

Putting Evidence Into Nursing Practice: Four Traditional Practices Not Supported by the Evidence

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Evidence-based nursing practice is essential to the delivery of high-quality care that optimizes patients' outcomes. Studies continue to show improved outcomes when best evidence is used in the delivery of patient care. Despite awareness of the importance of practicing by using best evidence, achieving and sustaining evidence-based practice within practice environments can be challenging, and research suggests that integration of evidence-based practice into daily clinical practice remains inconsistent. This article addresses 4 practice issues that, first, are within the realm of nursing and if changed might improve care of patients and, second, are areas in which the tradition and the evidence do not agree and practice continues to follow tradition. The topics addressed are (1) noninvasive measurement of blood pressure in children, (2) oxygen administration for patients with chronic obstructive pulmonary disease, (3) intravenous catheter size and blood administration, and (4) infection control practices to prevent infections. The related beliefs, current evidence, and recommendations for practice related to each topic are described. (*Critical Care Nurse*. 2013;33[2]:28-44)

Evidence-based nursing practice involves integration of a problem-solving approach within the context of caring, considering best evidence from studies, patient care data, clinical experience and expertise, and patients' preferences and values.¹ Health care agencies, government agencies, and national professional organizations such as the American Association of Critical-Care Nurses have all been supporters of evidence-based practice (EBP) as studies continue to show improved outcomes when best evidence is used in the delivery of patient care.^{2,3} Despite the awareness of the importance of practice being based on best evidence, achieving and sustaining EBP within practice

CNE Continuing Nursing Education

This article has been designated for CNE credit. A closed-book, multiple-choice examination follows this article, which tests your knowledge of the following objectives:

1. Identify key evidence-based components that demonstrate how research can be translated into bedside nursing practice
2. Analyze 4 nursing practice issues to understand how to incorporate evidence-based guidelines into nursing interventions
3. Validate evidence-based guidelines and nursing research to incorporate practice changes in your own work environment

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environments can be challenging, and research suggests that integration of EBP into daily clinical practice remains inconsistent.⁴

Barriers to and facilitators of practicing on the basis of best evidence have been well documented^{4,6} but can be categorized into several themes, one of which is the perceived peer emphasis on the status quo: “We’ve always done it this way.”⁶ Such status quo practices, often steeped in tradition rather than best evidence, have been referred to as “sacred cows.”⁷ To move evidence into practice, several essential elements are needed: (1) selection of a framework or model for EBP, (2) identification of the clinical question, (3) critiquing of current evidence, (4) evaluation of current practice and development of a strategy to implement EBP change, and (5) evaluation of the translation of evidence into practice and outcomes.⁶ Details of these steps have been outlined in previous articles that have explored sacred cows in critical care nursing practice.^{5,8,9}

To achieve excellence in practice, critical care nurses must embrace EBP as the norm. We cannot knowingly continue clinical practice interventions that are not supported by current best evidence, especially if those actions are known to be unhelpful and possibly harmful. This article is devoted to putting 4 more clinical sacred cows out to pasture. These practice issues were selected for 2 reasons. First, they are within the realm of nursing and a change in practice could improve patient care. Second, these are areas in which the tradition and the evidence do not agree and practice continues to follow tradition. The sacred cows to be addressed here are (1) noninvasive measurement of blood pressure in children, (2) administration of

oxygen in patients with chronic obstructive pulmonary disease (COPD), (3) intravenous catheter size and blood administration, and (4) infection control practices to prevent infections. The related beliefs, current evidence, and recommendations for practice related to each topic are described in the following sections.

Best Method for Measuring Blood Pressure Noninvasively in Children

Noninvasive blood pressure (NIBP) monitoring by using an oscillometric technique is a primary method of obtaining an NIBP measurement for both adults and children.¹⁰⁻¹² For more than 20 years, NIBP monitoring has been used despite questions about its accuracy and reliability¹³ as well as questions about providers’ technique.¹⁰ The sacred cow is related to the belief that the oscillometric method is the best method for measuring a patient’s blood pressure. However, the reference standard for NIBP measurements is the auscultatory method for adults and children.^{10-12,14,15} Often the oscillometric technique is used without checking the accuracy of oscillometric measurements by comparing them with auscultatory measurements.^{10,12,13} Obtaining an accurate NIBP measurement is essential to guide treatment decisions. In the management of critically ill children (age 1 year or older), nurses should measure blood pressure by using the auscultatory method and comparing that measurement with an oscillometric measurement for continued monitoring of vital signs.^{10,15}

Nurses should measure blood pressure by using the auscultatory method and compare that measurement with those obtained via the oscillometric method used for trending and treatment.

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Table 1 Research on blood pressure measurement in the pediatric intensive care unit

Study title	Findings	Practice implications
Comparison of blood pressure measurement methods in critically ill children ¹⁴	Differences between direct and indirect were not statistically significant; however, there was significant variability that the author thought was clinically significant Differences between oscillometric and direct measurements were based on the difference being greater than 10 mm Hg (47.2% of systolic blood pressure, 22.2% of diastolic blood pressure, and 27.8% of mean arterial pressure)	Clinically significant differences were noted between direct and indirect monitoring of blood pressure Investigation of possible measurement error is indicated when these differences are recognized Need to base clinical decisions on multifaceted assessments Study supports the merits of monitoring mean arterial pressure Author recommends study replication with a larger sample and inclusion of hemodynamically unstable children
Comparison of arm and calf automatic noninvasive blood pressures in pediatric intensive care patients ²⁰	Calf blood pressures were higher in 73% of the sample Measurements are not interchangeable and clinical differences are greatest in children 2 to less than 5 years old Paired <i>t</i> tests showed statistically significant measurements for systolic blood pressures and mean arterial pressure	Do not recommend calf measurements, if must use trending from this site should be consistent Recommend consistent technique: oscillometry vs auscultation Maintain limbs at heart level for most accurate measurements Limb measurements mandatory to determine optimal cuff size Document site of blood pressure measurement in medical record Authors recommend future research to include study samples of arm and calf blood pressure measurements and replication of study with larger sample size Further exploration of covariables suggested (eg acuity, presence of mechanical ventilation)

