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Blood Cultures Drawn From Central vs Peripheral Lines: Does it Matter?

ABSTRACT & COMMENTARY

Synopsis: This study of blood culture draw sites in febrile ICU patients found that it is safe and reliable to obtain at least 1 of the blood cultures from a central venous catheter, irrespective of the type of catheter in place.

Source: Beutz M, et al. Clinical utility of blood cultures drawn from central vein catheters and peripheral venipuncture in critically ill medical patients. *Chest*. 2003;123(3):854-861.

IN THIS ARTICLE BY KOLLEF'S GROUP AT WASHINGTON University, the authors explore the usefulness of obtaining blood cultures in febrile ICU patients, using existing central venous catheters as one of the sites for obtaining blood cultures. Beutz and colleagues prospectively collected data from medical ICU patients over 9 months. The goal was to establish the sensitivity and specificity of blood cultures obtained from central venous catheters and peripheral sites using a very reasonable definition of "true bacteremia." The latter was considered to be present when 2 physician investigators blinded to the culture site analyzed the results following these pre-established criteria: (1) Certain pathogens such as *Staphylococcus aureus*, Gram-negative bacilli, and *Candida* species identified from any culture sample; or (2) common skin contaminants (coagulase-negative staphylococci, diphtheroids, *Propionibacterium* species, *Bacillus* species, or *Micrococcus* species) or viridans streptococci isolated from 2 or more culture samples from different sites and associated with fever, rigors or hypotension. Similar criteria were applied for polymicrobial infections. Other clinical information was also used to classify polymicrobial bacteremia as true bacteremia. Paired blood cultures drawn by standard technique and equipment were included in the study.

During the study period, 300 blood culture sets met the entry criteria for paired blood cultures. Each paired culture was used as an independent observation, even when obtained from the same patient. In 235 of the paired cultures, both the central venous catheter- and peripherally drawn cultures were negative. Sixty-five

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paired cultures had at least one positive site. Sixteen were catheter-positive/venipuncture-positive, 17 were catheter-negative/venipuncture-positive, and 32 were catheter-positive/venipuncture-negative. The majority of the catheter specimens (223) came from traditional multi-lumen catheters, with others obtained from a variety of central accesses such as including Hohn catheters, dialysis catheters, and Cordis catheters. Using the investigators' pre-established criteria, 34 paired culture results were classified as true bacteremia (11.3%; 95% CI, 7.8-14.8%). All 16 catheter-positive/venipuncture-positive patients were classified as having true bacteremia. Additionally, 6 out of 17 catheter-negative/venipuncture-positive and 12 out of 32 catheter-positive/venipuncture-negative pairs were classified as true bacteremia.

Using Beutz et al's definition of true bacteremia, the sensitivity of catheter drawn specimens was 82.4%, as compared to 64.7 % for peripherally drawn specimens. The specificities for true bacteremia from these specimens were 92.5% and 95.9%, respectively. The positive

predictive values were 58.3% for catheter drawn specimens compared to 66.7% for peripherally drawn specimens, whereas the negative predictive values were 97.6% and 95.5%, respectively.

■ COMMENT BY UDAY NANAVATY, MD

Febrile illness in the ICU is a very common problem. There are multiple infectious and noninfectious causes of fever in the ICU patient. When fever is associated with clinical manifestations of sepsis, it is routine to obtain paired blood culture specimens. It has been shown before that multiple cultures (up to 3 sets) increase the yield to identify the existence of bacteremia.

There are many problems with obtaining multiple cultures in ICU patients. Edema may make access to peripheral veins difficult. Peripheral catheters are often inserted prior to the patient's arrival in ICU, again limiting the sites available for peripheral blood draws. In 1998 guidelines for evaluation of fever in ICU, O'Grady and colleagues¹ suggested that blood cultures can be obtained from existing central venous catheters along with a peripheral site, but that care should be taken to obtain cultures within a reasonable interval between the 2 draws, that the drawing of cultures should not delay initiation of antibiotics if clinically indicated, especially in patients with new manifestations of sepsis, and that the interpretation of culture results should take the clinical picture into consideration.

This study further adds to the literature by suggesting that it is safe and reliable to obtain at least one of the blood cultures in febrile ICU patients from a central venous catheter, irrespective of the type of the catheter in place. It further suggests that if the probability of bacteremia is estimated to be 10% or less, the catheter-drawn culture has high negative predictive value. These data and conclusion are similar to those of a study in oncology patients with central venous catheters.² When interpreting studies involving the usefulness of a test, it is helpful to remember the formulas used to derive the sensitivity, specificity, positive predictive value and negative predictive values:

- Sensitivity (the proportion of people with disease who have a positive test) = the proportion of patients with catheter positive results among true bacteremia patients;
- Specificity (the proportion of people free of disease who have a negative test) = the proportion of patients with catheter negative results among those free of true bacteremia;
- Positive Predictive Value (the proportion of people with positive test who have disease) = the proportion

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of patients with catheter positive results among true bacteremia; and

- Negative Predictive Value (the proportion of people with negative test who are free of disease) = the proportion of patients with catheter negative results among those who do not have true bacteremia.

