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The Need for an Effective Process to Resolve Conflicts Over Medical Futility: A Case Study and Analysis
Jocelyn A. Olmstead and Michael D. Dahnke
Page 13

Chlorhexidine-Impregnated Dressings and Prevention of Catheter-Associated Bloodstream Infections in a Pediatric Intensive Care Unit
Duygu Sönmez Düzkaya, Nejla Canbulat Sahiner, Gülzade Uysal, Tülay Yakut, and Agop Çitak
Page e1 (Page 12)

Measuring Family Satisfaction With Care Delivered in the Intensive Care Unit
Kathleen Clark, Kerry A. Milner, Marlene Beck, and Virginia Mason
Page e8 (Page 12)

Planning for Deactivation of Implantable Cardioverter Defibrillators at the End of Life in Patients With Heart Failure
Page 32

Use of Neuromuscular Blockers During Therapeutic Hypothermia After Cardiac Arrest: A Nursing Protocol
Page 41

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In the February 2016 issue of *Critical Care Nurse (CCN)*, the title of my editorial posed an intentionally disquieting question intended to prompt readers’ self-reflection on how they envisioned the last weeks and days of their life. More specifically, it inquired about their preferences for the type and location of care they received at life’s ebb: “When it’s your time, will it be your way?” The remainder of that editorial reviewed the Institute of Medicine’s definition of comprehensive end-of-life (EOL) care as both patient-centered and consistent with one’s goals and preferences, described the benefits and challenges associated with advance directives, explored both physician and nurse attitudes toward and disregard of existing advance directives, and implored critical care providers to honor their patients’ expressed preferences and to ensure that their own wishes were documented, current, and communicated. We have no published information about critical care nurses’ perspectives on this topic, so the editorial ended with a 2-item survey to solicit that. This issue of *CCN* is devoted to the theme of futile and EOL care, so it seems an appropriate place to provide a report on the findings of that survey.

### Survey Items

The 2 questions included in *CCN*’s EOL Preferences Survey were the following:

1. If you had a terminal condition with death anticipated within 6 months, which of these EOL care options would you prefer for yourself?
   - Go home with comfort measures or hospice, as necessary, but no cardiopulmonary resuscitation or extraordinary measures
   - Remain in whichever health care facility is necessary to receive all available medical therapies that could possibly extend my life

2. Do you have an advance directive that identifies your EOL preferences?
   - Yes
   - No

### Survey Submission

*Critical Care Nurse* typically uses its website to locate information, resources, and other material related to content in the print edition. Unfortunately, at the time this survey was published in the print edition, our website was not available to employ for this purpose. As an alternative, we offered an email address for submission of survey replies. That option seemed to work well for receipt and acknowledgment of all replies.

### Survey Participants

We were pleased to receive replies to this survey from *CCN* readers, but disappointed that these numbered so few: a total of only 31 replies were received. To keep the survey as brief as possible, no demographic information was solicited from survey participants, so we are unable to describe those attributes.

### Survey Responses

All of the survey participants (n = 31) responded to both items.
• If you had a terminal condition with death anticipated within 6 months, which of these EOL care options would you prefer for yourself? This item elicited a nearly universal response; 30 of 31 responses identified option a ("Go home with comfort measures or hospice, as necessary, but no cardiopulmonary resuscitation or extraordinary measures") as their preference for EOL care. A single participant selected option b ("Remain in whichever health care facility is necessary to receive all available medical therapies that could possibly extend my life").

• Do you have an advance directive that identifies your EOL preferences? This item generated greater variance in responses. Of the 31 respondents, 21 (68%) indicated option a, the Yes response, whereas 10 (32%) indicated option b, the No response.

Discussion

The small number of respondents to this survey pretty much nullifies the validity or reliability of the results in any meaningful way, except perhaps as a pilot for another attempt that generates a genuinely representative proportion of practicing critical care nurses. That said, a few unscientific observations might be shared from this tiny volume of input:

• Virtually everyone who took the time to respond to the survey identified “Home” as the place they prefer to be in their final hours. That finding is consistent with data drawn from the multiple studies with representative samples of both physicians and nurses that were identified in the February 2016 editorial as well as from polls of the general public.

• One participant described their goal clearly and succinctly as “Go home and live out the rest of my life in as much comfort as possible with my loved ones. I would do everything possible to stay out of the hospital.”

• In this small sample, more than two-thirds of respondents indicated that they already had an advance directive prepared that included their EOL preferences. As an unscientific poll, this finding may also suggest that critical care nurses who have already addressed this issue in their own lives were more likely to respond to the survey than those who have not given it thoughtful consideration.

Self-selection can easily affect survey results and needs to be considered in even a rudimentary analysis such as this.

• One respondent suggested that “more people should take advantage of the Medical ID in the Health Kit on iOS devices,” explaining that health care providers can access the Medical ID from the lock screen on an iPhone to reach emergency contacts even if the patient is unable to communicate.

• Other respondents reported that the survey prompted them to update their existing advance directive; facilitate other nurses’ completion of advance directives during Nurse Week; secure a family member who would follow their expressed EOL preferences in addition to their spouse (who indicated some reluctance to do so); and discuss the editorial at their Journal Club meeting, where they would also distribute copies of their state advance directive form and invite a social worker to discuss the form with nursing staff.

Conclusions

Although no scientific conclusions can be legitimately drawn from a survey this small, knowing that even a few facilities have now launched meaningful efforts toward getting more critical care nurses to confront, consider, decide, and document their EOL preferences is encouraging. When you next encounter a patient situation in which the lack of an advance directive creates confusion or stymies development of a clear plan of care, remember that patient could be you. If we don’t know what you want for care when the end of your life draws near, there is no way to ensure that your wishes are respected and followed. Let those who love you know where you want to be, what you want and do not want for care, and let all of your critical care colleagues know your wishes by preparing an advance directive and issuing a copy to whomever will be making decisions on your behalf.

Wishing you a healthy and safe and joyous holiday season with those you love. CCN

JoAnn Grif Alspach, RN, MSN, EdD
Editor

References


Chlorhexidine-Impregnated Dressings and Prevention of Catheter-Associated Bloodstream Infections in a Pediatric Intensive Care Unit

Duygu Sönmez Düzkaya, RN, BSC, PhD, Nejla Canbulat Sahiner, RN, BSC, PhD, Gülzade Uysal, RN, BSC, PhD, Tülay Yakut, BSC, and Agop Çitak, MD

BACKGROUND Bloodstream infections related to use of catheters are associated with increased morbidity and mortality rates, prolonged hospital lengths of stay, and increased medical costs.

OBJECTIVES To compare the effectiveness of chlorhexidine-impregnated dressings with that of standard dressings in preventing catheter-related bloodstream infections.

METHODS A total of 100 children were randomly divided into 2 groups of 50 each: a chlorhexidine group and a standard group. Patient care was provided in accordance with prevention bundles. Patients were followed up for development of catheter-related bloodstream infections.

RESULTS Catheter colonization occurred in 4 patients in the standard group (8%) and in 1 patient in the chlorhexidine group (2%). Catheter-related bloodstream infections occurred in 5 patients in the standard group (10%) and in 1 patient in the chlorhexidine group (2%). Although more patients in the standard group had catheter-related bloodstream infections, the difference in infection rates between the 2 groups was not significant ($P = .07$).

CONCLUSIONS Use of chlorhexidine-impregnated dressings reduced rates of catheter-related bloodstream infections, contamination, colonization, and local catheter infection in a pediatric intensive care unit but was not significantly better than use of standard dressings. (Critical Care Nurse. 2016;36[6]:e1-e7)

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Measuring Family Satisfaction With Care Delivered in the Intensive Care Unit

Kathleen Clark, RN, DNP, CCRN, Kerry A. Milner, RN, DNSc, Marlene Beck, RN, DNP, and Virginia Mason, RN, PhD, CCRN, ACNS-BC

BACKGROUND In our competitive health care environment, measuring the experience of family members of patients in the intensive care unit to ensure that health care providers are meeting families’ needs is critical. Surveys from Press Ganey and the Centers for Medicare and Medicaid Services are unable to capture families’ satisfaction with care in this setting.

OBJECTIVES To implement a sustainable measure for family satisfaction in a 12-bed medical and surgical intensive care unit. To assess the feasibility of the selected tool for measuring family satisfaction and to make recommendations that are based on the results.

METHODS A descriptive survey design using the Family Satisfaction in the Intensive Care Unit 24-item questionnaire to measure satisfaction with care and decision-making.

RESULTS Forty family members completed the survey. Overall, the mean score for families’ satisfaction with care was 72.24% (SD, 14.87%) and the mean score for families’ satisfaction with decision-making was 72.03% (SD, 16.61%). Families reported that nurses put them at ease and provided understandable explanations. Collaboration, inclusion of families in clinical discussions, and timely information regarding changes in the patient’s condition were the most common points brought up in free-text responses from family members. Written communication, including directions and expectations, would have improved the families’ experience.

CONCLUSIONS Although patients’ family members reported being satisfied with their experience in the intensive care unit, there is room for improvement. Effective communication among the health care team, patients’ families, and patients will be targeted for quality improvement initiatives. (Critical Care Nurse. 2016;36[6]:e8-e14)

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The Need for an Effective Process to Resolve Conflicts Over Medical Futility: A Case Study and Analysis

Jocelyn A. Olmstead, RN
Michael D. Dahnke, PhD

The issue of medical futility requires a well-defined process in which both sides of the dispute can be heard and a resolution reached in a fair and ethical manner. Procedural approaches to medical futility cases provide all parties involved with a process-driven framework for resolving these disputes. Medical paternalism or the belief in the absolute rightness of the medical model will not serve to resolve these disputes. Although medical futility is first determined by medicine, in order for the determination to meet legal criteria, it must be subject to review. The hope is that through a review process that meets legal criteria, the issue can be resolved without the need for court proceedings. If resolution cannot be obtained through this process, surrogates still have the right to seek court intervention. This issue is of relevance and importance in critical care nursing because of the role and position of critical care nurses, who have direct contact with patients and patients’ families, the potential for moral distress in cases of possibly futile treatment, and the expanding roles of nurses, including critical care nurses and advanced practice nurses, in management and policy development. (Critical Care Nurse. 2016;36[6]:13-23)

Mrs. J, an 88-year-old woman with an admitting diagnosis of change in mental status, originally on a nonmonitored medical surgical unit, was a full code. During her stay in the hospital, she had pneumonia develop. Mrs. J underwent cardiopulmonary resuscitation (CPR) several times and was transferred to the intensive care unit, back to the medical surgical unit, then to an intermediate care unit, and back to the intensive care unit. During the last CPR attempt, Mrs. J was intubated and became ventilator dependent. During her admission, Mrs. J had been deemed not competent to make her own decisions by...
hospital psychiatrists. The patient’s daughter had her legal power of attorney and was the surrogate decision maker; she refused to have the patient’s status changed to do not resuscitate, even after several resuscitations. The patient’s attending physician had deemed continued life support medically futile. The ethics committee was consulted, but they were unable to persuade the patient’s daughter, and the patient continued to receive mechanical ventilation. The patient’s surrogate decision maker was notified of the hospital’s intent to discontinue mechanical ventilation, and the hospital’s legal department began court proceedings.

Before the court proceedings started, the patient died in the hospital while being maintained on life support. Situations such as this one are difficult for everyone involved, and the courtroom is not the ideal place to resolve medical disputes. As this case illustrates, many patients suffer because of disputes over medical futility. Unfortunately, many states do not have laws in place to resolve disputes about medical futility, and many facilities do not have effective policies to resolve such disputes. In order to ensure the protection of patients unable to make end-of-life decisions, conflicts over medical futility must be resolved through a procedural approach that protects physicians and health care systems.

Mickelsen et al note that actions by health care organizations, “acting as unique moral communities, may contribute to a tipping point in our cultural perception of the proper resolution of disputes on futile medical treatment.”1 With increases in life-sustaining technologies, the need to establish a procedural approach to conflict resolution in medical futility cases will increase as well.

Although such decisions may appear to be primarily the purview of physicians and patients or patients’ families, these cases are ethically relevant for critical care nurses as well. In a case of providing futile care, it is primarily the critical care nurse who will see to the delivery of that care and will have the majority of contact with the patient and the patient’s family. Delivery of such care and constant contact with such patients can lead to despair (feelings of futility in nurses themselves) and moral distress. In addition, nurses, including critical care nurses and especially advanced practice nurses, have an important and expanding role in the decisions regarding the care of patients. Because of the nurses’ position in the direct delivery of care to patients and day-to-day interaction with patients and patients’ families, nurses should have a voice in these matters and in the development of policies to aid in the resolution of these cases. In the following sections, we investigate the ethical problems that arise from seemingly intractable futility conflicts, argue for a procedural approach toward addressing these conflicts, and analyze and evaluate the Texas law designed to address these types of conflicts as a possible template for resolution.

The Concept of Medical Futility

The concept of medical futility appears in writing during the times of the ancient Greeks. Fine notes the following passage from the Hippocratic treatises as referring to medical futility without the direct use of the term, “refusal to treat those overmastered by disease.”2(p963) Given the severe limits of Hippocratic medicine, as compared with modern Western medicine, it is not difficult to imagine that patients were commonly overwhelmed by their disease. Because of the rapid advances in medicine during the late 19th and 20th centuries, the 1950s and 1960s saw modern medicine geared at preserving life at all costs. Medicine primarily relied on paternalistic application of the ethical principles of beneficence and nonmaleficence, with attention to patients’ autonomy not as paramount in importance as it has become in contemporary medicine and medical ethics. At the time, this meant that medical professionals were expected to benefit patients by keeping them alive. The standard of care was to provide life-sustaining interventions without consent from the patient, with CPR common practice for all patients.3

During the 1970s, some began to question resuscitation efforts and the prolonging of the dying process in critically ill patients, also, ironically, due to advances in the techniques and capabilities of modern medicine.
With that, questions about the legal and ethical ramifications of withholding CPR and/or life-sustaining support also emerged. By the 1980s, with the use of more and more life-sustaining equipment, the concept of medical futility came into play, and the ethical principle of autonomy became central to the debate. By the 1990s, US hospitals no longer maintained universal CPR policies. Upon admission, patients were asked about their wishes for treatment should CPR become necessary. With patients having the right to decide whether or not they would want life-support measures, surrogates were now requesting that measures viewed as medically futile in particular situations be continued. Surrogates opposed to the withdrawal of life support appealed to the ethical principle of autonomy and the concept of vitalism to support the continued use of life-sustaining measures.

In addition, opponents of the belief that physicians had a right to determine futility felt that this label used by physicians was reverting back to a form of medical paternalism in which physicians may be “given the power to impose on their patients their own personal values under the guise of medical expertise.”

In response to objections such as this, many attempts were made to reach a concrete definition of what medical futility is. Much work was done to establish an agreed-upon definition, but as the debate was so heated and the concept so value-laden, no consensus could be established. Nonetheless, the next step was to attempt to develop policies and procedures on handling cases of medical futility. This process continues today without a standardized approach throughout the United States. In a recent policy statement, the American Thoracic Society (ATS) has recommended more specific terminology to describe situations that typically would be described as “futile.” These include “potentially inappropriate,” “legally proscribed,” and “legally discretionary” treatments. Further, the term “futile,” per the ATS statement, should be reserved for “the rare circumstance that an intervention simply cannot accomplish the intended physiologic goal.”

The Case for a Procedural Approach

Given the intractable equivocation of the concept of medical futility, difficult-to-resolve conflicts regarding the continued treatment of patients in critical care will be inevitable. Approaches to dealing with such events are limited. One very important strategy that should be implemented in every health care institution is proactive communication that makes clear to patients and surrogates the limitations of medical technology as well as any relevant policies in place regarding such situations.

This strategy may prevent some cases from reaching points of intractable conflict but most likely not all cases. For cases that reach these levels of contention, one could take a paternalistic view, in which the view of the physician and the health care team, based on an assumption of technical expertise, should be ultimately authoritative. Alternatively, one could accept the full authority of patient/surrogate autonomy.

Yet either of those options results in simply the denial of a true conflict of principle and the neglect of either patient or professional autonomy. Further, absolute authority in the hands of surrogates ignores the problem of emotional obstacles for surrogates in choosing to withdraw life-sustaining treatment, even when such a decision may be the one the patient would choose. Placing the decision solely in the hands of clinicians neglects the fact that such decisions are based not only on technical knowledge but values as well and provides an excuse for physicians not to engage in the open communication that should be occurring with surrogates. A procedural approach has the advantage of carving out a middle path between these 2 extreme options that acknowledges the existence of a true conflict and respects the rights on both sides of the conflict. A procedural approach also encourages discussion and understanding between different viewpoints, acknowledging the deep controversy of the disagreements involved that cannot be resolved through simplistic application of rules or policies but only through the contribution of the different viewpoints involved. In this way, procedural approaches can better reflect or achieve important decision-making ideals such as “transparency, legitimacy, accountability, and opportunity for appeal.”

The ATS has proposed a 7-step process for addressing requests for inappropriate treatment that remain intractable (Table 1). This process included continued negotiation, surrogate notification, second opinion, committee review, patient transfer, and extramural appeal. Steps such as these increase the likelihood that understanding of concerns and goals across both sides
of the dispute occurs and a resolution that recognizes the rights and ethical views of all is reached. Absent a procedural approach, judicial appeals would be more likely and common. Although the court system can be an excellent place to address new and revolutionary issues that our society faces, for most cases of these types of conflict, the judicial process can be too costly, adversarial, and time-consuming.

A procedural approach to resolving futility disputes rests on a foundation of procedural justice, the social, ethical, and legal concept that fair and just outcomes are to be found through delineated processes for resolving disputes. Through a procedural approach to dispute resolution, general norms are particularized in order to guide action, all parties are guaranteed meaningful participation in the process, decisions are made through publicly available and acceptable standards and rationale, vague and general policies and principles are specified and disambiguated, and objectivity is attained by transcending the partiality of the individual, conflicting interests. Norman Daniels and James E. Sabin have notably addressed this concept of procedural justice from specifically within a health care context, identifying the procedural qualities of transparency, publicly available reasoning, and procedures for revising decisions when justified as what they call “accountability for reasonableness.”

Stakeholders

Many stakeholders have much to gain from finding a procedural process to resolve medical futility disagreements. End-of-life decision-making involves not just the determinations of clinicians, but also the hospitals and health care systems of which they are a part. In addition, hospitals must involve a number of departments in managing these disputes, including ethics committees, consulting physicians, risk management, internal and external communications, and the hospital’s legal department.

Because of the sensitivity of the issue, health care organizations need to protect the integrity of their organization and the health care team that provides patient care. The health care team, including critical care nurses, may be at risk legally, emotionally, and morally in such cases without a procedural approach in place to resolve these disputes. These risks include possible legal repercussions depending on one’s response to the request for the provision of care one believes is futile, despair and moral distress associated with providing futile care, and loss of moral integrity in feeling professionally compelled to provide treatment with which one disagrees. Of course, the patients and their families clearly have the most at stake in such cases. Thus, for patients, clinicians, hospitals, and the various departments in hospitals managing disputes, having a clear and uniform procedure for resolving these disputes can better guarantee protection of all that is at stake, whether that be unnecessary suffering, medical and ethical integrity, or the reputation of a caring, proficient, and capable medical institution.

Ethical and Legal Issues

A core ethical principle in making end-of-life decisions for patients is respect for patients’ autonomy. Patients have the autonomy to choose what medical treatments they want or do not want; however, they do not have the right to demand that physicians provide treatments that are nonbeneficial. That is to say, physicians also have professional autonomy, the right to act in a manner that is medically and ethically warranted. So, physicians have the right to refuse to offer treatments that they deem nonbeneficial and outside standards of care. In addition, physicians have an ethical duty to provide treatment that honors the ethical principles of beneficence and nonmaleficence. By providing medical treatment that goes against these ethical principles and continuing to offer life-sustaining treatments in futile cases, physicians are operating outside professional boundaries. Procedural processes are needed to fairly and effectively adjudicate disputes regarding putatively futile treatment. The

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<thead>
<tr>
<th>Table 1 American Thoracic Society 7-step process for addressing intractable requests for inappropriate treatment</th>
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<tbody>
<tr>
<td>1. Enlist expert consultation to continue negotiation during the dispute-resolution process</td>
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<tr>
<td>2. Give notice of the process to surrogates</td>
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<tr>
<td>3. Obtain a second medical opinion</td>
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<td>4. Obtain review by an interdisciplinary hospital committee</td>
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<tr>
<td>5. Offer surrogates the opportunity to transfer the patient to an alternative institution</td>
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<tr>
<td>6. Inform surrogates of the opportunity to pursue extramural appeal</td>
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<td>7. Implement the decision of the resolution process</td>
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*Based on information from Bosslet et al.6*
inability to act in an ethical manner can instill moral distress, the sense of anxiety caused by a power disparity that results in obstacles to an individual’s ability to act ethically and participating in an ongoing ethical wrong. Moral distress can affect clinicians of all types, but it has been particularly identified as a problem among nurses. Further, futility conflicts have been identified as a major factor in causing moral distress.

In situations where patients are able to make decisions for themselves regarding whether or not they choose to pursue or forgo life-sustaining measures, decision-making is usually without complication. However, when patients are unable to express their wishes, decisions must be made for them through the employment of surrogate decision-making. In such cases, disputes between patients’ families and providers, among patients’ family members, and between surrogates and existing advance directives are all too common. Within such disputes, a negotiation of the principles of autonomy, beneficence, and nonmaleficence is needed. But with so many parties, each with unique investments in the case, without a clear procedure for such negotiation, chaos and moral error are inevitable.

Procedural approaches allow for resolution of medical futility disputes in a manner that considers the interests of all parties in reaching an objective and fair result through transparency of standards, a publicly acceptable rationale, and procedures for revising decisions when needed. Cases must be subjected to independent review with the best interests of the patient as the ultimate goal. This review involves looking at medical indicators as well as individual factors related to patients. Without this process, there are many different ways that physicians can handle these types of situations; however, not having a process in place can leave the health care team and the health care system open to unnecessary moral distress and possible legal consequences. For instance, if a physician decides against his or her better judgment to give in to requests for nonbeneficial treatment, the health care providers that take care of the patient on a day-to-day basis will most likely experience significant emotional stress. A physician can choose to cease life-sustaining treatment without agreement from the patient’s family. However, this practice is not common, as many physicians would not subject themselves to the possibility of legal repercussions.

Some hospitals have adopted policies in which the physician will request an ethics consultation and if the ethics committee comes to the same conclusion as the physician, they will notify the surrogate that they intend to remove life support. However, before removing life support, the process may need to go to court. This process is an effort to protect the hospital from litigation. However, it can be a time-consuming and resource-taxing endeavor if the surrogate does not come to an agreement before the court proceedings begin. With an established procedure in place, these issues can be alleviated.

**Ethics Committees**

With these disputes, many organizations have adopted the use of ethics committees to offer advice and assist in conflict resolution. Most cases reach conflict resolution at this stage. In a review of ethics consultations in medical futility cases at Baylor University Medical Center, researchers found that 98% of conflicts were brought to closure before going to formal dispute stages. With end-of-life cases, it is important for health care organizations and the physicians that work for them to be united in medical futility decisions. Mickelsen et al note, “When the same organization is unwilling or unable to place itself at public risk when faced with controversial cases, it may contribute to the moral distress of its caregivers and undermine its own integrity.”

