessment of psychological and psychiatric aspects is ongoing; grief and bereavement services are provided for patients, patients’ families, and staff members</td>
<td>Early introduction of palliative care at diagnosis of a serious disease or life-threatening condition</td>
</tr>
<tr>
<td>4. Social aspects</td>
<td>Health care providers assess social structure of patients and patients’ families, including culture, values, strengths, goals, and preferences of family system</td>
<td>Interdisciplinary collaborative palliative care</td>
</tr>
<tr>
<td>5. Spiritual, religious, and existential aspects</td>
<td>All health care providers assess spiritual needs of patients and patients’ families; health care providers are aware of their own spirituality and how it may influence the care provided</td>
<td>Clinical and communication expertise among palliative care team members</td>
</tr>
<tr>
<td>6. Cultural aspects</td>
<td>Health care providers should be culturally competent and provide appropriate cultural care to patients and patients’ families</td>
<td>Relief of physical, psychological, emotional, and spiritual suffering of distress of patients and patients’ families</td>
</tr>
<tr>
<td>7. Care of the patient at the end of life</td>
<td>Health care providers promote a peaceful and honorable death, with awareness of the values, preferences, beliefs, culture, and religion of patients and patients’ families</td>
<td>A focus on quality</td>
</tr>
<tr>
<td>8. Ethical and legal aspects</td>
<td>Health care providers need awareness of ethical principles and access to legal and ethical expertise to support palliative care practice</td>
<td>Equitable access to palliative care services</td>
</tr>
</tbody>
</table>

* Based on information from Dahlin.16
addition, rural areas have prominent barriers that may limit access to health care, including long distances, unpredictable weather, lack of public transportation, limited health care resources, shortages in the number of health care providers, few certified specialists, and limited opportunities for training in palliative care. Providing palliative care services can be especially challenging in rural settings because of personal and professional role strain, including lack of anonymity and role diffusion, which is common among health care providers in rural environments.

Nurses’ Role in Palliative Care

All patients with serious and life-threatening illnesses deserve access to high-quality palliative care. The tenets of palliative care include being patient and family centered, providing continuity across health settings, working with patients with serious disease or life-threatening conditions, collaborating with other disciplines, using excellent communication skills, providing relief of suffering and distress, focusing on quality, and providing equitable access to care (see Table). The Hospice and Palliative Nurses Association promotes the importance of the professional nurse in palliative care, stating that “nursing care is critical to achieving healthcare goals of patients, families, communities, and populations through the end of life.” Patients and patients’ families benefit when nursing care includes both the science (assessment, management of signs and symptoms, critical thinking) and the art (compassion, empathy, and excellent communication) of nursing. Nurses are well positioned to provide support and promote quality of life for vulnerable patients and families facing serious or life-threatening illnesses.

Mr J’s case report illustrates how he and his family benefited from the care he received in a rural community. Mr J’s serious illnesses were managed, but not cured, and his injury was surgically repaired so he could regain a level of physical functioning that allowed him to return home to his rural community. Consistent with the domains and tenets of palliative care (see Table), Mr J’s physical, emotional, social, and spiritual needs were addressed by a small number of local health care providers and the support of neighbors and family members. Mr J’s autonomy was maintained when local health care providers provided information necessary for him and his family to make choices about what was important at the end of his life. Mr J’s local physician knew that Mr J wanted to remain active and explained that surgery would allow Mr J to regain mobility. A nurse familiar with Mr J and his family provided encouragement about the care provided at the large urban hospital. Emotional support was provided by a friend in town, who suggested Mrs J ask the children to assist with preoperative appointments. Coordination of care took place as surgical and critical care nurses in the urban hospital facilitated Mr J’s transfer back to the local CAH after surgery (domain 1). Mr J’s signs and symptoms were well managed, and assessments of his pain and anticoagulant status continued in his rural community (domain 2). Staff at the CAH involved Mr J’s family in the plan of care and provided emotional and spiritual support (domain 3). Health care professionals in the rural community were known to Mr J and his family and supported his social, spiritual, and cultural connections in the community (domains 4, 5, and 6). Home health and palliative care services from the local CAH enabled Mr J’s family to accommodate his wish to die at home (domains 7 and 8). After Mr J’s death, his family received bereavement support (domain 3) from local providers in the family’s rural community.

Shadd et al provide an important differentiation between palliative care provided by a specialized team and a palliative approach to care, stating that as an approach to care, “palliative care appreciates death as a normal life event, emphasizes good communication and clarification of goals of care, and focuses on quality of life including symptom management.” A palliative approach provides patients with life-threatening illnesses an opportunity to receive primary palliative care on a daily basis from frontline health care providers. A palliative approach provides patients with serious and life-threatening illnesses an opportunity to receive primary palliative care on a daily basis from frontline health care providers, thus leaving specialty palliative care for more complex cases that cannot be handled by primary level palliative care providers. A palliative approach is a model that works especially well in rural settings.