In conclusion, this study suggests that clinicians should make case-by-case assessments of blood culture results in medical ICU patients with central venous catheters. It is unclear to me whether it is possible to obtain specimens from 2 different existing catheters, such as 2 central catheters, a central catheter and a dialysis catheter, or a central catheter and an arterial catheter. If such paired cultures were as reliable as peripherally drawn cultures, it would save sticks and a lot of nursing time across all ICUs. ■

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Cardiac Troponins in Pulmonary Embolism

ABSTRACT & COMMENTARY

Synopsis: *In patients with pulmonary embolism, elevated plasma levels of cardiac troponins help to identify a subgroup of patients who are at high risk and who may benefit from more aggressive treatment.*

Source: Janata K, et al. Cardiac troponin T in the severity assessment of patients with pulmonary embolism: Cohort study. *BMJ.* 2003;326:312-313.

JANATA AND COLLEAGUES CARRIED OUT A STUDY TO assess the association between serum concentrations of cardiac troponin T and severity of pulmonary embolism as well as the role of troponin T as a predictor of mortality. They assessed 136 consecutive patients who were admitted to the emergency department of a tertiary care university hospital with pulmonary embolism, confirmed by computed tomography or

scintigraphy, between December 1999 and November 2001. Two patients with terminal illness and 7 patients admitted after out-of-hospital cardiac arrest were excluded. In 106 patients troponin concentrations were determined in the first 12 hours after admission. The severity of the event was classified according to the grading system by Grosser¹ (see Table). Right ventricular strain in the electrocardiogram was defined as right bundle branch block, T wave inversion in precordial leads, or presence of the S₁Q₃T₃ pattern.

Six patients had fulminant pulmonary embolism; in 37 it was massive, in 62 it was submassive, and in 1 it was minor. Janata et al reported that troponin concentrations increased with increasing severity of pulmonary embolism ($r = 0.56$; $P < 0.001$). Added to that, the median troponin concentration was higher in patients with electrocardiographic signs of right ventricular strain than in patients without these signs (0.03 ng/mL vs < 0.01 ng/mL; $P < 0.001$). The same happened when signs of right ventricular strain were considered in 93 patients who underwent echocardiography.

As for the prediction of mortality, troponin concentrations were higher in the 5 patients who died than in survivors (0.18 ng/mL vs < 0.01 ng/mL; $P < 0.001$). A cut-off value for troponin of 0.009 ng/mL was a suitable predictor of death in hospital. The area under the curve was 0.92, and the cut-off value had a sensitivity of 0.80 and a specificity of 0.92. The negative predictive value was 0.99 and the positive predictive value 0.34.

■ COMMENT BY FRANCISCO BAIGORRI, MD, PhD

A high incidence of clinically unrecognized myocardial injury, according to elevated levels of cardiac troponins, has been reported in critically ill patients, and is associated with increased morbidity and mortality.² In my hospital almost 30% of ICU patients with acute noncardiac disease have elevated levels of troponin I in the first 24 hours after admission. Tachycardia, arrhythmia, hypotension and treatment with inotropic drugs have all been associated with higher serum troponin concentrations.³

As far as pulmonary thromboembolism is concerned, it has been shown that an elevated cardiac troponin T level is an independent risk factor for a fatal outcome.⁴ As the study of Janata et al supports, right ventricular dysfunction is more often found in patients with elevated troponins. Experimental and clinical evidence suggest that myocardial ischemia and even right ventricular infarction may result from an acute rise in pulmonary artery pressures and may then cause right ventricular failure which correlates with increased risk of death.

Right ventricular dysfunction also is a well-known

Table

Classification of the Severity of Pulmonary Embolism¹

Clinical indicators	I (minor)	II (submassive)	III (massive)	IV (fulminant)
Symptoms and signs	Transient symptoms: dyspnea, pleuritic pain, hemoptysis, fever	Persistent moderate symptoms: sudden dyspnea, tachypnea, tachycardia, pain	Persistent severe symptoms: dyspnea, tachypnea, cyanosis, tachycardia, syncope	Persistent severe symptoms, plus: shock, cardiac arrest
Systemic blood pressure	Normal	Normal (slightly depressed)	Hypotension	Severe hypotension
Pulmonary artery oxygen content (mm Hg)	Normal	80	< 70	< 60

complication of chronic obstructive pulmonary disease. In fact, it has been recently reported that elevated troponin I is quite frequent in patients with chronic obstructive pulmonary disease (18%) and it is a strong and independent predictor of in-hospital death in these patients.⁵ From all this it follows that elevated plasma levels of troponins help to identify a subgroup of patients who are at high risk. However, further studies are needed to determine whether specific and early medical interventions (such as thrombolytics and inotropic vasoactive drugs) in patients with troponin elevation decrease mortality rate.