Related Beliefs and Evidence

NIBP measurements are obtained by 4 methods: auscultation, oscillometry, palpation, and Doppler imaging. In patients with certain clinical variables and patients less than 1 year of age, Korotkoff sounds can be difficult to hear,¹⁰ so blood pressure is best measured by using Doppler or palpation methods.^{10,15} NIBP measurement is more common in the management of critically ill children than is direct measurement of blood pressure via an arterial catheter.^{14,16,17} Arterial catheters are often not used because of technical challenges with device insertion and complications such as bleeding, impairment of distal perfusion (thrombosis and arteriospasm), and infection.¹⁷ In a survey of 800 members of the Society of Critical Care Medicine, 73% of respondents reported using NIBP measurement for hypotensive patients and 47% reported using NIBP measurements for patients being treated with a vasopressor.¹⁶ What was unclear in this study was whether clinicians consistently validate the oscillometric method of NIBP measurement by comparing its

measurements with auscultatory measurements and whether providers ensured that the size of the blood pressure cuff was accurate for the child's age with the upper extremity positioned level with the right atrium. NIBP measurement is commonly used in the assessment of critically ill children; consistent use of a measurement technique that is based on best evidence is needed in practice to ensure that blood pressure assessment data are accurate.

The body of evidence on the accuracy and reliability of NIBP measurements in critically ill children is growing. However, study results are inconsistent because the research questions vary, the blood pressure measurement techniques are inconsistent, different limbs or body positions are used, the blood pressure parameters assessed (systolic, diastolic, mean) vary, and the statistical procedures used vary, making it difficult to provide a definitive clinical recommendation for acute care practice.^{16,18-20} Two studies^{14,20} have explored the accuracy of NIBP measurement in critically ill children (Table 1).

Current standards for NIBP measurement in children are based on recommendations for identifying hypertension in ambulatory settings.^{10,12,15,21} As these are the only published guidelines, they are used in acute and critical care settings. The Cincinnati Children's Hospital Medical Center's Best Evidence Statement¹⁵ and the Fourth National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents²¹ are the primary EBP guidelines used to direct standard, accurate measurement of blood pressure in children with NIBP monitoring techniques.

NIBP Methods. The auscultatory method is suggested for NIBP measurement in children more than 1 year of age.^{10,12,15,21} The practice recommendation is that the best way to measure a child's blood pressure is to take the average of 2 measurements obtained 30 seconds apart.^{10,12,15} Mercury devices previously used for auscultatory NIBP measurements have been replaced by "hybrid" sphygmomanometers. The hybrid device combines the features of electronic (oscillometric) and auscultatory devices by using an electronic pressure gauge that allows a nurse to measure blood pressure by using a stethoscope to listen for Korotkoff sounds.^{10,22} The first Korotkoff sound reflects the systolic blood pressure. The diastolic blood pressure is Korotkoff sound 4 or when muffling is appreciated. The disappearance of sound (Korotkoff sound 5) is thought to reflect the diastolic blood pressure in children less than 12 years of age.¹⁹ Obtaining an auscultatory blood pressure measurement in children may be challenging because their arms may be too small and contain too much fat to accommodate the cuff and the position of the stethoscope. Research and practice standards have found that Korotkoff sounds, specifically sounds 1, 4, 5, are routinely audible and provide a reliable estimate of systolic and diastolic blood pressure in children 1 to 36 months of age and older.^{10,15,19}

The oscillometric method uses an electronic device to sense pressure oscillations (vs sound) on the wall of the artery to determine blood pressure. When the cuff is inflated, the oscillations begin at approximate systolic pressure and continue until oscillations of pressure are no longer sensed (diastolic pressure).^{10,22} Mean arterial pressure is the point of maximal oscillation.^{10,22} Blood pressure measurements (systolic and diastolic) are

estimated indirectly according to oscillations sensed and an empirically derived algorithm built into the electronic device.²² Oscillometric measurements are sensitive to external movement, which results in artifact or inability to obtain an accurate measurement of blood pressure. Oscillometry may be advantageous over auscultation in newborns, as Korotkoff sounds are difficult to hear in neonates. Similar to the auscultatory method, 2 measurements should initially be made 30 seconds apart and then averaged to determine the child's blood pressure.

Best-practice recommendations suggest that blood pressure should initially be measured by using the auscultatory method until the oscillometric measurements are consistently within 5 mm Hg of the auscultatory measurements.^{10,15,19,21} Either method can be used to obtain subsequent measurements; however, elevated blood pressure measurements obtained with an oscillometric device should be verified by using the auscultatory method.^{15,21}

Palpation and Doppler ultrasound methods can be used to measure blood pressure when Korotkoff sounds are not

appreciable. The Doppler method

involves placement of an ultrasound probe over the artery distal to the cuff and inflation of the cuff; the first pulse signal heard is the approximate systolic blood pressure. Direct (arterial catheter) and Doppler methods of measuring blood pressure have yielded statistically insignificant differences in children.^{23,24} In the palpation method, the child's pulse is palpated and then disappears when the cuff is inflated; with deflation of the cuff, a pulse that reflects the systolic blood pressure is appreciated. As both systolic and diastolic blood pressure are measured with the oscillometric method, that method is preferred to both the Doppler ultrasound and the palpation methods.¹⁰

NIBP Technique. Several elements influence the accuracy of NIBP measurement, specifically cuff size, extremity used, and the patient's position. Appropriate cuff size is based on the circumference of the extremity. The cuff width should be approximately 40% of the circumference of the arm measured at a point midway between the olecranon and the acromion (Figure 1)

Nurses should ensure that the correct cuff size is selected, the arm is at the level of the patient's heart, and any movement by the patient is minimized.

