CRITICAL CARE ALERT®

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INSIDE

Predicting Post-Extubation Stridor

ABSTRACT & COMMENTARY

Jaber and colleagues report a series of 112 intubations of patients in their multidisciplinary ICU in Montpellier, France, during a 14-month period. Every ventilated patient underwent a cuff-leak test prior to extubation, and the incidence of post-extubation stridor was determined.

Jaber et al performed the cuff-leak test as follows: After oral and endotracheal suctioning and in the volume assist-control mode, the expired tidal volume is first measured with the endotracheal tube cuff inflated. The cuff is then deflated and the expiratory tidal volume determined by averaging 6-10 breaths. Cuff-leak volume is the difference between the 2 tidal volume measurements.

Twelve percent of the patients developed post-extubation stridor, a mean of 3.2 ± 3.3 h following extubation. Extubation failure (ie, the need to reintubate the patient within 48 hours of extubation) occurred in 11/112 (10%) patients, of whom 9 developed stridor ($P < 0.001$ for occurrence of stridor in patients requiring reintubation).

Jaber et al then constructed receiver operating characteristic curves plotting the true- and false-positive rates of post-extubation stridor as a function of cuff-leak volume. They found that when thresholds of 130 mL leaked volume and 12% of the pre-cuff-deflation volume were used as a cut-off, the positive and negative predictive values for the cuff-leak test in predicting post-extubation stridor were 85% and 95%, respectively. Thus, a low cuff-leak volume measured before extubation permits the identification of patients at increased risk for developing post-extubation stridor, and post-extubation stridor is a strong predictor of the need to reintubate the patient. The occurrence of post-extubation stridor was associated with an increased severity of illness as assessed by SAPS II, with having a medical (as opposed to a surgical) reason for admission to the ICU, with a history of self-extubation, and with a prolonged period of intubation. (Jaber S, et al. Post-extubation stridor in intensive care unit patients: Risk factors evaluation and importance of the cuff-leak test. *Intensive Care Med*. 2003;29:69-74.)

COMMENT BY DAVID J. PIERSON, MD

Should patients who develop stridor following endotracheal tube

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removal be reintubated? If the clinician's answer to this is an automatic "yes," the results of this study shed little light on the still poorly lit corner of critical care occupied by weaning and extubation. Jaber et al showed that if patients developed stridor they were almost always reintubated. However, this study shows us more than that. It shows that patients with a low cuff-leak volume (< 130 mL or < 12% of pre-cuff-deflation expired tidal volume) are at increased risk for development of post-extubation stridor and subsequent reintubation. It reiterates the importance of assessing upper airway function in addition to gas exchange and ventilatory mechanics in deciding when to extubate a patient following an episode of acute respiratory failure. Clinicians usually think of weaning and extubation together, and in most cases this works. However, there are patients who can be liberated from ventilatory support who still need airway protection, just as there are patients who can be extubated but still need ventilatory support, at least part of the time.

This study emphasizes the fact that the decision to extubate a patient who otherwise seems ready for ventilator weaning should include consideration of airway patency following extubation, and reminds us that at least semi-quantitative tests are available for evaluating upper airway function in this setting. ■

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'Normal' Hemoglobin Decline in ICU Patients

ABSTRACT & COMMENTARY

Synopsis: *In a cohort of 91 ICU patients without known causes for hemoglobin decline other than blood draws and critical illness, serum hemoglobin levels declined by an average of 0.52 g/dL/d. The decline was more rapid during the first 3 days in the ICU and among patients who were septic.*

Source: Ba VN, et al. Time course of hemoglobin concentrations in nonbleeding intensive care unit patients. *Crit Care Med*. 2003;31(2):406-410.

In this prospective observational study from a combined medical-surgical ICU in Brussels, Ba and colleagues enrolled every patient admitted to the unit who did not have a known reason for bleeding, and followed both the quantity of blood drawn for diagnostic purposes and daily hemoglobin levels. They excluded patients with trauma or recent surgery, as well as those with gastrointestinal bleeding, hematologic or renal disease, and those who left the ICU within 24 hours. Also excluded were patients who developed sepsis after ICU admission. The slope of the linear regression of hemoglobin concentration over time was calculated for each patient.