On the other hand, another lesson to be learned from these results is that we should be aware of conditions such as pulmonary embolism that are associated with elevated cardiac troponin levels in the absence of an acute coronary syndrome. For instance, pulmonary embolism should be considered in the differential diagnosis of patients presenting with undifferentiated chest pain or dyspnea and an elevated cardiac troponin level.⁶ ■

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Special Feature

Adrenal Insufficiency in Critically Ill Patients

By Karen Johnson PhD, RN

IN 1936 SELYE NOTED THAT RATS EXPOSED TO STRESSORS had enlarged adrenal glands. In the late 1940s, Kendall and Reichstein isolated cortisone as the active principle of the adrenal glands. In more recent years our understanding of the hypothalamic-pituitary-axis has grown immensely. The purpose of this special feature is to examine the adrenal corticosteroid function and adrenal insufficiency in critical illness.

The Hypothalamic-Pituitary-Adrenal Axis

The integrity of the hypothalamic-pituitary-adrenal (HPA) axis is a major determinant of the host's response to stress.^{1,2} When confronted with stressors (trauma, infection, surgery, hypotension, etc), the HPA axis is activated (*see Figure 1*). The hypothalamus releases corticotropin releasing hormone (CRH), which in turn does 3 things: 1) It stimulates sympathetic nervous system to release (a) norepinephrine from its postganglionic neurons, and (b) epinephrine from the adrenal medulla; 2) It stimulates the posterior pituitary to release antidiuretic hormone; and 3) It stimulates the anterior pituitary to release adrenal corticotropin hormone (ACTH), which in turn stimulates the adrenal cortex to

release the mineralocorticoid hormone aldosterone and the glucocorticoid hormone cortisol. Activation of the HPA axis, through its hormones, enhances cardiovascular function, substrate metabolism, and inhibits immune mediated inflammation.

Adrenal Cortex Corticosteroid Production and Function

With severe illness, trauma, infection, burns, or surgery, cortisol production increases 6-fold and this increase is roughly proportional to the severity of the illness.³⁻⁵ Cortisol is derived from cholesterol in the adrenal cortex under negative feedback control of the HPA axis. Approximately 90-95% of the cortisol in the plasma binds to plasma proteins (cortisol-binding globulin). This high degree of binding to proteins slows the elimination of cortisol from the plasma, giving cortisol a relatively long half-life of 60-90 minutes. Cortisol is degraded mainly in the liver and conjugated to an inactive form. Some of the conjugates are excreted in the bile and feces. The majority of the conjugates enter the circulation as highly soluble substances that are filtered by the kidneys and excreted in the urine. Therefore, liver disease can markedly impair the inactivation of cortisol and renal disease can reduce the excretion of inactive conjugates.

Cortisol is vitally important for carbohydrate, protein, and fat metabolism and for its anti-inflammatory effects (*see Table 1*). Cortisol's net effects are to metabolically relieve the damaging nature of the stressor. Cortisol secretion has been estimated to be approximately 10 mg/m² per day (equivalent of 20-30 mg/d of hydrocortisone or 5-7 mg/d of oral prednisone).³

Adrenal Insufficiency

Decreased production and/or secretion of cortisol can occur with adrenal insufficiency as a result of primary or secondary causes. Chronic primary adrenal insufficiency (Addison's Disease) is most commonly caused by autoimmune adrenalitis (slow destruction of the adrenal cortex by cytotoxic lymphocytes) and is sometimes accompanied by autoimmune thyroid disease and other autoimmune endocrine disorders (autoimmune polyglandular syndromes).⁶