**The Texas Advance Directives Act of 1999**

In response to the need for a concrete process to resolve disputes about medical futility, the state of Texas passed the Advance Directives Act of 1999 (TADA). This act outlines a clear process for resolving futility disputes when a patient or surrogate requests life-sustaining treatment that the treating physician or health care facility believes to be ineffective, inappropriate, or futile. The law also clarifies and updates important terminology related to end-of-life decisions and clarifies rights of patients and surrogates. However, the most revolutionary and most commented-on part of the law is Section 106.016, Subsection (e), which provides a legal process for unilateral withdrawal of life-sustaining treatment by a health care facility. Procedural processes can be institutional and extralegal or a procedural process can be supported by force of law. Institutional processes can provide many of the practical and ethical advantages based in procedural justice. Legal support permits individual institutions to implement their own policies and procedures consistent with the minimal
requirements of the law and with protection of the law from criminal and civil complaints for clinicians and the institution.

If the physician fails to reach an agreement with the family, a medical futility hospital committee will review the case and attempt to resolve the matter. This committee may be the institution’s standing ethics committee or a committee designed specifically for this purpose. The law is silent regarding the specific composition of this committee. Whether members with expertise in areas of critical care or bioethics should be included or community members not directly affiliated with the health care institution should be on the committee is not addressed. The attending physician can request a formal meeting to resolve the dispute. The patient’s family is given 48 hours’ notice and an opportunity to attend the meeting. If the review committee agrees with the physician, the family is notified and they have 10 days’ time to find another facility willing to care for the patient. This step is sometimes referred to as the 10-day rule. During this time, the hospital will assist in finding alternative facilities and will maintain life-sustaining processes. If the family wishes, at any time during these 10 days, they can seek court proceedings to extend the time provided to find an alternative facility. If an alternative facility willing to provide life-sustaining treatment cannot be found, unilateral removal of the life-sustaining treatment by the facility, without risk of criminal or civil liability, is permitted.

In many health care facilities outside of Texas, when conflict arises regarding futility, often the institutional ethics committee or physicians will advise the surrogate to search for another facility willing to continue the desired life-sustaining treatment. However, if an alternative facility cannot be found, often the facility has little choice but to continue providing life-sustaining treatment indefinitely. Unilaterally removing life-sustaining treatment risks severe legal ramifications for clinicians and the institution. The option to petition the court for a neutral guardian or for the authority to remove life-sustaining treatment contrary to a surrogate’s wishes exists. However, this route is costly, time-consuming, and, history demonstrates, difficult to achieve.

The case of Helga Wanglie involved just such a dispute. Hennepin County Medical Center in Minneapolis, Minnesota, attempted to have a new guardian appointed to make medical decisions for Ms Wanglie, who was in a vegetative state and ventilator-dependent. The court ruled that Ms Wanglie’s husband was the appropriate surrogate, and she continued to receive mechanical ventilation until her death a few days following the decision.

Further cases in the 1990s were similarly decided, although in 2008 and 2009, cases began to be decided for replacing surrogates. Although this type of judicial relief may have become a more potentially viable option, this option is still costly, time-consuming, and, as Pope argues, only a partial solution that may still leave surrogates demanding particular futile treatment as “irreplaceable.” According to both existing statutes and case law, it is not clear that clinicians and the facilities under which they operate have the legal right to unilaterally withdraw life-sustaining treatment on the basis

Table 2: The Texas Advance Directives Act of 1999: procedure for refusing a surrogate’s request to continue life-sustaining treatment

1. Committee review: The physician’s refusal is reviewed by an ethics or medical committee. The physician should not be a member of the committee, and the patient should continue to receive life-sustaining treatment during this process.

2. Patient-surrogate notification: The patient or surrogate is to be given a written description of the review process and any other relevant policies and procedures. The patient or surrogate should be given at least 48 hours’ notice of the review by the ethics or medical committee.

3. Patient-surrogate participation: The patient or surrogate is entitled to attend the meeting and receive a written explanation of the decision reached.

4. Committee decision: If the physician, patient, or surrogate disagrees with the decision of the committee, the facility shall make a reasonable effort to transfer the patient to another facility that is willing to comply with the directive.

5. 10-day rule: The health care facility is required to provide life-sustaining treatment for only 10 days following the written decision.

6. Extension: A court can grant an extension of the 10-day period if there is a reasonable expectation that an alternative, willing facility can be found during the period of the extension.

Based on information from McDonagh et al.
of standards like medical futility.\textsuperscript{30} Without a procedural process founded in the law, clinicians and health care facilities are risking much when following their ethical beliefs and judgments in these cases.

**Strengths and Advantages of TADA**

Proponents of the law tout its many strengths and benefits. First, the law can help clinicians preserve moral integrity.\textsuperscript{2,26,27,30} To maintain a patient on a treatment that a clinician finds inappropriate, ineffective, or futile—and possibly harmful—requires the clinician to act against his or her medical and ethical judgment. On the one hand, the importance of respecting patients’ autonomy, even if operational through the request of a surrogate, needs to be recognized. However, on the other hand, recognition of the principles of beneficence, nonmaleficence, and justice may be at odds with the autonomous decisions of the patient or surrogate. According to Mayo, with legal liability at stake, in the case of a futility conflict, physicians might simply adopt “dispute-avoidance strategies.”\textsuperscript{27(p1009)} These strategies would include merely acceding to the wishes of the surrogate or doing what the physician wishes to do without consultation with the surrogate. In the former case, the physician would be ignoring or neglecting her or his own judgment for the sake of expediency. Not only would such an act violate the moral integrity of the clinician himself or herself, but, according to Pellegrino,\textsuperscript{31} it may amount to a form of moral abandonment of the patient. In the latter case, the physician would be acting dishonestly and with no recognition of the patient’s autonomy.

Second, according to the law’s proponents and defenders, while giving more power to the moral authority of clinicians, the law also defines limits to clinicians’ moral authority, for example, through providing for license review for clinician neglect of a living will or surrogate of a terminally ill patient without review of an ethics committee.\textsuperscript{2,26,27} In recognizing legitimate moral concerns on both sides, the law, in the words of Thomas Mayo, “tries to steer a course between the Scylla of judicial review and the Charybdis of unfettered, unexamined physician discretion.”\textsuperscript{27(p1010)}

Third, along with the question of clinician integrity, the law’s defenders also claim that it could help reduce the problem of moral distress. By allowing clinicians to act in the manner they believe to be medically and ethically appropriate in cases of futility conflict, instances of moral distress are likely to decrease. Fourth, the law, according to its proponents, allows for, encourages, and provides moral space for further discussion and dispute resolution.\textsuperscript{2,26,32-35} Fine,\textsuperscript{33} for example, interprets the fact that following implementation of the law, 93% of futility disputes between patients’ families and health care institutions were resolved without use of the 10-day rule as evidence that the law furthers and encourages discussion and dispute resolution. The fact that the vast majority of cases do not reach the most controversial and apparently adversarial step of the 10-day rule, according to Fine, demonstrates the success of the law in providing a framework for resolving disputes between parties.

The law may even encourage dispute resolution for disagreements among other parties. Fine presents the case of an 82-year-old man who has suffered a major stroke followed by additional bilateral strokes.\textsuperscript{32} These events left the man profoundly neurologically impaired, with decubitus ulcers, and general debility, showing “no clear evidence of joy in life” but demonstrating “he felt pain by grimacing and moaning.”\textsuperscript{32(p144)} The man was receiving parenteral nutrition. The treating physician judged that a do-not-resuscitate order be put in place and surrogate, the man’s wife of 3 years, appeared to agree in principle. However, the man’s daughter wanted “everything done.” In an attempt to get along with the man’s family, the wife refused to act contrary to the daughter’s wishes. In a case such as this, a family dispute preventing the agreed-upon choice of both the health care providers and the surrogate may be more effectively negotiated. In this way, the law can be seen as providing the means to address a variety of disputes that prevent the implementation of ethically justified acts.

Finally, defenders of the law often also identify the fact that the law provides for an extrajudicial process for dealing with futility conflicts as a strength.\textsuperscript{2,26,27,32} Even Robert Truog,\textsuperscript{36} a harsh critic of the law and in fact an advocate for resolving such disputes in the court system, notes that the typical slow movement of the court system can be an obstacle in futility cases that are often in need of swift resolution given the critical nature of the
cases. Ethics committees will typically include medical expertise that judges will lack, making the ethics committee better prepared to weigh the complex medical issues that arise in these cases.27 Also, the objectivity that may be one advantage of a judicial process can exist under TADA as well, as the deciding committee will include members not directly involved in the care of the patient in question.27 Just as in a judicial process, the patient or surrogate is given the opportunity to present his or her views to the deciding body.26 Further, even with the extrajudicial process in place, the law “does not preclude resort to the courts by families that are motivated to seek judicial review.”27(p1010) It should also be noted that the law sets minimum standards, and many hospitals in Texas have adopted futility policies that exceed the 48-hour and 10-day time periods indicated in TADA. This situation demonstrates a certain flexibility in the law to make room for a variety of ethical viewpoints regarding the matter of time constraints.

**Criticism or Weakness of TADA**

Possibly the most damning ethical criticism of the law is that it places too much power in the hands of the health care institution through the decision-making authority of the ethics committee or some other such designated medical or futility committee.26,30,35-39 Institutional ethics committees traditionally (and it should be noted this is a “tradition” of just a few decades) hold no formal authority. The roles of ethics committees have customarily been largely consultative. Allowing an ethics committee the kind of decisional authority indicated in TADA appears to be a radical departure, establishing these committees, as described by Robert Truog,38 as judge and jury. Fine,31 though, answers this criticism by comparing the authority given an ethics committee under this law with the established and accepted authority of organ transplant committees.

Even more powerfully, Truog describes the procedural provision of the law as an illusory due-process at risk for becoming “a rubber-stamp mechanism for systematically overriding families’ requests that seem unreasonable to the clinicians involved.”38(p1013) Following the increasing recognition of the legal and ethical importance of patients’ autonomy among both bioethicists and clinicians in the past few decades, TADA may be perceived as an attempt to correct for recent emphasis on autonomy at the expense of other important values such as beneficence and just distribution of scarce resources. Might it be that TADA overcompensates in pursuit of this goal? That certainly is possible and should be part of the continued discourse regarding this law and any other future laws like it.

A similar complaint, or possibly a more specific form of the complaint just discussed, is that the 10-day rule is coercive and will erode trust between patients (or patients’ families) and clinicians and health care institutions.26,30,35,37 This concern is particularly noteworthy because trust between patients and the health care industry has arguably suffered in the past few decades as a result of the commodification of health care and the too-common reduction of patients to consumers.30

Another criticism questions the justice of the law, alleging that it will disproportionately affect marginalized ethnic or socioeconomic populations.36,40 A law with such an effect would, as described by Truog, instantiate a “tyranny of the majority.”36 If either in principle or in practice the law does disproportionately affect either ethnic minorities or socioeconomically deprived groups, that would be a serious concern that would need to be addressed and should possibly be enough to disqualify the law in a rights-based democracy such as ours. So, this is a concern that without a doubt needs to be studied.

Finally, just as some defenders of TADA judge that the extrajudicial process is a strength of the law, Truog finds this aspect of the law to be a weakness or flaw.36,38 “Legal mechanisms,” asserts Truog, “already exist to challenge surrogates as decision makers.”36(p969) Also, he maintains that our judicial system is designed precisely as “a fair and neutral decisional process,” which is what is needed in these cases.36(p970) So, this issue is a clear point of contention between defenders and critics of the law. One must then consider whether a committee composed of (at least primarily) members internal to one of the parties in the dispute (the health care institution) can be adequately objective and unbiased. But also, can a judge have the requisite understanding of the medical issues at stake to make an informed judgment comparable, if not equal, to that of a hospital’s ethics committee or futility committee?
Improving TADA

Given both the strengths and the weaknesses of the law, as just discussed, some commentators on the law have proposed amendments to improve it. Pope proposes that instead of an internal ethics committee given the authority to decide futility cases, a multi-institutional committee would avoid the concerns of bias while retaining the expertise and extrajudicial nature of an ethics committee. Mayo offers several possible improvements, including requiring a dispute resolution–style ethics consultation before the committee hearing and immediately after the 10-day post-committee time period and also extending the 48-hour notice before the committee hearing and the 10-day time period following the committee’s decision. These changes will improve the quality of the law that promotes further discussion and dispute resolution and possibly also reduce the coercive aspects of those time limits.

Even Robert Truog, possibly the law’s harshest critic, offers suggestions for improvement. Following his concerns for the disproportionate power that the law gives to the ethics committee and the possible bias inherent to an internal ethics committee, he proposes that the decisional authority be removed from the ethics committee and placed under “a more neutral entity.” He then suggests that this “more neutral entity” would ideally be the judicial system. Such a change, however, would appear to merely negate the central part of this law.

In 2013, Texas State Senator Robert Deuell (R-Greenville) and State Representative Susan King (R-Abilene) introduced a bill that would amend the Texas Advance Directives Act (SB 303/HB 1444). Proposed changes to the law included clarifying the types of patients to whom the law applies, ensuring that patients receive artificial nutrition and hydration as long as they do not become harmful and until the natural death process begins, establishing clear and objective criteria for the ethics committee’s decision-making process, and clarifying the definition of “medically ineffective” treatment. This bill generated a great deal of controversy in Texas. The original bill died in session in 2013 but a similar bill introduced in the 2015 session has been passed and signed by the governor.

Evaluation of TADA

Given the problems that have arisen during the past few decades regarding the ability to sustain life almost indefinitely (the use of limited resources, the possible suffering and loss of dignity of patients, the moral distress of clinicians), a procedural process for resolving futility disputes appears to be a needed development for the contemporary medical environment. Is TADA the answer? Perhaps it is and perhaps it is not. Perhaps it would be with specific improvements. But it marks an important attempt to resolve some unexpected problems raised by advances in medical technology. As such, a procedural process that attempts to address these problems but works to preserve other ethical values and concerns, as indicated by TADA’s critics, not only may be useful but may be the best ethical option. So, whether or not TADA is the right and correct law to respond to these problems of medical technology, it (and the discourse that surrounds it) represents the attempt to respond to these problems ethically and intelligently. TADA may or may not be the best or right response, but only open and continued dialogue on attempts such as these will lead to the best or right response.

Conclusion

TADA is not the only example of a policy that attempts to address these problems, but it is the one with the most controversy and discourse surrounding it and in that way may be the most instructive as to the best way to approach this issue. Children’s Hospital of Boston (CHB) has a policy that has some similarities to TADA but is wholly internal to the institution and not memorialized and supported in state law (Table 3). The CHB policy does not specify the amount of time allotted to transfer a patient after a futility decision has been made by the ethics advisory committee. Also, following a futility determination, the family is notified of their right to seek judicial intervention, an option that is limited in the state of Texas by TADA. Another important difference is that under the CHB futility policy, without support from a state law, clinicians are not legally immune following unilateral withdrawal of life-supporting treatment. Absent legal immunity, a futility policy like that of CHB may be hindered or even paralyzed, leaving clinicians to continue a treatment they deem ethically and medically inappropriate and instilling moral distress and risking ethical abandonment.

The problem of medical futility requires a well-defined process in which both sides of the dispute can be heard and a resolution reached through policies and procedures
in an equitable manner. Procedural approaches to conflict resolution in medical futility cases are the fairest and most ethical way to resolve these disputes. Medical paternalism or the belief in the absolute rightness of the medical model will not serve to resolve these disputes. Stewart notes, “The necessarily subjective and non-medical elements of futility mean that, while the medical profession can speak with some authority about futility, it cannot claim to have complete sovereignty over the definition.” Absolute discretion to continued life-supporting treatment on the side of the surrogate also will not resolve these disputes. A procedural approach supported by the law can provide requisite attention to the ethical needs and concerns of all involved stakeholders while providing clinicians with the support to follow their conscience without fear of legal repercussions.

The perception and perspective of critical care nurses will also be relevant and valuable in such disputes, for providing needed plurality to the concept of futility and avoiding a univocal, medical understanding of the concept, and for their position as most directly encountering patients and patient families on a daily basis, “nurses can be the bridge connecting families to clinicians.” and, in the words of Thomas Mayo, “the buffer between what is really happening and the family’s perception of what is happening.”

With our current state of medical technology, it may be an unfortunate truth, although a truth nonetheless, that, “There are . . . cases in which unilateral withdrawal of life-sustaining treatment is the only course that keeps faith with the duty to do no harm.” Although medical futility is first determined by medicine, in order for the determination to meet ethical standards of fairness and objectivity, it must be subject to review. States, clinicians, health care institutions, and even patients would benefit from the adoption of a procedural process similar to the law passed in Texas, The Texas Advance Directive Act (1999). The exact details of the ideal law concerning these problems should be the subject of continued study and discourse. We do not presume that TADA, even if it is useful, is without flaws. But it is, at the very least, a starting point that recognizes the problems at both ends of the dispute.

Financial Disclosures
None reported.

References

Table 3

<table>
<thead>
<tr>
<th>1. Committee review: A 3-phase review process by the institution’s ethics advisory committee to determine whether a case of continued life-supporting therapy is inappropriate or harmful:</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Review by members of the committee;</td>
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<tr>
<td>b. Review including the care team;</td>
</tr>
<tr>
<td>c. Review including patient and/or supporting individuals, including surrogate and possibly clergy, friends, etc.</td>
</tr>
<tr>
<td>2. Lack of committee consensus: If the committee fails to reach a consensus, then alternative forms of dispute resolution will be pursued.</td>
</tr>
<tr>
<td>3. Committee consensus:</td>
</tr>
<tr>
<td>a. If the committee supports a patient’s or surrogate’s refusal of continued life-supporting treatment, then the clinicians can agree to withhold or withdraw care or seek to transfer care to another institution.</td>
</tr>
<tr>
<td>b. If the committee does not support clinicians in withdrawing life-supporting treatment, then clinicians can choose to continue to provide life-supporting treatment, seek transfer of the patient to another institution, or an attending physician can ask to be reassigned.</td>
</tr>
<tr>
<td>c. If the committee supports clinicians in withdrawing life-supporting treatment, then</td>
</tr>
<tr>
<td>i. Transfer of care to another institution can be attempted, further attempts at consensus with patient or surrogate could be attempted, or</td>
</tr>
<tr>
<td>ii. A judicial resolution could be sought, or</td>
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<tr>
<td>iii. Hospital administrators could sanction unilateral withdrawal of life-supporting treatment.</td>
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Based on information from Fine.22

Financial Disclosures
None reported.

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References


Implantable cardioverter defibrillators (ICDs) may be burdensome in end-stage heart failure. At the end of life, as many as one-fifth to one-third of patients experience an ICD shock. Critical care nurses should be aware of the potential burden of these shocks at the end of life as well as the ethics and organizational policies surrounding ICD deactivation. This literature review examines the issues surrounding ICD therapy at the end of life. Based on this author’s findings, recommendations for discussing and implementing ICD deactivation are offered. Health care organizations should have clear policies addressing ICD deactivation to provide for seamless integration of palliative care services throughout the course of heart failure. These policies should empower nurses to activate resources in a timely manner and should clearly outline processes for ICD deactivation. (Critical Care Nurse. 2016;36[6]:24-32)

New technologies have allowed patients with heart failure to live longer after diagnosis. These life-prolonging technologies may eventually become incongruent with a patient’s goals and preferences at the end of life. An implantable cardioverter defibrillator (ICD) is one technology that may conflict with these goals and preferences. At the end of life, ICD therapy can become burdensome for both the patient and the patient’s family by causing pain and anxiety and preventing a sudden death.

CE 1.0 hour, CERP B

This article has been designated for CE contact hour(s). The evaluation tests your knowledge of the following objectives:
1. Discuss strategies for reducing unwanted implantable cardioverter defibrillator shocks in patients with heart failure at the end of life
2. Identify key triggers for when the discussion of device deactivation should be addressed
3. Describe barriers to the discussion of device deactivation with patients with heart failure

To complete evaluation for CE contact hour(s) for test #C1662, visit www.ccnonline.org and click the “CE Articles” button. No CE test fee for AACN members. This test expires on December 1, 2019.

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Patients have the right to be informed of all options that might decrease pain and suffering at the end of life, including the option to deactivate ICD therapy. Critical care nurses often provide care for patients with heart failure at the end of life and play an important role in assessing patients’ goals and preferences. Deactivation of an ICD is ethically acceptable and should be discussed with all patients when goals and preferences are likely to change. This literature review explores the issues surrounding ICD therapy at the end of life; based on this author’s findings, recommendations for discussing and implementing device deactivation are provided.

ICD Therapy in End-Stage Heart Failure

An ICD reduces the risk of death from potentially lethal arrhythmias. In patients with heart failure, ICD implantation is often recommended for individuals with a reduced ejection fraction and a life expectancy greater than 1 year. Unfortunately, providing an accurate prognosis in heart failure is difficult. Prognostication tools predict life expectancy in populations of patients, but cannot accurately predict how long an individual patient will live. Heart failure has a changeable course, characterized by acute exacerbations followed by periods of relative stability. It has been estimated that between 300,000 to 600,000 individuals in the United States have end-stage refractory heart failure.

The first ICDs became available in the 1980s, and the prevalence of these devices continues to increase, with most implanted in patients more than 65 years of age. These devices may prolong life in some stages of heart failure, but given the increased prevalence of these devices at the end of life, it is crucial that health care professionals discuss device management when the goals of care change. Patients may not desire prolongation of life as heart failure advances and are not always aware of their progression into end-stage disease. The difficulty in prognostication and the changeable course of heart failure contribute to uncertainty about how close the patient is to death for both health care professionals and patients. This uncertainty may delay end-of-life discussions and place patients at risk for increased pain and anxiety in the final hours of life because of ICD shocks.

Published reports suggest that 21% to 27% of patients receive a shock in the last 30 days of their life and that these shocks were distressing when witnessed by the patient’s family. In a Swedish study of 130 ICD devices explanted postmortem, 31% of patients with active ICDs experienced a shock in the last 24 hours of life. Approximately half of the patients with a do-not-resuscitate (DNR) order still had active shock therapy at 1 hour before death, and 24% of these patients received shocks in the last hour of life. In cases where the device was discharged, 55% of patients received at least 3 shocks, and 32% received more than 10 shocks. Two-thirds of these shocks were not documented in the medical records and may not have been noticed by family or nursing staff; however, 19% did have a notation of pain or stress accompanying the shocks. These statistics are in stark contrast to the estimated 14% of patients who receive a shock in the first year after implantation. Patients are more likely to receive shocks at the end of life if their ICD has fired previously, but predicting which patients will receive a shock at the end of life is impossible.

ICD Deactivation

Patients’ Preferences Regarding ICD Deactivation

Patients’ knowledge and preferences about ICD deactivation are variable. Awareness of the option to deactivate the ICD has been estimated at 38% to 73%, with some smaller studies noting that none of the participants knew this option existed. Discussions about deactivation have been reported to occur with less than a third of patients who died with an ICD in place. Patients’ support for ICD deactivation were as low as 28% in one US study and as high as 79% in the Netherlands. In the US study, 26% of patients considered deactivation a form of physician-assisted suicide. Culture and knowledge about ICD function may explain these disparate findings. Evidence indicates that some patients and health care professionals think that discussion of end-of-life issues is not acceptable in our culture. Withdrawal of life-prolonging devices at the end of life is frequently controversial, and although

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ICD deactivation is generally accepted, not every patient or health care professional is comfortable with it. In cases where the health care professional is not comfortable with deactivation, it is important that patients be referred to another professional who can assist them.