The model of distinguishing palliative care provided by specialized teams from a palliative approach of care provided by all health care providers affirms nurses’ ability to provide palliative care to patients in all settings. Furthermore, because of the close link between

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nursing care and the tenets of palliative care, all nurses, whether intentionally or not, often use a palliative approach to provide care. Rural nurses often do not have a palliative care team to consult and yet instinctively resort to a palliative approach to care: advocating for patients and implementing work-arounds for rules and policies that do not support the needs of patients and patients’ family members. The differences between a model of specialist-promoted palliative care teams, which exist in urban settings, and the model of a palliative approach to care, which is common in rural settings, are important. These differences may lead to tensions, which in turn, weigh heavily on rural nurses and lead to adverse effects on the nurses’ emotional well-being. Rural health care providers are often supported by colleagues and professional networks, as well as the inherent sense of connectedness found between friends and neighbors in rural communities.19

Conclusion
Because millions of patients are living with serious, complex, and potentially life-threatening conditions, the need for palliative and end-of-life care for patients and patients’ families is increasing. Because of limited fiscal and human resources in all health care settings, health care providers can no longer rely on specialized palliative care teams as the only clinicians to provide palliative care. A palliative approach, which requires all health care providers to provide palliative care, is especially suited for rural settings. As expert generalists, rural nurses are well positioned to provide care close to home for patients of all ages and the patients’ families. Rural nurses’ familiarity with community members and knowledge of available resources allow these nurses to work with their urban counterparts to overcome challenges when providing compassionate palliative care to rural residents and the residents’ families. CCN

Financial Disclosures
None reported.

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References
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The dictionary definition of competence is “the ability to do something successfully or efficiently.” Synonyms for competence include capability, ability, proficiency, expertise, adeptness, skill, mastery, talent, and know-how. Successfully achieving certification is one avenue to demonstrate knowledge and competence in acute and critical care nursing. CCRN, PCCN, CMC, and CSC are credentials of competence.

Adult CCRN Practice Questions
1. Which of the following statements by the nurse provides the best rationale to delay attempts to wean from the ventilator?
   A. “The patient is breathing over the set rate of 12 breaths/min.”
   B. “The patient has only had a tracheostomy for 3 days.”
   C. “The patient is still receiving continuous sedation.”
   D. “The patient still requires significant vasopressor support.”

2. A patient is admitted after experiencing a major motor vehicle crash (MVC) and sustaining fractures of a femur and ribs. The patient now states that they “fear for their life and do not want to drive again.” What would be the best goal related to this fear by discharge? The patient will
   A. Be free from flashbacks
   B. Not require sedatives to sleep at night
   C. Exhibit a full range of emotions before discharge
   D. Not discuss the traumatic event with family members

Test plan topic: Behavioral/Psychological is part of Neuro/Multisystem/Behavioral, 13% of the CCRN questions

3. A patient is admitted after slipping and falling on the ice. The patient is alert and oriented and the nurse notes a 5-cm laceration of the occipital scalp. What intervention should be next?
   A. Prepare to have the laceration stapled
   B. Immediately get a head computed tomography (CT) scan
   C. Administer tetanus prophylaxis
   D. Assess the wound to determine need for irrigation

Test plan topic: Integumentary is part of Endocrine/Hematology/GI/Renal & Integ, 20% of the CCRN questions

4. Twenty-four hours after a small-bowel resection and 5 L of fluid replacement, a patient’s hemodynamics are as follows: heart rate (HR), 120/min; blood pressure, 90/48 mm Hg with a
mean arterial pressure (MAP) of 62 mm Hg; central venous pressure (CVP), 14 mm Hg; pulmonary pressures (PA) 40/24 mm Hg; and cardiac index (CI, calculated as cardiac output [CO] in liters per minute divided by body surface area in square meters), 2. Urine output has been 10 mL/h for the past 4 hours and intra-abdominal pressure (IAP) is 14 mm Hg. Which of the following interventions are appropriate?
A. Raise the head of the bed to >30º
B. Place nasogastric tube back to suction
C. Administer intravenous bolus of furosemide
D. Continuous infusion of diltiazem

Test plan topic: Gastrointestinal is part of Endocrine/Hematology/GI/Renal & Integ, 20% of the CCRN questions

5. A nurse is preparing to transfer a patient with traumatic brain injury to a long-term care facility. Before transfer, the nurse works with the care team to facilitate the family accompanying the patient during the transfer to decrease the patient’s and the family’s anxiety regarding the move. This nursing practice represents which aspect of the AACN Synergy Model?
A. Collaboration
B. Advocacy
C. Clinical judgment
D. Caring practices

Test plan topic: Professional Caring and Ethical Practices, 20% of the CCRN questions

Correct Answers and Rationales for Adult CCRN Practice Questions
1. Correct Answer: D
Rationale
Weaning should be a protocol-driven and multidisciplinary procedure. Weaning should not begin until the patient is hemodynamically stable. Breathing over the ventilator (A) is not a criterion for weaning. The only reason to delay weaning after being intubated (B) would be to ensure that the anesthesia is no longer affecting the drive to breathe. Ventilator patients should be given a sedation holiday daily to assess their ability to breathe/wean (C); spontaneous breathing trials should be done for all patients who meet the other criteria for weaning.

Source

2. Correct Answer: B
Rationale
Patients experiencing a traumatic event may exhibit signs of posttraumatic stress disorder (PTSD) for weeks to years after an event has occurred. Nurses can provide support, identify coping strategies, and work with patients’ families to support the patient. A patient’s reactions to a traumatic event may differ depending on past experiences, how they cope, and the patient’s family support system. Having no flashbacks (A) and experiencing a full range of emotions (C) are long-term outcomes. Patients should be encouraged to discuss the traumatic event with providers or family members (D). During the hospital stay, sleep routines should be encouraged along with pain-control strategies to help the patient reach the point where no sedatives are required to sleep at night.