Secondary causes of adrenal insufficiency include necrosis of the adrenal gland, head trauma, pituitary lesions, and long-term glucocorticoid therapy. Head injury, pituitary infarction, and central nervous system depressants can impair CRH release from the hypothalamus.⁷ Cytokines, anesthetics, and anti-infective agents can impair adrenal cortisol synthesis, exogenous administration of corticosteroids, hemorrhage, infection, and HIV infiltration.⁸ Adrenal hemorrhage can occur in critically ill patients with septicemia and underlying coagulopathy.⁸ Inflammatory cytokines during sepsis also appear to promote corticosteroid resistance so that normal adrenal responses may be insufficient.⁸⁻¹⁰ Long-term administration of corticosteroid therapy induces adrenal atrophy and suppresses CRH production. These effects can persist for months after cessation of corticosteroid therapy.¹¹ The individual effect is highly variable and depends on the dose and duration of treatment but should be anticipated in any patient who has been receiving more than 30 mg of hydrocortisone (7.5 mg prednisone; 0.75 mg dexamethasone) per day for more than 3 weeks.⁸

Annane and colleagues suggested the presence of a relative adrenal insufficiency in critically ill patients.¹² "Functional adrenal insufficiency" is a term used to describe subnormal adrenal corticosteroid production during acute illness.¹³ It has been estimated that the incidence of this functional adrenal insufficiency approaches 30% of all ICU patients.¹⁴ The incidence of adrenal insufficiency in patients with septic shock has been reported to be 54%.¹⁵ Inability to mount an adequate adrenal corticosteroid response increases mortality during critical illness.^{11,16} Therefore, early identification of functional adrenal insufficiency and treatment with exogenous corticosteroids may be beneficial.⁸

Diagnosis of Adrenal Insufficiency

Many of the symptoms of adrenal insufficiency are nonspecific and occur insidiously, but can include:^{6,8} weakness, fatigue, depression, anorexia, weight loss, nausea, vomiting, diarrhea, and a craving for salt. Findings on physical examination can include hyperpig-

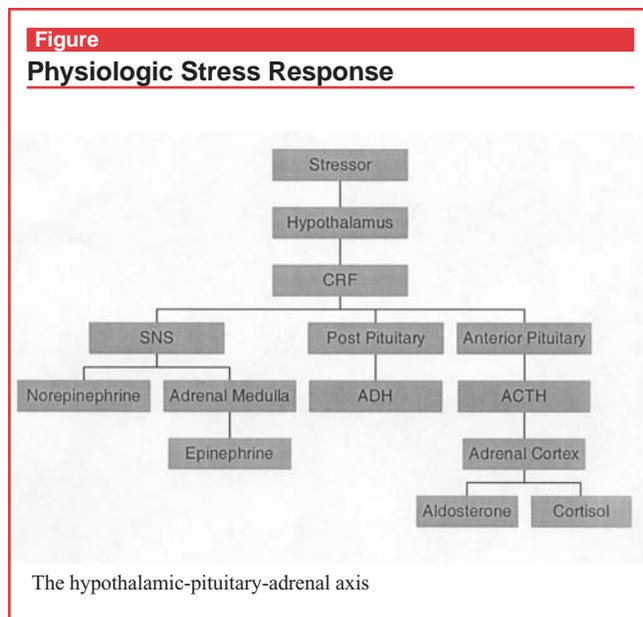


Table 1**Effects of Cortisol**

Carbohydrate Metabolism	Stimulation of gluconeogenesis Decreased glucose use by cells
Protein Metabolism	Reduction in cellular protein Increase in plasma and liver proteins Mobilization of amino acids from extra-hepatic tissues Increase in protein synthesis in the liver
Fat Metabolism	Mobilization of fatty acids from adipose tissue Cells shift from using glucose for energy to use of fatty acids
Anti-inflammatory Effects	Blocks early phases of inflammatory response Causes rapid resolution of inflammation
Other	Facilitates catecholamine production Modulates β -adrenergic receptor synthesis, regulation, coupling, responsiveness

mentation, vitiligo, decreased body hair, fever, hypotension, and tachycardia. Laboratory findings may include hyponatremia, hypoglycemia, hyperkalemia, and eosinophilia.

When one considers these manifestations in the face of critical illness, it is obvious that adrenal insufficiency is difficult to detect in this patient population. Many patients are in altered levels of consciousness and are unaware of the physical symptoms. Fever and hypotension are common clinical findings in patients with hypovolemia and or sepsis. Electrolyte abnormalities in the critically ill are not only common, but also masked by continuous and frequent electrolyte administration. Hypoglycemia and eosinophilia are uncommon in critically ill patients and should alert clinicians to the possibility of adrenal insufficiency.¹⁷ A high index of suspicion of adrenal insufficiency should be considered with the presence of unexplained catecholamine-resistant hypotension⁶ despite adequate fluid resuscitation and ongoing evidence of inflammation (without an obvious source) that does not respond to empirical treatment.^{8,13,18}

Evaluation of adrenal function can be made using serum cortisol levels and the corticotropin stimulation tests (see Table 2).