**Ethical Considerations**

The ethics of medical decision-making in the United States rest on the principles of autonomy, beneficence, nonmaleficence, and justice. Competent patients have the right to accept or refuse medical treatments. In addition, the Patient Self-Determination Act of 1991 provides the legal basis for this right. It is the obligation of health care professionals to ensure that patients understand the risks and benefits of all recommended therapies. Health care professionals have an ethical obligation to do no harm (nonmaleficence) and to act in patients’ best interests (beneficence). Justice requires us to support all patients in these rights. These ethical principles are often operationalized as informed consent. Nurses, although not solely responsible for informed consent, should ensure that patients have adequate information on which to base their decisions.

As the burden of ICD therapy may outweigh benefits when patients’ goals and preferences change, patients have the right to request deactivation of these devices.2,3,5,6,12,15,16,25-29 This right is well accepted and supported by the most recent guidelines on heart failure from the American College of Cardiology Foundation (ACCF) and the American Heart Association (AHA).7 Although most published reports2,5,20,21,29 support discussion of deactivation before implantation, in one study,5 only 3% of patients recalled that this discussion actually occurred.

Health care organizations should have policies that ensure device deactivation is systematically addressed.15 Although some patients may not choose deactivation, most want to be informed about the option of deactivation.5,20,22 All patients with an ICD should understand the purpose of the device, as well as the risks, benefits, and options for device management as health declines. The literature suggests that patients may not have the information needed to make informed decisions and may not understand how the device works or the possible burden of active devices at the end of life.30,31 There may also be a knowledge deficit when it comes to understanding the nature of their condition. As a chronic condition with a progressive course, it is important that patients are able to periodically reevaluate whether to continue with ICD therapy.31 Patients with heart failure tend to overestimate their life expectancy21,32 and often do not consider heart failure to be a life-limiting disease.11,30,33

It is important that we develop guidelines for practice that ensure that patients are able to make informed decisions about device deactivation. A shared decision-making approach is suggested by the most recent guidelines from the American College of Cardiology Foundation and American Heart Association.7 True informed consent and shared decision-making are difficult to achieve because it takes time to explain all the information that patients need to know in a way that they can understand. Patients may need more than one explanation or discussion to understand this information. Despite these difficulties, true informed consent should remain the goal. Policies and procedures in acute care settings can help us achieve this goal through a team-based systematic approach.

**Recommendations**

Key themes were identified on the basis of this author’s review of the literature. Shocks from an ICD may be burdensome at the end of life and occur often when devices remain active. Discussions regarding deactivation did not take place consistently or early enough in the course of heart failure despite support for these discussions among health care professionals and patients. Guidelines and policies can be developed to improve care and uphold key ethical considerations for this population. Included are recommendations for (1) discussion before implantation, (2) triggers for discussion of ICD deactivation, (3) screening for devices upon admission, (4) interprofessional team discussions, and (5) incorporating palliative care into critical care settings. Additionally, recommendations are made for procedural processes when deactivation is requested.

**Guidelines and Policy Development**

**Discussion Before Implantation.** Health care organizations should develop policies to help health care professionals discuss deactivation at all points of care delivery, from insertion of the ICD to outpatient
and acute management. Organizations where these devices are implanted or maintained should develop programs to better educate patients at the time of insertion. These educational programs should assist patients and their families in understanding the device functions and discuss situations in which patients may choose to have the device deactivated, as well as the ease of deactivation. Individualized nurse-led educational programs beginning before implantation with follow-up sessions improved patients’ knowledge in a Turkish study.34 Nurse educators can assist electrophysiologists by providing this in-depth teaching. Implantation should trigger a discussion about end-of-life preferences and the usual course of heart failure.2,21 This early discussion may make future discussions easier. Discussing end-of-life care early may normalize the topic and help patients and their families understand the life-limiting nature of heart failure.1

Key teaching points about ICD deactivation are listed in Table 1. Patients and their families should know that the defibrillation function can be turned off without deactivating pacing or cardiac resynchronization therapy.2 Any misconception that deactivation is similar to euthanasia should be corrected. Evidence shows that patients believe that deactivation should be discussed at the time of implantation.4,5,20 Patients should also understand that these devices may need periodic replacement.2 The need for ICD replacement should be an additional trigger to assess patients’ preferences, and replacement should not be automatic.2,3,16

Triggers for Discussion of Deactivation. Hospital policy should ensure that when an order for DNR code status or “comfort measures only” is written, the provider should document that ICD deactivation was offered to the patient and/or surrogates. According to a survey of 558 physicians, the majority thought that deactivation discussions should accompany a DNR order.4 Patient support is strong for advance directives that specifically address ICD deactivation at the end of life.22 Writing a DNR order should trigger the provider to assess whether an ICD is present and whether the patient or surrogate would like the device deactivated. When discussions regarding deactivation are incorporated into end-of-life conferences, patients receive fewer shocks in the time preceding death.14 Despite support for offering deactivation for patients with DNR orders, 1 study18 demonstrated that only 50% of patients have had the ICD deactivated 1 hour before death. Deactivation should also be discussed whenever clinical signs of a poor prognosis are present.

Screening. Upon admission, patients should be screened for the presence of an ICD. Patients and their families may not remember the type of device or may forget to mention the device.15 Devices can usually be detected by inspecting and palpating the anterior chest wall and are identifiable via chest radiography. The chest radiograph will indicate what programmer is required to interrogate the device.36 When specific information about the device settings is not available through the patient or medical records, the device should be interrogated and the findings documented carefully in the medical record. This information should be easily accessible and in a place where all caregivers will see it. Without screening, health care professionals may not be able to address deactivation when indicated.

Table 1  Key teaching points about deactivation of an implantable cardioverter defibrillator (ICD) a

There may come a time when ICD therapy causes more burdens than benefits; for example, at the end of life or in the case of a terminal disease.

ICD therapy can be painful and distressing to experience and witness at the end of life.

Deactivation will not cause death, but the ICD will not automatically treat potentially life-threatening arrhythmias in the future.

Pacemaker and resynchronization functions can be retained when deactivating defibrillation.

ICDs may need periodic replacement, and patients can choose not to replace ICDs.

The patient is unlikely to notice or feel anything different after deactivation. Deactivation is painless.

Defibrillation can be deactivated urgently by using a strong magnet placed over the device.

a Based on information from Matlock and Stevenson,2 Jezewski and Meeker,24 and Swetz and Mansel.25

Nurses should be empowered to initiate discussions about deactivation with the interprofessional team.
Interprofessional Teams. Health care organizations should provide for regular interprofessional discussions about patient goals in which bedside nurses have a meaningful role. Nurses spend the largest portion of time with patients and can provide valuable input when the team’s goals of care do not align with the patient’s goals and preferences. Nurses should be empowered to initiate discussions about deactivation with the interprofessional team at key trigger points (Table 2). Nurses are responsible for acknowledging and advocating for the needs of patients and patients’ families. In critical care environments, it is easy to focus on physiological processes and curative paradigms. Bedside nurses should assert their knowledge of the whole individual and assist in steering interdisciplinary goals to meet the needs of patients and patients’ families.

Palliative Care in Critical Care. One common misconception is that palliative care is mutually exclusive with life-prolonging or curative treatment and is reserved for the last days of life. On the contrary, palliative care should begin with the diagnosis of heart failure and continue throughout the course of the disease. Palliative care is treatment with a focus on the prevention and relief of suffering. In the ICU, palliative care may not only help manage symptoms, but can assist the team in alignment of goals and provide support for patients and their families. Acute care organizations should provide seamless integration and/or referral to palliative care services. Protocols should be developed to allow nurses to independently activate these services when indicated.

### Procedures

Successful implementation of policies is enhanced when there are procedural outlines to follow. Health care organizations should have clear procedures indicating how ICDs are deactivated when requested by patients or surrogates. These procedures should include pathways for nonurgent and urgent deactivation (Table 3). Nonurgent pathways may outline which providers should be consulted when ordering deactivation, how to request deactivation by trained staff, and a timeline for how long this process should take. Urgent pathways should allow bedside nurses to deactivate the ICD with a magnet under specific circumstances. Consider a situation in which a patient with a DNR order is requesting urgent deactivation following a shock. This pathway would be needed only if a patient or surrogate had decided against deactivation but, after a shock, changes his or her mind.

#### Table 2 Triggers for discussing deactivation of an implantable cardioverter defibrillator (ICD)\(^a\)

<table>
<thead>
<tr>
<th>Trigger</th>
<th>Rationale</th>
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<tbody>
<tr>
<td>Before implantation or pulse generator change</td>
<td>Informed consent should provide education about function and the possibility of deactivation at a future time.</td>
</tr>
<tr>
<td>After ICD shocks</td>
<td>Patients are more likely to be aware of their mortality and the possible burdens of defibrillation.</td>
</tr>
<tr>
<td>Frequent hospitalizations (3 admissions in &lt;6 months)</td>
<td>Frequent hospitalizations may indicate the steady decline in health before death.</td>
</tr>
<tr>
<td>Do not resuscitate or comfort care orders</td>
<td>ICDs provide life-sustaining treatment and may not be consistent with patients’ preferences to avoid resuscitation and are antithetical to comfort measures.</td>
</tr>
<tr>
<td>Admission to hospice</td>
<td>Hospice referrals are made when life expectancy is 6 months or less, ICDs are indicated only in patients with a life expectancy of at least 1 year and may prolong suffering.</td>
</tr>
<tr>
<td>Significant functional decline</td>
<td>Functional decline may change patients’ goals and preferences as they become more dependent on caregivers to meet basic needs.</td>
</tr>
<tr>
<td>New York Heart Association stage IV or American Heart Association stage D</td>
<td>These stages of heart failure are considered end stage, and the value of ICDs in advanced stages is not proven.</td>
</tr>
<tr>
<td>Intolerance of angiotensin-converting enzyme inhibitors and (\beta)-adrenergic blockers, hypotension, dependence on inotropic agents, hyponatremia, serum albumin level &lt;2.5 g/dL, elevated creatinine level, and low hemoglobin level</td>
<td>These are clinical signs of poor prognosis in heart failure.</td>
</tr>
</tbody>
</table>

\(^a\) Based on information from Goodlin et al., Matlock and Stevenson, Allen et al., Hupcey et al., Wingate and Wiegand, Wotton et al., Kirk, and Jezewski and Meeker.
suggested protocol would help alleviate suffering for patients at the time of death and would provide nurses with the ability to act quickly. Empowering nurses with such a protocol might also reduce the risk of moral distress.

Discussion

Support for deactivation of ICDs at the end of life is apparent, and this article has provided some guidelines to assist critical care units and nurses in policy development. Although it is ethically acceptable to deactivate ICDs when a patient requests, deactivation should not be automatic for every patient at the end of life.15 Patients have the right to continue ICD therapy even when requesting DNR or comfort status. Many patients develop complex psychological relationships with their device and see it as a “trusted friend” or “insurance policy.”30 Results of a survey of 105 patients with heart failure indicate that many were reluctant to deactivate their device even when asked to consider a hypothetical terminal disease or daily shocks.21 Although some patients may be reluctant to deactivate their device, they also have the right to change their mind and should not be forced to endure suffering in their final hours.

Nurses can support decision-making by communicating with patients about their goals and preferences (Table 4). In order for these conversations to be meaningful, nurses need to allot an appropriate amount of time to explore and ensure understanding of a patient’s perspective. Providing opportunities for patients and their families to express feelings may reveal values that are incongruent with the care provided. To advocate for patients, nurses must understand the needs of patients and their families.33 Asking questions to determine what a patient understands about his or her condition can reveal knowledge deficits. Whenever a patient’s values, goals, preferences, or understanding is incongruent with the clinical picture, nurses should discuss these concerns with the

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**Table 3** Pathways for deactivation of an implantable cardioverter defibrillator (ICD)\(^a\)

<table>
<thead>
<tr>
<th>Facility with electrophysiology services</th>
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</tr>
</thead>
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<tr>
<td><strong>Nonurgent deactivation pathway</strong></td>
<td></td>
</tr>
<tr>
<td>Deactivation is requested by patient or appropriate surrogate</td>
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</tr>
<tr>
<td>Attending provider notified</td>
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</tr>
<tr>
<td>Electrophysiology consultation is ordered</td>
<td>Attending provider discusses deactivation options with the patient and writes the order for deactivation of specific features</td>
</tr>
<tr>
<td>• Patient is seen in &lt; 12 hours</td>
<td>• Seeks assistance from manufacturer to obtain the programmer and technical expertise</td>
</tr>
<tr>
<td>• Deactivation options discussed with patient and attending provider</td>
<td>• Contacts the patient’s primary cardiologist or electrophysiologist to discuss patient’s wishes</td>
</tr>
<tr>
<td>• Attending provider orders deactivation of specific features</td>
<td></td>
</tr>
<tr>
<td>Electrophysiologist or trained designee deactivates the ICD</td>
<td>Trained technician assists the provider in deactivating the ICD within 24 hours of the patient’s request</td>
</tr>
</tbody>
</table>

**Urgent deactivation pathway**

Deactivation is requested by patient or legal surrogate and witnessed by 2 nurses.

Primary nurse places magnet over the device to urgently deactivate it and relieve the patient’s distress.

Attending provider is notified and initiates the nonurgent pathway to permanently deactivate the device.

\(^a\) Based on information from Lampert et al.39

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**Table 4** Interventions to support decision-making

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<th>Suggested phrases(^a)</th>
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<tr>
<td>Determine patient’s and family’s understanding of condition</td>
<td>“What do you understand about your health and your illness?”</td>
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<tr>
<td>Ask about goals and preferences</td>
<td>“What is most important to you and your family right now in terms of your health?”</td>
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<td>Discuss any incongruent care with the interdisciplinary team and involve patient’s usual providers when possible</td>
<td>To the interdisciplinary team: “I’m concerned that the patient’s goals have changed and we need to address the option of ICD deactivation”</td>
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Abbreviation: ICD, implantable cardioverter defibrillator.
interprofessional team. Whenever possible, a health care professional who has an existing relationship with the patient should be involved because patients may prefer that this person be the one to address end-of-life issues.12

When deactivation is chosen, nurses should be prepared for the possibility that the patient might have a different course of dying, and death could occur abruptly with a sudden loss of consciousness.40 Patients and their families may expect an acute change immediately after deactivation and should be taught that the patient is unlikely to look or feel any different afterwards.2 Regardless of whether a patient chooses to deactivate an ICD at the end of life or to continue with ICD therapy, the patient’s informed decision should be honored and respected.

Conclusion

Deactivation of an ICD should be discussed with all patients periodically, especially at the end of life, when the device can lead to suffering without benefit. Health care organizations should have clear policies and procedures for nurses to follow in advocating for their patients. These policies should include (1) discussing deactivation and providing education before implantation, (2) screening for and documentation of ICD presence, (3) an interprofessional team–based approach to goal setting, (4) seamless integration of palliative care services, and (5) ensuring that deactivation is addressed with DNR orders and with signs of worsening prognosis. Urgent and nonurgent pathways for deactivation should be created. The implementation of these recommendations may reduce painful shocks at the end of life and improve care for patients who have an ICD.

Financial Disclosures

None reported.

Letters

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

Letters

To learn more about caring for patients with heart failure, read “Depressive Symptoms and the Relationship of Inflammation to Physical Signs and Symptoms in Heart Failure Patients” by Heo et al in the American Journal of Critical Care, September 2014;23:404-413. Available at www.ajconline.org.

References


New technologies have allowed patients with heart failure to live longer after diagnosis. These technologies may become incongruent with a patient’s goals and preferences at the end of life. An implantable cardioverter defibrillator (ICD) is one technology that may conflict with these goals and preferences. At the end of life, ICD therapy can become burdensome for both the patient and the patient’s family by causing pain and anxiety and preventing a sudden death. Patients have the right to be informed of all options that might decrease pain and suffering at the end of life, including the option to deactivate ICD therapy.

- Nurses can support decision-making by communicating with patients about their goals and preferences (see Table). In order for these conversations to be meaningful, nurses need to allot an appropriate amount of time to explore and ensure understanding of a patient’s perspective.
- To advocate for patients, nurses must understand the needs of patients and their families. Asking questions to determine what a patient understands about his or her condition can reveal knowledge deficits. Whenever a patient’s values, goals, preferences, or understanding is incongruent with the clinical picture, nurses should discuss these concerns with the interprofessional team.
- Whenever possible, a health care professional who has an existing relationship with the patient should be involved because patients may prefer that this person be the one to address end-of-life issues.

- Health care organizations should have clear policies and procedures for nurses to follow in advocating for their patients. These policies should include (1) discussing deactivation and providing education before implantation, (2) screening for and documentation of ICD presence, (3) an interprofessional team–based approach to goal setting, (4) seamless integration of palliative care services, and (5) ensuring that deactivation is addressed with DNR orders and with signs of worsening prognosis.
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Abbreviation: ICD, implantable cardioverter defibrillator.
Use of Neuromuscular Blockers During Therapeutic Hypothermia After Cardiac Arrest: A Nursing Protocol

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**BACKGROUND** Neuromuscular blockers used to prevent shivering during therapeutic hypothermia in comatose patients after out-of-hospital cardiac arrest are associated with adverse events.

**OBJECTIVE** To assess the influence of a nurse-implemented protocol on use of neuromuscular blockers in patients treated with 24-hour therapeutic hypothermia after out-of-hospital cardiac arrest.

**METHODS** A before and after study was done in a 24-bed cardiac arrest center. During the before period, paralysis was maintained by continuous infusion of vecuronium during therapeutic hypothermia. During the after period, a nurse-implemented protocol was used to strictly control use of neuromuscular blockers. The primary outcome measure was duration of infusion of neuromuscular blockers; secondary end points included rates of ventilator-associated pneumonia and intensive care unit mortality.

**RESULTS** Among the 22 patients in the before group and the 23 patients in the after group, most were men (78%) with a median age of 66 years. Baseline characteristics were similar between the 2 groups. Median duration of sedation was 36 hours, shorter in the after group (34 hours) than in the before group (38 hours; \( P = .02 \)). Median duration of infusion of neuromuscular blockers was significantly shorter in the after group (6 hours) than in the before group (33 hours; \( P < .001 \)). Ventilator-associated pneumonia occurred more frequently in the before group (45%) than in the after group (13%; \( P = .02 \)). Overall intensive care unit mortality rate was 58%, similar in both groups (\( P = .44 \)).

**CONCLUSION** Use of a nurse-implemented protocol to reduce use of neuromuscular blockers is feasible. (Critical Care Nurse. 2016;36[6]:33-41)

**Therapeutic hypothermia is a major component of care in comatose patients resuscitated from an out-of-hospital cardiac arrest (OHCA).** Therapeutic hypothermia can improve neurological functional outcomes in patients with OHCA-related shockable rhythm. Although a wide range of temperatures may be suitable for patients after a cardiac arrest, therapeutic hypothermia of 32°C to 34°C (89.6°F-93.2°F) is highly recommended for successfully resuscitated patients who are comatose.
Therapeutic hypothermia is usually well tolerated but can lead to side effects, most often shivering.6 Shivering is an involuntary, rhythmic tremor of skeletal muscle groups that consists of oscillatory movement.7,8 Shivering is a physiological response to cooling that appears as soon as body temperature decreases to less than 36°C (<96.8°F). Shivering leads to an increase in muscular activity to generate heat by increasing the basal metabolic rate but is associated with adverse effects such as an increase in oxygen consumption and production of carbon dioxide.9 Sedative agents, which are often used to permit mechanical ventilation, also facilitate the control of shivering by lowering the shivering threshold. However, continuous infusion of sedatives may be insufficient or not well tolerated or both in patients whose hemodynamic status may be worsening. In such situations, neuromuscular blockers (NMBs) are commonly used to totally suppress shivering. However, NMBs may mask seizures, which are frequent after anoxic brain injury and require urgent treatment. Moreover, NMBs increase the risk for acquired weakness related to polyneuropathy10,11 and ventilator-associated pneumonia (VAP).12 To date, NMB use remains a matter of debate regarding the benefit in early acute respiratory distress syndrome13 and the lack of agreement among results observed in patients after cardiac arrest.14,15

On the whole, clinical evidence suggests that use of NMBs should be reduced unless shivering is uncontrolled. Because we decided to reduce use of NMBs, we evaluated a nurse-implemented NMB titration protocol during therapeutic hypothermia after OHCA and the tolerance of nonsystematic use of NMBs in OHCA patients.

Methods

Study Setting and Intensive Care Management

We performed a before (May 2012 through September 2012) and after (May 2013 through September 2013) study in a 24-bed cardiac arrest center in Paris, France. Data were prospectively collected according to Utstein style,16 as has been the case at the center for all cardiac arrest patients since 2003, as previously described.17 After any required imaging procedure, all patients were admitted to the intensive care unit (ICU) for further supportive treatment. Therapeutic hypothermia was started as soon as possible after ICU admission, and each patient’s temperature was maintained at 33°C (91.4°F) for 24 hours. During the study period, we used external cooling via forced cold air.18 Sedation was achieved by continuous infusion of midazolam and fentanyl to obtain a score of -5 on the Richmond Agitation-Sedation Scale. Temperature was continuously monitored via temperature-sensing indwelling urinary catheters during both therapeutic hypothermia and the rewarming period (at least 48 hours).

Neuromuscular Blockers

During the before (control) period, paralysis was maintained by continuous infusion of vecuronium throughout the time of therapeutic hypothermia and was stopped during the rewarming phase when central body temperature reached 35°C (95°F). For the after period, we created a nurse-implemented protocol (Figure 1) that was progressively implemented (washout period) in all post-OHCA patients. Briefly, the goal of the new protocol was to reduce use of NMBs according to the results of regular assessment of shivering as indicated by scores on the Bedside Shivering Assessment Scale.9 Scores on the scale range from 0 (no shivering) to 3 (severe shivering).9 We evaluated the impact of this
change in the after period in all consecutive OHCA patients. The method of NMB treatment was the only change in practice during the entire study period. Results of train-of-four monitoring were evaluated every 3 hours.

Primary and Secondary Outcomes

The primary outcome was the duration of NMB infusion in each period. The secondary outcomes were duration of sedation, ICU mortality, VAP incidence, and ICU length of stay.

Data Collection

The following information was recorded prospectively for each patient: demographic data, clinical parameters, location of the cardiac arrest, time from collapse to basic life support and time from basic life support to return of spontaneous circulation, initial rhythm, methods of therapeutic hypothermia, and ICU mortality. The presence of an ST-segment elevation, assessed on electrocardiograms obtained after return of spontaneous circulation, was defined as an elevation of at least 1 mm in 2 contiguous leads in standard leads and at least 2 mm in precordial leads. Shock after resuscitation was defined as the need for vasopressors (epinephrine or norepinephrine) for more than 6 hours despite adequate fluid replacement or the need for ventricular assistance (intra-aortic balloon pump counterpulsation). Information collected on sedation and NMB use was duration and cumulative doses of midazolam and fentanyl and type and duration of NMB. In the after period, the number of patients who needed NMB boluses was also recorded. Minimal value of train-of-four testing was recorded during therapeutic hypothermia.

Ventilator-associated pneumonia was diagnosed if a patient had evidence of a new and persistent infiltrate on chest radiographs and 2 or more of the 3 following criteria: body temperature greater than 38°C (> 100.4°F); white blood cell count greater than 12,000/μL, and purulent tracheobronchial secretions. Alternatively, VAP was diagnosed if the patient had been receiving mechanical ventilation for 2 or more calendar days on the date of the event and the ventilator was in place on the date of event or the day before, as previously described. VAP diagnoses were reviewed by 2 investigators (G.G. and A.C.) regardless of the period of the study. A third senior ICU physician with no knowledge of the before and after designations reviewed VAP diagnoses for all patients.