Sources

3. Correct Answer: D
Rationale
If the laceration is found on secondary assessment, any bleeding would not be life-threatening. Before the wound can be closed (A) it needs to be cleaned and examined (D) for any foreign objects. The patient is awake and alert, so a head CT (B) would not be immediately indicated. The need for tetanus prophylaxis (C) would depend on a patient’s immunization history.

Source

4. Correct Answer: B
Rationale
A patient is at risk of intra-abdominal hypertension developing after abdominal surgery, which will reduce venous return and impede cardiac outflow because of back pressure from the abdominal cavity. Normal intra-abdominal pressure is 0 to 12 mm Hg. The increased pressure in the abdominal cavity and decreased cardiac output also reduce perfusion of the abdominal organs, resulting in decreased urine filtration and urine output.
The goal is to maintain perfusion to the abdominal organs and decrease pressure within the abdominal cavity. One way to reduce pressure within the abdominal cavity is to reduce abdominal contents by resetting the nasogastric tube to suction (B). Elevating the head of the bed (A) may worsen the intra-abdominal pressure. Administering furosemide (C) will not correct the underlying problem of increased abdominal pressure. Diltiazem (D) will not treat the underlying problem of decreased venous return to the heart and decreased CO.

Source

5. Correct Answer: D
Rationale
The AACN Synergy Model relies on the patient’s characteristics to drive the nurse’s competencies; the interaction is synergistic. Collaboration (A) and advocacy (B) would have occurred between the nurse and the transfer service to facilitate the family presence during transfer. The actual act of determining the need for the family presence to decrease anxiety regarding the move is caring practices. Clinical judgment (C), in the Synergy Model, refers to the science of nursing practice.

Source

CMC Practice Questions
1. A patient admitted for heart failure has a stroke volume variance of 25%. The nurse should prepare to administer
   A. Dobutamine
   B. Norepinephrine
   C. Nitroglycerine
   D. Fluid

Test plan topic: Monitoring and Diagnostics, 16% of the CMC questions

2. A patient with complete heart block and a temporary ventricular transvenous pacemaker is experiencing occasional episodes of R-on-T phenomenon. The nurse should
   A. Increase the milliamps (mA)
   B. Increase the sensitivity

Test plan topic: Therapeutic Interventions, 16% of the CMC questions

3. A patient following a percutaneous intervention (PCI) in the left anterior descending coronary artery (LAD) due to an anterior myocardial infarction (MI) has a new systolic murmur, shortness of breath (SOB), and palpitations. The most likely cause of these signs and symptoms is
   A. Cardiogenic shock
   B. Reocclusion of the LAD
   C. Ventricular tachycardia
   D. Aortic insufficiency

Test plan topic: Cardiovascular, 47% of the CMC questions

4. Which of the following hemodynamic assessment changes is most likely to occur when a patient is treated with bilevel positive airway pressure (BiPAP)?
   A. Increased intracranial pressure (ICP), increased blood pressure (BP), increased pulmonary artery pressure (PA), and increased cardiac output (CO)
   B. Decreased ICP, increased BP, decreased PA, and increased CO
   C. Increased ICP, decreased BP, increased PA, and decreased CO
   D. Increased ICP, increased BP, decreased PA, and increased CO

Test plan topic: Therapeutic Interventions, 16% of the CMC questions

5. A nurse notifies the provider who admitted a patient for exacerbation of heart failure and a history of alcohol abuse that the patient is experiencing new-onset agitation. The HR is 115/min with a QT interval of 0.54 seconds. The nurse should anticipate doing which one of the following?
   A. Obtain an electrolyte panel
   B. Obtain a sample for arterial blood gas (ABG) analysis
   C. Administer amiodarone
   D. Administer haloperidol

Test plan topic: Therapeutic Interventions, 16% of the CMC questions
Test plan topic: Other Patient Problems, 21% of the CMC questions

Correct Answers and Rationales for CMC Practice Questions

1. Correct Answer: D
Rationale
A stroke volume variance reflects a patient’s fluid status. A variance of greater than 13% indicates more fluid is needed. There is no indication of contractility complications (A) or the need for the additional support of vasopressors (B). Nitroglycerine (C) is a vasodilator and would be counterproductive as this patient most likely has issues with blood pressure regulation.

Sources

2. Correct Answer: B
Rationale
The R-on-T phenomenon that predisposes a patient to dangerous arrhythmias can occur in a paced rhythm when the pacemaker is undersensing the patient’s intrinsic rhythm. Increasing the sensitivity by lowering the millivoltage (mV) setting will allow the pacemaker to see more of the patient’s own intrinsic electrical activity that it was not able to see in the complication described. Increasing or decreasing the milliamperage (A, C) will only increase or decrease the energy used to elicit the depolarization.

Source

3. Correct Answer: A
Rationale
An MI can damage the ventricle, causing the chordae to rupture and creating mitral regurgitation. A systolic murmur can be heard with mitral regurgitation and may cause signs and symptoms of SOB and palpitations. When these are present shortly after the MI, cardiogenic shock is a likely complication. Additional prominent signs and symptoms such as diaphoresis, electrocardiographic changes, and chest pain would most likely occur for reocclusion of the LAD (B). Ventricular tachycardia (C) can be a complication but would not cause a systolic murmur. Aortic insufficiency (D) is not a common complication of an MI.