Cooper and Stewart⁸ have recently proposed an algorithm to investigate adrenal insufficiency in critically ill patients on the basis of these tests. If adrenal insufficiency is suspected, a random cortisol sample is drawn. If the results are < 15 m/mL, then adrenal insufficiency is likely and corticosteroid replacement should be con-

sidered. If the random cortisol is 15-34 m/dL, a corticotropin stimulation test is performed. Cosyntropin (synthetic peptide consisting of the first 24 amino acids of corticotropin) 250 m IV or IM is administered with plasma cortisol levels measured before, 30 and 60 minutes after administration. A small increase (< 9 m/dL) from the baseline cortisol level to the highest cortisol level (30, 60 minutes) has been associated with increased mortality^{20,21} and the diagnosis of adrenal insufficiency is likely. Absolute increment of cortisol concentration less than 9 m/dL may be associated with impaired vasopressor responsiveness to norepinephrine.²² Corticosteroid replacement should be considered. If the levels are ± 9 m/dL, functional adrenal insufficiency is unlikely. Critically ill patients with established adrenal insufficiency should be treated with hydrocortisone 60 mg intramuscularly or intravenously every 6 hours.⁸

Impaired Adrenal-Cortical Reserve in Septic Shock

During sepsis, activation of the HPA axis is associated with increased corticotropin release from the anterior pituitary,²³ enhanced adrenal secretion of cortisol,²⁴ and high plasma cortisol levels.^{18,24} Glucocorticoids modulate the stress response to sepsis through permissive (enhanced cardiovascular response) and suppressive (inhibit cytokine synthesis) effects.²⁵ Proinflammatory mediators activate the HPA axis to release cortisol as a mechanism to counterattack the inflammatory process. It is this mechanism that for years provided the physiologic basis for the use of cortisol in sepsis trials. However, administration of short-term high-dose steroids in early septic shock was found to be harmful, primarily as a result of increased incidence of secondary infections.^{26,27} A meta-analysis examining the relative risk differences in steroid administration between 1963-1990 suggested a trend toward an increased risk of death among steroid-treated patients.²⁸

In contrast to short-term, high-dose steroid administration of the past, 4 recent randomized clinical trials indicated that administration of low-dose hydrocortisone (240-300 mg/d) administered over longer periods (± 5 days) improves shock reversal.^{15,29-31} These results support the concept of an impaired "adrenal cortical reserve" in septic shock³¹ and have initiated a re-evaluation of the role of steroids in septic shock.

Conclusion

The integrity of the HPA axis is a major determinant of the host's response to stress. Cortisol production and secretion from the adrenal cortex is significantly

Table 2
Interpretation of Tests of Adrenal Function

Test	Normal Range	Interpretation	References
Cortisol (8-9 am)	6-24 ug/dL	If < 3 ug/dL, confirm adrenal insufficiency	19
Spot (random)	Minimal levels: 10-34 ug/dL	If 15 ug/dL adrenal insufficiency likely; > 34 ug/dL functional adrenal insufficiency unlikely	8
Corticotropin	±20 ug/dL	Insufficient increase in plasma cortisol: insufficiency. Increase < 9 ug/dL from baseline cortisol levels = adrenal insufficiency unlikely; Increase ±9 ug/dL from baseline cortisol level = functional adrenal insufficiency likely	6, 8

increased during critical illness. Cortisol is vitally important for substrate metabolism, modulation of the inflammatory response, and enhancement of the effects of catecholamines on vascular smooth muscle tone. Critically ill patients have multiple risk factors for developing adrenal insufficiency. Adrenal insufficiency is difficult to detect in this patient population. However, a high index of suspicion should be considered in patients with unexplained catecholamine resistant hypotension and ongoing evidence of inflammation. Cortisol and corticotropin stimulation tests can confirm the diagnosis of adrenal insufficiency. Exogenous cortisol replacement should be initiated accordingly. The use of short-term high-dose steroids in septic shock has not demonstrated an improvement in mortality. However, recent randomized clinical trials using low-dose steroids administered over longer periods of time may improve shock reversal. As our knowledge of sepsis pathophysiology increases, we are becoming more aware of the delicate balance between protection from overshooting the inflammatory response and the risk of aggravated immunosuppression.³² ■

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CME / CE Questions

16. The sensitivity of a test is defined as:
- a. the proportion of patients with positive test results among all tested patients.
 - b. the proportion of patients with disease who have a positive test.
 - c. the proportion of patients without disease with a negative test result.
 - d. The proportion of patients with a positive test who do not have