Study Population

Patients were included in the analysis if they had been successfully resuscitated from an OHCA and admitted to our medical ICU, their condition indicated a need for therapeutic hypothermia, and their planned ICU length of stay at admission was longer than 24 hours. Patients were not included in the analysis if they did not undergo
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Median duration of sedation was significantly shorter in the after group than in the before group.

Statistical Analysis
Descriptive statistics were reported as medians (with interquartile range [IQR]) for continuous variables and as frequency (percentage) for categorical variables unless otherwise specified. OHCA patients’ baseline characteristics were compared according to the treatment period by using the Mann-Whitney test or the Wilcoxon rank sum test and Pearson $\chi^2$ analysis or the Fisher exact test, as appropriate, for continuous and categorical variables, respectively. All statistical tests were 2-tailed at $\alpha = .05$ (type I error) unless mentioned otherwise. Analyses were performed by using Stata 11.2 software (StataCorp LP).

Results
Baseline Characteristics
A total of 35 patients were admitted after OHCA during the before period and 31 during the after period. After exclusion of patients who did not meet the criteria for inclusion in the study, the final sample consisted of 45 patients, 22 in the before period and 23 in the after period (Figure 2). All 45 patients were treated with therapeutic hypothermia. The median age of the final sample was 65.6 years (see Table).

Cardiac arrest was related to an initial shockable rhythm in two-thirds of cases and to a cardiac cause in 31 (69%). Median body temperature at ICU admission was similar in both groups ($P = .14$): 35.5°C in the before group (IQR, 34.6°C-35.2°C) and 36°C (IQR, 35.3°C-36.4°C) in the after group. Median minimal body temperature during the first 24 hours was also similar ($P = .60$): 32.6°C (IQR, 32.2°C-32.8°C) in the before group and 32.8°C (32.1°C-33°C) in the after group. Baseline characteristics did not differ significantly between the 2 groups.

Sedation and NMBs
All 45 patients were sedated by using fentanyl and midazolam. Median duration of sedation for the 45 patients in the sample was 36 hours (IQR, 32-39 hours). Median duration was significantly shorter ($P = .02$) in the after group than in the before group: 34 hours (IQR, 31-36 hours) in the after group and 38 hours (IQR, 35-42 hours) in the before group (Figure 3). During therapeutic hypothermia, 82% of the 45 patients in the sample were adequately paralyzed, with a score of 1 on train-of-4 testing.

Overall median duration of NMB infusion was 18 hours (IQR, 6-32 hours). Median duration was significantly shorter ($P < .001$) in the after group than in the before group: 6 hours (IQR, 3-8 hours) in the after group and 33 hours (IQR, 27-38 hours) in the before group (Figure 3). Median cumulative dose of vecuronium in the before group was 123 mg (IQR, 97-162 mg), whereas median cumulative dose of atracurium in the after group was 38 mg (IQR, 35-42 mg). Need for atracurium pulses in the after period occurred in 10 patients (43%). Continuous infusion of atracurium was necessary in 9 cases (39%), for a median duration of 16 hours (IQR, 5-19 hours). One patient did not require any NMB in the after period.
Other End Points

VAP occurred in 13 of 45 patients (29%) and was more frequent \( (P = .02) \) in the before group (45%) than in the after group (13%). Among the 45 patients in the sample, median duration of mechanical ventilation was 5 days (IQR, 3-9 days), and median ICU length of stay was 6 days (IQR, 3-10 days). Median duration of mechanical ventilation was similar in both groups \( (P = .76) \): 6 days (IQR, 2-11 days) in the before group and 4 days (IQR, 4-6 days) in the after group. Median ICU length of stay also did not differ significantly \( (P = .95) \) between the 2 groups: 6 days (IQR, 3-11 days) in the before group and 6 days (IQR, 4-7 days) in the after group. Overall ICU mortality rate was 58% and was similar \( (P = .44) \) in both groups: 52% in the before group and 64% in the after group.

Discussion

Our aim in this study was to evaluate a nurse-implemented protocol to reduce the amount of NMBs infused during therapeutic hypothermia after cardiac arrest. Our data revealed 2 striking findings: nurse management of NMB during therapeutic hypothermia after cardiac arrest is feasible and leads to a decrease in duration of sedation and infusions of NMBs.

The critical point is that we evaluated a nurse-implemented protocol for NMB titration and compared the results with the results of usual care. The efficacy of use of nurse-implemented protocols in the ICU has already been reported. For example, Roh et al\(^2\) evaluated a weaning protocol used by critical care nurses for patients receiving mechanical ventilation. In a prospective randomized trial, the investigators compared a protocol-based weaning with usual care and found that use of the protocol was safe and allowed a reduction in the weaning time from mechanical ventilation.\(^2\) Similarly, Arias-Rivera et al\(^2\) found an improvement in the
probability of successful extubation associated with use of a nurse-implemented protocol. Other investigators reported that use of nurse-implemented glucose control\textsuperscript{23} and potassium regulation\textsuperscript{24} was associated with a reduction in metabolic disturbances and a reduction of the time needed to correct these abnormalities. However, so far as we know, NMBs have never been the subject of development of a nurse-implemented protocol. Our findings highlight the need for a careful and nonsystematic use of NMBs during therapeutic hypothermia after cardiac arrest.

In critically ill patients, NMBs are mainly used in patients with acute respiratory distress syndrome\textsuperscript{13} and during therapeutic hypothermia, but doses of the agents are determined solely by physicians according to a patient’s condition. Decisions about the initial need for NMBs should be made by physicians in charge, but our findings indicate the safety of using a nurse-implemented protocol to reduce use of these drugs in OHCA patients treated with therapeutic hypothermia.

Because of the various side effects of NMBs, some researchers have studied different methods of sedation to prevent shivering. Indeed, some sedative agents such as propofol or meperidine can decrease the shivering threshold.\textsuperscript{25,26} In addition, Lenhardt et al\textsuperscript{27} found that the combination of buspirone and dexmedetomidine could decrease the shivering threshold, highlighting the fact that prevention of shivering was possible without use of NMBs. Accordingly, Choi et al\textsuperscript{28} used a stepwise protocol to prevent shivering in a neurocritical care unit. They found that a significant proportion of patients undergoing therapeutic hypothermia could be effectively treated for shivering without oversedation and paralysis. Indeed, NMBs were used only in patients with refractory shivering and were deemed necessary in 5.1% of patients.\textsuperscript{28} Logan et al\textsuperscript{29} reported use of a practical nurse protocol after cardiac arrest in which use of NMBs was restricted to refractory shivering. Similarly, Bjelland et al\textsuperscript{30} reported NMB use in similar proportions in both groups during therapeutic hypothermia after cardiac arrest in patients in a randomized trial in which half of the patients were given propofol and remifentanil and half were given midazolam and fentanyl.

Interestingly, in our study, VAP incidence was lower in the after period than in the before period. However, this association must be interpreted cautiously because our small sample size did not allow multivariate analysis. The association between NMB infusion and VAP occurrence remains a matter of debate. NMBs inhibit the cough reflex and increase the risk for atelectasia by decreasing clearance of endotracheal secretions and gut motility. To date, published data vary, from no association at all between NMB use and risk for VAP to a deleterious effect.\textsuperscript{12,31} In our study, use of a nurse-implemented protocol was associated with a decrease in the duration of sedation that may partly explain our findings. Indeed, Quenot et al\textsuperscript{32} reported a decrease in the incidence of VAP in a before and after study in which the duration of sedation was markedly decreased after implementation of a nurse-led sedation protocol. This consideration is all the more important because cardiac arrest patients are at high risk for infection, especially pulmonary infection.\textsuperscript{33,34} Our findings should be carefully interpreted because of the design and the small sample but should encourage further larger studies. Taken together, our findings highlight the need for a careful and nonsystematic use of NMBs during therapeutic hypothermia after cardiac arrest.

Interestingly, unlike Lascarrou et al\textsuperscript{14} and Salciccioli et al,\textsuperscript{15} we did not find any difference in terms of ICU mortality between our 2 groups. However, these differences between findings may be mostly explained by baseline characteristics of the patients treated with and without NMB. Indeed, Lascarrou et al\textsuperscript{14} reported that compared with patients treated with NMBs, patients who did not receive NMBs were older, more often experienced unshockable rhythm–related OHCA, and required longer times for resuscitation. Moreover, the value of the Simplified Acute Physiology Score II was higher in patients treated without NMBs than in patients treated with the agents.\textsuperscript{14} All these factors are strongly associated with worse outcomes.\textsuperscript{35} The results of Salciccioli et al\textsuperscript{15} could be interpreted in a similar way. Moreover, in a study by Adrie et al,\textsuperscript{36} OHCA scores were dramatically higher in patients treated without use of NMBs; predicted poor outcomes were about 65% for patients not given NMBs and 20% for patients given NMBs. However, this univariate association was adjusted for baseline vasopressor use and international normalized ratio, strengthening the crude association observed. We could not perform a multivariable analysis because of the small number of patients in our sample and thus could not take into account potential cofounders included in previous studies. On the whole, a
randomized controlled trial would be useful to determine whether the use of NMBs is associated with outcomes after cardiac arrest.

Limitations

Our study has several limitations. First, the retrospective design may have introduced some recruitment bias. The optimal design of a study such as the one reported here would be a prospective randomized trial. However, selection of consecutive cardiac arrest patients for the same period of the year may have helped minimize the risk for bias. Second, the small number of patients in the sample might prevent generalization of our findings. However, even with a small sample, we found some significant results consistent with the results of previous studies, a characteristic that improves the external validity of our findings. Third, the NMB used in the before period (vecuronium) differed from the agent used in the after period (atracurium), making comparisons of the 2 groups difficult. Because it has a shorter half-life and its elimination does not depend on liver and kidney metabolism, atracurium seems to be the most appropriate NMB in cardiac arrest patients. Finally, our study was not designed to evaluate VAP incidence according to the treatment period, preventing extrapolation of our conclusions.

Conclusion

Our results indicate the feasibility of a nurse-implemented NMB protocol. This protocol leads to a marked decrease in the duration of sedation and the infusion of NMBs. CCN

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Financial Disclosures

None reported.

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References


Use of Neuromuscular Blockers During Therapeutic Hypothermia After Cardiac Arrest: A Nursing Protocol

**Therapeutic hypothermia is a major component of care in comatose patients resuscitated from an out-of-hospital cardiac arrest (OHCA).** Although a wide range of temperatures may be suitable for patients after a cardiac arrest, therapeutic hypothermia of 32°C to 34°C (89.6°F-93.2°F) is highly recommended for successfully resuscitated patients who are comatose. Our aim was to evaluate a nurse-implemented protocol to reduce the amount of neuromuscular blockers (NMBs) infused during therapeutic hypothermia after cardiac arrest.

- Our data revealed 2 striking findings: nurse management of NMB during therapeutic hypothermia after cardiac arrest is feasible and leads to a decrease in duration of sedation and infusions of NMBs.
- In critically ill patients, NMBs are mainly used in patients with acute respiratory distress syndrome and during therapeutic hypothermia, but doses of the agents are determined solely by physicians according to a patient’s condition. Decisions about the initial need for NMBs should be made by physicians in charge, but our findings indicate the safety of using a nurse-implemented protocol to reduce use of these drugs in OHCA patients treated with therapeutic hypothermia.
- Because of the various side effects of NMBs, some researchers have studied different methods of sedation to prevent shivering. Indeed, some sedative agents such as propofol or meperidine can decrease the shivering threshold. In addition, the combination of buspirone and dexmedetomidine can decrease the shivering threshold, highlighting the fact that prevention of shivering was possible without use of NMBs.
- The association between NMB infusion and ventilator-associated pneumonia occurrence remains a matter of debate. NMBs inhibit the cough reflex and increase the risk for atelectasia by decreasing clearance of endotracheal secretions and gut motility.
- In our study, use of a nurse-implemented protocol was associated with a decrease in the duration of sedation that may partly explain our findings. Our findings should be carefully interpreted because of the design and the small sample but should encourage further larger studies. Taken together, our findings highlight the need for a careful and nonsystematic use of NMBs during therapeutic hypothermia after cardiac arrest.
- We did not find any difference in terms of intensive care unit mortality between our 2 groups. However, these differences between findings may be mostly explained by baseline characteristics of the patients treated with and without NMBs.

Patients with hypoplastic left heart syndrome undergo a series of operations to separate the pulmonary and systemic circulations. The first of at least 3 operations occurs in the newborn period, with a stage I palliation. The goal of stage I palliation is to provide pulmonary blood flow and create an unobstructed systemic outflow tract. Advances in surgical techniques and intraoperative and postoperative care have helped decrease morbidity and mortality for patients with hypoplastic left heart syndrome who have the stage I Norwood operation, but the patients continue to be at increased risk for hemodynamic collapse and adverse outcomes. This article discusses risk factors, surgical approach, postoperative nursing and medical management strategies, differences between and outcomes for the Norwood operation with the right ventricle to pulmonary artery conduit and the Norwood operation with a modified Blalock-Taussig shunt. (Critical Care Nurse. 2016;36[6]:42-51)

Hypoplastic left heart syndrome (HLHS) is a congenital heart disease that involves the left-sided structures, including the mitral valve, left ventricle, and aortic outflow tract. Variations may include degrees of mitral and aortic stenosis and atresia.1 The structures are collectively too small to provide adequate cardiac output and systemic perfusion. Without palliation in the neonatal period, the disease is generally fatal because of progressive hypoxia and acidosis.1,2
In this article, I focus on stage I palliation for HLHS with either the Norwood procedure with the right ventricle to pulmonary artery (RVPA) conduit or the Norwood procedure with a modified Blalock-Taussig shunt (mBTS). I discuss risk factors, variations in surgical approach, postoperative nursing and medical management, differences between the 2 shunt types, and a comparison of outcomes for the Norwood operation.

**Historical Perspective**

In 1981, Norwood et al described the use of valved and nonvalved RVPA conduits, among other approaches to establish pulmonary blood flow (PBF), for stage I palliation of HLHS in a series of patients who had surgical repair. This early group of patients, including those who had RVPA conduits established, had an overall mortality rate of 79%. Then in 1983, Norwood et al reported a successful outcome with a staged surgical approach for treatment of HLHS. A central shunt between the aorta and branch pulmonary arteries was used to provide PBF for the first stage of palliation. Later the central aorta to pulmonary artery shunt was replaced with an mBTS, from the subclavian artery to the right pulmonary artery. This method became the preferred one for providing a controlled source of PBF in the Norwood operation. Modifications to the original surgical approach, including use of an mBTS, became widely adopted as the standard approach to surgical palliation.

Kishimoto et al reintroduced the RVPA conduit for surgical palliation with a valved conduit. In 2003 Sano et al described the use of smaller, nonvalved, 4- or 5-mm polytetrafluoroethylene conduits to provide PBF as part of the Norwood operation with improved stage I survival (53%-89%). Since then, the Norwood procedure with an RVPA conduit, sometimes referred to as a Sano modification, has been accepted by many centers for initial palliation of HLHS and is associated with improved survival (74% vs 64% for the mBTS) at 12 months.

**Table 1** Risk factors for early mortality after stage I palliation

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Reference(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noncardiac congenital and chromosomal abnormalities</td>
<td>11-14</td>
</tr>
<tr>
<td>Prematurity</td>
<td>11-13</td>
</tr>
<tr>
<td>Mechanical circulatory support before surgery</td>
<td>11,12</td>
</tr>
<tr>
<td>Dominant right ventricle</td>
<td>11,12</td>
</tr>
<tr>
<td>Low birth weight or weight &lt; 2.5 kg</td>
<td>11,13,14</td>
</tr>
<tr>
<td>Unbalanced atrioventricular canal defect diagnosis</td>
<td>13</td>
</tr>
<tr>
<td>Preoperative shock</td>
<td>11</td>
</tr>
<tr>
<td>Mitral stenosis–aortic atresia variant of hypoplastic left heart syndrome</td>
<td>15</td>
</tr>
<tr>
<td>Open sternum immediately after surgery</td>
<td>14</td>
</tr>
<tr>
<td>Increased duration of deep hypothermic cardiac arrest</td>
<td>14</td>
</tr>
<tr>
<td>Postoperative renal dysfunction</td>
<td>14,8</td>
</tr>
<tr>
<td>Increased duration of mechanical circulatory support</td>
<td>14,8</td>
</tr>
<tr>
<td>Increased length of hospitalization</td>
<td>14,8</td>
</tr>
</tbody>
</table>

*Independent risk factors for survivors with genetic abnormalities, low number of stage I palliative procedures for center/surgeon, open sternum and additional surgeries following stage I palliation.

Despite advances and modifications in palliation of single-ventricle disease, substantial differences have been reported in choice of palliation (including Norwood with mBTS vs RVPA conduit, or the hybrid approach), intraoperative technique (type of RVPA shunt, perfusion techniques), and postoperative management strategies (eg, types of inotropes and vasodilating agents used) among numerous institutions in which a Norwood procedure is used. Pasquali et al reported that among 53 institutions in which the Norwood operation was used, survival varied by 14%, and overall in-hospital mortality was 22%. An analysis by Baker-Smith et al of the Society of Thoracic Surgeons Congenital Heart Database indicated that development of renal and cardiovascular complications posed the greatest risk to survival. Risk factors for early, in-hospital mortality after stage I palliation are listed in Table 1.

**Surgical Approach**

Surgical techniques for performing the Norwood operation with either type of shunt vary from center to center. Regional cerebral perfusion is widely used in the operation at many centers, although some institutions prefer a brief period of deep hypothermic cardiac arrest. Regional cerebral perfusion is commonly used to limit total body circulatory arrest during aortic arch repairs,

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including repairs needed for stage I palliation. Deep hypothermic cardiac arrest may also be used during the aortic arch repair as part of the stage I procedure. With both techniques, the patient is commonly cooled to 18°C (64.4°F) on cardiopulmonary bypass for at least 20 to 30 minutes before regional cerebral perfusion or deep hypothermic cardiac arrest is initiated.17

The surgical procedure usually includes division of the patent ductus arteriosus; division of the main pulmonary artery; the Damus-Kaye-Stansel procedure to join the aorta to the main pulmonary artery, along with an extended aortic arch augmentation and coarctectomy; and construction of a source for PBF.16 When the RVPA conduit is used for PBF, the nonvalved conduit is inserted from the ventricle to the distal stump of the pulmonary trunk. The proximal end of the conduit is placed by using a right ventriculotomy incision (Figure 1). Transmural insertion of an externally reinforced conduit allows for a ring-enforced, polytetrafluoroethylene, nonvalved RVPA conduit, usually 5 mm in diameter, to be “inserted like a straw” transmurally into the right ventricle with a limited ventriculotomy incision.18 The ring-reinforced conduit has been associated with decreased incidence of proximal conduit obstruction and interstage interventions and with greater pulse pressures and improved pulmonary artery growth before a stage II operation.19 When the mBTS is used to establish PBF, a nonvalved polytetrafluoroethylene conduit as small as 3 mm, although usually 3.5 to 4 mm, is placed from the innominate or subclavian artery to the right pulmonary artery (Figure 2). The weight of the patient determines the size of the pulmonary shunt used for either the RVPA conduit or the mBTS. Use of the optimal shunt size aids in minimizing the postoperative effects of increased PBF at the expense of systemic circulation.20

Good technical outcomes after a Norwood operation require ensuring an unobstructed pulmonary venous return by creating a nonrestrictive intra-atrial communication, unobstructed systemic outflow through the coronary arteries and aortic arch via the Damus-Kaye-Stansel anastomosis, and adequate controlled PBF.21 In addition to good technical outcomes, decreasing morbidity and improving survival with excellent postoperative management are required.

Goals of Postoperative Management

The goals of stage I palliation with a Norwood operation include balancing pulmonary-to-systemic circulation and providing adequate cardiac output for tissue oxygenation and perfusion until the infant is ready for a stage II palliation with a bidirectional Glenn or a hemi-Fontan procedure.20 Strategies to achieve the goals include maximizing the ratio of systemic oxygen delivery
to oxygen extraction. Maximizing the ratio depends on using the appropriate pulmonary shunt size, managing the ratio of pulmonary to systemic perfusion (Qp:Qs) and oxygenation, and maintaining unobstructed coronary and systemic perfusion in the postoperative period.21 Ideally, a Qp:Qs of approximately 1:1 is optimal. Qp:Qs can be calculated by using the Fick principle22 (Table 2). Although the Fick principle is commonly used to assess the balance of Qp:Qs, the results may not be accurate in determining the absolute ratio if the actual pulmonary venous saturation is an assumed value. As a result, calculation of Qp:Qs should only be used in conjunction with bedside assessment, including a nurse’s evaluation of hemodynamic status, perfusion, and other indicators of cardiac function.

Postoperative Nursing Assessment and Interventions

General Management

Improved monitoring and prompt intervention after stage I palliation can significantly decrease early mortality in high-risk patients.23 Nursing and medical management should focus on optimizing pulmonary and systemic perfusion while maintaining adequate cardiac output. Managing excessive PBF in the postoperative period, most often a challenge associated with the mBTS, has traditionally required inducing respiratory acidosis via ventilatory maneuvers, including decreasing minute ventilation, and by decreasing the fraction of inspired oxygen.20,21 Decreasing minute ventilation and the fraction of inspired oxygen may increase pulmonary vascular resistance (PVR) and thereby reduce PBF. However, the most critical variable with the greatest impact on PBF is the shunt size, not pharmacological or ventilatory strategies to increase PVR.20,21 Excessive measures to increase PVR may lead to pulmonary venous desaturation, resulting in decreased oxygen delivery if not compensated for with an increase in cardiac output.21 Manipulation of PVR alone should be avoided because it increases the risks for cardiac arrest and early mortality. Patients may be at higher risk for adverse events, such as vagal stimulation related to suctioning of endotracheal tubes, and loss of functional residual capacity. Adequate analgesia and sedation to reduce stimulation and stress, and ventilation by hand to ensure adequate functional residual capacity before suctioning should be carefully considered when suctioning of an endotracheal tube is required.

Nursing interventions include providing adequate analgesics and sedatives and avoiding hyperventilation, which may increase PBF and markedly reduce systemic output. Persistent excessive PBF in the preoperative period predisposes patients to pulmonary hypertensive crisis and subsequent worsening of clinical status in the postoperative phase.24

Interventions to manipulate systemic vascular resistance (SVR) are a more reliable way of ensuring good cardiac output and balancing Qp:Qs.20,21 Low cardiac output, an increase in SVR, and myocardial dysfunction often occur after surgery. Measures to decrease SVR in the postoperative period are of paramount importance. Systemic afterload can be augmented by using medications such as milrinone, sodium nitroprusside, phenolamine (a reversible, nonselective α-adrenergic blocker used during the intraoperative period), or phenoxybenzamine. Phenoxybenzamine, although not approved by the Food and Drug Administration, is a nonselective, irreversible α-adrenergic blocking agent with a long half-life that may be effective in improving systemic oxygen delivery and outcomes in patients in the postoperative period.25 Other inotropic agents such as dopamine and epinephrine may be indicated to balance the effects of afterload-reducing agents. Vasopressin is the drug of choice to counteract the effects of excessive vasodilation induced by phenoxybenzamine.