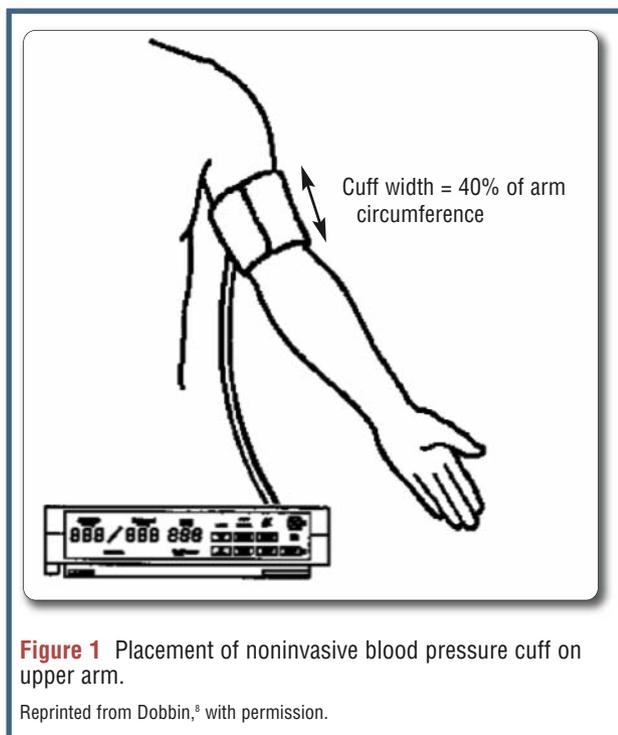


Figure 1 Placement of noninvasive blood pressure cuff on upper arm.

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and should cover 80% to 100% of the circumference of the arm.^{10,12,15,21} Clinicians should use markings on the cuff to determine the correct cuff size.¹⁵ A blood pressure cuff that is too big causes falsely low measurements and a cuff that is too small results in falsely elevated measurements. If the optimal cuff size is not available, it is preferable to use a larger blood pressure cuff.^{10,15,22,25}

Standards for blood pressure measurement are based on upper extremity measurements, with the right upper extremity the preferred limb.^{15,21} The right arm is suggested primarily for consistency in obtaining blood pressure measurements and assessing clinical trends.¹⁵ Lower extremity measurements are not recommended for children because blood pressure measurements in children's calves differ significantly from measurements obtained in the arms.²⁰ The recommended positioning of children is similar to that of adults: sitting with legs uncrossed, with the arm and the blood pressure cuff at the level of the heart.^{10,15,21} Experts state that it is acceptable for blood pressure to be measured when infants and small children are lying down.^{10,15,21} In critically ill children, a position that promotes hemodynamic stability (supine with or without head elevation) may be indicated.¹⁴

Measurement of mean arterial pressure may be helpful in the monitoring of critically ill children.^{14,26}

Standards for systolic and diastolic blood pressure are based on a child's age and height and were established to determine the presence of hypertension in children.^{14,21,25} Normal references for mean arterial pressure are lacking for children.²⁶ However, mean arterial pressure reflects an average arterial pressure and may be a helpful assessment parameter in the management of critically ill children.¹⁴ More research is needed to determine the benefit of incorporating measurement of mean arterial pressure in practice.

Implications for Practice

Blood pressure is a vital sign often measured during the care of a critically ill child. To ensure that the best measurements of blood pressure are obtained and assessed for trends, nurses should follow current evidence and measure blood pressure by using the auscultatory method and compare that measurement with the measurements obtained via the oscillometric method used for ongoing trending and treatment.^{10,12,15,21} When an oscillatory measurement is questioned, the measurement should be compared with an auscultatory measurement of blood pressure in children older than 1 year in age.^{10,15} The nurse should ensure that the correct cuff size is selected, the arm is at the level of the patient's heart, and movement is minimized, especially when oscillometric monitors are used to reduce artifacts that may interfere with the accuracy of the device's measurements of level. Failure to measure blood pressure accurately can lead to inappropriate treatment decisions.

Use of Oxygen in Patients With COPD

The use of oxygen at levels that potentially may eliminate "hypoxic drive" in patients with COPD has long been a clinical concern.²⁷ Statements such as "if you give oxygen, you will wipe out their drive to breathe and their carbon dioxide will increase" and "it is ok for the COPD patient to have a high Paco_2 and a low PaO_2 , they live there"; are often repeated in clinical practice settings, in academic classrooms, and even in textbooks. Although it is true that providing oxygen to patients with COPD may result in an elevated carbon dioxide level and potentially untoward clinical consequences, the carbon dioxide level is not elevated because of hypoxic drive. Importantly, the practice of

withholding oxygen from these patients in an effort to prevent the adverse outcomes is dangerous and unwarranted in most cases.²⁸⁻³⁰

Related Beliefs and Evidence

Hypoxic Drive: How We Got There. Patients with COPD work at a mechanical disadvantage compared with patients without the disease. Chronic inflammatory changes lead to destructive changes in the airways, pulmonary vasculature, and lung parenchyma.³¹ Thickening of smooth muscle and connective tissues in the airways leads to scarring and fibrosis, which affect effective gas exchange, causing a ventilation/perfusion (V/Q) mismatch from progressive limitations of airflow.^{32,33} The loss of lung elastance and parenchymal surface area contributes to hyperinflation, displacing the diaphragm into a flattened position. Concomitantly the chest expands into the stereotypical “barrel” shape. Exhalation is active, contributing to a high work of breathing. Eventually the effort to maintain carbon dioxide levels within normal limits becomes excessive and the patient retains carbon dioxide; the kidneys compensate by retaining bicarbonate to normalize the pH.³⁴

Previously, the belief was that the chronically elevated carbon dioxide levels blunted the normal response of the carbon dioxide chemoreceptors, resulting in the “drive” to breathe becoming reliant on the oxygen chemoreceptors’ response to low oxygen levels, a situation called “hypoxic drive.” The assumption continued with the idea that administering oxygen obliterated the drive to breathe. Although hypoxic drive is a real phenomenon, it is responsible for only approximately 10% of the total drive to breathe.^{31,32,35}

Does Giving Oxygen to Patients With COPD Result in an Elevated Carbon Dioxide Level? In a patient with COPD who has a chronically elevated carbon dioxide level, the provision of oxygen may lead to an increase in carbon dioxide level, apnea, and other related adverse outcomes. But the elevation in carbon dioxide level is not solely due to hypoxic drive. Three mechanisms are implicated: the Haldane effect, hypoxic vasoconstriction, and a decrease in minute ventilation.