Source

4. Correct Answer: C
Rationale
When BiPAP is applied, the positive end-expiratory pressure (PEEP) causes the alveoli to open and remain expanded on exhalation. This causes continuous compression on the capillary bed, making it more difficult for blood to pump from the right ventricle through the lungs and causing increased pressure in the right ventricle and pulmonary artery. Continuous pulmonary capillary compression impedes venous return and PA outflow, increases ICP, and diminishes both BP and CO.

Sources

5. Correct Answer: A
Rationale
Electrolytes play a significant role in cardiac conduction. It is important that electrolyte levels be monitored in a patient with the risk factors of alcohol abuse and prolonging QT intervals because these are precursors for the dysrhythmia torsades de pointes. ABGs (B) will most likely be monitored, but doing so is not a priority for this issue. Antiarrhythmic agents (C) and haloperidol (D) are inappropriate interventions because they may prolong the QT interval further.

Source

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

Administering Medications During Targeted Temperature Management

Q

Should medications be given subcutaneously during targeted temperature management at 33°C?

A

Michelle E. Deckard, RN, MSN, ACNS-BC, CCRN-CMC, replies:

The neuroprotective effects of targeted temperature management (TTM) after cardiac arrest are well known, but how hypothermia affects the distribution and metabolism of medications is only beginning to be understood. Most of these studies have focused on those medications that are given intravascularly. Few studies have been reported that specifically address hypothermic patients and the subcutaneous administration route, although other studies can help guide decision making on whether to use the subcutaneous route to administer medications.

From a simple physiological view, hypothermia causes vasoconstriction, a great defense mechanism to protect the vital organs by shunting blood away from nonessential areas. The resulting decrease in blood circulation to the subcutaneous tissue hampers the ability of medications administered subcutaneously to be absorbed. But what does the evidence tell us?

Wong¹ studied the effects of progressive hypothermia on blood flow to the organs (see Figure). In his study, Wong addresses the descending order of oxygen consumption for the kidneys, liver, heart, brain, skeletal muscle, and skin and points out the parallel decrease in blood flow as the core temperature decreases.¹ Skeletal muscle and skin were not included in the graph and were not mentioned in the article text. Thus we are left to wonder if they were not included because hypothermia had little effect on blood flow to these areas or because the skeletal muscle and skin were not considered important.

In a prospective, controlled, open-label study, Priglinger et al⁵ explored the efficacy of using the

Figure

Blood flow to the organs reduces with progressive hypothermia. The shaded area is total flow. The heart, liver, and brain maintain a higher level of flow in comparison with the kidneys to 27°C. However, at 25°C to 20°C, renal and myocardial blood flows are sustained at 20% to 25% of normothermic levels, whereas cerebral and hepatic blood flow show greater decreases.

subcutaneous route in critically ill patients. They compared critically ill patients who were receiving low-molecular-weight (LMW) heparin subcutaneously with medical patients who were not critically ill. All patients had normal renal function and received 40 mg of enoxaparin. They reported significantly lower levels of anti-Xa, a measure of plasma concentration of LMW heparin, in the critically ill patients. The researchers suggested that “it is unknown whether vasoconstriction due to low output or vasopressor therapy may delay or interfere with subcutaneous absorption and might explain lower levels in the critically ill patients.” The conclusion was that standard-dose LMW heparin might not be sufficient for prophylactic anticoagulation in critically ill patients, raising the question of why the critically ill patients had lower levels.3

In a prospective, convenience-sample study, Dorffler-Melly et al4 addressed one of the factors in question from the study by Priglinger et al.3 They measured the bioavailability of LMW heparin when administered subcutaneously to patients receiving vasopressors and compared them with intensive care unit (ICU) patients not receiving vasopressors and patients not in the ICU. Although this study is not specific to hypothermic patients, its look at absorption due to vasocostriction can add insight into the search for our answer. All patients received the usual prophylactic dose of LMW heparin to prevent venous thromboembolism. The researchers reported a significantly lower systemic concentration of LMW heparin in the critically ill patients receiving vasopressors than in the other 2 groups. Dorffler-Melly et al4 noted, “physiologically or pharmacologically induced vasoconstriction of the peripheral blood vessels impairs subcutaneous perfusion, thereby impeding adequate absorption of subcutaneously administered LMW heparin.”

Sunjic et al5 provide a review of published studies on the pharmacokinetic alterations and related pharmacodynamic implications of drug therapy during TTM. They suggest that TTM should be considered a drug-therapy interaction because of the changes in drug distribution and metabolism that occur during TTM. Patients receiving TTM have the potential for “toxic or subtherapeutic drug concentrations [that] could lead to adverse effects, suboptimal effects, or heightened drug interactions.” They found “limited data available regarding the safety and efficacy of transdermal, subcutaneous, and intramuscular drug absorption in hypothermia (32°C-36°C); therefore it is reasonable to consider alternative routes of administration during TTM.”

An aspect of subcutaneous medication administration that is not available in the literature is, What happens to medication that is administered subcutaneously while the patient is hypothermic, when the patient is rewarmed? Could the dose become supra-therapeutic once normal perfusion is restored to subcutaneous tissue and medication is then absorbed?

These studies and the questions that remain suggest that more research is needed to determine the effect of medications during the entire course of TTM. So where does this leave us in answering our original question: Should medications be given subcutaneously during TTM at 33°C?