Of 251 patients admitted to Ba et al's ICU during the study period, 160 were excluded. This left 91 patients, of whom 33 remained in the ICU longer than 3 days. None of the patients had a clinically apparent reason for acute blood loss other than diagnostic blood draws and other ICU procedures. Admission hemoglobin concentrations were 12.2 ± 2.0 g/dL (mean ± SD).

Overall, the blood hemoglobin levels of the 91 patients declined at a mean rate of 0.52 ± 0.69 g/dL/d. Among the patients who were in the ICU for more than 3 days, this rate was 0.66 ± 0.84 g/dL/d during the first 3 days and 0.12 ± 0.24 g/dL/d thereafter. The decline in hemoglobin levels did not correlate significantly with net fluid balance. The rate of decline was greater in patients with higher APACHE II scores, but only after 3

days in the ICU. The average number of blood samples taken per day was 11.7 ± 4.7, and the total volume of blood drawn per day was 40.3 ± 15.4 mL.

COMMENT BY DAVID J. PIERSON, MD

Many ICU patients are anemic, and the questions of when to transfuse and whether to use erythropoietin are much on clinicians' minds these days. This paper answers neither of them, but provides a potentially important piece of the overall puzzle: How much should patients' hemoglobin levels be expected to decline simply as a result of being sick enough to be in the ICU? The answer is about half a gram per dL (or roughly 1.5 hematocrit percentage points) per day in the unit, somewhat more if the patient is septic, and less after the first 3 days except in the presence of continued sepsis.

This finding is conceptually useful to think about, but several qualifying issues need to be taken into consideration. By design, the study excluded nearly two-thirds of all patients admitted to the ICU. Thus, the "expected" figure of 0.52 g/dL/d (or 1.21 g/dL/d for patients 1 standard deviation away from the mean value) derives from patients without a recent potential bleeding source who do not have renal or hematologic disease. It also derives from patients with an average admission APACHE II score of 14, whose ICU mortality rate was 13%. One would expect sicker patients to have a more rapid rate of "normal" hemoglobin decline, but this was the case for only one small segment of the patients in this study.

When today's hemoglobin level is lower than yesterday's, but there has been no overt bleeding and the patient is not markedly "fluid positive" during that interval, what should the clinician do? How much of a drop should trigger a workup for occult hemorrhage or hemolysis? From a practical perspective, these are difficult questions to answer. The regression plots provided by Ba et al as Figure 2 in their paper suggest a great deal of variability in the slopes of individual patients' hemoglobin levels over time. And not only do individual patients vary, but also the hemoglobin values reported by the laboratory may vary substantially day-to-day in a given patient. A single hemoglobin level reported to be more than 1.5-2.0 g/dL less than the previous day's value (or a hematocrit drop of more than 4 or 5%) should prompt consideration of the likelihood of potential causes for blood loss in that patient but should perhaps be repeated before transfusion or further diagnostic testing is undertaken.

An interesting point raised in the discussion of this paper is that the average volume of blood drawn from an ICU patient has apparently declined over the last decade or two. The 40 mL/d found by Ba et al compares with 65 mL/d in a 1986 study[1] and 62 mL/d in a study from 1996.[2] The current trend toward smaller sample volumes and reduced discard volumes should help to further reduce this component of the "normal" hemoglobin decline during a patient's stay in the ICU.

References

1. Smoller BR, Kruskall MS. Phlebotomy for diagnostic laboratory tests in adults: Pattern of use and effect on transfusion requirements. *N Engl J Med*. 1986;314:1233-1235.
2. Alazia M, et al. Blood loss from blood sample removals in intensive care: A preliminary study. *Ann Fr Anesth Reanim*. 1996;15:1004-1007.

Lower Than Expected In-Hospital Mortality of COPD Exacerbations

ABSTRACT & COMMENTARY

Synopsis: *In this study of a large nationwide database, mortality during hospitalization for acute exacerbation of COPD was 2.5%, which is substantially lower than that reported in previous studies.*

Source: Patil SP, et al. In-hospital mortality following acute exacerbations of chronic obstructive pulmonary disease. *Arch Intern Med*. 2003;163:1180-1186.