The Haldane effect: The physiological mechanism associated with the ability of the hemoglobin to carry

oxygen and carbon dioxide is known as the Haldane effect. When the hemoglobin becomes desaturated, the capacity to bond with carbon dioxide increases. The provision of oxygen increases the plasma oxygen concentration, displacing carbon dioxide on the hemoglobin molecule and increasing the carbon dioxide level in the plasma. Because of the inability of the patient with COPD to increase minute ventilation and “blow off” carbon dioxide (remember the mechanical disadvantage described earlier), the net effect is an increase in carbon dioxide, lowering the pH, resulting in a respiratory acidosis.^{33,34}

Hypoxic vasoconstriction: Hypoxic vasoconstriction is a normal response to a decrease in alveolar oxygen level. This physiological mechanism is designed to move the corresponding capillary blood flow from the inactive alveolus (eg, in conditions such as pneumonia or atelectasis) to an open alveolus. In the normal lung, this adaptive physiological mechanism improves V/Q matching, decreases shunting, and improves oxygenation.³⁴ When oxygen is provided to the lung in a patient with

COPD, no hypoxic vasoconstriction occurs

Although it is true that carbon dioxide levels increase with the administration of oxygen, that increase is not due to elimination of hypoxic drive.

and V/Q matching is not optimized. Dead-space ventilation increases carbon dioxide levels as a result.^{31,33,34}

Decreased minute ventilation: The third mechanism resulting in an increased carbon dioxide level is decreased minute ventilation. Some patients with COPD actually decrease their minute ventilation as a consequence of retaining carbon dioxide and the increased dead-space ventilation further limiting the inspiratory reserve capacity.^{31,33} Although this happens only in some patients with COPD in acute respiratory failure, it may account for an additional 15% to 20% decrease in minute ventilation and a subsequent increase in PaCO₂.^{31,33,36}

Using Oxygen for Patients With COPD. Chronic hypoxemia causes the development of cor pulmonale in patients with COPD. The associated pulmonary hypertension adversely affects survival. Additional consequences of hypoxemia include poor nutritional status, cardiac modulation, poor postoperative wound

healing, and delayed recovery. Because these adverse outcomes are the result of tissue hypoxia, the provision of oxygen is warranted. EBP recommendations for patients with acute on chronic respiratory failure and patients with chronic stable COPD who have chronic hypoxemia and hypercarbia follow.^{28-30,34}

Patients with COPD who have acute on chronic respiratory failure: Although patients with COPD who have acute respiratory failure may increase their PaCO₂ with the provision of oxygen, the provision of oxygen should be ensured to increase oxygen saturation to 90%

to 93% or a PaO₂ of 60 to 70 mm Hg in most cases.^{29,32,37,38}

Oxygen should be provided to prevent hypoxia and organ failure; mechanical ventilation may be necessary to rest respiratory muscles.

Failure to administer oxygen to treat the patient's hypoxemia puts them at greater risk^{29,30,32,37,38} than does the hypercarbia because these patients with acute on chronic respiratory failure are generally well compensated with only mild to moderate decreases in pH.^{29,30,32,37,38}

In acutely ill patients with COPD who are being provided supplemental oxygen, vigilant monitoring of acid-base status is required so that interventions to prevent apnea, should it occur, are quickly initiated. More than 20 years ago, one author noted:

One should not fear apnea and cardiorespiratory arrest when giving oxygen to a patient with an exacerbated chronic obstructive lung disease and respiratory failure. Instead, one should be prepared to help the patient eliminate carbon dioxide when dead space increases. Providing assistance with the elimination of carbon dioxide has been around since the beginning of critical care medicine. It is called mechanical ventilation.³⁹

In an early study by Crossley et al,⁴⁰ 12 patients with COPD and chronic retention of carbon dioxide who required mechanical ventilation reported that an increase in oxygen levels did not cause a loss of respiratory drive and hypercarbia; rather, the mechanical ventilation provided a "rest period," improving respiratory muscle unloading and the reversal of respiratory muscle fatigue. Following the episode of mechanical support, the patients' plasma level of carbon dioxide

was lower (ie, there was no Haldane effect because the carbon dioxide had been replaced with oxygen) and/or the patients were able to maintain a more effective minute ventilation to reduce carbon dioxide levels. Treatment standards continue to support the idea that the administration of oxygen and mechanical ventilation should not be withheld from patients with acute exacerbations of COPD.^{31,41}

Patients with chronic stable COPD who have chronic hypoxemia and hypercarbia: The Global Initiative for Chronic Obstructive Lung Disease²⁹ and the Singapore Ministry of Health³⁰ agree that administration of oxygen for 15 or more hours daily can improve survival in patients with chronic respiratory failure. There is also agreement that oxygen therapy should be administered to patients with a PaO₂ of 55 mm Hg or less and an oxygen saturation of 88% or less. Both reports recommend oxygen therapy for patients with a PaO₂ of 60 mm Hg when there is evidence of pulmonary hypertension, congestive heart failure, or polycythemia (hematocrit >55%).

Implications for Practice

The sacred cow related to the use of oxygen in patients with COPD is the presumption that provision of oxygen eliminates "hypoxic drive," resulting in serious complications such as hypercarbia, acidosis, and death. Although it is true that carbon dioxide levels increase with the administration of oxygen, that increase is not due to elimination of hypoxic drive. Instead 3 mechanisms are responsible: the Haldane effect, hypoxic vasoconstriction, and a decrease in minute ventilation. Withholding oxygen from these patients in an effort to prevent hypercarbia is dangerous and unwarranted.³² Oxygen should be provided to prevent hypoxia and organ failure. Mechanical ventilation may be necessary to rest respiratory muscles. Table 2 provides a review of the classic evidence debunking the sacred cow of hypoxic drive. Understanding and carefully applying the evidence may improve these patients' well-being and extend their lives.