Given that no studies have specifically addressed the absorption, distribution, serum concentration, or metabolism of subcutaneous medications administered in hypothermic patients, the question remains unanswered. With the available research and the presumed physiological effects of hypothermia, the subcutaneous route of medication administration should generally be avoided while the patient is hypothermic. Intravascular administration may be an alternative route that is safer for hypothermic patients and available for most medications that might be administered subcutaneously. CCN

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The author has received honoraria from Bard Medical Division, Covington, Georgia, for presentations and participation in research.

References

Ask the Experts
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A

s part of its “100 000 Lives Campaign,” the Institute for Healthcare Improvement introduced rapid response teams (RRTs) in 2004 to bring critical interventions to the bedside at the first sign of deterioration. They quickly caught on, and by 2008, the Joint Commission had made RRTs part of hospital accreditation.1

Most in-hospital arrest states are caused by respiratory compromise and hypotension.2-4 RRTs were based on the finding that caregivers outside of intensive care units (ICUs) often were unable to recognize these and other early signs and symptoms of patients’ deteriorating condition or waited too long to call for assistance to prevent a cardiac arrest, which can occur up to 6 hours before a code blue situation.1,4-6 At the first sign of deterioration, RRT activation brings critical interventions to the bedside, including a team of multidisciplinary critical care providers and resources4,7 (Table 1). The frequent monitoring that occurs in the hospital facilitates fast interventions to avoid code blue situations, which occur when patients reach a state of cardiac arrest. Ideally, RRTs mean that hospitals have fewer activations of the code blue team.

Background

When our academic medical center first created an RRT in 2006, the team included ICU registered nurses who were assigned either to patient care or as charge nurses. The RRT structure became a burden for the ICU nursing staff because ICU nurses sometimes had to respond to activations while assigned to patient care. An RRT event took the nurse away from the ICU for 45 minutes, on average, during which time the ICU was short staffed. In addition, each RRT event produced a stressful situation because no formalized or centralized management of patient flow existed. The ICU nurse was often stranded with the critically ill patient waiting for a bed at a higher level of care to become available or waiting for interventions to be performed that would allow the patient to stay on the unit.

Over time, the nursing department realized that the existing RRT
design was inefficient. So in 2011, our academic medical center sought to redesign the RRT while maintaining the emphasis on the role of the ICU nurse. The redesign, which was led by nurses, eliminated the need to remove nurses from the units by creating a dedicated team of ICU nurses to function on the RRT. The responsibilities of this non–unit-based RRT nurse position are listed in Table 2.

Dedicating a team of ICU nurses to function as designated RRT nurses streamlined the RRT process and improved patient care by supporting early recognition and intervention for non-ICU patients in deteriorating condition.

### Review of the Literature

Debate still exists about whether use of RRTs improves patients’ outcomes and mortality, but at least some studies have shown that it does. Karpman and colleagues concluded that RRTs did not improve the “severity-of-illness-adjusted outcome of patients transferred to the ICU from the non-ICU patient care areas” after studying the direct relationship between the number of RRT activations and increased ICU admissions from non-ICU patient care areas.

Meanwhile, Al-Qatani and colleagues examined the effect of implementing an intensivist-led multidisciplinary RRT on cardiopulmonary arrests and hospital mortality and found that after the RRT was implemented, non-ICU cardiopulmonary arrests decreased from 1.4 to 0.9 per 100 hospital admissions.

In a similar study, researchers concluded that in-hospital mortality rates decreased after RRT implementation in 6 of 10 tertiary care hospitals. Furthermore, a retrospective chart review indicated that before implementation of the RRT, the percentage of cardiopulmonary arrests was 83% or 1.84 per 1000 discharges and mortality was 1.42 per 1000 discharges whereas after RRT implementation, cardiopulmonary arrests decreased to 12.7% or 1.7 per 1000 discharges and hospital mortality decreased to 1.25 per 1000 discharges.

Certainly the success of the RRT relies on staff awareness and willingness to activate it. Our initial difficulties with RRT activation are reflected in the review of the literature. Studies have shown that nurses are aware of the RRT, but many still hesitate to activate it when patients show signs of distress. Two independent studies reported that the relationship between nurses and physicians can be a barrier, because many nurses believe that the physician should be contacted before an RRT. Some nurses may view

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**Table 1** Reasons for activation of rapid response team

<table>
<thead>
<tr>
<th>Reason for Activation</th>
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</thead>
<tbody>
<tr>
<td>Heart rate &lt; 45/min or &gt; 125/min</td>
</tr>
<tr>
<td>Respiratory rate &lt; 8/min or &gt; 24/min</td>
</tr>
<tr>
<td>Oxygen saturation &lt; 90% or increasing oxygen requirements</td>
</tr>
<tr>
<td>Diastolic blood pressure &lt; 90 mm Hg or systolic blood pressure &gt; 180 mm Hg</td>
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<tr>
<td>Seizure including eclamptic seizure</td>
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<tr>
<td>New onset of chest pain</td>
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<tr>
<td>Acute change in mental status</td>
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<tr>
<td>Postpartum hemorrhage</td>
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<tr>
<td>Unplanned spontaneous delivery</td>
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<tr>
<td>Vaginal bleeding before delivery</td>
</tr>
<tr>
<td>Patient has not responded to treatment already underway from recent change in status</td>
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<tr>
<td>Concerned staff</td>
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</tbody>
</table>