The purpose of this study using a large administrative database was to obtain generalizable estimates of in-hospital mortality in patients admitted for an acute exacerbation of COPD, and also to identify risk factors for death during the hospitalization. Patil and associates used data from the 1996 Nationwide Inpatient Sample, a 20% sample of all admissions to acute-care, nongovernmental hospital beds (roughly 6 million patients), and identified patients with COPD exacerbations using ICD-9 discharge codes. Outcome variables examined were in-hospital mortality, length of stay, total charges, mechanical ventilation, and discharge disposition. Demographic data on the patients included age, gender, race, and income (as estimated from residence zip codes).

A total of 71,130 patients (1.1% of the total database) had the 429.21 ICD-9 code for acute COPD exacerbation and were older than 40 years, and were thus

used in the data analysis. Median patient age was 69.9 years; 56.4% were female; 86.6% were white; and the majority was below the national median for annual income. Median length of hospital stay was 5 days (interquartile range, 3-7 days), 3% of the patients required mechanical ventilation during the hospitalization, and 2.5% died (99% confidence interval, 2.4-2.7%). Among patients who underwent mechanical ventilation, the mortality rate was 27.8%. Patients who died following acute exacerbation of COPD were older (74.1 ± 9.3 years vs 69.8 ± 11.2 years), had a higher level of comorbid illness, had longer length of stay, and generated higher charges than those who were alive at discharge. By multivariate analysis, older age, male sex, higher income, nonroutine admission sources, and more comorbid medical conditions were all independent risk factors for mortality during the hospitalization. Race was not related to outcome.

COMMENT BY DAVID J. PIERSON, MD

The 2.5% in-hospital mortality for patients admitted with an acute COPD exacerbation in the present study is markedly lower than virtually all previously reported mortality rates. The discrepancy is most likely due to selection bias in previous studies, which have been institution- or ICU-based or have examined other nonrepresentative segments of the general population. This study is the closest yet to an assessment of the "average" American patient, in that it included all acute-care hospital admissions other than those to government (ie, VA and military) hospitals, nationwide, during 1996.

Most previous studies that have attempted to identify risk factors for adverse outcomes of COPD exacerbations have used physiologic indices, such as measures of oxygenation and acid-base status and acute physiology scores. The data available from the database used by Patil et al were confined to administrative information, yet clear predictors of adverse outcomes could be identified.

Not surprisingly, older patients and those with more comorbid medical conditions fared less well than their younger and healthier counterparts in this study. Despite a larger overall number of women in the database, men were more likely to die during hospitalization. Patil et al speculate that this may be because men are more likely to delay seeking medical care when they are sick than women, and thus tend to present later in the course of illness. Somewhat surprisingly, patients with annual incomes less than $25,000, as assessed from the postal zip code of residence, were significantly less likely to die during the hospitalization than patients with incomes of more than $35,000. This is at odds with what most studies of COPD prognosticators have found. Here, Patil et al speculate that, with more access to outpatient health care, individuals with higher incomes might have delayed presentation to the hospital when they became seriously ill, whereas lower-income patients with fewer resources presented to the hospital earlier in the course of illness.

Like death certificate diagnoses, discharge ICD-9 codes are a pretty shaky source for accurate information on what was wrong with a patient. However, despite this limitation, the findings of this study are of considerable interest. The degree to which its lower than previously reported mortality rate can be ascribed to improvements in patient assessment and management since earlier studies were performed is impossible to say. However, the fact that more than one-fourth of all patients who required mechanical ventilation during hospitalization for an acute exacerbation of COPD died should remind us that acute-on-chronic ventilatory failure remains a life-threatening event and stimulate us to continue to look for ways to improve its outcome. ■

A Universal Consent Form for 8 Common ICU Procedures

ABSTRACT & COMMENTARY

Synopsis: *Providing a universal consent form to patients, proxies, and staff increased the frequency with which consent was obtained without compromising understanding of the process.*

Source: Davis N, et al. Improving the process of informed consent in the critically ill. *JAMA*. 2003;289: 1963-1968.