Nursing and medical assessment includes vigilant monitoring of vital signs, hemodynamic parameters, waveforms, and cardiac rhythms while ensuring optimal acid-base balance and adequate preload, afterload, and systemic perfusion26 (Table 3). Assessment includes evaluation of blood pressure, central filling pressures, peripheral warmth and perfusion, pulses, capillary

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### Table 2 Fick principle

<table>
<thead>
<tr>
<th>Qp:Qs</th>
<th>systemic arterial oxygen saturation (SaO2) - mixed venous oxygen saturation (SvO2)</th>
<th>pulmonary venous oxygen saturation (SpvO2) - systemic arterial oxygen saturation (SaO2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example</td>
<td>Patient’s oxygen saturation = 85%, measured SvO2 from internal jugular access = 50%, and SpvO2 = 95%. a Then Qp:Qs = (85 - 50) ÷ (95 - 85) or 35 ÷ 10 = 3.5</td>
<td>Qp:Qs = 3.5:1</td>
</tr>
</tbody>
</table>

a The 95% is used as an assumed value and is not directly measured for pulmonary venous oxygen saturation in this calculation.
refill, hourly volume status, and urine output, (minimum approximately 0.5-1 mL/kg per hour\textsuperscript{36}). The bedside nurse is responsible for monitoring hematologic values and for replacing blood and fluid loss with the appropriate blood products and volumes as indicated. Maintaining a hematocrit of 40% to 50% may optimize systemic oxygen delivery.\textsuperscript{20}

Diligent monitoring of temperature is of paramount importance in the postoperative period, and measures should be taken to avoid both hypothermia, which can interfere with clotting and increase PVR and SVR, and hyperthermia. A temperature greater than 37°C (98.6°F) exacerbates tachyarrhythmias, decreases the seizure threshold, and increases myocardial work and oxygen consumption, predisposing the patient to hemodynamic compromise.\textsuperscript{37} Measures to decrease metabolic demand and stress include temperature control (~36°C-37°C (~96.8°F-98.6°F)), mechanical ventilation, steps to minimize pulmonary reactivity, and adequate levels of analgesia and sedation. Physiological parameters (tachycardia, hypertension, oxygen desaturation) and developmentally appropriate sedation and pain tools are required to appropriately manage pain and distress.\textsuperscript{38}

**Detection and Management of Early Worsening in Clinical Status**

Early indicators of inadequate systemic perfusion and low cardiac output include tachycardia, hypotension, decreased urine output, inadequate systemic perfusion, elevated temperature, low mixed venous oxygen saturation (\(S\text{\textsubscript{vO}}\text{\textsubscript{2}}\)), and increased serum levels of lactate.\textsuperscript{30,31} A low \(S\text{\textsubscript{vO}}\text{\textsubscript{2}}\) via the superior vena cava with a widening difference in arterial and venous oxygen saturation greater than 25% to 30% and increasing levels of serum lactate may be ominous signs of impending cardiovascular collapse.\textsuperscript{33-35} A low \(S\text{\textsubscript{vO}}\text{\textsubscript{2}}\) indicates a mismatch of tissue oxygen delivery and demand and increased oxygen extraction. As this mismatch worsens, decreased tissue oxygen delivery and anaerobic metabolism result in lactic acidosis. An increase in the serum level of lactate indicates inadequate peripheral perfusion and is a predictor of mortality.\textsuperscript{33-35} The risk of anaerobic metabolism is increased significantly when \(S\text{\textsubscript{vO}}\text{\textsubscript{2}}\) is less than 30%.\textsuperscript{30} Hoffman et al\textsuperscript{30} found that targeting an \(S\text{\textsubscript{vO}}\text{\textsubscript{2}}\) of 50% after the Norwood procedure was the most important clinical parameter in decreasing early mortality. Monitoring with near-infrared spectroscopy may be helpful to follow trends in \(S\text{\textsubscript{vO}}\text{\textsubscript{2}}\). Early detection and intervention for decreased cardiac output and afterload-reducing strategies have been correlated with better outcomes and decreased mortality.\textsuperscript{23,31} Other signs of low cardiac output are metabolic acidosis, tachycardia, oliguria, and hypotension.

Further diagnostic evaluation for indications of low cardiac output should be instituted early when indicated. Echocardiography is used to determine potential causes of low output, including atrioventricular valve regurgitation, aortic arch obstruction, aortic regurgitation, decreased ventricular function, pericardial effusion, and a restrictive atrial septum (Table 4). Reoperation or other interventions

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**Table 3** Nursing monitoring considerations

| Temperature control (~36°C-37°C [96.8°F-98.6°F]), consider continuous temperature monitoring (rectal probe)\textsuperscript{32} |
| Mean arterial blood pressure ~40-50 mm Hg with systolic blood pressure > 60 mm Hg and diastolic blood pressure > 30 mm Hg\textsuperscript{28} |
| Central venous pressure < 12-14 mm Hg\textsuperscript{29} |
| Mixed venous oxygen saturation ~50%\textsuperscript{30,31} |
| Hematocrit 40%-50%\textsuperscript{20} |
| Ventilator management to achieve optimal arterial blood gas values\textsuperscript{32} (pH ~7.40, \(P\text{\textsubscript{CO}}\text{\textsubscript{2}}\) 40 mm Hg, \(P\text{\textsubscript{O}}\text{\textsubscript{2}}\) 40 mm Hg) |

**Table 4** Postoperative considerations

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Potential cause</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>(S\text{\textsubscript{aO}}\text{\textsubscript{2}}) ~ 80%</td>
<td>Balanced Qp:Qs</td>
<td>No intervention</td>
</tr>
<tr>
<td>(S\text{\textsubscript{vO}}\text{\textsubscript{2}}) ~ 55%</td>
<td>Blood pressure normal</td>
<td>Vasodilators Controlled hypoventilation</td>
</tr>
<tr>
<td>(S\text{\textsubscript{aO}}\text{\textsubscript{2}}) &gt; 90%</td>
<td>Blood pressure decreased</td>
<td>Increased PVR/ increased SVR/ decreased PVR</td>
</tr>
<tr>
<td>(S\text{\textsubscript{vO}}\text{\textsubscript{2}}) decreased</td>
<td>Decrease PVR</td>
<td>Increase cardiac output Increase hematocrit</td>
</tr>
<tr>
<td>(S\text{\textsubscript{aO}}\text{\textsubscript{2}}) &lt; 75%</td>
<td>Blood pressure increased</td>
<td>Aortic arch obstruction</td>
</tr>
<tr>
<td>(S\text{\textsubscript{vO}}\text{\textsubscript{2}}) decreased</td>
<td>Low cardiac output Atrioventricular valve regurgitation</td>
<td>Inotropic support Minimize stress</td>
</tr>
</tbody>
</table>

Abbreviations: Qp, pulmonary perfusion; Qs, systemic perfusion; PVR, pulmonary vascular resistance; \(S\text{\textsubscript{aO}}\text{\textsubscript{2}}\), systemic arterial oxygen saturation; \(S\text{\textsubscript{vO}}\text{\textsubscript{2}}\), mixed venous oxygen saturation.
for residual anatomic lesions causing low cardiac output should be carefully considered to decrease morbidity and mortality after the Norwood operation.

Management of Acute Shunt Obstruction

Acute shunt obstruction may occur in patients undergoing the Norwood operation with an mBTS. The obstruction is usually due to an occlusive thrombus in the shunt. The initial signs usually include acute refractory hypoxemia and decreased end-tidal carbon dioxide in patients receiving mechanical ventilation. Severe hypoxemia due to shunt obstruction can lead to cardiovascular collapse. Acute shunt obstruction is usually managed by adjustments in the fraction of inspired oxygen, volume expansion, and administration of a heparin bolus to avoid further thrombus formation. Stabilization with extracorporeal membrane oxygenation may be necessary until the shunt obstruction can be relieved with interventional cardiac catheterization or reoperation. Patients with shunted single-ventricle physiology who require mechanical circulatory support for hypoxia related to acute shunt thrombosis have better outcomes than do patients who require extracorporeal membrane oxygenation predominantly for hypotension leading to cardiac arrest.49,50 Acute shunt obstruction due to thrombosis is rare with the RVPA shunt because to-and-fro flow via the conduit decreases the likelihood of clot formation.

Nutrition

Malnutrition and inadequate growth are common in infants with HLHS after initial surgical palliation.41,42 Optimizing caloric intake often begins with the initiation of total parenteral nutrition early in the postoperative period, with a goal of 90 to 100 kcal/kg per day.43 Fluid intake should be adjusted to at least 100 mL/kg per day on postoperative day 1 to maximize nutritional intake.43 Enteral feedings should be initiated early when the patient shows indications of adequate systemic output (low serum level of lactate, sufficient urine output, and good peripheral perfusion), with a goal of 120 to 150 kcal/kg per day.53,44 Optimal weight gain is 20 to 30 g/d.43 Nursing assessment includes monitoring feeding tolerance, nutritional intake, and daily calorie counts. The use of feeding algorithms can be both beneficial and safe in advancing nutritional intake in patients with HLHS.43,45

Care of the Patient’s Family

Parents experience considerable stress throughout the hospitalization of their child, regardless of severity of illness.46 Parents may feel most supported when they receive honest communication and ongoing delivery of information about their child’s clinical course from the interdisciplinary team.47,48 Nurses are central in providing emotional support and timely information, helping families navigate unfamiliar settings and circumstances, and encouraging family members to participate in care whenever possible.

Norwood Procedure With RVPA Conduit and Norwood Procedure With mBTS

The Norwood procedure with an mBTS results in continuous forward flow into the pulmonary artery in both systole and diastole, causing diastolic retrograde flow into the aorta and coronary arteries. In contrast, the Norwood procedure with an RVPA conduit allows greater balance of pulmonary-to-systemic circulation in the postoperative period. Unlike the situation with an mBTS, with the RVPA conduit, no diastolic steal from runoff of blood from the aorta to the pulmonary circuit occurs. As a result, diastolic blood pressure is generally higher and pulse pressure is narrower.49,50 This situation allows improved coronary and end-organ perfusion because the coronary arteries are perfused in diastole.

Palliation with the RVPA shunt usually results in free pulmonary regurgitation via the conduit that may decrease net PBF because pulmonary circulation occurs solely in systole via the conduit. The decrease in net PBF may result in lower oxygen saturation. Decreased oxygenation may lead to reduced respiratory reserve and then greater cyanosis with any coexisting lung disease. Increased cyanosis also occurs with increases in somatic growth. The RVPA conduit may predispose patients to decreased growth of the distal pulmonary artery because of the decreased PBF.7

Because the single ventricle supports both pulmonary and systemic perfusion, the right ventricle is subjected to volume overload, hypertrophy, and diminished ventricular function. These issues may cause comorbid conditions
in patients with single-ventricle congenital heart disease treated with the Norwood operation regardless of the shunt type. However, these issues may be of particular concern for patients who have the Norwood procedure with the mBTS because of the larger ventricular volume loading from diastolic runoff through the shunt.

Stenosis or obstruction in the shunt, branch pulmonary arteries, or neoaorta requiring intervention have been reported more often in patients with the RVPA conduit than in patients with the mBTS. A known complication of the RVPA conduit is proximal conduit stenosis, although the incidence most likely will be decreased with the use of newer surgical techniques and use of a ringed conduit. The ventriculotomy incision associated with placement of the RVPA conduit may lead to ventricular dysfunction, arrhythmias, and, possibly, aneurysm formation. The long-term effects of a ventriculotomy are still unknown. Patients with the RVPA conduit most likely will require an earlier stage II operation because of increased cyanosis (Table 5).

In comparison with the RVPA conduit, the mBTS allows diastolic steal, which may lead to lower diastolic blood pressure, widened pulse pressure and decreased coronary perfusion. The mBTS allows diastolic steal, which may lead to lower diastolic blood pressure, widened pulse pressure, and decreased coronary perfusion. The mBTS allows excessive pulmonary perfusion because blood flow to the pulmonary circuit from the aorta occurs during both systole and diastole. Volume load to a single ventricle may result in marked congestive heart failure and poor somatic growth, predisposing the patient to earlier stage II palliation (Table 5). Although the Norwood procedure with an RVPA conduit has generally been accepted as the standard operation for HLHS in many centers, stage I palliation with the mBTS may be indicated for neonates who have a restrictive atrial septum (resulting in obstructed pulmonary venous return, high PVR, lung injury, and increased cyanosis) and in patients with a single left ventricle in whom a ventriculotomy incision is avoided.

Investigators in the Single Ventricle Reconstruction trial, a randomized study at 15 North American centers by the Pediatric Heart Network, compared the Norwood procedure with the mBTS and the Norwood procedure with the RVPA conduit. Transplant-free survival with the RVPA conduit was greater at 12 months than was survival with the mBTS; the greatest number of deaths occurred during the interstage period (from discharge after stage I palliation to a stage II operation), before a bidirectional Glenn or hemi-Fontan procedure. Although mortality was decreased, more unplanned cardiovascular interventions were associated with the RVPA conduit than with the mBTS. Furthermore, the differences between the 2 groups were not significant for right ventricle size and function at 14 months, nonfatal serious adverse events at 12 months, and transplant-free survival after 12 months. Several secondary outcomes of the trial included additional findings related to early

### Table 5: Comparison of potential issues related to shunt type in the Norwood operation

<table>
<thead>
<tr>
<th>Variable</th>
<th>Norwood with RVPA conduit</th>
<th>Norwood with mBTS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Shunt related</strong></td>
<td>Blood flow</td>
<td>Blood flow</td>
</tr>
<tr>
<td></td>
<td>No diastolic steal</td>
<td>Diastolic steal</td>
</tr>
<tr>
<td></td>
<td>Stenosis/obstruction</td>
<td>Lower diastolic blood pressure</td>
</tr>
<tr>
<td></td>
<td>Proximal conduit stenosis</td>
<td>Decreased coronary perfusion</td>
</tr>
<tr>
<td><strong>Pulmonary blood flow</strong></td>
<td>Free pulmonary regurgitation via conduit</td>
<td>Excessive pulmonary blood flow from flow in systole and diastole</td>
</tr>
<tr>
<td></td>
<td>Decreased pulmonary blood flow via conduit</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Decreased respiratory reserve</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Problems associated with growth of distal pulmonary arteries</td>
<td></td>
</tr>
<tr>
<td><strong>Effects on ventricle</strong></td>
<td>Volume load to single ventricle from pulmonary regurgitation</td>
<td>Volume load to single ventricle from excessive blood flow via shunt</td>
</tr>
<tr>
<td><strong>Indications for early stage II palliation</strong></td>
<td>Hypoxia</td>
<td>Volume-load congestive heart failure</td>
</tr>
</tbody>
</table>

Abbreviations: mBTS, modified Blalock-Taussig shunt; RVPA, right ventricle to pulmonary artery.
were significantly associated with greater severity of illness and patient factors, including genetic anomalies, decreased birth weight, and lower maternal education. A 3-year follow-up\(^6\) of the Single Ventricle Reconstruction trial revealed no transplant-free survival benefit associated with an RVPA conduit as compared with an mBTS. Compared with patients with an mBTS, patients with an RVPA conduit had a slightly decreased right ventricular ejection fraction, an increase in heart rate as they grew older, a greater number of cardiovascular interventional procedures, and an increased hazard ratio as time progressed.\(^6\)

### Conclusion

Patients undergoing the stage I Norwood procedure are at risk for labile hemodynamic status and adverse events, including cardiac arrest. Postoperative management requires balancing Qp:Qs, reducing SVR, optimizing systemic oxygen delivery, avoiding increased PBF with excessive mechanical ventilation, enhancing myocardial contractility, treating low cardiac output immediately, monitoring of \(\text{SvO}_2\) and serum lactate levels, and promptly evaluating and correcting residual anatomical lesions (eg, aortic arch obstruction).

Compared with the Norwood procedure with an mBTS, the Norwood procedure with an RVPA conduit prevents diastolic steal and usually enables better coronary perfusion and improved stable hemodynamic status in the postoperative period. Although survival is better at 12 months with the RVPA conduit (74% vs 64% for the mBTS), mortality rates were similar to those associated with the mBTS beyond 1 year,\(^7\) and the long-term effects of a ventriculotomy associated with an RVPA conduit remain unknown. Providing postoperative care to patients after the Norwood procedure is a challenge. Further research should focus on improving care processes that decrease morbidity and mortality in patients undergoing the Norwood operation. **CCN**

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### Financial Disclosures

None reported.
References


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As consumer use of complementary and alternative medicine or modalities continues to increase in the United States, requests for these therapies in the acute and critical care setting will probably continue to expand in scope and frequency. Incorporation of complementary therapies in the plan of care is consistent with principles of patient- and family-centered care and collaborative decision-making and may provide a measure of relief for the distress of admission to an acute or critical care setting. An earlier article provided an overview of complementary and alternative therapies that nurses may encounter in their practices, with specific attention to implications for acute and critical care nurses. This article provides key information on the legal, ethical, safety, quality, and financial challenges that acute and critical care nurses should consider when implementing patient and family requests for complementary therapies. (Critical Care Nurse. 2016;36[6]:52-58)

Consumer use of complementary and alternative medicine or modalities (CAM) continues to increase in the United States,\(^1\,^2\) potentially increasing requests to incorporate such therapies in acute and critical care settings. Reasons for requesting CAM include perceived improved quality of life, management of symptoms not relieved through conventional treatment, personal involvement in decision making, preference for holistic care, concerns for potential toxic effects or invasiveness of conventional interventions, and cultural preferences.\(^3\) Because of physiological instability, critically ill patients may be unable to express their preferences and goals of care, leaving family members to serve as surrogate decision makers. Studies have identified that admission of a loved one to an acute or critical care setting often results in family member distress and perception of unmet needs.\(^4\,^5\) In such cases, any uncertainty or reluctance by the health care team to consider requests for CAM from patients and patients’ families may further exacerbate the families’ anguish. Effective communication with members of the health care team and inclusion of the patients’ family members in care ameliorates the negative psychological symptoms expressed by the family members.\(^6\,^7\)

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An earlier article1 provided an overview of various forms of CAM, including common examples, uses, and potential safety concerns of selected therapies. This article deals with the important legal, ethical, safety, quality, and financial implications that acute and critical care nurses should consider when integrating CAM with conventional care. Although certain therapies may not be permitted in the acute care setting, nurses must be aware of resources to facilitate implementation of CAM whenever possible. This article describes strategies that acute and critical care nurses may use when family-centered care includes patient and family requests for CAM.

Managing Requests for CAM by Patients and Their Families

I have found that CAM is often requested by patients and their families at 3 junctures during hospitalization for acute and critical illness: on admission, to continue home therapies; when unpleasant symptoms, such as pain, nausea, anxiety, and sleep deficit, have been difficult to manage; and when end-of-life care has been initiated. When patients and their families request continuation of their usual CAM practices, it is important to ascertain the reasons for the request as well as their beliefs and understanding regarding benefits and risks of the specific therapy requested. Those CAM practices that the patient has found beneficial for managing chronic symptoms or for health maintenance and that are unlikely to interfere with medical therapies may be safely continued. In circumstances where the CAM therapy may have precipitated a critical illness, exacerbated a chronic condition, or may be contraindicated, as may be the case with herbal remedies and vitamin and mineral supplements, it may not be possible to honor the request. The nurse must base a response on evidence and institutional policy while acknowledging the request with respect and sensitivity. Such an approach is consistent with the concept of collaborative decision-making, defined as “a process of engagement in which health professionals and patients (and their loved ones) work together, often using information and communication technologies to understand clinical issues and determine the best course of action.”14

Natural Product Requests

As previously noted, natural products (substances typically found in nature, formerly termed biologically based therapies) are the most popular form of CAM, with nearly 18% of adults in the United States reporting use of nonvitamin, nonmineral products, such as herbs, essential oils, and glucosamine.15 Surveys have shown that a large proportion of physicians and nurses personally use dietary supplements, and 72% of responding cardiologists indicated that they recommend dietary supplements to their patients.16,17 Vitamin and mineral supplements and herbal therapies may be prescribed by licensed health care professionals, and some academic institutions and hospitals have integrative medicine programs that include prescription of dietary supplements.6,18,19 These surveys indicate that supplements and herbal therapies are accepted as relatively safe and effective for a variety of conditions.

Evidence regarding efficacy and safety of supplements is variable.20,21 The Dietary Supplement Health and Education Act of 1994 classified dietary supplements as foods, which exempts them from Food and Drug Administration regulation.21,22 Guidelines for management of dietary supplements by health care facilities have been established by The Joint Commission and the American Society of Health-System Pharmacists, yet policies and practices remain inconsistent or nonexistent.18,23,24 Unclear policies and procedures regarding use of herbal remedies and dietary supplements complicate efforts by nurses to safely support patients’ and families’ preferences. Nurses must advocate for explicit policies to guide practices regarding use of supplements in the acute care setting.

When patients or their families request continuation or initiation of herbal remedies or dietary supplements, the nurse should first ascertain in a nonjudgmental manner their motivation as well as the condition for which the request is being made. The initial request may stimulate further discussion regarding other CAM practices and preferences. Studies have shown that caring communication with critically ill patients and their families and shared
With careful planning and collaboration, requests for CAM may be safely incorporated in the plan of care.

**Mind and Body Practice Requests**

Mind and body practices (formerly termed body- and energy-based therapies), such as chiropractic or osteopathic manipulation, yoga, and massage therapy, are among the most commonly practiced forms of CAM. These therapies, though not likely considered by patients and their families as crucial to the patient’s survival, may nonetheless be requested for comfort. Several challenges are associated with provision of body-based therapies in an acute or critical care setting. Space is often a factor, particularly in the presence of life-sustaining biomedical equipment and monitoring devices. The design of many critical care units often limits privacy, and some forms of mind and body practices may disturb other patients and their families. Requests from patients and their family members for body- and energy-based therapies may be incorporated into the plan of care with careful planning and collaboration with the family and practitioners, once the specific CAM therapy has been deemed safe. Biomedical equipment and monitoring devices may be positioned to optimize practitioners’ access to patients. Environmental controls, such as dimmed lights and lowered alarm volumes, can enhance the healing experience. Signs may be placed at the entrance to the patient’s room to promote privacy and discourage interruptions during the therapy session. If a particular therapy involves ritual chanting, modifications in the volume may be requested of the family and practitioner to avoid disruption of other patients and their families. Regardless of the CAM therapy provided, adherence to all safety and infection control principles must be ensured.

Currently, no standardized national system exists for training, credentialing, or regulation of practitioners of these therapies. Hospital access by CAM practitioners, particularly if unlicensed, may be restricted. Some hospitals, including my practice setting, offer integrative medicine consultation services and provision of therapies such as osteopathic manipulative medicine, acupuncture, massage, and Reiki. Although many acute and critical care nurses report personal use of CAM therapies for self-care and have become practitioners of these therapies to provide holistic care, nurses must be aware of institutional policies, scope of practice, and ethical boundaries before including CAM therapies in their patients’ care. Nurses must first advocate for their patients rather than promote a particular healing technique.

**Requests to Incorporate Other Alternative Health Approaches**

Most CAM practices fit within the categories of natural products and mind/body practices; however, other alternative health approaches have evolved from cultural and spiritual traditions and may include whole systems of care such as Ayurvedic medicine, traditional Chinese medicine, folk medicine, homeopathy, and naturopathy.
Inclusion of traditional healers in the plan of care requires effective communication with conventional health care providers. These alternative health approaches variously encompass holistic combinations of natural products, mind and body practices, and spiritual practices. Spiritual practices, though often not considered alternative forms of therapy, may indeed seem foreign in the acute and critical care setting, particularly if those practices involve chanting and ritual ceremonies. Requests from patients and their families for alternative health approaches may be accommodated, in part or in whole, through open communication and collaboration between CAM and conventional practitioners. Hospital chaplains are excellent resources to facilitate integration of patients’ and families’ faith and spiritual practices in the plan of care.