- the disease.
- e. None of the above
17. As far as the risk stratification in patients with pulmonary embolism is concerned which of the following assertions is true?
- a. Elevated cardiac troponin levels help to identify patients who are at high risk.
 - b. Elevated cardiac troponin levels only help to identify patients with an associated acute coronary syndrome.
 - c. Elevated cardiac troponin levels doesn't help in the severity assessment of these patients.
 - d. Elevated cardiac troponin levels help to identify patients with minor or submassive pulmonary embolism.
 - e. Elevated cardiac troponin levels help to exclude the diagnosis of pulmonary embolism.
18. All of the following are influenced by cortisol except:
- a. Carbohydrate metabolism
 - b. Protein metabolism
 - c. Fat metabolism
 - d. Cholesterol metabolism
19. A high index of suspicion of adrenal insufficiency should be considered with:
- a. the presence of unexplained catecholamine-resistant hypotension.
 - b. ongoing evidence of inflammation without an obvious source.
 - c. morning cortisol level less than 3 mcg/dL.
 - d. a and b, but not c
20. Recent clinical trials on the use of steroids in septic shock reveal:
- a. administration of low-dose hydrocortisone over longer periods improves shock reversal and outcome.
 - b. administration of high-dose hydrocortisone over shorter periods improves shock reversal and outcome.
 - c. an increased risk of death among steroid-treated patients.
 - d. an increased incidence of secondary infections.

Answers: 16. (b); 17. (a); 18. (d); 19. (d); 20. (a)

CME / CE Objectives

After reading each issue of *Critical Care Alert*, readers will be able to do the following:

- Identify the particular clinical, legal, or scientific issues related to critical care.
- Describe how those issues affect nurses, health care workers, hospitals, or the health care industry in general.
- Cite solutions to the problems associated with those issues.

In Future Issues:

'Normal' Hemoglobin Decline in ICU Patients

CRITICAL CARE **Plus**

EXPANDING YOUR FOCUS IN INTENSIVE CARE

Bill for as Much Critical Care as You Deliver, Consultant Says

Every day but the last should be considered as critical care

By Julie Crawshaw, Critical Care Plus Editor

MANY ICU PHYSICIANS DON'T GET THE REIMBURSEMENT THEY DESERVE BECAUSE THEY QUIT BILLING FOR critical care too soon, says consultant Frank Lucas, who has performed chart audits based on payer mix and midnight census of 100-150 records to assess potential revenues for more than 35 ICUs.

For example, if the patient is in the unit for six days, Lucas says that many physicians will quit billing for critical care when the patient begins to stabilize on the third or fourth day. Because physicians perceive the patient to be recovering, they deprive themselves of the \$90 to \$128 reimbursement differential between the billing codes for critical care and subsequent hospital visits.

Provided that physician spends 30 minutes per critical care patient per day excluding teaching and procedures, Lucas says ICU docs should bill for critical care for the first five days of that six-day stay, dropping to the subsequent hospital visit billing code only on the last day. "If you want to see patients who aren't critically ill, go look on another floor," Lucas frequently admonishes the physicians for whom he bills. "Except for the day of discharge, you're providing critical care, period."

Intensivists Make Money for Hospitals

Lucas owns Pittsburgh-based Physician Technologies, an ICU medical billing company that bills currently for six ICUs in which physicians have no office practices. He says intensivists have no reason whatsoever to under-bill, especially given the amount of money they make for the hospitals in which they work. He points to numerous studies that show that ICU patients under intensivist care recover more quickly, have fewer ventilation days and a lower rate of nosocomial infection than patients in nonintensivist care. Implementing intensivist care in an ICU usually lowers the average length of stay from 0.75 to one day per patient, which could translate into millions of dollars in cost savings for the hospital. "There's a laundry list of about 34 areas in which various studies have shown decreased length of stay with intensivists that equates to big bucks," Lucas notes. And other than gerontologists, critical care physicians have the highest percentage of Medicare patients, which increases their chances of being audited.

Cost-savings are the number one reason hospitals employ intensivists, Lucas says. Medicare, Medicaid-type programs and most Blue Shields pay on a diagnostic related group (DRG) basis, so if a hospital will receive \$7,000.00 for the DRG and needs to discharge the patient in nine days in order to make money, it begins to lose money on day ten.

Critical care is any hospital's most expensive cost center, Lucas notes, yet trained intensivists are present only in about 10% ICUs nationwide. In the remaining 90% of hospitals, an average of four and a half consultants round on ICU patients daily only for the specific body problem their specialties cover.