In this study, the research team first documented all invasive procedures performed within the first 21 days of a patient's stay in a medical ICU, how often informed consent was obtained, and, if it was not obtained, the reason for this, by contacting the clinician. When invasive procedures were performed without consent, the most common reasons given were emergency, consent not deemed necessary, and no proxy present. Patients and proxies who gave consent were given a multiple-choice test to assess knowledge of the procedure, what it entailed, their right to refuse, and potential complications. The researchers then

developed a universal consent for 8 common ICU procedures, eg, arterial, central venous, pulmonary artery, or peripheral catheter insertion; lumbar puncture; thoracentesis; paracentesis; and intubation/mechanical ventilation with accompanying forms that described each procedure and common complications.

The universal consent form was introduced into the MICU and comparisons were made for 2 months before and after its use. Before use, 53% (155/292) of procedures in 125 patients were performed with consent, as compared to 90% (308/340) of procedures in 145 patients after introduction or the form ($P < .001$). There was no change in patient/proxy knowledge of indications for the procedure, what it entailed, and the option to refuse; scores on the comprehension test were 81.7% before and 89.8% after use of the universal consent ($P = 0.75$).

COMMENT BY LESLIE A. HOFFMAN, PhD, RN

This investigation is one of only a few to examine ways to improve the process of obtaining informed consent in a critical care setting. While many invasive procedures are performed in ICUs, some are more commonly required than others. Based on this observation, Davis and associates developed a universal informed consent form that applied to 8 commonly performed invasive ICU procedures, along with corresponding handouts that described each procedure, its indications, and common complications. Each patient/proxy was then asked to sign the universal consent at the time of ICU admission.

Before the universal consent was adopted, several procedures had almost universal written consent, eg, blood transfusion (98%), gastrointestinal track endoscopy (95%), and bronchoscopy (100%). However these procedures accounted for only a minority (27%) of the procedures performed. Procedures most commonly performed without consent included insertion of an arterial, central venous, or pulmonary artery catheter, with the rationale that the procedure was emergent, that consent was not deemed necessary, or that the patient was unable to consent and no proxy was present. Patient/proxy understanding of the indications for the procedure was assessed before and after use of the universal consent. Importantly, use of the form was not associated with change in understanding. Once constructed, the form was viewed as simple to use and well received by patients and/or proxies. There was only one refusal during the study period.

Findings of this study support a relatively simple method of improving the consent process in critical care areas. By providing clinicians with a standard consent form and accompanying literature, and by encouraging routine completion by patients and/or proxies at the time of admission to the ICU, Davis et al were able to significantly increase the frequency with which informed consent was obtained without any change in patient/proxy understanding of the procedures involved.

Computer Keyboards: A Reservoir for Nosocomial Pathogens

ABSTRACT & COMMENTARY

Synopsis: *Of 100 keyboards in 29 clinical areas tested for bacterial contamination, 95% were positive for microorganisms, including one with vancomycin-resistant* Enterococcus.

Source: Schultz M, et al. Bacterial contamination of computer keyboards in a teaching hospital. *Infect Control Hosp Epidemiol*. 2003;24:302-303.

This study was conducted in a 167-bed veterans Affairs Medical Center to identify potential sources of drug-resistant organisms. In that institution, 2000 desktop computers were in use throughout the medical center, including inpatient units, ICUs, the operating room, and ambulatory care center. In addition, laptop computers were transported to the bedside by nurses and physicians to enter orders, progress notes, and vital signs. During a 4-week period, 100 specimens were collected from computer keyboards in high-use patient care areas. Of 100 cultures, 95% had growth of one or more microorganisms. The majority of the cultures were positive for skin organisms. These included 84 keyboards with *Staphylococcus*, 44 with *Bacillus* species, and 8 with *Corynebacterium* species. In addition, 9 keyboards were positive for *Streptococcus*, 6 for Gram-negative rods, 4 for *Clostridium perfringens*, 4 for enterococci, including one for vancomycin-resistant *Enterococcus*, and 2 for *Pseudomonas*. Three of the negative cultures were from the operating room and the remaining 2 were from patient care areas.

COMMENT BY LESLIE A. HOFFMAN, PhD, RN

During the past decade, a number of studies have examined the hospital environment as a potential source of bacterial contamination and risk for infection. In this medical center, the overwhelming majority of cultures

obtained from computer keyboards grew microorganisms. Although most keyboards were contaminated with skin flora, a minority grew *Staphylococcus aureus*, enterococci, Gram-negative rods, and other organisms known to be potential pathogens.