Intravenous Catheter Size and Blood Administration

Administration of packed red blood cells (PRBCs) is often a life-sustaining measure for patients to replace

Table 2 Debunking “hypoxic drive” and support for providing oxygen to patients with chronic obstructive pulmonary disease (COPD)

Evidence-based literature (Authors, year)	Provide oxygen for acute on chronic respiratory failure	Provide oxygen for chronic respiratory failure	Main points
Rudolf et al, ³⁸ 1977	NA	NA	Hypercapnia during oxygen therapy in acute exacerbations of chronic respiratory failure not due to “hypoxic drive” but other mechanisms
Easton et al, ³⁶ 1986	NA	NA	Minute ventilation may decrease in some patients in acute respiratory failure who are given oxygen; P _{aco} ₂ subsequently increases
Crossley et al, ⁴⁰ 1997	Yes	NA	Described response of COPD patients’ to high fractions of inspired oxygen after a period of rest on mechanical ventilation; provision of oxygen did not result in hypercarbia or respiratory muscle failure
Dick et al, ³⁵ 1997	NA	NA	Described the oxygen-induced change in ventilation and ventilatory drive in COPD; was not due to “hypoxic drive”; although hypoxic drive is a real phenomenon, it is responsible for only ~10% of the total drive to breathe
Pierson, ²⁸ 2000	NA	Yes	Dangerous to withhold oxygen. Effects of chronic hypoxia include organ failure and a shortened lifespan
Singapore Ministry of Health, ³⁰ 2006	Yes	Yes	Evidence-based recommendations for the use of oxygen in both chronic and acute on chronic COPD
West, ³⁴ 2008	NA	NA	Describes Haldane effect and hypoxic vasoconstriction as mechanisms of increased carbon dioxide with provision of oxygen in COPD
Global Initiative for Chronic Obstructive Lung Disease, ²⁹ 2009	Yes	Yes	Evidence-based recommendations for the use of oxygen in both chronic and acute on chronic COPD

Abbreviation: NA, not applicable.

lost blood or treat symptomatic anemia. The size of the intravenous catheter traditionally has been believed to influence the delivery of PRBCs: it was thought that smaller-bore catheters (eg, 22-gauge needle or smaller) result in slower infusion rates and cell hemolysis.⁴²⁻⁴⁶ The common misperception, or sacred cow, is the belief that it is necessary to insert the largest-bore intravenous catheter possible to administer PRBCs so as to avoid destruction of cells through the administration process. The goal with blood administration is to insert the best intravenous catheter according to the assessment of the patient’s venous access while making the intervention as comfortable for the patient as possible.

Related Beliefs and Evidence

It is often difficult to place a large-bore intravenous catheter in elderly and oncology patients. Forcing a large-bore needle (eg, 20-gauge needle or larger) into

a small vein can be quite painful. Using a smaller-gauge catheter (eg, 22-gauge needle or smaller) may reduce the number of needle sticks and avoid complications such as infiltrations, hematomas, and phlebitis.⁴³ A misstatement in practice is the perceived need to insert a larger-bore intravenous catheter, size 18 or 20, to safely infuse PRBCs and prevent cell hemolysis during the infusion. As far back as 1970, Moss and Staunton⁴⁷ demonstrated that drawing blood through a 25-gauge catheter did not cause hemolysis. They reported that hemolysis was caused by using a high-pressure delivery system, not by the gauge of the intravenous catheter. Herrera and Corless⁴² performed an in vitro study of 1 unit of fresh whole blood and 1 unit of PRBCs using a Harvard pump at constant speeds of 20, 50, and 100 mL/h with different needle gauges (21, 23, 24, and 27). No hemolysis occurred even at the highest speed tested with the smallest-gauge catheter.

In a more recent study, Acquillo⁴⁸ compared hemolysis of blood after transfusion at different infusion rates with various intravenous catheter gauges. The study used autologous outdated blood and autologous non-expired blood. The study was conducted in the blood bank to simulate a patient receiving a transfusion. The blood was infused by using secondary tubing attached to normal saline and an infusion pump at different rates (100, 125, 150, 999 mL/h) using 4 different intravenous catheter sizes (18-, 20-, 22-, 24-gauge). Samples assessed after transfusion showed hemolysis only in the outdated blood. No hemolysis was found in the nonexpired blood when blood was transfused at different rates or intravenous catheter gauges, reflecting practice. Acquillo also reported that PRBCs infusing through smaller-gauge catheters could be completed within 4 hours without adverse infusion outcomes.

The pediatric oncology literature has supported blood transfusions through a 24-gauge intravenous catheter without hemolysis.⁴⁹ Similarly other clinical practice literature discusses that pressure applied to PRBC infusions, not the gauge of the needle, is responsible for cell hemolysis.^{45,50,51} Hemolysis of cells occurs when pressure (eg, excessive force) is used to facilitate rapid infusion of blood products. The force applied to the blood products, rather than the gauge of the intravenous catheter is more likely responsible for cellular hemolysis.^{47,48}

Current practice guidelines established by the American Association of Blood Banks suggest that PRBCs may be safely transfused through catheters from 14 gauge through 22 gauge.⁴⁶ Additionally the American Red Cross and the Infusion Nurses Society practice guidelines incorporate the American Association of Blood Banks guidelines in their practice recommendations. Table 3 provides a summary of catheter-gauge recommendations and practice guidelines for infusion of blood products.⁴⁶

Although the body of evidence about the gauge of intravenous catheters and hemolysis of PRBCs is small, the evidence is consistent: the gauge of an intravenous catheter does not adversely affect administration of blood.^{42,43,46,48} Hemolysis of cells during transfusions is influenced by adding pressure to the infusion process.⁴⁷

Table 3 Catheter gauge recommendations and blood product infusion based on American Association of Blood Banks practice guidelines^a

Gauge of intravenous catheter	Description
22-14	Acceptable for transfusion of cellular blood components in adults (catheter size may need to be adjusted for rate of infusion)
24-22	Acceptable for transfusion of cellular blood components in infants and toddlers (may require infusion through pump or syringe)

^a Based on information from Roback et al.⁴⁶

Implications for Practice

Nursing assessment should guide the choice of intravenous catheter size in nonurgent PRBC transfusions.⁴⁶ The transfusion of 1 unit of PRBCs should result in an increase of approximately 3% in hematocrit and an increase of 1 g/dL in hemoglobin.⁴⁶ To achieve the desired clinical effects of a PRBC infusion, infusion of blood products without the application of pressure is necessary, rather than insertion of the largest intravenous catheter possible. The benefits of using a smaller-gauge intravenous catheter for the transfusion of PRBCs are increased comfort and satisfaction for patients, potentially preventing the need for insertions of a central catheter, thus eliminating and reducing costs overall.⁴⁸