In many parts of the world, traditional healers are the primary source of health care, particularly for indigenous peoples. Immigration and the increasingly diverse US population are changing the demographics of the acute and critical care population. Patients and their families may request the inclusion of their traditional healers in the plan of care. The World Health Organization, the Institute of Medicine, and the American Public Health Association have provided guidelines for integration of traditional healers in mainstream medicine. Shaman healers have been successfully integrated in acute care in some parts of the country. Community health outreach workers and cultural brokers can promote communication between traditional and conventional healers regarding preferences of patients and their families, specific healing traditions, and safe alternatives in the acute care setting.

**Patient and Family Assessment for Use of CAM Therapies**

Effective communication with patients and their families is vital to facilitating thorough assessment of patients, determining patients’ preferences and goals of care, and establishing therapeutic healing relationships. Some CAM therapies may result in physiological instability or exacerbate chronic health conditions, further complicating accurate assessment and diagnosis of critical illness. Early identification of CAM practices as well as reasons for and beliefs about CAM use may enhance the diagnostic process and mitigate any misunderstanding regarding the ability to continue these therapies in the critical care setting.

Willingness of patients to disclose CAM use to health care providers (HCPs) may be related to the patients’ perception of the attitudes and knowledge of the HCP regarding CAM. In a 2010 telephone survey conducted by the American Association of Retired Persons and the National Center for Complementary and Alternative Medicine (now known as the National Center for Complementary and Integrated Health, or NCCIH), more than half of the random sample of 1013 Americans aged 50 years and older reported any form of CAM use, with herbal products and dietary supplements being the most widely used. Only one-third of the respondents reported discussing CAM with their HCP; if CAM is discussed, respondents were twice as likely as their HCP to have raised the subject. In 42% of those cases, the HCP never asked about CAM; another 30% of respondents stated that they were not aware that they should bring it up. One-third of the respondents indicated that they were uncomfortable discussing the subject, that they did not think their HCP knew about the subject, or that they thought that their HCP would have disagreed with them.

Discussions about CAM use may not be initiated because HCPs lack standardized assessment methods. It has been suggested that questions regarding CAM use, particularly herbal supplements, be included on routine admission assessment forms. The Ullrich-Hodge Alternative Therapy Assessment Model proposed the use of open-ended rather than direct questions to elicit more complete information and “create a safe, supportive, empowering, nonjudgmental environment for this discussion.” This model has not been widely published, yet its concepts are consistent with the nurse characteristics described in the American Association of Critical-Care Nurses Synergy Model for Patient Care, specifically advocacy and moral agency, caring practices, collaboration, and response to diversity. The ethical principle of respect for persons, as demonstrated through involvement of patients and patients’ families in decision-making and cultural humility, is fundamental for acute and critical care nurses to build trust with patients and their families.

**Implications for Acute and Critical Care Nurses**

Studies demonstrating evidence of the efficacy of CAM therapies are being conducted more recently in
<table>
<thead>
<tr>
<th>Consideration</th>
<th>Suggestions</th>
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<tr>
<td><strong>Liability for harm</strong></td>
<td>CAM practitioners retained and paid by family should be approved by the hospital in advance; collaborate with risk management department to reduce the risk of vicarious liability for any harm. Cam practitioners credentialed or employed by the hospital: be aware of training, qualifications, and conditions for provision of therapy specified by the hospital. Hospitals must ensure existing liability insurance covers CAM practices. CAM practitioners should carry sufficient liability insurance to cover their practices.</td>
</tr>
<tr>
<td><strong>Credentialing of practitioners</strong></td>
<td>CAM practitioners who are regulated by state or federal government (eg, massage therapists) must show proof of credentials. CAM practitioners typically not regulated by government must still have identity and training cleared by the hospital. All CAM practitioners, regardless of license or regulation, must display identification indicating they have been approved for practice by the hospital.</td>
</tr>
<tr>
<td><strong>Informed consent</strong></td>
<td>Informed consent must be obtained before delivery of any care, CAM or conventional. In the case of pediatric patients, parents bear the burden for decision-making; serious concerns about increased risk to a child must be reported to child welfare authorities. Children capable of understanding basic information (typically from age 7 years) may assent/dissent; in cases of conflict between parents and children, courts or tribunals may need to intervene.</td>
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<tr>
<td><strong>Standards of care</strong></td>
<td>Regulated CAM practices are typically guided by standards of care; the hospital must determine risks and benefits of these CAM practices within the acute care setting and develop corresponding policies and procedures guided by those standards. Unregulated practices (eg, Reiki) often include ethical standards of practice; the hospital has a duty to be aware of those standards when approving practitioners and to develop corresponding policies and procedures.</td>
</tr>
<tr>
<td><strong>Scope of practice</strong></td>
<td>Regulated CAM practices: scope of practice typically authorized by legislature; however, in the absence of efficacy or presence of risks, the scope of practice may be limited. Unregulated CAM practices typically are limited in scope (eg, Reiki involves only light touch or hands-off in close bodily proximity). Licensed practitioners who are also CAM practitioners (eg, nurses who also practice Reiki) must exercise caution and not confuse their roles in the delivery of care, whether CAM or conventional.</td>
</tr>
<tr>
<td><strong>Collaboration among practitioners</strong></td>
<td>Protocols should be developed to ensure open communication and collaboration among CAM and conventional practitioners. Documentation in the health record is key and should include patient’s preferences, the treatment plan and responsible provider, and patient’s response to therapy.</td>
</tr>
<tr>
<td><strong>Supervision of practitioners</strong></td>
<td>The hospital must ensure that supervision of nonemployee practitioners is adequate.</td>
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<tr>
<td><strong>Duty to refer</strong></td>
<td>Conventional practitioners should consider referral to CAM providers (eg, osteopathic manipulation or massage therapy) if no improvement in patient’s symptoms is noted.</td>
</tr>
<tr>
<td><strong>Monitoring effects of CAM therapies</strong></td>
<td>Patients should be monitored by conventional means regardless of whether CAM or conventional therapy is used (eg, continue cardiorespiratory monitoring). Patient signs and symptoms should be assessed and documented before and after any CAM therapy.</td>
</tr>
<tr>
<td><strong>Product safety, efficacy, and compliance</strong></td>
<td>Natural products, such as herbal supplements, are considered foods, not drugs, by the US Food and Drug Administration and are, therefore, not subject to the same testing, manufacturing, and labeling standards and regulations as pharmaceuticals. Ascertain and document patient use of natural products and practices that may be disruptive to tissues (eg, cupping). Consider safety of such products and practices; assess risks and benefits. Explain contraindications and hospital policies to patient and patient’s family. Monitor for compliance of patient and patient’s family to avoid risk to patient.</td>
</tr>
<tr>
<td><strong>Quality assurance</strong></td>
<td>Report any adverse effects of CAM practices to the appropriate internal departments and external agencies. Disclose any harm to patients. Make sure internal quality assurance programs include CAM practices.</td>
</tr>
<tr>
<td><strong>Cost and reimbursement for services</strong></td>
<td>Third-party insurance may limit coverage for CAM therapies. Communicate clearly with patients and their families about who is responsible for any costs incurred for CAM therapies.</td>
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* Considerations and suggestions apply to US settings only; readers outside the United States should consult their own local or national guidelines.

** Based on information from Gilmour et al.60,61
acute care settings. Reiki is reported to be beneficial for reduction of pain and anxiety in the inpatient dialysis setting.\textsuperscript{31} Massage therapy has been successfully incorporated into preprocedural invasive cardiovascular practice to reduce pain and anxiety.\textsuperscript{52} Preliminary studies are suggesting potential benefits of traditional Chinese medicine as an adjunct to treatment for septic shock.\textsuperscript{53} Sleep in the acute care setting may be enhanced with the use of lavender aromatherapy.\textsuperscript{54} Given the increasing prevalence of CAM use in the United States, requests from patients and their families for these therapies in the acute and critical care setting will probably continue to expand in scope and frequency.

Many deaths in the United States are related to admission to an intensive care unit,\textsuperscript{55} and these patients often experience unrelieved distressing symptoms. Additionally, unrelieved pain in critically ill patients remains problematic and carries a risk of transitioning to chronic pain syndromes.\textsuperscript{56} Complementary and alternative therapies may provide some measure of relief for these patients and comfort to the patients’ family members.\textsuperscript{57,58} Investigation into the efficacy and feasibility of CAM therapies is consistent with the priorities for critical care research, such as exploration of new approaches to enhance patients’ comfort and evaluation of interventions to relieve distressing symptoms experienced by patients and their families.\textsuperscript{59}

Complementary and alternative therapies should be integrated with conventional acute care in a responsible, safe, and ethical manner.\textsuperscript{60,61} Legal, ethical, safety, quality, and financial considerations are summarized in the Table. As noted, risks to the patient may be reduced through clear and open communication, adherence to institutional policies and procedures, and development of evidence-based guidelines. Acute and critical care nurses are in an excellent position to advocate for practice changes to accommodate safe patient- and family-centered care that includes CAM therapies requested by patients and their families. Accurate knowledge is foundational to such advocacy.

Resources are available to assist acute and critical care nurses to safely incorporate CAM therapies requested by patients and their families into the plan of care, including the NCCIH website (https://nccih.nih.gov) and the National Institutes of Health Office of Dietary Supplements (http://ods.od.nih.gov/factsheets/list-all). Effective communication strategies and patient- and family-centered care principles regarding requests for CAM can promote collaborative practice and better outcomes for our patients. CCN

Financial Disclosures
None reported.

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References


Integrating Nurse Practitioners Into Intensive Care Units

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Brooke Andersen, MS, CRNP

As demand for nurse practitioners in all types of intensive care units continues to increase, ensuring successful integration of these nurses into adult and pediatric general and specialty intensive care units poses several challenges. Adding nurse practitioners requires strategic planning to define critical aspects of the care delivery model before the practitioners are hired, develop a comprehensive program for integrating and training these nurses, and create a plan for implementing the program. Key strategies to ensure successful integration include defining and implementing the role of nurse practitioners, providing options for orientation, and supporting and training novice nurse practitioners. Understanding the importance of appropriate role utilization, the depth of knowledge and skill expected of nurse practitioners working in intensive care units, the need for a comprehensive training program, and a commitment to continued professional development beyond orientation are necessary to fully realize the contributions of these nurses in critical care. ([Critical Care Nurse. 2016;36(6):59-69])

The role of nurse practitioners in the intensive care unit (ICU) has evolved considerably since the 1990s. After early descriptions of the role of these nurses in pediatric¹ and adult² ICUs, delineation of role development in a variety of critical care settings and recent descriptions of successful orientation programs,³⁴ models of care,⁵¬⁶ and evidence of positive outcomes⁷¬⁸ for nurse practitioners have strengthened the value of having the practitioners on the critical care team. However, despite concerted efforts by professional organizations and regulatory bodies to standardize the scope of practice of nurse practitioners on the basis of patient populations,¹⁹ entry-level nurse practitioners still have variable backgrounds in education and nursing experience and are entering practice in a variety of specialized ICUs that require a depth of knowledge and skills. Thus, ensuring successful integration of new nurse practitioners can be extremely challenging and requires strategic planning to define critical aspects of the care delivery model before the practitioners are hired, develop a comprehensive program for integrating and training these advanced practice registered nurses as providers, and create a plan for implementing the program.
At the University of Maryland Medical Center (UMMC), nurse practitioners have been employed in the neonatal, pediatric, and adult ICUs since the mid-1990s. However, as in other hospitals, gaps in provider care were increasingly experienced as the numbers of ICU beds and specialty programs were expanding, resulting in a rapid increase in the number of advanced practice providers (APPs). Currently, the medical center has 250 nurse practitioners, with 90 practicing in ICU settings. With the development of a centralized leadership structure for APPs in 2008, many processes were established that directly affect the success of nurse practitioners, including a competency-based orientation and a postgraduate fellowship program. In this article, we describe key strategic planning for new roles, 2 training programs, and other strategies that have resulted in successful nurse practitioners in all 10 ICUs at UMMC.

Establishing Nurse Practitioner ICU Resources

Several organizations have published reports of successful integration of APPs into care delivery models for ICU providers.2,9-11,13-16,19 Appropriate planning for role implementation, which is critical to this success, begins with conducting a needs assessment to determine what the provider need is, define the model of care and nurse practitioner role, and plan implementation strategies. Gathering everyone involved in the use of nurse practitioners to discuss the resources needed helps clarify the need and vision for the role; identify the stakeholders; determine the number of residents and fellows available, if any; identify the gap to be covered; and begin collaboration with both physician and nurse leaders to assess the readiness of the unit to integrate nurse practitioners.

Determining the full-time equivalent nurse practitioner positions needed for a new or an expanding unit is based on several factors, including the type of ICU, the care delivery model, patient acuity levels, and providers’ responsibilities. Although data on optimal nurse practitioner to patient ratio are limited, the ratio is an important consideration when calculating the numbers of providers, nurse practitioners, residents, fellows, and physician assistants needed and determining how each will work on the team.9,13,16 Depending on the patient population (eg, infants and children vs adults) and acuity level, the provider to patient ratio varies from 1 to 4 to 1 to 8 during the day and 1 to 10 at night. For example, for staffing a 10-bed critical care unit, with a provider to patient ratio of 1 to 5 during the day and 1 to 10 at night, the calculation yields 7 full-time equivalents for 24/7 coverage. The calculation includes nonproductive time (paid time off, sick coverage, and educational or nonclinical time).

Challenges in role design include deciding on the work model and hours of coverage expected and blending nurse practitioners into an existing care delivery model. Both hospitalist and academic training models involve questions such as how will the nurse practitioners be used; what will be the role of the nurse practitioners; will the nurse practitioners be integrated into the hierarchy of the academic model, and if so, what will that reporting structure look like in the context of the nurse practitioner scope of practice? Each of these questions should be discussed before the role is developed or the job descriptions are written because stakeholders’ clarity about the role of nurse practitioners sets the expectations early and avoids disappointment, role confusion, and, ultimately, problems with turnover of nurse practitioners and physician assistants.

Once the care delivery model is established and the need for nurse practitioner providers is confirmed, the next step is recruitment and hiring. An advanced practice leadership model helps to address the challenges of whom to hire and how to successfully orient and integrate nurse practitioners into the ICU team. For example, having a lead nurse practitioner helps organize the process of

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recruitment, interviews, orientation and integration into the unit, role development, and performance management. The leaders understand the patient care and work flow responsibilities of the ICU, are familiar with the stakeholders’ vision of nurse practitioners’ role in the ICU, and represent the nurse practitioner workforce when discussions on who can do what occur.

Regulatory Requirements
The consensus model for regulation: licensure, accreditation, certification, and education of advanced practice registered nurses was developed by collaboration of more than 40 organizations across the United States in an effort to standardize the practice of these nurses across the country. The model recommends standards for licensure, accreditation, certification, and education (LACE) of nurse practitioners for the population of patients served. In short, these recommendations guide organizations on which persons to hire for what role to ensure that acute care nurse practitioners, for either pediatric or adult populations, who are educated to provide care to acutely ill patients are identified to work in critical care. The LACE model has not been uniformly adopted by all 50 states; however, state boards of nursing are moving to address scope of practice to ensure consistency with LACE, a situation that explains why some states still allow family nurse practitioners or primary care nurse practitioners to practice in critical care settings.

Recruitment and Training Needs
Most hospitals have recruiters who understand the hiring practices of their organizations but may need education about the specific knowledge, skills, and abilities of nurse practitioners required for successful implementation of the practitioner role within each unit, particularly if the organization does not have an infrastructure that supports transition of entry-level nurse practitioners into ICUs. Orientation programs specifically tailored for novice providers are beneficial, and successful integration of nurse practitioners depends on having all stakeholders understand the level of experience the candidates have and on hiring providers who can do the job. Identifying a leader who can develop a nurse practitioner orientation is key. New graduate nurse practitioners, although educated about acute care diagnoses and management, may lack ICU competency. The lack of ICU competency lengthens the time required to ensure that nurse practitioners can practice autonomously. Finding experienced ICU nurse practitioners is challenging because the demand may exceed the supply. Thus, full discussion about the hiring decisions, the additional training that may be required, and the trajectory to competency should be discussed before the role is implemented. Ensuring that the medical leaders of the unit understand the differences between novice and experienced nurse practitioners versus resident trainees, and can foster collaboration aids in successful integration of APPs into the ICU. Many physician leaders champion the successful transition because they have had successful experiences working with nurse practitioners; those who have not worked with nurse practitioners in the ICU benefit from a transparent and honest dialogue before the recruitment begins. Interviews of candidate nurse practitioners should include all stakeholders (physicians, nurse leaders, and other nurse practitioners) if no formal APP leadership model exists. The reporting structure for the nurse practitioners should be clear. The anticipated hours to be covered should be known, and all references of the applicants should be checked before any offer of employment.

Start-up Preparation
Once the nurse practitioners are selected, their training and integration into the unit should be tailored and organized to ensure a smooth transition to successful practice. Nurse practitioners should be credentialed and privileged to practice to their full scope as allowed by the organization’s medical staff bylaws. Understanding the nurse practitioner scope of practice and aligning the bylaws with state regulation ensure that each provider practices to the highest level the law allows. Each unit leader should establish a clear job description for nurse practitioners. Determining if they will practice as primary patient providers and how they will be used must be fully understood before they are hired. For example, will the nurse practitioner team provide
24/7 coverage and will they be integrated into a medical teaching model? The answers to these questions help unit leaders identify clear expectations about who does the work. Many organizations have care delivery models for nurse practitioners and attending physicians. These models are cost-effective and can result in streamlined care because the providers are consistent and the patient management is standardized. Some academic models integrate nurse practitioners into teams in which novice providers work in the traditional house staff role and more experienced nurse practitioners fulfill the fellow role. The value of clearly identifying the role at the beginning cannot be underestimated because the monetary and emotional cost of orientation coupled with the cost of turnover can prevent success. Other considerations include supervision in the teaching units, administrative time off for continuing education, nonclinical work such as quality and process improvement, and establishing policy and resources to provide vacancy, sick call, and holiday coverage.

Training Curriculum

Development of a structured, comprehensive orientation program is a key component to ensuring successful integration of nurse practitioners. The critical care orientation program at UMMC was first described by Bahouth and Esposito-Herr in 2009. With the development of a centralized leadership model, this program has evolved substantially to include standardized general and specific competency-based training to meet the needs of all ICUs (Tables 1 and 2). Although the structured training improved nurse practitioners’ satisfaction with the transition process, the complexities of ICU care and the desire to increase the level of preparation of entry-level nurse practitioners by providing clinical rotations in a variety of specialized ICUs prompted the nurse practitioner leadership team to explore other models of training. This exploration led to the development of an innovative postgraduate fellowship program to train a small cohort of postgraduate adult critical care nurse practitioners. The training curriculum has since expanded to provide standardized didactic sessions (Table 3), high-fidelity simulation, and procedural education as well as weekly educational and networking opportunities to nurse practitioner fellows as well as all newly hired and experienced critical care nurse practitioners and physician assistants.

Competency-Based Orientation Program

The orientation program was designed to provide a standard process, establish clarity about expectations of orientation, improve accountability for oversight and organization of orientation, and streamline the workload for the leadership team and preceptors. All newly hired nurse practitioners attend a 2-day hospital orientation and a 1-day APP orientation that includes material on regulatory requirements, computer training, access to systems, and business and office supplies. The orientations also provide information on APPs’ mission, values, activities, and leadership structure and support resources. Each newly hired nurse practitioner then meets with the lead nurse practitioner to review specific operations of the nurse practitioner team and the orientation plan. Each nurse practitioner receives an orientation manual that includes the general orientation framework; job description; a competency assessment tool; and learning methods, evaluation tools, and additional unit-specific learning resources and tools (Table 4). The orientation framework outlines the expected progression of the nurse practitioner, learning methods, and a time line for achievement. The specialty competency-based assessment tool includes knowledge, systems, procedural skills, communication, professionalism, and performance improvement competencies and proposed learning methods to acquire knowledge and skills. Knowledge, systems, and procedural skill competencies and learning methods are specific to the ICU; however, the communication, professionalism, and performance improvement competencies are standard to all settings. Learning methods include a focused standardized didactic curriculum (general content needed by all nurse practitioners and specific content for specialty ICUs), clinical preceptorships with a progression plan of patient management, and methods targeted for specific knowledge or skills (eg, high-fidelity simulation exercises). The expected competencies are based on the scope-of-practice competencies for specific populations of patients as outlined by professional organizations and are tailored to the
<table>
<thead>
<tr>
<th>No.</th>
<th>Competency</th>
<th>N/A</th>
<th>NP preceptor signature</th>
<th>Date</th>
</tr>
</thead>
</table>
| 1.  | Obtains a relevant comprehensive or problem-focused health history from patient/medical records  
     a. Effectively resolves inconsistencies  
     b. Updates previously recorded information |     |                        |      |
| 2.  | Performs a physical assessment  
     a. Differentiates between normal and variations of normal and abnormal findings  
     b. Organizes and prioritizes data  
     c. Presents the organized data in a logical system-based format to team members | |                        |      |
| 3.  | Laboratory and diagnostic testing  
     a. Orders appropriate laboratory and diagnostic studies  
     b. Analyzes data to determine health status  
     c. Performs ongoing analysis of laboratory and diagnostic studies at appropriate intervals | |                        |      |
| 4.  | Establishes medical diagnosis  
     a. Synthesizes data collected  
     b. Demonstrates critical thinking and diagnostic reasoning skills in clinical decision making:  
     i. Develops differential diagnosis  
     ii. Establishes medical diagnosis  
     iii. Prioritizes health needs/problems | |                        |      |
| 5.  | Plan of care  
     a. Formulates an evidence-based plan of care  
     b. Initiates the plan of care  
     c. Provides for continuity of the plan of care over time  
     d. Communicates the plan of care to staff, patient and family, and interdisciplinary team  
     e. Calls appropriate consultations as needed, including but not limited to:  
     i. Rehabilitation (PT/OT, speech), Case management, Social work, Dietary, Substance abuse, Palliative care, Infectious disease, Wound ostomy, Chaplain/Spiritual support, Respiratory therapy  
     f. Follows up on recommendations of consultative services and interdisciplinary team members | |                        |      |
| 6.  | Evaluation  
     a. Evaluates outcomes at appropriate intervals  
     b. Modifies plan of care on the basis of the response to treatment  
     c. Communicates changes to the plan of care to patient, staff, team members  
     d. Collaborates with colleagues | |                        |      |
| 7.  | Procedures  
     a. Completes required competency training (separate form, procedural log) and approval through MSO and MBON or Maryland Board of Physicians  
     b. Accurately states the indications, contraindications, risks, and alternatives to procedures  
     c. Obtains informed consent  
     d. Adheres to procedure-related policies and protocols  
     e. Participates in Time Out and documents as appropriate  
     f. Documents procedure in accordance with hospital policy  
     g. Provides appropriate follow-up testing/diagnostic studies postprocedure as indicated | |                        |      |
| 8.  | Patient management  
     a. Communicates effectively using appropriate terminology, format, and technology in accordance with hospital policy  
     b. Documents admitting history and physical/daily progress notes appropriately in standard format using electronic medical record or paper  
     c. Completes admission, transfer, and discharge medication reconciliation  
     d. Accurately and effectively utilizes electronic order entry  
     e. Determines appropriate pain medication modality and evaluates effectiveness  
     f. Maintains confidentiality and privacy of patient information  
     g. Provides support care to patients and families | |                        |      |

**Table 1** University of Maryland Medical Center’s documentation for 6-month focused provider practice evaluation (FPPE) of nurse practitioners’ completion of core competencies
needs of the organization and the unit. All critical care nurse practitioners attend a specialty course (ie, fundamentals of critical care support for adults or for infants and children, advanced trauma life support) and other specialty workshops as required (eg, ventricular assist devices). Orientation is 12 to 26 weeks long, depending on competency expectations and individual nurse practitioners’ knowledge needs. Each newly hired nurse practitioner meets weekly with the lead nurse practitioner to evaluate progress and tailor learning methods as needed.