The common practice of data entry before, during, and after patient rounds creates the possibility of transmitting microorganisms from one patient to another. Whether this actually occurs or how often is unknown. Several prior studies have also found computer keyboards to be contaminated with microorganisms. In one study conducted in a medical intensive care unit (MICU), contamination of computer keyboards (24% of samples) was higher than that for faucets (11%). Using pulsed-field gel electrophoresis, Bures and colleagues documented an indistinguishable methicillin-resistant *S aureus* strain in 2 patients, the computer keyboards and faucets in each of their rooms, and several other keyboards throughout the MICU.[1]

A second study traced bacterial contamination to a practice wherein gloved patient care staff moved back and forth between the patient and the keyboard and ungloved support staff, who never touched the patient, entered the room and retrieved data from the same computer.[2] In the present study, no specific method or group was assigned to clean computer keyboards on a routine basis and plastic keyboard covers were not in use. Findings of the present study provide further support that computer keyboards, as well as other environmental surfaces, can serve as a source for nosocomial infection. Given this, the use of keyboard covers and adherence to routine cleaning practices would seem essential. ■

References

1. Bures S, et al. Computer keyboards and faucet handles as reservoirs of nosocomial pathogens in the intensive care unit. *Am J Infect Control*. 2000;28:465-471.
2. Neely AN, et al. Computer keyboards as reservoirs for *Acinetobacter baumannii* in a burn hospital. *Clin Infect Dis*. 1999;29:1358-1359.

Special Feature

Aerosol Delivery During Mechanical Ventilation

By Dean R. Hess, PhD, RRT

INHALED DRUGS ARE COMMONLY USED DURING mechanical ventilation. The physiologic effects of bronchodilators delivered by nebulizer or pressurized metered dose inhaler (pMDI) are virtually equivalent.[1, 2] Choice of device is typically based on clinician preference rather than clear superiority of one approach over the other. Dry powder inhalers, however, cannot be used in the ventilator circuit.

Nebulizers

The pneumatic nebulizer uses a pressurized gas flow to generate an aerosol.[3] An important characteristic of nebulizer performance is the respirable dose, determined by its mass output and the size of the droplets. The droplet size should be 2-5 m m for airway deposition and 1-2 m m for parenchymal deposition. Other important characteristics of nebulizer performance include nebulization time, cost, ease of use, and requirements for cleaning and sterilization. Nebulizer output increases when the fill volume is increased—a fill volume of 4-5 mL is recommended. Increased nebulizer flow also increases output and decreases the particle size—a flow of 8 L/min is recommended. An alternative to the pneumatic nebulizer is the ultrasonic nebulizer. Although these are less commonly used than pneumatic nebulizers (related to their cost and complexity), they offer potential advantages over the pneumatic nebulizer during mechanical ventilation because no additional gas flow is delivered into the circuit.

Metered Dose Inhalers

A pMDI consists of a pressurized canister containing a micronized powder or solution of drug that is suspended in a mixture of propellants and other components. This mixture is released through a metering valve and stem that fits into an actuator boot. The volume emitted from the pMDI is 15-20 mL following volatilization of the propellant. The dose is loaded into the metering chamber by shaking. Several features of pMDI performance are not commonly appreciated by clinicians. The pMDI can be used as often as every 15 to 30 s without affecting its performance. A new pMDI, or one that has not been recently used, should be actuated several times before use to properly prime the metering chamber. The pMDI should not be used beyond the labeled number of actuations, as the delivered dose is unpredictable at this point despite the ability to actuate the device.

Aerosol Delivery During Mechanical Ventilation

Many factors affect aerosol delivery during mechanical ventilation (*see Table*).[4-7] Deposition in the

Table

Factors Affecting Aerosol Delivery During Mechanical Ventilation

Nebulizer or MDI

- Endotracheal tube size
- Humidification of the inspired gas

Nebulizer

- Position of nebulizer placement in the circuit
- Type of nebulizer and fill volume
- Treatment time
- Duty cycle (I:E ratio)
- Pressure control vs volume control ventilation
- Ventilator brand

MDI

- Type of actuator
- Timing of actuation

circuit and endotracheal tube may reduce the amount of aerosol delivered to the lower respiratory tract. Circuit humidity increases particle size and decreases aerosol deposition in the lower respiratory tract by about 40%. Nebulizer placement 30 cm from the endotracheal tube is more efficient than placement at the Y-piece. Operating the nebulizer only during the inspiratory phase is more efficient than aerosol generation throughout the respiratory cycle. Disadvantages of nebulizers during mechanical ventilation include circuit contamination, decreased ability of the patient to trigger the ventilator, and increased tidal volume and airway pressure.