"Hospital administrators in facilities that lack intensivists are frequently stunned to learn by how much

intensivists increase the facility's bottom line," Lucas says. "Most physicians are paid as fee for service and are actually incentivized to increase a patient's length of stay, but intensivists are in partnership with the hospital." Even given that intensivists often receive "shortfall" subsidies, having one or more on board is a tremendous financial benefit. "A hospital that offers \$200,000 annual shortfall payment may well be saving a million dollars because of the intensivists, and the net savings to the hospital is \$800,000 not counting the better care for the patient," Lucas says. Contact information: Frank Lucas (412) 371-9831. ■

Denver ICU Maintains Sedative Cost Savings

Formulary Decisions Supported by Literature

THE INITIAL 80% SAVINGS RATE THAT DENVER'S Centura-St. Anthony Central Hospital realized through standardizing a formulary for ICU sedative drugs has held firm for more than four years, according to medical director Joseph Heit, MD. Centura, which is Denver's largest not-for-profit provider of integrated health services, is a 300-bed public facility.

The reason for standardizing the sedative drug formulary was decreasing variability, not costs, Heit says, though cost was always a determining factor when choosing between two otherwise equivalent drugs. Too much variability arose when a new drug came out that was touted as having great benefit. "New drugs were frequently adopted and used even though they were much more expensive and lacked evidence of superiority to those already available," Heit says.

Given that most drugs used for sedation in the ICU are basically narcotics or benzodiazepines—for which there are many studies that compare effectiveness—Heit felt quite confident about restricting standard usage. "There wasn't anything in the literature that persuaded us we shouldn't standardize and certainly patients can receive other drugs when warranted," he notes. "The literature helped us decide which narcotics or benzodiazepines work best." Heit and his colleagues picked Fentanyl as their narcotic choice.

No Basis in Literature for Choosing Versed

Heit's team selected Valium as their benzodi-

azepine, despite the fact that the drug Versed was more popular than Valium at the time. Heit says he found no basis in the literature for the anecdotal belief that patients regain consciousness more quickly with Versed, which has a shorter half-life than Valium. "If you can't come up with good logic, it makes no sense to use the more expensive drug," Heit says. "We couldn't find any justification for relying on Versed for long-term sedation." Heit says his ICU still uses Versed for single-shot sedation, but not when the patient needs to be sedated for 24 hours or more. "Certainly, Valium is much cheaper," he says. "But if Valium were more expensive and the literature supported its benefit over Versed, we'd use it regardless of cost."

Heit's ICU uses a modified Ramsey pain rating scale to avoid variability between what different nurses see as acceptable sedation levels. Some nurses, Heit points out, are willing to accept the patient being semi-awake and moving around a little while others want patients completely sedated. The literature, Heit says, was becoming pretty clear that using a scoring system allowed more precision. He acknowledges that it's difficult to take a linear approach to something as variable as pain, but believes that state-of-the-art-scoring systems rather than caregivers judgement are what effective sedation in the ICU should depend upon because they work better than anything else most of the time.

"We didn't want to limit a physician's or nurse's ability to vary dosages or tailor make them for an individual patient, we did want to say 'Give this dose if the patient shows X level of agitation,'" Heit says. "Sometimes the night nurses would over-sedate patients we wanted to wean from ventilators and we'd half to wait half a day for them to wake up enough to begin weaning."

In-House Research Supports Decision

Limiting the sedative formulary not only lowered ICU sedation costs dramatically, Heit says, but it also improved pain control. After standardizing Heit and colleagues queried ICU patients about how well they felt their pain was controlled. Heit says that not only did responses show dramatic post-standardization improvement, but patients got better faster and their subjective sense about how appropriately they were sedated rose sharply. "Before the change, about 70% of patients were satisfied with pain control," Heit says. "Now 90-95% consistently express satisfaction. Reduced risk because less time spent on ventilator. Lack of a supporting IT resource didn't deter Heit and

his team from quantifying the effects their decision created—they simply collected and compared all data by hand.

Randy Vogenberg, RPh, PhD, vice-president and pharmaceutical consulting head with Aon Consulting says Centura's success came from aligning its drug formulary with protocols and care paths used. "You could probably do that in most hospital areas as part of process improvement activity," Vogenberg notes. "Just figure out what the areas are you want to improve and locate the best value for that kind of activity."

Vogenberg adds that many times the care paths and protocols a hospital uses are out of date or just not followed. Yet staying current is paramount to evaluating the efficacy of new drugs on the market. As an example, Vogenberg says that, typically, many hospitals have been using Heparin for thrombosis. Even though the drug is cheap, it ends up costing the hospital more money because it's an IV infusion and the patient has to be monitored more frequently. "Looked at from cost of care, even though you may be using a less expensive, old technology drug it can cost more to use," he says.

Vogenberg's consulting division finds the biggest opportunities for cost savings lie in the ICU. Hospitals, he says, often do a great job of assessing costs but fail to take all the actions required to harvest all the potential savings. "You need to evaluate the literature then DO what it says—take an action step," he counsels. "Are you using resources in the most appropriate fashion? A lot of formulary choices are habit. Medicine is still performed by people who practice an art, not a science and there's a lot of existing habit that makes it hard to make changes that stick."