Postgraduate Fellowship Program
Postgraduate training programs, first described in 2007, have rapidly emerged in all specialties, including critical care, to either increase the knowledge and breadth of clinical expertise of nurse practitioner students or to improve the transition of entry-level nurse practitioners into practice.28 However, confusion about this type of program, plus national recommendations for improved transition of advanced practice nurses into practice and recent evidence of gaps in the readiness of entry-level nurse practitioners to practice, resulted in the call by the American Nurses Credentialing Center for creation of fellowship programs that provide comprehensive training for entry-level licensed advanced practice nurses.29,30

The UMMC critical care fellowship program was launched in 2010 after a team of nurse practitioners and physician leaders identified gaps in practice-based experience as indicated by the results from a large survey of UMMC nurse practitioners.31 This program designed to support new graduate and experienced acute care adult nurse practitioners is based on a blended framework of the acute care nurse practitioner competencies25 and the Accreditation Council for Graduate Medical Education competencies.32 The initial fellowship program included a 9-month, 2-armed program (both trauma and medical-surgical critical care) allowing for crossover electives, and although the fellowship has recently been condensed to a 6-month program, the overall program continues to enhance and expedite the knowledge and skills of entry-level nurse practitioners. The nurse practitioner fellows rotate through the various ICUs and participate in weekly 1-day standardized didactic sessions (Table 5) and bimonthly procedural workshops or simulation sessions. Critical care presentations are provided by an interdisciplinary group of content experts. Procedural training includes insertion of arterial catheters, thoracotomy and paracentesis, insertion of central venous catheters, lumbar puncture, suturing, incision and drainage techniques, and bronchoscopy. The high-fidelity

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**Table 1 Continued**

<table>
<thead>
<tr>
<th>No.</th>
<th>Competency</th>
<th>N/A</th>
<th>NP preceptor signature</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.</td>
<td>Organizational</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>a. Models professionalism and upholds the UMMC Behavioral Standards</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>b. Adheres to Professional Code of Conduct</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>c. Promotes the role of the nurse practitioner and physician assistant:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>i. Collaborates with other health care providers, patients, staff, visitors</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ii. Maintains professionalism at all times with communication and behavior</td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>d. Adheres to organization policies and procedures</td>
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</tr>
</tbody>
</table>

Affixed signatures attest to the proficiency in the above competencies completed by the orienting nurse practitioner at the end of orientation period.

**Signature of Orienting NP**

Date

**Signature of Precepting NP/MD**

Date

Abbreviations: MBON, Maryland Board of Nursing; MD, physician; MSO, medical staff office; N/A, not applicable; NP, nurse practitioner; OT, occupational therapy; PT, physical therapy; UMMC, University of Maryland Medical Center.

Courtesy University of Maryland Medical Center, Baltimore, Maryland.
### Table 2  Specialty critical care competency-based orientation (snapshot examples)

<table>
<thead>
<tr>
<th>Knowledge competencies</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Competency 1:</strong> Understand and manage common diagnoses seen in the critical care setting.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Diagnoses</th>
<th>Pathophysiology &amp; differential diagnoses discussed</th>
<th>Work-up/EBP management discussed</th>
<th>Date completed</th>
<th>Preceptor signature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiovascular</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Congestive heart failure</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Myocardial infarction</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| **Competency 2:** Discuss the indications and specifics of the following devices or therapies |

<table>
<thead>
<tr>
<th>Devices/therapies</th>
<th>Indications/therapy discussed</th>
<th>Date completed</th>
<th>Preceptor signature</th>
</tr>
</thead>
<tbody>
<tr>
<td>EKG interpretation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inotropic therapy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vasoactive therapy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temporary pacemaker</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fluid resuscitation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cardioversion/defibrillation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ECMO</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Competency 3: Discuss the indications, initiation, and modification of enteral and parenteral nutrition.

<table>
<thead>
<tr>
<th>Nutrition considerations</th>
<th>Indications discussed</th>
<th>Date completed</th>
<th>Preceptor signature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calculate caloric requirements</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Identify fluid and electrolyte needs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Establish initial parameters for TPN</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modify TPN on the basis of laboratory values</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Competency 4: Discuss the indications for the following diagnostic modalities.

<table>
<thead>
<tr>
<th>Diagnostic modalities</th>
<th>Indications discussed</th>
<th>Date completed</th>
<th>Preceptor signature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiographs – chest, abdomen</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ECHO</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CT scan</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cardiac MRI</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12-Lead EKG</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Competency 5: Understand physiological monitoring in the critical care setting.

<table>
<thead>
<tr>
<th>Physiological monitoring</th>
<th>Indications discussed</th>
<th>Date completed</th>
<th>Preceptor signature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hemodynamic monitoring</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NIRS monitoring</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Competency 6: Demonstrate ability to effectively perform advanced assessment skills and patient presentation.

<table>
<thead>
<tr>
<th>Patient presentation</th>
<th>Components discussed</th>
<th>Date completed</th>
<th>Preceptor signature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obtains a relevant comprehensive or problem-focused health history</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Performs comprehensive or problem-focused and developmentally appropriate examination</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distinguishes between normal and abnormal findings</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Continued*
Clinical simulations with adults and children are failure-to-rescue and rapid-response scenarios with debriefing sessions. Case scenarios include hypoxia, pulmonary embolism, myocardial infarction, trauma, sepsis, seizure, cardiac arrest, dysrhythmias, and moderate sedation.

The clinical rotations in the fellowship program are presented in Table 5. The nurse practitioner fellows are supervised by a nurse practitioner or physician preceptor and are not credentialed to practice independently until they have successfully completed the program. Also required for successful completion is development and dissemination of an evidence-based practice project.

### Table 2

**Clinical skill competencies**

**Competency 1:** Demonstrate skill in resuscitation and stabilization of the critically ill patient.

<table>
<thead>
<tr>
<th>Date completed</th>
<th>Preceptor signature</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Completes in simulation laboratory</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Completes in simulation laboratory</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Functions appropriately in codes and RRT as part of multidisciplinary team</td>
</tr>
</tbody>
</table>

Abbreviations: CT, computed tomography; EBP, evidence-based practice; ECHO, echocardiography; ECMO, extracorporeal membrane oxygenation; EKG, electrocardiogram; MRI, magnetic resonance imaging; NIRS, near-infrared spectroscopy; PICU, pediatric intensive care unit; RRT, rapid response team; TPN, total parenteral nutrition.

Courtesy University of Maryland Medical Center, Baltimore, Maryland.

### Table 3

**Critical care core lectures and technology**

**Critical care core lectures**

- Airway management
- Respiratory failure and mechanical ventilation
- Fluid and electrolyte management
- Acid-base disturbances
- Shock states and management
- Endpoints of resuscitation
- Metabolic disturbances
- Arrhythmia recognition and management
- Hemodynamic monitoring
- Vasoactive/vasopressor therapy
- Transfusion practices
- Bleeding dyscrasias/coagulopathies
- Acute renal failure
- Gastrointestinal disorders
- Neurological emergencies
- Stroke management
- Pain, sedation, delirium management
- Traumatic injuries
- Enteral and parenteral nutrition
- Acute abdomen/surgical emergencies
- Liver failure
- Multiorgan dysfunction syndrome
- Acute infections and antibiotic therapy
- Substance abuse/overdoses
- Critical illness specialized populations
- Palliative care/end of life
- Ethical considerations in the intensive care unit
- Organ donation

**Core technology**

- Ventilator management
- Noninvasive ventilation
- 12-lead EKG interpretation
- Bedside ultrasound
- Continuous renal replacement therapy
- Plasmapheresis
- Extracorporeal membrane oxygenation therapy

Abbreviation: EKG, electrocardiogram.

**Evaluation and Feedback**

Evaluation of clinical performance and ongoing feedback ensure achievement of basic competence during orientation and continued professional growth. Key evaluation components include a standardized competency assessment and weekly evaluation during orientation, ongoing professional practice evaluation (OPPE), focused professional practice evaluation (FPPE), and an annual 360-degree performance evaluation (confidential, anonymous feedback from work colleagues) with peer and multidisciplinary feedback. In addition to evaluation of and feedback on a nurse practitioner’s performance,
defined goals and practice-learning opportunities that provide continual learning and professional fulfillment enhance the nurse practitioner’s contributions to the ICU and the organization.

Table 4  Contents of the nurse practitioner orientation manual

| Welcome letter from nurse practitioner director |
| General orientation: |
| Start-up activities and checklist |
| Orientation framework with time line and clinical expectations |
| Job description |
| Specialty practice orientation: |
| Introduction to unit or service |
| Work model |
| Daily routine |
| Rounding process |
| Nurse practitioner roles and responsibilities |
| Competency checklist |
| Knowledge, system, behavioral, procedural |
| Objectives |
| Learning methods |
| Lecture and simulation schedule |
| Oral and written communication guidelines |
| Documentation forms |
| Evaluation forms |
| Scheduling guidelines |
| Resources |
| Reading list |
| Website resources |
| Other |

The OPPE and FPPE mandated by the Joint Commission33 ensure ongoing evaluation at specific intervals (minimum of 9 months) to assess each nurse practitioner’s performance in meeting quality standards and patient safety measures within the practitioner’s scope of practice and approved privileges. The evaluation methods are delineated by individual institutions but may include chart audit, observation of clinical practice, and peer feedback. The FPPE is completed during a nurse practitioner’s first 6 months of employment, with attainment of new privileges, and if performance concerns arise. Table 1 presents the general competency-based tool used at UMMC for this review.

Mentorship

Informal and formal mentorship is a critical thread in all aspects and stages of professional development of nurse practitioners and can positively affect satisfaction and retention. Matching a preceptor who is committed to investing time and energy to facilitate the growth and development of a nurse practitioner during and beyond the orientation period is desirable. This matching promotes early development of a professional relationship that benefits both the novice and the experienced nurse practitioner. However, this relationship cannot be successful without effective communication that is respectful and open and involves ongoing dialogue, sharing of

Table 5  Clinical structure of the critical care fellowship program for nurse practitioners

| Specialty intensive care unit (ICU) program | Weeks of rotation | Trauma program | Weeks of rotation |
| General orientation | 1 | General orientation | 1 |
| Surgical ICU | 3 | Surgical ICU | 3 |
| Medical ICU | 3 | Medical ICU | 3 |
| Neuroscience ICU | 3 | Trauma ICU | 4 |
| Infectious disease consultation service | 2 | Infectious disease consultation service | 2 |
| Lung rescue unit | 2 | Lung rescue unit | 2 |
| Trauma ICU (multitrauma or neurosurgical trauma) | 3 | Trauma neurosurgery | 1 |
| Cardiac surgery ICU | 3 | Cardiac surgery ICU | 3 |
| Radiology/trauma acute pain service/echocardiogram/ultrasound | 1 | Radiology/trauma acute pain service/echocardiogram/ultrasound | 1 |
| Neurosurgery | 1 | Trauma admitting team | 1 |
| Critical care resuscitation unit | 3 | Orthopedics | 1 |
| Elective week | 1 | Critical care resuscitation unit | 3 |
| Elective week | 1 | Total clinical experience | 26 |

Total clinical experience | 26
knowledge, and constructive feedback. A simulation-based education program is under way to help nurse practitioner preceptors gain the skills needed to provide feedback to novice nurse practitioners. The overall aims of the program are to ensure that the novices receive the support and guidance needed when learning new skills and to foster independence and autonomy as competency is achieved.

**Team Collaboration**

A variety of care delivery models exist in general and specialty ICUs and include APPs with resident and fellow teams, in separate teams, or as sole providers. A variety of care delivery models exist at UMMC. They provide unique clinical and leadership opportunities for nurse practitioners but also pose challenges when responsibilities of the nurse practitioners, residents, or fellows are unclear. Building collaborative relationships with clear communication, trust, mutual respect, and cooperation to achieve a common goal promotes effective teamwork. The nurse practitioner mentor and supervisor are instrumental in guiding novice nurse practitioners’ ability to foster these relationships.

Promoting collaborative, team-based care also requires a commitment to shared mentoring of novice fellows, nurse practitioners, and residents by physicians and experienced fellows and nurse practitioners. This culture must support a cooperative, shared leadership with overlapping competences and various shared degrees of responsibilities between fellows and nurse practitioners. Medical educational offerings for fellows must also be available to nurse practitioners to foster this cooperative and collaborative spirit.

The experience of the nurse practitioner leadership team and the processes put into place to improve the transition of novice nurse practitioners into practice have improved our retention rate.

**Program Outcomes**

At UMMC, the increasing experience of the nurse practitioner leadership team and the processes put in place to improve the transition of novice nurse practitioners into practice has affected the turnover rate for nurse practitioners, which decreased to 11.47% in fiscal year 2015, from almost 14% 2 years earlier. In a recent employee opinion survey, the mean overall job satisfaction scores of nurse practitioners were higher than the organizational mean and the national mean for all categories. The orientation and the fellowship program are key to this success. Evaluation of the competency-based orientation is conducted by soliciting feedback from nurse practitioners after they complete the orientation program and by annually surveying the entire nurse practitioner group on readiness to practice and improvements needed in the orientation program. Program review and refinements are then addressed at an annual nurse practitioner leadership retreat. The results of our orientation survey for the past 4 years indicate a steady increase in novice nurse practitioners’ perception of readiness to practice. In the most recent annual survey, 70 nurse practitioners participated. Among these, 54% noted that they were not ready to practice after completion of their graduate education, but nearly 90% were ready to practice after they completed the orientation program.

Since the launch of the fellowship program in 2010, a total of 8 nurse practitioners have successfully completed the program, and all but 1 are employed in critical care or trauma settings at UMMC. These 8 nurse practitioners are credentialed to work in all specialty ICUs and willingly cross-cover areas when staffing issues arise. Program evaluation includes 2 surveys, 1 before and 1 after completion of the program. The results indicate that all fellows rate themselves as fully competent to practice and all are privileged to perform procedures at the end of the fellowship. The nurse practitioner fellows also reported that the simulation and skills laboratory part of the fellowship program was valuable for learning and growth.

**Summary**

Ensuring successful integration of nurse practitioners into ICUs requires strategic planning to define the role of nurse practitioners in the particular ICU setting,
recruit, hire, integrate into the ICU, train, and provide support to nurse practitioners throughout this transition. A centralized nurse practitioner leadership team can provide key resources to develop, implement, evaluate, and refine the steps needed; however, such a team is not feasible in all organizations. We have presented key role preparation steps, orientation options, and other strategies to support the integration of novice nurse practitioners. Others who are embarking on integration of nurse practitioners into a unit or are seeking to improve their existing program can use this information as a guide and to promote success. CCN

Financial Disclosures

None reported.

eLetters

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

dotmore


References


www.ccnonline.org
F or the 14th year in a row, nursing is regarded as the most trusted profession in the United States. According to the annual Gallup poll,1 85% of Americans rated nurses’ honesty and integrity standards as “very high” or “high.” Confidence in the nurse’s skills and abilities help form this trusting bond with the patient.2 Certification shows the patient, the employer, and fellow staff that the nurse possesses skills and knowledge well beyond the basics. This expertise is necessary to deliver specialized care for critically ill patients. Indeed, multiple research studies have confirmed lower mortality rates and improved patient outcomes in hospitals with higher levels of certified nurses.3-8

References

Contributors
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Pamela Shumate, RN, DNP, CCRN, CNE, assistant professor at the University of Maryland School of Nursing, wrote the introduction and the adult CCRN review questions.

Nicole Gendron-Trainer, RN, MSN, CNS-BC, CCRN-K, educational coordinator for critical care and emergency service lines, Inova Health System, Fairfax, Virginia, contributed the PCCN review questions.

Adult CCRN Practice Questions

1. Four days into an admission for urosepsis, the patient becomes restless with a positive rating on the Confusion Assessment Method for the Intensive Care Unit (CAM-ICU). The expected plan of care should include
   A. Begin treatment with haloperidol every 6 hours
   B. Change sedative agent from propofol to lorazepam
   C. Initiate an exercise and progressive mobility program
   D. Titrate sedation agent to a score of -3 to -4 on the Richmond Agitation-Sedation Scale (RASS)

2. A patient presents with new-onset severe headache, unilateral hearing loss, fever, neck stiffness, and a petechial rash on arms and legs. The initial computed tomography (CT) scan of the head showed normal findings. The nurse should anticipate an order for
   A. Antibiotic therapy as soon as possible
   B. Antiviral therapy as soon as possible
   C. Diuretic therapy to prevent cerebral edema
   D. Calcium channel blocker for cerebral vasodilatation

Test plan topic: Behavioral, part of Musculoskeletal, Neurology, Psychosocial, 13% of the CCRN questions
3. A patient with acute kidney injury (AKI) from septic shock has been in normal sinus rhythm, but the rhythm shown below (6-second strip) develops. The patient is complaining of feeling light-headed, and blood pressure is 88/70 mm Hg. The nurse would anticipate administering intravenous (IV)

A. 3% Saline and corticosteroids
B. Calcium gluconate and 3% saline
C. Corticosteroids and sodium bicarbonate
D. Sodium bicarbonate and calcium gluconate

Test plan topic: Renal, with Endocrine, Hematology/Immunology, Gastrointestinal, and Integumentary, 20% of the CCRN questions

4. Resuscitation efforts are in progress for ventricular fibrillation. The end-tidal carbon dioxide (P\textsubscript{ETCO\textsubscript{2}}) capnography measurement is 8 to 10 mm Hg. The best treatment option is to

A. Assess the patient for return of spontaneous circulation
B. Assess the quality and depth of chest compressions
C. Check the placement of the endotracheal tube
D. Continue resuscitation with no change in plan

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

5. A patient weighing 81.6 kg is admitted with a diagnosis of urosepsis. Broad-spectrum antibiotics and 1 L of 0.9% saline as an IV bolus have been administered. Six hours have passed. Repeat laboratory tests and measurement of vital signs reveal the following. What therapy would the nurse next expect?

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Admission</th>
<th>6 Hours later</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lactate, mmol/L</td>
<td>4.4</td>
<td>4.2</td>
</tr>
<tr>
<td>Blood pressure, mm Hg</td>
<td>90/50</td>
<td>84/50</td>
</tr>
<tr>
<td>Mean arterial pressure, mm Hg</td>
<td>63</td>
<td>61</td>
</tr>
<tr>
<td>Central venous pressure, mm Hg</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

A. Administer 0.9% saline IV bolus up to 30 mL/kg
B. Begin dobutamine at 10 μg/kg per minute continuous IV infusion
C. Begin vasopressin at 0.03 U/min continuous IV infusion
D. Administer 3% saline continuous IV at 30 mL/h

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

Correct Answers and Rationales for Adult CCRN Practice Questions

1. Correct Answer: C
Rationale
Early mobilization when possible reduces the incidence and duration of delirium (level 1B). No evidence currently exists to show that haloperidol (A) prevents or reduces the duration of delirium. Use of benzodiazepines such as lorazepam (B) may be a risk factor for development of delirium. Light sedation levels (D) are associated with improved outcomes for ICU patients. Early progressive mobility and promoting night time sleep in adult patients are recommended to decrease the incidence and severity of ICU delirium.

Source

2. Correct Answer: A
Rationale
Common symptoms of meningitis include fever, headache, nuchal rigidity, photophobia, focal neurological deficits, and seizures. Meningitis caused by the bacteria Neisseria meningitides (meningococcal meningitis) often produces a characteristic petechial rash that may advance to purpura. Antibiotic therapy with ceftriaxone is the primary treatment. Delays in initiating antibiotic therapy increase the risk of mortality and morbidity. Because
Critical Care Nurse Vol 36, No. 6, DECEMBER 2016

meningococcal meningitis is caused by a bacterial infection, antiviral (B) therapy would not be indicated. If cerebral edema (C) does develop, therapy to reduce the edema may then be indicated. Administration of a calcium-channel blocker such as nimodipine (D) will cause cerebral vasodilatation but the current headache is from meningeal irritation.

Source

3. Correct Answer: D
Rationale
This rhythm strip reveals a second-degree heart block type II (Mobitz II) with a heart rate of 40 beats per minute. Hyperkalemia can cause multiple electrocardiographic (ECG) changes, including bradycardias, heart blocks, widened P waves and QRS complexes, shortened QT intervals, tall tented T waves, ventricular fibrillation, or asystole. Calcium gluconate (B) temporarily raises the heart’s stimulation threshold but does not lower the serum potassium level. Sodium bicarbonate temporarily shifts potassium back into the cell. Corticosteroids (C) are sometimes used to treat hypercalcemia. Hypercalcemia may cause flat or inverted T waves or shortened ST or QT intervals. Hypertonic (3%) saline (A) may be used to treat significant hypovolemia. Hyponatremia does not normally produce ECG changes.

Source

4. Correct Answer: B
Rationale
High-quality chest compressions typically yield a PETCO2 measurement of at least 10 to 20 mm Hg. An abrupt increase in PETCO2 up to 35 to 40 mm Hg is commonly seen with return of spontaneous circulation (B) because of the dramatic improvement in blood flow. A loss of PETCO2 (C) measurement is seen when the endotracheal tube is not in the trachea. Lower levels of PETCO2 (D) indicate poor compression quality and poor perfusion.

Sources


5. Correct Answer: A
Rationale
Crystalloid fluid administration is the initial therapy recommended to manage and treat hypovolemia and prevent or manage tissue hypoperfusion in sepsis. Fluid challenges of at least 30 mL/kg are indicated, with a target suggested mean arterial pressure (MAP) of at least 65 mm Hg and a lactate level less than 4 mmol/L. If crystalloid fluids alone do not achieve these parameters, norepinephrine is the first vasopressor recommended. Dobutamine (B) may be used if myocardial dysfunction is suspected. Vasopressin (C) may be added if fluids and norepinephrine do not achieve the target blood pressure. Hypertonic saline (D) is used primarily as an osmotic diuretic or for hyponatremia.