A special actuator is needed to adapt the pMDI into the ventilator circuit. Size, shape, and design of these actuators affect drug delivery to the patient. A pMDI with a chamber results in a 4-6 fold greater delivery of aerosol than pMDI actuation into a connector that lacks a chamber. When using a pMDI during mechanical ventilation, it is important to synchronize actuation with the initiation of inspiratory airflow to optimize drug delivery.[8]

Delivery of a large tidal volume, use of an end-inspiratory pause, use of a slow inspiratory flow, and use of pressure control vs volume control ventilation affect aerosol delivery by nebulizer but *not* by pMDI.[9-13] Thus, a more consistent dose may be delivered when using the pMDI in mechanically ventilated patients. *In vitro* modeling has reported a 50% increase in deposition of albuterol from a pMDI during mechanical ventilation with heliox.[14] Performance of a nebulizer, however, may be adversely affected by the use of heliox.[15]

Although the nebulizer is less efficient than the pMDI during mechanical ventilation, the nebulizer delivers a greater dose to the lower respiratory tract.[16] Nebulizers and pMDI produce similar therapeutic effects in mechanically ventilated patients. Use of pMDI for routine bronchodilator therapy in ventilator-supported patients is preferred due to the problems associated with use of nebulizers (contamination, triggering difficulty, increased pressure and volume delivery). When a pMDI is used with an inline spacer, the ventilator circuit does not need to be disconnected with each treatment, reducing risk for ventilator-associated pneumonia.

Aerosol therapy can also be administered during noninvasive positive pressure ventilation (NPPV) using nebulizer or pMDI. With NPPV an inline nebulizer[17-19] or pMDI[20] provides an aerosol bronchodilator dose that is therapeutic. However, aerosol delivery with NPPV has not been studied as extensively as during invasive ventilatory support.

Summary

Aerosols can be delivered effectively during mechanical ventilation using either a nebulizer or pMDI. The pMDI is the most efficient method of aerosol delivery, whereas the greatest absolute amount of drug delivery is with the nebulizer. ■

References

1. Cates CJ. The Cochrane Database or Systematic Reviews 1999.
2. Dolovich MA, et al. *Respir Care*. 2000;45:589-593.
3. Hess DR. *Respir Care*. 2000;45:609-622.
4. Dhand R, Tobin MJ. *Eur Respir J*. 1996;9:585-595.
5. Dhand R, Tobin MJ. *Am J Respir Crit Care Med*. 1997; 156:3-10.
6. Hess D. *Minerva Anestesiol*. 2002;68:321-325.
7. Fink JB, et al. *Respir Care*. 1999;44:53-69.
8. Diot P, et al. *Am J Respir Crit Care Med*. 1995; 152:1391-1394.
9. Hess DR, et al. *Intensive Care Medicine*. 2003;29: 1145-1150.
10. Mouloudi E, et al. *Intensive Care Med*. 1999;25: 1215-1221.
11. Mouloudi E, et al. *Eur Respir J*. 1998;12:165-169.
12. Mouloudi E, et al. *Eur Respir J*. 2000;16:263-268.
13. Mouloudi E, et al. *Intensive Care Med*. 2001;27:42-46.
14. Good M, et al. *Am J Respir Crit Care Med*. 2001; 163: 109-114.
15. Hess DR, et al. *Chest*. 1999;115:184-189.
16. Marik P, et al. *Chest*. 1999;115:1653-1657.
17. Chatmongkolchart S, et al. *Crit Care Med*. 2002; 30:2515-1519.