**Table 2** Responsibilities of the non–unit-based rapid response team nurse

<table>
<thead>
<tr>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Responding to activations of the rapid response team</td>
</tr>
<tr>
<td>Performing proactive rounding in patient care areas other than the intensive care unit in order to help identify changes in patients’ conditions and effect early intervention</td>
</tr>
<tr>
<td>Functioning as a critical care resource nurse in patient care areas other than the intensive care unit</td>
</tr>
<tr>
<td>Offering real-time educational opportunities to nursing staff</td>
</tr>
<tr>
<td>Collecting, recording, and reporting data</td>
</tr>
<tr>
<td>Providing formal education about the rapid response team to new nurses, residents, medical students, and staff</td>
</tr>
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</table>
the RRT as punitive and personal or as a reflection of poorly delivered care. In a survey of nurses who work in hospitals with RRTs, nurses have reported that negative implications of RRTs include strained relationships between nurses and physicians, tension between the ICU nurse and bedside nurse, negative reflection of poor care delivery, increased workload on hospitalists, and reduced autonomy for the primary provider and the bedside nurse.12

Methods
When our academic medical center first decided to implement the RRT in 2006, it formed a multidisciplinary subcommittee of the existing code blue committee to design the RRT team. The subcommittee developed 2 documents to record each general RRT activation and each obstetrical RRT activation.

In its first iteration, before redesigning the RRT design and implementing a designated RRT nurse, RRT documentation was the responsibility of the ICU nurse. The form to document an RRT was basic, with 3 areas to record vital signs; a large, free text area for noting events; and check boxes for outcomes. The information collected on this part of the form included patient information, trigger for activation, activator, responding team members, date and time of activation, activation location, interventions, disposition, and outcomes. This information was entered into a computer database that stored information on every RRT activation and tracked outcomes for performance improvement. Documentation was often incomplete. Contributing to the poor documentation was the fact that the form itself lacked any consistent mechanism for recording vital signs, patient assessment, and interventions.

Furthermore, although the ICU nurse was responsible for bringing the actual RRT form to the RRT event, the person responsible for completing the form varied. Employees from different disciplines completed it, including the ICU nurse, nursing supervisor, bedside nurse, respiratory therapists, and nursing students. In addition, the process for entering the information into the database was not clearly established. The data entered were often incomplete and lacked quality control.

In 2011, the Department of Nursing redesigned the RRT team to include 4 full-time-equivalent nurses dedicated to the RRT. Responsibility for documenting the RRT and data entry became the responsibility of the RRT nurse. This change resulted in complete and accurate data collection and entry. However, as the RRT nurses became acclimated to their role, it became clear that the RRT documentation form was inefficient. So they redesigned the RRT form as a flow sheet capturing vital signs, fetal heart tones, and interventions. In addition, the form was redesigned to accommodate obstetrical activations so that a separate form was no longer needed.

Over time, the RRT nurses also realized that the database was not capturing metrics, such as events that occurred within 24 hours of an emergency department stay, within 24 hours of an ICU stay, or within 24 hours of direct admission. So the RRT subcommittee met to redesign the database. The subcommittee worked with staff from the information systems department to adjust the existing database to capture the revised metrics. In particular, this provided a new mechanism to track patient progress and milestones throughout hospitalization. A comment section was added to enable daily data entry, and indicators were added to include obstetrical causes. Other changes included the addition of primary team notification, palliative care consultations, and pastoral care. Documentation of “who called the RRT” was eliminated and instead the activating discipline is now entered.

The database generates reports on a quarterly basis. For each quarter, the number of RRTs is divided by the number of patient days for that quarter, and multiplied by 1000 to produce the rate of RRTs per 1000 patient-days. This rate eliminated the fluctuations that resulted from changes in hospital census during each time period. This calculation was also done to determine the non-ICU code blue rate per 1000 patient-days.

Results
Between 2012 and 2014, RRT activations increased throughout the hospital while non-ICU code
blues and emergent intubations decreased (see Figure). During this time period, a significant increase occurred in RRT activations along with a significant decrease in non-ICU code blues. Results also suggested a decrease in intubations; however, this trend was not significant.

**Discussion**

Since the RRT redesign, a culture change has occurred at our hospital. The RRT is no longer viewed as negative or punitive, but rather it is accepted and encouraged. RRT nurses provide an open channel of communication between the patient care nurse, physician, and family. The RRT is activated earlier and more frequently. As RRT activations have increased, non-ICU code blues have decreased, as have emergent intubations.

As the RRT process has evolved, the database is periodically updated to focus on specific metrics. The data are used to continually improve quality and outcomes. The RRT database is periodically adjusted to capture targeted quality and outcomes information. For instance, the existing database uses heart rate as a trigger for RRT activation, but a newer version of the database will differentiate between bradycardia and tachycardia as triggers.

The RRT database is also periodically adjusted to capture targeted quality and outcomes information. In addition, data will capture information occurring 12 hours before activation. This information will be used in case review and for teaching. Postactivation data to be collected will include change in level of care up to 4 hours after the RRT and effectiveness of treatment techniques.

Our RRT is used only in inpatient units at this time. For example, if a patient received a diagnostic procedure and experienced a change in status, the RRT system was not activated. In 2014, the RRT expanded to radiology so that patients who decompensate while undergoing a radiologic procedure may benefit from RRT resources and intervention. Because critical care patients receive numerous radiologic procedures, this change has provided support to the ICU nurse. In addition, the radiology technicians have reported that the RRT has given them greater “peace of mind” compared with the past.
when they reported feeling alone when patients experienced a change in status, for example, chest pain or shortness of breath.