Sources

PCCN Practice Questions

1. A patient admitted for observation suddenly begins vomiting bright red blood. Vital signs: heart rate (HR) 120/min, blood pressure 85/40 mm Hg, respiratory rate (RR) 24/min, temperature of 37ºC (98.6ºF), and urine output less than 0.5 mL/kg per hour. In addition to transfer to the intensive care unit (ICU), the nurse should give the highest priority to

A. An IV fluid bolus
B. Warming blankets
C. Emergent endoscopy
D. A Protonix (pantoprazole) infusion

Test plan topic: Gastrointestinal, with Endocrine, Hematology, and Renal, 18% of the PCCN questions

2. The lab calls for a potassium level of 7.0 mEq/L on a patient with suspected kidney transplant rejection and no current access for dialysis who has had two 6-beat runs of ventricular tachycardia in the past 5 minutes. What intervention is most appropriate first?
A. Administer a cation-exchange resin such as Kayexalate (sodium polystyrene)
B. Administer IV 50% dextrose, regular insulin, calcium
C. Get consent form signed and prepare for hemodialysis catheter placement
D. Restrict dietary intake of potassium to 40 mEq per day

Test plan topic: Renal, with Endocrine, Hematology, and Gastrointestinal, 18% of the PCCN questions

3. Before doing patient education, a nurse reviews the new medications for a patient admitted with an acute myocardial infarction and should know that the
A. β-Blocker is used to increase myocardial oxygen consumption
B. Aspirin is used to decrease the activity of the coagulation cascade
C. Nitrates are used to decrease preload
D. Angiotensin-converting enzyme (ACE) inhibitors are used to increase left ventricular afterload

Test plan topic: Cardiovascular, 33% of the PCCN questions

4. After a colon resection, an older adult becomes agitated in the evening, yelling and trying to get out of bed independently, whereas the patient is sleeping excessively during the daytime. The patient’s daughter confirms that this behavior is not typical for the patient. The first priority for the nurse would be
A. Increase safety surveillance and apply soft wrist restraints
B. Keep room lighting dim during the day and off at night
C. Administer benzodiazepines as ordered by the provider
D. Ensure that the patient is wearing his/her glasses and hearing aids

Test plan topic: Behavioral, with Neurology and Multisystem, 15% of the PCCN questions

5. Left shoulder pain, tachypnea, and tachycardia develop in a patient who is on day 2 after laparoscopic Roux-en-Y bariatric surgery. The nurse should
A. Notify the bariatric surgeon immediately
B. Limit the volume of liquids consumed at one time
C. Limit ambulation for the patient for the next 24 hours
D. Ensure that the patient is using the continuous positive airway pressure (CPAP) machine properly

Test plan topic: Multisystem, with Behavioral and Neurology, 15% of the PCCN questions

Correct Answers and Rationales for CMC Practice Questions

1. Correct Answer: A
Rationale
The goal of initial treatment for gastrointestinal bleeding is volume resuscitation. This patient is demonstrating signs of shock (tachycardia, hypotension, increased respirations, and urine output less than 0.5 mL/kg per hour). Prevention of hypothermia (B) is a priority in gastrointestinal hemorrhage to maintain normal coagulation. This patient however, is currently normothermic. Emergent endoscopy (C) is used to identify the source of gastrointestinal bleeding. Volume resuscitation and stabilization should occur before the patient is sent for endoscopy. Proton pump infusions (D) are appropriate after volume resuscitation and emergent endoscopy.

Source

2. Correct Answer: B
Rationale
Hypertonic (50%) glucose and IV regular insulin acts immediately to drive potassium into the cells on a temporary basis, thereby protecting the heart from the effect of the elevated serum potassium level. Intravenous calcium temporarily protects the heart and muscles from the effects of hyperkalemia. This intervention is the quickest to prevent life-threatening dysrhythmias from hyperkalemia. Cation-exchange resins (A) are used to increase potassium excretion through feces. The potassium level will not decrease until the patient has a bowel movement and the resins may take up to 2 hours to work. Dialysis (C) is an appropriate intervention; however, it will take some time to place an access. Dietary restriction
of potassium (D) is also appropriate but does not address the urgent issue.

Source

3. Correct Answer: C
Rationale
Nitrates dilate the veins, which results in venous pooling and decreases preload. β-Blockers (A) decrease myocardial oxygen consumption. Aspirin (B) is an antiplatelet drug not an anticoagulant. ACE inhibitors (D) decrease afterload by dilating the arterioles.

Source

4. Correct Answer: D
Rationale
Delirium is the most common cause of agitation in progressive care patients. Delirium is evidenced by disorientation, confusion, perceptual disturbances, restlessness, distractibility, and disturbances in the sleep-wake cycle. Ensuring that patients are wearing their glasses and hearing aids helps maintain orientation. Increasing monitoring is indicated, but restraints (A) tend to increase agitation. Lighting (B) should be bright during the day and dim at night to promote a normal circadian rhythm. Benzodiazepines (C) may instigate delirium in older adults and should be given judiciously after nonpharmacological methods (reorientation, sleep promotion, and progressive mobility) are not successful.

Source

5. Correct Answer: A
Rationale
Left shoulder pain, tachypnea, and tachycardia are signs of an anastomotic leak causing peritonitis, which is a medical emergency. Untreated, severe sepsis will develop. The surgeon should be notified immediately and may order a diagnostic test such as a CT scan. Limiting volumes of liquids (B) will not help these symptoms. Early ambulation (C) is appropriate to reduce the risk of deep vein thrombosis. Many bariatric surgery patients use CPAP (D); however, left shoulder pain is not a symptom of respiratory insufficiency.

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
I’ve seen the terms acute kidney injury and acute renal failure used interchangeably. What is the difference?

Susan M. Dirkes, RN, MS, CCRN, replies:

Acute renal failure (ARF) was used in the past to describe any kind of kidney failure. In fact, in one study, Kellum et al\(^1\) showed that physicians had more than 35 definitions of renal failure. When the term ARF was used, it was regarded as a simple complication of the patient’s illness. The diagnosis then was that the kidney had failed. In the past decade, however, ARF has been extensively researched. The new term acute kidney injury (AKI) indicates that this problem is a clinical manifestation of several disorders that affect the kidney acutely. AKI indicates injury is occurring and it can be graded into mild, moderate, and severe injury. The key is to identify kidney injury before it becomes kidney failure.

AKI is common in hospitalized patients and even more so in critically ill patients. In the latter group, AKI is most often associated with events occurring outside the kidney (sepsis, hypoperfusion, and impact of nephrotoxic drugs, to name a few). The research done also indicates that if patients survive their illness and have AKI, they often typically recover to dialysis dependence. In one study,\(^2\) AKI was separated into AKI on admission (early AKI) and AKI developed in the intensive care unit (unit-acquired AKI), with a large difference in prognosis (49% vs 19% survival). Even in patients in whom renal replacement therapy (RRT) was started early, only about 29% survived. In this study,\(^2\) 35% of surviving patients showed a transition of AKI into chronic kidney disease.

So AKI is the new consensus term for ARF. We now know that even small changes in kidney function can have large effects on outcomes. AKI has replaced ARF to emphasize a continuum of kidney injury occurring long before any loss of kidney excretory function can even be measured with standard laboratory tests. AKI is a syndrome characterized by rapid (hours to days) decrease in renal excretory function, with the accumulation of products of nitrogen metabolism such as creatinine and urea. Other manifestations include decreased urine output, accumulation of metabolic acids, and increased levels of potassium and phosphorus. AKI also suggests a prognosis continuum, with even small increases in creatinine level increasing mortality.\(^3\) AKI plays a critical role in modulating and affecting any inflammatory process and also is associated with the development of profound immunosuppression.\(^2\)

In 2004, the Acute Dialysis Quality Initiative (ADQI) was formed to improve the definition of AKI. The ADQI criteria are termed the RIFLE (risk, injury, failure, loss of function, end-stage renal disease) criteria and have been supported by the Acute Kidney Injury Network.\(^4\) These experts have found that renal injury seems to trigger organ injury elsewhere, emphasizing the complexity of the biological response to AKI, specifically in the lungs, heart, liver, and brain.\(^2\) In the past decades, many clinicians used principles to guide their understanding of AKI, but those principles have little relevance to patients today in hospitals and intensive care units.
Because AKI is asymptomatic until significant loss of renal function occurs, and there are no characteristic clinical findings, diagnosis is late and occurs as a part of the diagnosis of another illness. Even though a low urine output is indicative of real-time kidney perfusion, it cannot be used always as a specific or sensitive sign of AKI.

Measurements of creatinine and urea levels are the standard diagnostic tests, but both are insensitive markers of glomerular filtration rate. They both also are modified by nutritional status, use of steroids, presence of gastrointestinal blood, muscle mass, age, sex, and fluid resuscitation. Fortunately, some new approved biomarkers do indicate the severity of AKI and are specific and predictable for the development of AKI.

Last, ARF was thought to be less important as a complication because it was assumed that the kidney function could be supported or replaced with dialysis. Dialysis, however, manages fluid and waste removal but does not replace the production of hormones and substances such as erythropoietin.

With the current understanding of the central role of the kidney in maintaining the interior environment of the body, we now know that any renal dysfunction exerts a profound effect on the physiology of the body and other organ systems. Therefore, AKI exerts a profound effect on the course of the disease and the outcome for both the patient and the kidney. Kidney failure is the worst outcome that can occur. We now know that being alert for developing kidney injury is the strongest indicator of outcome in intensive care unit patients and of long-term survival. CCN

Financial Disclosures
None reported.

References
Extracorporeal Membrane Oxygenation for Critically Ill Adults
Cass Piper Sandoval, RN, MS, CCRN, CCNS

Review Question
The objective of this review was to determine if the use of venovenous (VV) or venous-arterial (VA) extracorporeal membrane oxygenation (ECMO) in adults is more effective in improving survival than conventional methods of respiratory and cardiac support.1

Relevance to Critical Care Nursing
Extracorporeal membrane oxygenation is a form of life support for the heart and/or lungs. In patients with severe lung failure, VV ECMO can be used to perform gas exchange. VA ECMO is used in patients with cardiogenic shock or refractory cardiac arrest to provide gas exchange and adequate systemic circulation. Though ECMO has been used successfully in neonates and infants for some time, the effectiveness of ECMO in adults is less established. ECMO is a high-risk therapy with potentially adverse effects such as bleeding, distal limb ischemia, hemolysis, air embolism, and thrombus. Nurses are integral members of the ECMO team whose responsibilities include monitoring for and preventing complications as well as evaluating the patient’s response to the therapy.

Study Description and Results
Studies selected for this review included randomized controlled trials (RCTs), quasi-RCTs, and cluster RCTs that compared ECMO and conventional therapy in adults. Participants were adults 18 years of age or older with cardiac or respiratory failure. Studies with ECMO using pump-driven VV or VA or pump-free AV circuits were included. Studies using ECMO as part of a planned surgical procedure or that compared other forms of mechanical support such as ventricular assist devices were excluded. The primary outcome measure in this review was the rate of all-cause mortality nearest to 30, 60, or 90 days and/or at 6 months. Secondary outcomes included in some of the studies were length of hospital stay, survival to discharge, disability, adverse outcomes, health-related quality of life, longer-term health status and well-being, and cost-effectiveness.

Two review authors independently screened titles and abstracts for inclusion criteria, assessed full texts of included studies, extracted data using a standardized form, and performed a risk of bias assessment. Of 450 studies screened, 13 full texts were reviewed. Of the 13, 4 RCTs and 1 economic analysis of one of the RCTs were included in the qualitative synthesis. A total of 389 patients in the 4 studies received either ECMO or conventional support for acute respiratory failure. Three of the studies were multicenter trials in either Europe or the United States, while one was a single-center study in the United States. No completed studies were found that evaluated ECMO for cardiogenic shock or...
cardiac arrest versus conventional therapy. One ongoing study in acute lung failure and 2 ongoing studies in acute cardiac failure were found but not included in this review.

Dichotomous data (eg, mortality) were analyzed as risk ratios (RRs) with 95% confidence intervals (CIs), whereas mean difference (MD) or standardized mean differences (SMDs) with 95% CIs were used for continuous data (eg, length of hospital stay). Pooling of data for meta-analysis was not possible because of the diversity of technical and medical advances in ECMO and ventilation methods used in the studies, which spanned 4 decades (1979-2013). No subgroup, sensitivity, or heterogeneity assessments were done because a meta-analysis was not conducted.

Summary of Main Results

- The 4 individual studies found no significant difference in all-cause mortality at or before 6 months between ECMO and conventional therapy groups.
  - Zapol et al\(^2\) reported no significant difference in 6-month all-cause mortality: 38/42 (91%) in intervention group (IG) compared with 44/48 (92%) in control group (CG) (RR, 0.99; 95% CI, 0.87-1.12).
  - Morris et al\(^3\) reported no significant difference in all-cause mortality within 30 days: 14/21 (66%) in IG compared with 11/19 (57%) in CG; (RR, 1.15; 95% CI, 0.71-1.88).
  - Peek et al\(^4\) reported no significant difference in all-cause mortality at or before 6 months: 33/90 (37%) in IG compared with 45/90 (50%) in CG (RR, 0.73; 95% CI, 0.52-1.03; \(P = .07\)).
  - Bein et al\(^5\) reported no significant difference in hospital mortality: 7/40 (17.5%) in IG compared with 6/39 (15.4%) in CG (RR, 1.14; 95% CI, 0.42-3.08).
- Three of the studies included data on length of hospital stay (LOS). Researchers in 1 study reported longer LOS in the ECMO group, while researchers in the other 2 studies reported no significant differences between groups.
  - Peek et al\(^4\) reported longer LOS in IG than CG; 35 days (interquartile range, 15.6-74.0 days) vs 17.0 days (interquartile range, 4.8-45.3 days).
  - Morris et al\(^3\) reported mean LOS of 26.9 (SD, 4.9) days in IG compared with 28.8 (SD, 5.7) days in CG; the mean difference of 1.9 days was not significant (\(P = .09\)).
  - Bein et al\(^5\) reported LOS of 46.7 (SD, 33) days in IG compared with 35.1 (SD, 17) days in CG; the mean difference of 11.6 days was not significant (\(P = .11\)).
- Two studies reported data on survival to discharge and found no significant difference between groups.
  - Morris et al\(^3\) reported non-significant survival to discharge: 33/40 (82.5%) in IG compared with 33/39 (84.6%) in CG (\(P > .99\)).
  - Bein et al\(^5\) reported non-significant survival to discharge: 33/40 (82.5%) in IG compared with 33/39 (84.6%) in CG (\(P > .99\)).
- Two studies included data on disability.
  - Zapol et al\(^2\) reported normal pulmonary function in 7 of 8 survivors (both groups), and no participants had limitations in their daily activities 6 months after discharge.
  - Peek et al\(^4\) reported improved survival to 6 months without disability in the ECMO group: 63% (57/90) in IG vs 47% (41/87) in CG (RR, 0.69; 95% CI, 0.05-0.97; \(P = .03\)).
- Data on adverse outcomes were reported in all 4 studies. In 3 studies, patients in the ECMO group received more blood transfusions. One study reported more nonbrain hemorrhage in the ECMO group. Two studies reported a total of 5 serious adverse events related to the ECMO device or cannulation in the ECMO group.
  - Zapol et al\(^2\) reported rates of septicemia (20%) and pneumothorax (45%) to be similar in both groups and not significantly different.
  - Morris et al\(^3\) reported the incidence of major complications as not significantly different (34 in IG vs 16 in CG; \(P = .12\)) but the frequency of nonbrain hemorrhage as significantly different (21 in IG vs 0 in CG). Transfusion rates in
the IG exceeded 0.8 L/d in 10 patients and led to bypass disconnection in 7 patients.

- Peek et al\(^4\) reported 2 adverse events in the IG vs 0 in the CG: 1 death due to mechanical failure of oxygen supply during ambulance transport and 1 vessel perforation during cannulation.

- Bein et al\(^5\) reported 3 adverse events in the IG (7.5%) vs 0 in the CG: 1 transient ischemia of the lower limb and 2 false aneurysms from arterial cannulation. Transfusion rates were significantly higher in the IG (mean [SD], 3.7 [2.4] vs 1.5 [1.3] units of red blood cells; \(P < .05\)).

- One study reported data on health-related quality of life and found no significant difference between groups, and no studies reported data on longer-term health status and well-being.

- Two studies reported data on cost-effectiveness that showed higher health care costs in the ECMO group, although authors in 1 of the studies regarded the lifetime predicted cost utility per quality-adjusted-life-year as demonstrating cost-effectiveness.

### Nursing Implications

This review primarily found little difference in outcomes between the use of ECMO and conventional treatment in acute respiratory failure. In 1 of the 4 studies in this review, researchers found improved survival to 6 months without severe disability and recommended transfer of patients with potentially reversible acute lung failure to centers with ECMO protocols. The other 3 studies were inconclusive and reported no difference in mortality rates; however, 2 of the 4 RCTs were conducted before the year 2000, when advancements in ventilator and ECMO technology were not in existence. Overall, very few RCTs on this topic have been done to date, and none have investigated the use of ECMO in cardiogenic shock or refractory cardiac arrest. Although numerous observational studies support the use of ECMO in acute pulmonary and heart failure, clinicians must await the outcomes from 3 ongoing RCTs to clarify the role of ECMO in caring for these patients. **CCN**

Financial Disclosures
None reported.

### References


Communication among team members on a critical care unit is integrally linked to patient safety.\(^1\) When the critical care unit at Chambersburg Hospital (Chambersburg, Pennsylvania) moved into the new wing in December 2012, it became apparent that the new layout was less conducive to facilitating staff interactions than the old layout had been. The team needed to adapt to preserve patient safety.

The prior unit was designed with a hub-and-spokes layout. Nurses congregated in the central nursing station to view the cardiac monitors, document, and obtain medications, enabling constant interactions. The new critical care unit was constructed in a horseshoe arrangement, with small working pods between each pair of patients’ rooms—complete with computers for documentation and medication drawers. Nurses were encouraged to stay in their “pods” to remain closer to their patients.

Although this new design improved the environment for patients, critical care staff began struggling with open communication. Thus, staff made efforts to overcome the hurdles created by their new environment. Communication boards were developed within the break room, e-mails were sent, and staff meetings were held, despite the fact that bedside staff members’ schedules were not well-suited to structured meetings.\(^2\) Meeting attendance was low, not all e-mails were read, and boards were infrequently updated. Communication barriers prevailed.

Staff voiced concerns regarding their lack of knowledge about the environment. Each nurse knew a great deal about his or her 2 assigned patients in the 18-bed unit, but the nurses were no longer passively acquiring information about the census of the unit, patients with safety concerns such as fall risks, patients requiring mechanical ventilation, or the number of nursing attendants available on the floor. Everyone was working in relative isolation, which was not conducive to functioning as a team.

**Implementing a Solution**

After multiple strategies to improve communication had failed, unit leaders decided to implement an informal morning huddle to review staffing. The unit’s nurse manager had used this type of effective communication while leading another unit, and she was excited to begin using it in the critical care unit. The new huddle format began in October 2013, but was noted to be infrequent and dependent on which staff member was in the resource role. Despite the infrequency, multiple staff members realized the effectiveness of the brief staffing huddle, especially in the way it enabled staff to work together more cohesively in the decentralized unit. The positive feedback drove the team to make the infrequent huddle a more permanent event. By June 2014, the preshift huddle was performed at every shift change, becoming standard work for every resource nurse or clinical manager.

This routine gathering of off-going and oncoming shifts presented an opportunity to share more than just staffing information. Material that had previously been distributed solely in e-mail format—such as patient safety...
Evolution of the Process

Allowing for continuous feedback is necessary to maintain a sense of buy-in. Although things ran smoothly, there was some feedback that information presented focused on mistakes or near misses that occurred on the critical care unit or on other units. Although this information is crucial for preventing future events and encouraging staff involvement in developing solutions, some staff felt they were bombarded with “all the things they do wrong.” Because the intention of the safety huddle was to share information and create a positive, collaborative environment, leaders were concerned with the new perception. Success stories and education were incorporated into the daily huddles and thank you cards from patients and families were shared to provide a balance.

With the addition of so many types of information, huddle duration started to run longer, resulting in an increase in overtime for many nurses. In response to this dilemma, the length of the huddle was limited to 5 minutes. Any item not addressed within the time frame was skipped, although exceptions were made for constructive discussions.

As the huddle developed into a well-functioning communication tool, attendance at staff meetings dropped—all of the information provided at these monthly meetings repeated what had been shared at huddles. Thus, in April 2015, the nurse manager abandoned the traditional model and implemented the monthly “virtual staff meeting.” The contents of the huddle binder were scanned and uploaded to the department intranet on a monthly basis. These data were condensed into a summary and distributed via e-mail as a virtual staff meeting.

Expansion of a Culture

As time passed, the change-of-shift huddle model spread throughout the facility. When other managers, including top nursing leaders, learned of the critical care unit’s successes, adoption of this format was encouraged on all other units.

Through invitation, other disciplines began to get involved in the nursing huddles as well. Providers, quality management staff, and other guest speakers now attend on a regular basis—both to present information and to participate in discussion. Throughout the hospital, the safety huddle has become the reference standard for disseminating information and is being adapted into other areas of practice, including postfall assessments, initial skin assessments, and pressure ulcer identification.

Many important factors must be considered to create and sustain a new practice, and team buy-in is arguably one of the most important. Although team buy-in can be elusive, and achieved in varying degrees, success lies in management. When managers encourage feedback from front-line staff, and adapt to that feedback, staff are empowered and are more likely to participate in new initiatives. The entire process is and continues to be a journey.

Conclusion

The Joint Commission has identified communication failure as the cause of more than 80% of serious medical errors. Communication in the busy acute care setting can sometimes be challenging, and its value overlooked. The huddle increases effective communication among members of the health care team, reducing errors due to...
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miscommunication and supporting a culture of patient safety. The critical care unit at Chambersburg Hospital is proud to share our huddle journey. Together, we have created and continue to develop this strategy for effective communication, focused on team work, safety, and quality. CCN

Financial Disclosures
None reported.

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References

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Kimberly Ortmayer, RN, BSN, CCRN, is a clinical supervisor in the pediatric cardiovascular intensive care unit at Levine Children’s Hospital/Carolina Medical Center in Charlotte, North Carolina.

Why did you become a nurse?
In grade school, the mother of a good friend of mine was diagnosed with cervical cancer. I remember visiting her and hearing about how amazing the nurses were that took care of her. She beat cancer, but later, while I was in nursing school, she was in a horrible car accident. Seeing what the intensive care unit (ICU) nurses did for her was truly amazing. I thought, “I want to be that nurse who could change the lives of pediatric trauma patients.”

What about your job as a nurse makes you happy?
The unit can start off with 7 patients, and by the end of the day we can have 20. The trauma pager can go off with 2 kids to come, and all I have to do is make a phone call and my ICU family pulls together. Even if I’m completely slammed with an extremely busy assignment, I know my colleagues will help as soon as they can. We truly are a family, and that’s what makes me happy.

Tell us about an extraordinary experience you’ve had as a critical care nurse.
I took care of a little boy with a severe heart defect. After 4 years and too many surgeries to count, he lost his fight to congenital heart disease. I learned so much about life from this little boy and his amazing family. When he passed, the charge nurse called me at home. I went to work to be there for his family. A few days later, they approached me and asked if I would give a eulogy at his wake. I didn’t go to funerals—that helps keep me sane. This time, however, I felt like I was supposed to do it. I gave the eulogy, and the whole experience was one I will never forget. In his short 4 years of life, this little child made me a better nurse, mother, wife, friend, and person. I will be forever changed because of this experience.

What are the challenges you encounter and how do you overcome them?
As a pediatric nurse you see many things that ethnically are not right. Parents who beat, stab, or shoot their children; parents who let their children’s heart medications run out and forget to refill them. These situations are extremely challenging because as a bedside nurse you have to be neutral. You cannot judge or blame. Your job is to take care of not only the patient but also the patient’s family, no matter what the circumstances are. On these difficult days, I take 5 minutes to myself and just breathe and tell myself, “It will be okay, just do your job and do it well.”

What has your journey as a nurse been like?
It has truly been rewarding. I have been able to see the United States through travel nursing and I have explored other countries through Medical Missions. After 16 years, I can honestly say I still love what I do.

At the end of a busy day, how do you find balance in your life?
I use my peers as an outlet if I need to talk. I also love spending time with my children. They know just what to say to make me feel better.

What would we be surprised to know about you?
My husband has undergone 2 heart surgeries: a coarctation of the aorta and an aortic valve replacement. This experience helps me relate more to my patients and their families. I hope I can be as helpful to my patients as the nurses taking care of my husband were to me.

How has AACN played a role in your career?
AACN has challenged me to constantly continue learning and exploring the nursing field. I love reading the journals and finding helpful tools. AACN is a wonderful resource to help me achieve all my nursing goals and assist me in always striving to learn something new.

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