18. Fauroux B, et al. *Am J Respir Crit Care Med*. 2000; 162:2265-2271.
19. Pollack CV, et al. *Ann Emerg Med*. 1995;26:552-557.
20. Nava S, et al. *Intensive Care Med*. 2001;27:1627-1635.

CME / CE Questions

29. Which of the following combinations of cuff-leak volume and percentage of pre-cuff-deflation expired tidal volume best predicts the development of post-extubation stridor and the need for reintubation?
a. Cuff-leak volume < 10 mL; < 1 % of pre-cuff-deflation expired tidal volume
b. Cuff-leak volume < 50 mL; < 4% of pre-cuff-deflation expired tidal volume
c. Cuff-leak volume < 90 mL; < 8% of pre-cuff-deflation expired tidal volume
d. Cuff-leak volume < 130 mL; < 12% of pre-cuff-deflation expired tidal volume
e. Cuff-leak volume < 175 mL; < 16 % of pre-cuff-deflation expired tidal volume

30. The negative predictive value for development of post-extubation stridor with a cuff-leak test, using the authors cutoff values for cuff-leak volume and pre-cuff-deflation expired tidal volume, is closest to which of the following?
a. 65%
b. 75%
c. 85%
d. 90%
e. 95%

31. Following implementation of a universal consent from for 8 common ICU procedures, there was:
a. infrequent use, despite extensive inservice education.
b. frequent use, but limited recall by patients/proxies of content.
c. frequent use and no change in recall by patient/proxies of content.
d. a higher consent rate for bronchoscopy procedures.
e. a change in the procedures performed making the consent not helpful.

32. Reasons most frequently given by clinicians for *not* obtaining informed consent for invasive ICU procedures included:
a. Procedure was performed as an emergency
b. No proxy present
c. Didn't think informed consent was necessary
d. Refusal by patient or proxy
e. a, b, and c, but not d

33. Which of the following patient groups would be expected to have greater than average rates of decline in hemoglobin concentration while in the ICU?
a. Septic patients
b. Patients with higher than average APACHE II scores
c. Fluid-overloaded patients
d. All of the above
e. a and b, but not c

34. In the study of hemoglobin decline in ICU patients, what was the mean total volume of blood drawn per day for diagnostic purposes in each patient?
a. 12 mL
b. 24 mL
c. 40 mL
d. 56 mL
e. 72 mL

35. In a national sample of patients admitted to nongovernmental acute-care hospitals, mortality among those with acute exacerbations of COPD was:
a. 2.5%.
b. 5.0%.
c. 7.5%.
d. 12.5%.
e. 27.5%.

36. Which of the following was associated with increased mortality in patients hospitalized with acute exacerbations of COPD?
a. Older age
b. Female sex
c. Lower annual income
d. All of the above
e. None of the above

37. When computer keyboards were cultured for microorganisms, the organisms cultured included:
a. skin flora only.
b. potential pathogens only.
c. skin flora and potential pathogens.
d. anaerobic, but not aerobic, organisms.
e. no growth in the majority of cultures.

38. Which of the following are advantages of using a pMDI rather than a nebulizer during mechanical ventilation?
a. No additional flow introduced into the circuit
b. Lower risk of ventilator-associated pneumonia
c. Consistent dose delivery with varying ventilator settings
d. Improved ability of the patient to trigger the ventilator
e. All of the above

Answers: 29.)d; 30.)e; 31.)c; 32.)e; 33.)e; 34.)c; 35.)a; 36.)a; 37.)c; 38.)e

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:

ICU Delirium Common in Older Patients

CRITICAL CARE Plus

EXPANDING YOUR FOCUS IN INTENSIVE CARE

Who Gets What in Critical Care? Task Force Tackles Care Rationing

Initiative to yield ethical guidelines for limiting treatment launched

By Cathi Harris

TWO SEVERELY ILL PATIENTS IN THE EMERGENCY DEPARTMENT OF YOUR HOSPITAL NEED ADMISSION TO THE ICU, but only one bed is available. Who gets admitted first? Another critical care patient is severely ill, with several coexisting conditions. A costly new medication is available to treat one problem, but her treatment may be complicated due to the other comorbidities. The new treatment also is in short supply. If she gets the medication, it might be unavailable for other patients who could benefit more. Should the physician take a chance and prescribe the medication anyway?