Future plans for RRT include expansion beyond inpatient areas to other areas throughout the hospital. For instance, RRTs will soon be available to the clinical decision unit, an observation unit of the emergency department with a capacity of 30 beds. Additionally, the RRT program is considering expansion to the outpatient cardiac catheterization laboratory, ultrasound, and nuclear medicine.

The success of the RRT redesign can be attributed to its multidisciplinary approach and support from nursing administration. To continue its success, the institution needs to analyze the current RRT and code blue policies, procedures, and use along with current performance improvement methods. Administratively, the hospital needs to continue dedicating full-time–equivalent positions to the RRT nurse. Ongoing education is also needed so that all disciplines are informed about the role of this newly developed RRT nurse position. As part of this effort, the RRT nurses in our institution provide education sessions to newly hired nurses, interns, residents, respiratory therapists, chaplains, and pharmacy residents.

RRTs were designed to bring critical care interventions to patients in deteriorating condition who are outside of the ICU. After initial implementation, our institution redesigned the nursing structure of the team to include dedicated critical care nurses, and this redesign has improved patient care.

Although debate still exists about whether RRTs improve patients’ outcomes and mortality, the declining rates of non-ICU code blues and emergent intubation at our hospital since the implementation of the RRT suggest that RRTs do, at least as long they are designed to fit within the needs of the institution. The perception of RRTs has improved, and channels of multidisciplinary communication and collaboration have improved, as well. Thanks to these positive indicators, expansion of RRT coverage to additional areas in our hospital is planned for the future.

Acknowledgments
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Financial Disclosures
None reported.

References
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Competency Assessment Field Guide: A Real World Guide for Implementation and Application

Donna Wright has been a leading name in competency assessment since the development of her model and common sense approach to evaluating staff competence. *Competency Assessment Field Guide* is a response to the questions and misconceptions that have arisen during her work with staff educators, leaders, and organizations around the country.

She divides the content into 3 sections. First Wright addresses the questions most commonly asked, as well as information that is poorly understood about competency assessment in health care.

The second section contains stories from organizations across the country that had issues with competency assessment and the strategies implemented based on the Wright Competency Assessment Model. These stories describe the motivation for change, an assessment of the current state compared to the desired state, what key stakeholders most appreciated about the Model, overcoming hurdles, and the benefits to the individual and the organization.

The second half of this section focuses on results and outcomes. Wright discusses problems addressed by organizations, the solution that was implemented, and, in most cases, the outcomes attained.

The third section of the book is devoted to tips for implementing the Wright Competency Assessment Model within an organization.

Wright’s first book on her Model laid the groundwork for changing the way we think about and implement competency assessment. This *Field Guide* shows how the model works in the real world environment. The stories provide the added benefit of demonstrating that there is no one-size-fits-all approach; organizations may have similar problems with competency evaluation but they must be managed within the framework of leadership and available resources. To be relevant, the Model must be useable in multiple environments.

This is an essential read for anyone involved in education and competency assessment in the health care environment. The common sense approach removes the reason frequently given for doing things the way we have always done them; that is, “it’s a regulatory requirement.” Competency can and must be evaluated in ways that make sense and provide reliable outcomes, especially in a resource-limited health care environment. The goal is to provide safe patient care, not just complete an annual skills checklist on a skills fair day.

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Arterial Blood Gases Made Easy, 2nd edition

The principles of oxygen transport and ventilation are core concepts for critical care nurses to understand in managing acutely and critically ill patients. Nurses must be able to assess the patient carefully and evaluate laboratory data, including blood gases. This is not an easy competency to attain.

Hennessey and Japp provide a great overview of the basics of gas exchange, the disorders of gas exchange, and acid-base basics and disorders. An algorithm for assessing pulmonary gas exchange and one for helping assess acid-base balance are included in part 1.

The second half of the book is a collection of case studies, with accompanying blood gases for analysis. Answers and rationales are provided to support learning. An additional benefit is access to the Student Consult online feature that provides enhanced information.

The Shift: One Nurse, Twelve Hours, Four Patients’ Lives

In this book, Theresa Brown describes a day working as a nurse on an oncology unit. She starts the day from the very beginning—her first thoughts as she wakes up and gets ready for work, her ride to work, report, patient assessment and rounds, and discharging one patient and admitting another. Although it sounds like she is describing a typical day of patient care, Brown provides her thoughts about the work, the issues that arise in the health care environment, and some of her history that informs what she is doing on this day. This is a thoughtful book that would be a terrific read for anyone thinking about nursing as a career, as well as for family members of nurses who would like to have an understanding of nursing.
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Los Angeles
Leadership Symposium: The Essence of Courageous Care
Date: February 27, 2016. Place: UCLA Campus Carnesale Commons, Palisades Ballroom. Address: 251 Charles E Young Dr West, Los Angeles, CA 90095. Sponsor: AACN Chapter at UCLA. Keynote Speakers: Karen McQuillan, Kathleen Vollman. Contact: Anna Dermenchyan. Phone: (818) 823-3943. E-mail: adermenchyan@mednet.ucla.edu. Fee: Early registration, $75; students, $45

Sacramento
Critical/Acute Care Spring Symposium
Date: February 25, 2016. Place: UC Davis Medical Center Education Building. Address: 4610 X Street, Sacramento, CA 95817. Sponsor: Sacramento Area Chapter of AACN. Keynote Speakers: Mary Kay Bader, Carol Jacobson. Contact: Laura Lee Tobin. Phone: (916) 781-1651. E-mail: tobs4@hotmail.com. Fee: Members, $50; nonmembers, $75