Contact info: Joseph Heit joeheit2000@yahoo.com or (303) 629-2106; Randy Vogenberg (781) 239-8242. ■

Survey Tool Measures Quality, Satisfaction with End-of-Life Care

Family and Caregiver Stresses Need More Attention, Research Shows

DEVELOPING A RESEARCH SURVEY INSTRUMENT IS a lengthy and complicated process, says Daniel P. Sulmasy, OFM, MD, PhD, of the John J. Conley Department of Ethics at Saint Vincent's Hospital in

Manhattan. Sulmasy and several colleagues spent five years developing an instrument that elicits ratings of quality and satisfaction with care from medical inpatients, especially those near the end of life.

The team conducted focus groups with terminally ill patients to learn about their greatest concerns. The resulting Quality of End-of-Life Care and Satisfaction With Treatment scale (scored from 1.0-5.0) is now used with standard measures of symptoms, anxiety, depression, and delirium. The researchers then did a cross-sectional survey of 84 seriously ill medical inpatients at two academic medical centers. Forty-five had do-not-resuscitate orders.

The results¹ showed mean patient ratings of quality of care were higher regarding physicians than nurses (4.39 vs 4.24; $P = .01$). Mean patient ratings of satisfaction with physicians were also higher, but not significantly (4.53 vs 4.43; $P = .32$). In analysis of variance models, patient ratings of physician quality were lowest for patients with do-not-resuscitate orders who were treated by a house-staff service compared with other patients ($P = .01$). These patients were also least satisfied with their physicians ($P = .03$). Non-depressed patients with private attending physicians rated nursing quality the highest ($P = .16$). These patients also reported the highest satisfaction with nurses ($P = .002$). Quality and satisfaction were not related to severity of illness, and pain was only weakly associated with satisfaction with physicians.

Their study found that patients with do-not-resuscitate orders who were treated by a house-staff service gave the lowest ratings of physician quality and satisfaction. Only private patients who were not depressed were highly satisfied with their nursing care.

Patients' Spiritual Needs, Family Members' Stresses Need More Attention

Physicians need to pay increased attention to patients' spiritual needs as well as to obtaining advance directives and better pain control, Sulmasy says, but the major piece of advice he gives to clinicians is that they need to recognize the stresses that occur for the family members and surrogates who actually make the end-of-life decisions.

Acknowledging that stress is by far the best way to begin a conversation with a family member, says Sulmasy, who is currently engaged in studying stress levels in surrogate decision-makers. "There's been so much emphasis on patient autonomy that we tend to forget that most of these patients are no longer

autonomous. We need to pay more attention to them.”

Sulmasy says that patients’ higher levels of satisfaction with physicians may be attributable to the fact that though nurses’ patient contacts add up to more time spent overall, the elapsed time in each contact is far less than the time physicians spend. He adds that results from an earlier study showed that the average time a nurse spends (averaged from patients with high APACHE scores both in and outside of ICUs) with patients close to the end of life is 2 minutes. “All told, nurses spend 90 minutes per in the room with each patient per 24 hours,” Sulmasy says. “But the average (dying) patient spends 18 hours of each 24 alone.”

Many patients emphasize the interpersonal aspects of care more than the care itself, Sulmasy says. “Competency was part of their concerns, but the greater part was how they felt treated, whether they felt there was a connection between them and their caregivers and if they felt respected, cared for and honored,” he observes.

Satisfaction Levels Differ for Patients and Family Members

Interestingly, Sulmasy’s research shows that levels of satisfaction of patients and their families differ randomly and go in both directions, though family members consistently overestimate patients’ pain levels. “I expect part of the reason is that their experiences are different,” Sulmasy notes. He points out that a family member’s experience may be that the doctor didn’t return phone calls while the patient may feel the doctor treated him well. Or a family member has great rapport with the nurse but the patient’s experience is that it takes the nurse too long to arrive when called for. “Both experiences are valid, but family members’ experiences can’t be used to get at what the patient is experiencing,” Sulmasy observes.

Sulmasy’s study revealed that patients who survived their DNR orders rated the care they received as lower, a finding that troubles him greatly. “We have not been able to show they get less time from their doctors, but they clearly perceive something (different) going on,” he says. Caregivers must look at ways in which they may be giving unintentional signals about patients’ meaning and value after a DNR order is written, Sulmasy stresses. “We also need to find better ways of helping physicians and nurses with their own ways of coping to they don’t reflect their own discomfort to the patients,” he says. “Caregivers need better care, too.” ■

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