Infection Control Precautions

Health-care acquired infections (HAIs) affect an estimated 4.5 of every 1000 hospital admissions.⁵² Prevention of infections that occur during hospitalization (eg, surgical site infections, catheter-associated urinary tract infections, central catheter bloodstream infections) is essential to providing high-quality care. Reducing the spread of multidrug-resistant organisms (MDROs) is equally important. Infection prevention and control interventions are often used by health care workers when patients are in isolation for known infection.^{53,54} The sacred cow is related to the consistency with which health care workers do or do not perform infection prevention activities, including hand hygiene and walking into isolation rooms without protective gear when the clinician does not plan to touch the patient.⁵³⁻⁵⁵

During the past 3 decades, the increasing prevalence of HCAs and MDROs such as methicillin-resistant *Staphylococcus aureus*, vancomycin-resistant enterococci, and certain gram-negative bacilli in US hospitals has adversely affected patient safety.^{52,54} HCAs and MDROs are associated with increased length of stay for patients, hospital costs, and mortality.^{54,56} Consistently implementing infection prevention measures is necessary to protect patients and control the spread of infections within critical care practice environments. Despite years of research and evidence supporting interventions to prevent infection, health care workers' translation of the evidence into daily practice is lacking.⁵⁶

Related Beliefs and Evidence

One goal in health care is to prevent HCAI, and when an infection occurs, implement a series of actions to control the spread of the infection to other patients.^{54,57} The concept of infection control is more frequently referred to today as infection prevention, but the 2 concepts work in tandem: specific interventions must be implemented consistently by health care workers to prevent HCAI in patients, and when infections are present, health care workers must take action to control the spread of the infection.⁵²⁻⁵⁶ Prevention and control of infections in health care settings is an "old" idea and has been evident in the literature for more than 50 years.^{53,55,56} Regulatory agencies, (eg, the Joint Commission's National Patient Safety Goals, the World Health Organization, the Centers for Disease Control and Prevention) have provided standards and quality improvement programs to address the problem of HCAs.^{52,56,58-61} In addition, the Centers for Disease Control and Prevention has established "never events" in which HCAs are categories of adverse outcomes for patients that may result in lack of reimbursement for hospitalizations.⁵⁶ Evidence-based principles of infection prevention have 4 primary tenets: (1) hand hygiene; (2) barrier precautions; (3) decontamination of environment, items, and equipment; and (4) antibiotic stewardship.^{55,56,60} Providing patient care that prevents infection requires all 4 tenets be implemented. Critical care nurses play an essential role in the consistent implementation and role modeling of effective strategies for infection prevention to stop HCAs.

Hand Hygiene. Evidence to support the importance of hand hygiene in preventing infection dates back to the 1800s.⁵⁶ The World Health Organization published guidelines for hand hygiene in health care to increase patient safety by ensuring clean care.⁶⁰ The guidelines state that for transmission of organisms from health care workers to patients, the following sequence of events must occur: (1) The organisms must be present on the patient's skin or inanimate objects and transfer to the health care worker's hands, (2) The organism must survive for several minutes on the hands of the health care worker, (3) Hand washing or hand antisepsis by the health care worker is inadequate or omitted, and (4) The contaminated hands of the health care worker come in direct contact with another patient or inanimate object that will be in direct contact with the patient.^{55,59} The health care worker acts as a vector of spreading organisms to susceptible patients through contaminated hands (Figure 2).⁶⁰

The easiest and most effective way to reduce the risk of contamination is consistent hand hygiene before and after interaction with the patient or environment. Hand hygiene should last for 40 to 60 seconds, ensuring that all areas of the hand surfaces have been decontaminated. The Centers for Disease Control and Prevention

Successful infection prevention requires (1) hand hygiene; (2) barrier precautions; (3) decontamination of environment, items, and equipment; and (4) antibiotic stewardship.

and The World Health Organization provide educational materials on correct hand hygiene procedures (http://www.who.int/gpsc/5may/How_To_HandRub_Poster.pdf), and the World Health Organization's hand hygiene guideline publication summarizes the evidence related to hand hygiene practices (http://whqlibdoc.who.int/publications/2009/9789241597906_eng.pdf).

Compliance with hand hygiene by all health care workers before and after contact with a patient ranges from 5% to 89%, with a mean reported compliance of 50%.⁶²⁻⁶⁴ The frequency of hand hygiene reported in the literature varies by specialty, and barriers to hand hygiene range from access to alcohol hand rubs, location and access to soap and water, intensity of practice (eg, intensive care unit), wearing gloves and gowns, and



CLEAN HANDS SAVE LIVES

Protect patients, protect yourself



Alcohol-rub or wash
before and after **EVERY** contact.



www.cdc.gov/handhygiene

Figure 2 Centers for Disease Control and Prevention's post about hands of health care workers and spreading of infections.

Table 4 Barriers to health care workers' adherence to hand hygiene^a

Observed risk factors for poor adherence to hand hygiene practices

- Provider's status (eg, physician, nursing assistant)
- Male sex
- Working in an intensive care unit
- Wearing gowns/gloves
- High number of opportunities for hand hygiene per hour of patient care

Self-reported factors for poor adherence with hand hygiene

- Hand hygiene agents cause skin irritation and dryness
- Skins are inconveniently located
- Lack of soap and paper towels
- Too busy
- Understaffing/overcrowding
- Perceived low risk of acquiring infection from patients
- No role modeling from peers and superiors
- Disagreement with hand hygiene guidelines/recommendations for practice

Additional perceived barriers to appropriate hand hygiene

- Lack of active participation in promotion of hand hygiene by the health care organization
- Lack of role modeling
- Lack of administrative sanction of noncompliers or rewarding of compliers
- Lack of organizational focus on hand hygiene safety climate

^a Based on information from Cohen et al,⁶² The Joint Commission,⁶⁵ Hugonnet et al,⁶⁶ and Backman et al.⁶⁷

irritant contact dermatitis associated with cleansing agents (see Table 4^{62,65-67}). Strategies found to improve hand hygiene include placing hand rubs at point of access to the patient and environment/room,⁶⁷ role modeling good hand hygiene practice,^{60,61} and providing expecting visual and verbal reminders.^{60-62,65} Steps to help reduce irritation from frequent hand hygiene include thoroughly drying hands before applying gloves and rehydrating the skin with moisturizers.⁶⁰ Making hand hygiene a personal and unit priority assists with overcoming perceived barriers to maintaining clean hands. Hand hygiene

remains the single most effective mechanism to reduce HCAIs.^{52,54,56,60,62,64,65,67} Critical care nurses need to practice effective and consistent hand hygiene as the first and last step of any interaction with a patient or a patient's environment so as to prevent and contain infections.