Florida
Miami
2-Day CCRN/PCCN Review Course
Date: February 12-13, 2016. Place: Nova Southeastern University Miami Campus. Address: 8585 SW 124th Ave, Miami, FL 33183. Sponsor: Greater Miami Area Chapter of AACN. Keynote Speaker: Cammy House-Fancher. Contact: Lee Fong Hong. Phone: (305) 586-7285. E-mail: lfonghong@gmail.com. Fee: Members, $140; nonmembers, $170; groups of 3 or more, $130 per person (applies only if all 3 applications are received together); 1 day course fee all attendees, $100. Credits: 14 CEUs

Miami
2-Day Trauma Certified RN (TCRN) Review Course
Date: February 12-13, 2016. Place: Nova Southeastern University Miami Campus. Address: 8585 SW 124th Ave, Miami, FL 33183. Sponsor: Greater Miami Area Chapter of AACN. Keynote Speaker: Kendra Menzies Kent. Contact: Ruth Salathe. Phone: (305) 586-4203. E-mail: ruthsalathe@gmail.com. Fee: Members, $180; nonmembers, $195; groups of 3 or more, $165 per person (applies only if all 3 applications are received together); 1 day course fee all attendees, $100. Credits: 14 CEUs

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Certification in Legal Nurse Consulting (5-Day Seminar and Online)
Date: April 11-15, 2016. Place: Caribe Royale Orlando. Address: 8101 World Center Dr, Orlando, FL 32821. Sponsor: Vickie Milazzo Institute. Keynote Speaker: Vickie L. Milazzo. Contact: Vickie L. Milazzo. Phone: (800) 880-0944. Fax: (713) 942-9075. E-mail: mail@LegalNurse.com. Website: www.LegalNurse.com. Fee: Varies. Credits: 25.3 CEUs (5-day seminar), 40 CEUs (online)

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2016 Midwest Critical Care Conference
Date: March 21-22, 2016. Place: Eaglewood Resort and Spa. Address: 1401 Nordic Rd, Itasca, IL 60143. Sponsor: Northwest Chicago Area Chapter (NWCAC) of AACN. Contact: Jenny A. Zaker. Phone: (847) 309-0662. E-mail: zakerj46@gmail.com. Fee: TBD. Credits: TBD

Texas
Tyler
Annual CCRN/PCCN Newview Course
Date: February 25-26, 2016. Place: The Pavilion Conference Center at East Texas Medial Center. Address: 1000 S Beckman, Tyler, TX 72701. Sponsor: Greater East Texas Chapter of AACN. Keynote Speaker: Julie Miller. Contact: Angie Nachman. Phone: (903) 245-0435. E-mail: getaacn@gmail.com

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Why did you become a nurse?
Nursing seemed like a good opportunity. I really liked the educational aspects and the hospital work, but when I started on a medical-surgical floor, I was quickly overwhelmed. I didn’t feel I was making a difference. Rather than selecting another profession, I decided to take a 4-week critical care course. After a short time I knew what to do when a patient was on the brink of death to pull him or her back, and I knew that I wanted to be a critical care nurse.

What about your job as a nurse makes you happy?
Every day in the cath lab is a new experience. We may have scheduled heart caths that are normal and uneventful, or we can have one emergency after another with balloon pumps, intubations, cooling catheters, pacemakers, or emergent coronary artery bypass surgery. It's exciting not to know what will happen. That has sustained me for the past 37 years.

Tell us about an extraordinary experience you’ve had as a critical care nurse.
One memorable patient had an out-of-hospital cardiac arrest, was defibrillated and intubated, and remained unresponsive. When he arrived at the cath lab, he arrested again. Throughout the heart cath procedure the vital signs were essentially non-existent. Multiple medications were given with minimal effect. The culprit lesion was opened and therapeutic hypothermia was initiated. I left the hospital thinking that this patient would not last through the night, but the next morning he was still here. Day by day he improved, and 5 days later he walked out of the hospital. I played only a small part in his recovery, but I made a difference and that is what it’s all about.

What are the challenges you encounter and how do you overcome them?
At the start of my nursing career, we didn’t use computers. Today everything is computerized and learning all the new procedures, charting, and equipment can be overwhelming at times. Thankfully, bedside nursing has not changed much.

What has your journey as a nurse been like?
I’ve had a long and fulfilling nursing career. I’ve seen a lot of changes occur in technology and advancements in cardiovascular procedures. Change is the way of life. Fortunately, I’ve had patient supervisors who have guided me through my journey. It hasn’t always been easy to keep up with change, but I believe I’ve become a better nurse and person. You can teach an old dog new tricks.

At the end of a busy day, how do you find balance in your life?
My family is very supportive and they don’t complain when the phone rings at 2 AM. To unwind I take spinning classes at the local YMCA, I do arts and crafts, and I read. I try to keep work at work.

What would we be surprised to know about you?
I absolutely hate to cook, clean, or do laundry. I have no domestic skills at all.

How has AACN played a role in your career?
I got my CCRN certification 27 years ago and have renewed every 3 years since then. With the recent financial problems of many hospitals, it has been difficult to obtain educational credits. Through AACN, I’ve been able to maintain my credits. Critical Care Nurse articles are relevant to my practice and help me keep up with the newest developments in medicine. CCN

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References

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