Environmental Considerations. Environmental considerations encompass several different interventions to include standard precautions, specific isolation precaution interventions based on the organism's vector of transmission (eg, contact, airborne, droplet), room and equipment decontamination, and decontamination of health care workers' clothing and items. Providers' knowledge and compliance with isolation precautions (barrier precautions) are essential in reducing the spread of organisms.

Standard precautions (eg, hand hygiene and use of gloves, gown, mask, goggles as appropriate) imply a routine level of intervention that health care workers will engage in during patient care as a "standard of care."^{55,58,60,63} Isolation precautions are not a medical determination, but are based in infection control principles to contain infection and should be implemented when the risk of pathogen transmission increases. Critical care nurses can and should implement isolation precautions on the basis of knowledge obtained from the patient's chart, specifically any admitting diagnosis suggesting an infection-related cause requiring treatment. Collaboration with a prescribing provider is necessary to determine when isolation precautions are no longer needed on the basis of the treatment's effectiveness (eg, the infection clears). The Centers for Disease Control and Prevention and hospitals provide clear guidelines for different types of isolation based on the microorganisms' mode of transmission.

Environmental control reduces the spread of organisms to inanimate objects or surfaces that act as an infectious source. In a classic study, Hayden and colleagues⁶⁸ found that health care workers were as likely to contaminate their hands with vancomycin-resistant enterococcus after environmental contact as after direct contact with

a patient. In that study,⁶⁸ the use of gloves was found to protect the health care workers, but gloves were worn less often by providers having environment contact only (eg, touching an infusion pump, monitor, bedside table). *Clostridium difficile* infections are known to spread through environmental sources such as blood pressure cuffs, thermometers, and contaminated hands of health care workers.^{62,69} Morgan et al⁷⁰ reported that 20% of interactions between health care workers and patients in contact precautions for MDROs resulted in contamination of the providers' gloves or gowns. A systematic review by Kramer et al⁶⁹ reported that organisms live on inanimate surfaces for hours to months if no regular disinfection is performed and that the most likely vector in the transfer of organisms from contaminated surfaces was health care workers' hands. Thus the expectation to perform rigorous hand hygiene every time a health care worker enters and exits a room; even if the health care worker did not touch the patient, the inanimate objects in the room are contaminated as well.^{59,62,63,69}

Health care workers' clothing has been found to be contaminated after working in a hospital.⁷¹ Connecting providers' contaminated clothing to a patient's infection or outbreak, however, is not well supported in the literature.^{71,72} Health care workers nevertheless should be aware of clothing contamination and take necessary steps to prevent the spread of organisms. Infrequently laundered clothing (eg, neckties, lab coats, stethoscope covers) becomes colonized with organisms, including MDROs.^{70,72-76} In a few studies of contamination of nurses' uniforms, researchers have reported that up to 65% of nurses' uniforms are contaminated with body fluids and bacteria/MDROs at the end of the shift.^{70,72,73,77} Researchers exploring laundering of health care workers' clothing /uniforms (except for clothing

Table 5 Recommendations for laundering uniforms

Wash uniforms separately from other clothing ^{80,81}
Fully submerge clothing during washing process; dilution is a key component of removing microbial contamination ⁷⁵
Use water temperature 60°C - 65°C ⁷⁹⁻⁸¹
Tumble dry uniforms ⁸¹
Ironing may serve to additionally reduce microbial counts after laundering ^{77,78,80,81}
Store clean uniforms in a manner that will ensure cleanliness ⁷⁹

of operating room personnel) have concluded that uniforms laundered at home are comparable to uniforms subjected to institutional laundering.^{55,75,77-81} Table 5 provides guidelines for laundering of uniforms.

Knowledge of and compliance with barrier precautions and health care workers' interventions to reduce environmental contamination are necessary to prevent the spread of infection. Everything that critical care nurses touch, including their uniforms, during the course of a shift, is a potentially contaminated surface. To reduce the spread of organisms, nurses must practice barrier precautions and consistently perform hand hygiene.

Antibiotic Stewardship. Preventing antibiotic misuse has long been argued as a necessary responsibility of providers to reduce rates of infection with MDROs. The rise of MDROs has prompted multiple interventions, ranging from doing nothing to placing patients in isolation from admission until surveillance cultures show no growth.^{54,59,82} The evidence supporting surveillance cultures is weak and may increase misuse of antibiotics.^{82,83} Placing all patients in contact isolation upon admission to the intensive care unit is unnecessary and creates additional expense. Current evidence suggests that only patients with known colonization of MDROs and active infections should be placed immediately in isolation and should have appropriate cultures for treatment obtained.^{54,55,59,82,83} If antibiotics are prescribed, a growing body of evidence supports the incorporation of monitoring of serum levels of procalcitonin to assist with evaluating the duration of antibiotic therapy.⁸⁴ Focusing on effective hand hygiene and environmental cleaning programs is more cost-effective and successful in reducing the spread of infection than the practice of universal culture screening programs.^{82,83}

Implications for Practice

Patients do not enter hospitals expecting to have infections controlled; rather, patients expect infections to be prevented.^{61,85} A prerequisite for effective HCAI reduction is health care workers' compliance with strategies to prevent infections. Critical care nurses are in a pivotal position to lead by example, consistently practicing evidence-based interventions to prevent infection. Ensuring environmental cleanliness and steadfast

practice inclusive of barrier precautions and personal protective clothing are basic actions to reduce the spread of infection. The evidence to support the importance of hand hygiene is vast.^{58,60} It is time to simply "do it." The daily work of a nurse is busy; however, it is important for nurses to examine their personal practice and consistently implement practices to prevent infection.

Conclusion

Evaluating our practice continually and adopting EBP interventions as research evolves and new evidence becomes available should be the norm in our practice. Some traditional practices of critical care nurses should be replaced with evidence-based practices. As Mick⁸⁶ recently stated, such practices are ones where "everyone is aware there are no benefits to this practice and would like to get rid of it." The 4 practices addressed in this article should be replaced with practice reflective of current best evidence and research to optimize patients' outcomes. Andy Warhol said it well: "They always say time changes things, but actually you have to change them yourself."⁸⁷ Critical care nurses provide an essential contribution to the translation of best evidence into practice by continually moving nursing practice forward in the care of the most vulnerable patients. **CCN**

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None reported.



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To learn more about traditions in evidence-based nursing practice, read "Evidence-Based Practice Habits: Putting More Sacred Cows Out to Pasture" by Makic et al in *Critical Care Nurse*, April 2011; 31(2):38-62. Available at www.ccnonline.org.

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Putting Evidence Into Nursing Practice: Four Traditional Practices Not Supported by the Evidence

Facts

- Research suggests that integration of evidence-based practice into daily clinical practice remains inconsistent.
- We cannot knowingly continue clinical practice interventions that are not supported by current best evidence, especially if those actions are known to be unhelpful and possibly harmful.

Measuring Blood Pressure Noninvasively in Children

- Nurses should measure blood pressure by using the auscultatory method and compare that measurement with the measurements obtained via the oscillometric method used for ongoing trending and treatment.
- Nurses should ensure that the correct cuff size is selected, the arm is at the level of the patient's heart, and any movement by the patient is minimized, especially when oscillometric monitors are used to reduce artifacts that may interfere with the accuracy of the device's measurements of level.

Use of Oxygen in Patients With Chronic Obstructive Pulmonary Disease

- Although it is true that carbon dioxide levels increase with the administration of oxygen, that increase is not due to elimination of hypoxic drive. Instead 3 mechanisms are responsible: the Haldane effect, hypoxic vasoconstriction, and a decrease in minute ventilation.
- Withholding oxygen from patients with chronic obstructive pulmonary disease in an effort to prevent hypercarbia is dangerous and unwarranted.

Oxygen should be provided to prevent hypoxia and organ failure.

- Oxygen should be provided to prevent hypoxia and organ failure; mechanical ventilation may be necessary to rest respiratory muscles.

Intravenous Catheter Size and Blood Administration

- Nursing assessment should guide the choice of intravenous catheter size in nonurgent packed red blood cell transfusions.
- To achieve the desired clinical effects of a packed red blood cell infusion, infusion of blood products without the application of pressure is necessary, rather than insertion of the largest intravenous catheter possible.
- Using a smaller-gauge intravenous catheter to transfuse packed red blood cells increases patients' comfort and satisfaction, and by potentially avoiding the need for insertion of a central catheter, eliminates some costs and thus reduces costs overall.

Infection Control Precautions

- Successful infection prevention requires (1) hand hygiene; (2) barrier precautions; (3) decontamination of environment, items, and equipment; and (4) antibiotic stewardship.
- Health care workers' consistent compliance with strategies to prevent infections is essential for effective health-care acquired infection reduction.
- Critical care nurses are in a pivotal position to lead by example, consistently practicing evidence-based interventions to prevent infection. **CCN**

Makic MBF, Martin SA, Burns S, Philbrick D, Rauen C. Putting evidence into practice: four traditional practices not supported by the evidence. *Critical Care Nurse*. 2013;33(2):28-44.

CNE Test Test ID C1322: Putting Evidence Into Nursing Practice: Four Traditional Practices Not Supported by the Evidence

Learning objectives: 1. Identify key evidence-based components that demonstrate how research can be translated into bedside nursing practice 2. Analyze 4 nursing practice issues to understand how to incorporate evidence-based guidelines into nursing interventions 3. Validate evidence-based guidelines and nursing research to incorporate practice changes in your own work environment

1. Evidence-based practice (EBP) considers the best evidence from studies, patient care data, clinical experience, and expertise as well as which of the following?

- a. Patients' preferences and values
- b. Economics of health care agencies
- c. National professional organizations
- d. Government agencies

2. "Sacred cows" can be defined as which of the following?

- a. Procedures that are invasive to the patient
- b. Practices that have better patient outcomes
- c. Practices steeped in tradition rather than best evidence
- d. Practices that are tried and true

3. What must critical care nurses do in order to achieve best practice?

- a. Identify a clinical question
- b. Embrace EBP as the norm
- c. Critique current evidence
- d. Evaluate the translation of evidence into practice and outcomes

4. The evidence shows that noninvasive blood pressure (NIBP) in children older than 1 year of age should be measured via which of the following methods?

- a. Doppler method
- b. Oscillometric method
- c. Palpation method
- d. Auscultation method

5. Best-practice recommendations suggest that blood pressure should initially be measured by using the auscultatory method until the oscillometric measurements are consistently within how many mm Hg of the auscultatory measurements?

- a. 5 mm Hg
- b. 10 mm Hg
- c. 15 mm Hg
- d. 20 mm Hg

6. What is a normal response to a decrease in alveolar oxygen level?

- a. Haldane effect
- b. Minute ventilation
- c. Hypoxic vasoconstriction
- d. Hypoxic drive

7. What causes the development of cor pulmonale in patients with chronic obstructive pulmonary disease (COPD)?

- a. Hypercapnia
- b. Chronic hypoxemia
- c. Pulmonary emboli
- d. Hypocarbica

8. Chronic hypoxia in COPD patients can result in which of the following?

- a. Organ failure
- b. Increase in blood pH
- c. Decrease in blood bicarbonate level
- d. Hypocapnia

9. Pressure applied to packed red blood cell infusions is responsible for which of the following?

- a. Polycythemia
- b. Decrease in hemoglobin
- c. Anemia
- d. Cell hemolysis

10. Transfusion of 1 unit of packed red blood cells should result in an increase of what percentage in hematocrit?

- a. 1%
- b. 2%
- c. 3%
- d. 4%

11. Which of the following gauges of intravenous catheters are approved by the American Association of Blood Banks for blood product infusion in infants and toddlers?

- a. 14-20
- b. 18-22
- c. 22-24
- d. 24-26

12. Which of the following actions is unnecessary and creates additional expense?

- a. Home laundering of uniforms
- b. Placing all patients in contact isolation upon admission to the intensive care unit
- c. Culturing nasal swabs of all new admissions
- d. Instituting isolation precautions when the risk of pathogen transmission increases

Test answers: Mark only one box for your answer to each question. You may photocopy this form.

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