These are some of the dilemmas that critical care specialists face nearly every day in the United States—limited resources and overwhelming demand.

The end result, say experts, is that most now are engaging in bedside rationing—deciding on a case-by-case basis which treatments to restrict or offer based on their assessment of the potential benefit to the patient vs. the costs to the system and to others.

In a 2002 survey of more than 5,000 members of the Society of Critical Care Medicine (SCCM), two-thirds of the respondents stated they would withhold from one patient a medication, test, or service that is in limited supply in order to give it to a patient who might benefit more.[1]

In addition, more than half of those providers reported routinely withholding medications, tests, or services from patients when they felt that costs outweighed the potential benefit. Yet most also indicated they wanted more guidance on how to make such decisions.

"The survey basically showed that a high percentage of physicians ration and, at the same time, feel badly that they do," says Mitchell Levy, MD, FCCM, FCCP, a critical care specialist at Brown Medical School/Rhode Island Hospital in Providence and chair of Brown University's Values, Ethics, and Rationing in Critical Care (VERICC) Task Force. "You have people making decisions at the bedside on resource allocation in a relatively haphazard way, not a measured way. We all struggle to deliver the highest quality of care possible for our patients, and we are successful to varying degrees. But some of the decisions that we make are not made from the broad overview perspective but from a more focused, bedside perspective."

In June, the VERICC Task Force announced a new, 18-month research and education initiative aimed at developing a national consensus on rationing in critical care—to include guidelines to help hospitals and critical care specialists determine how to make treatment decisions when resources are in short supply.

The task force plans to conduct a larger nationwide attitudinal survey of critical care physicians, nurses, hospital administrators and the public to determine what rationing practices take place and the attitude the various groups of

people have toward them.

Then, the VERICC group will conduct focus groups, summit meetings, and conferences for clinicians, hospital CEOs, and administrators that will lead to the development of resource allocation practice guidelines for critical care clinicians.

The task force also wants to develop a comprehensive database and sophisticated software capable of assisting ICU personnel in making resource allocation decisions, no matter where in the country they are located.

"What you'd really like to do [as a physician] is to take into account your patient's perspectives—what they want—and then a more global perspective of what works and what doesn't work and be able to make a more measured decision about the most effective way to apply resources at the bedside," Levy explains. "Unfortunately, there are no guidelines and no clear ways to go about it."

Bringing it Out in the Open

The first step for the task force will be to initiate discussions that encourage physicians to begin talking about their rationing decisions, to educate the public about how and why rationing is necessary and to foster public dialogue about the moral and ethical values that need to be addressed, says Dan W. Brock, PhD, senior scientist in the Department of Clinical Bioethics at the National Institutes of Health in Bethesda, MD, and a member of the VERICC Task Force.

"There is a denial that it happens on the part of both the health care system and the public," Brock says. "On the part of the public, there is always a concern about getting the care they need, and this sort of belief that rationing does not occur—and if it occurs, it is wrong."

The truth is that rationing of health care services does occur and has always occurred, in some form, and that it is necessary, he adds. "We need to acknowledge that: a) it does happen and has always happened; and b) it is necessary because if we didn't there would be enormous costs. There is an assumption, by many, that all care is beneficial. But few people would say that we should provide all possible care to everyone no matter what the cost."

The initial mission of the task force will be to educate the public about how rationing in critical care occurs, by what criteria resources might be allocated and the processes by which they might be rationed.

Health care providers also must be more willing to discuss rationing in an open way, adds Levy. "We don't want to admit to or talk about these decisions: 'Who should get the bed if I have one left? How much time do I spend with the patient? Who is going to get the more acute nursing care? Which patient should I send down [for a test] if I have to send down one first? Who do I want to insist get the test today and who can wait until tomorrow?' Rationing happens at a very subtle level, and making those decisions is part of medical judgment. But we could provide better help for physicians if we were willing to talk a little more in public."

The bioethicists on the VERICC panel will help the task force explore the different criteria that might be used to allocate scarce resources, Brock adds.

For example, many may feel that scarce resources should be reserved for those who will most benefit.

"But there are also concerns about justice in medicine—about preserving care for those worst off," Brock adds.

Patients who have not had adequate access to primary care or care early in a disease process may end up sicker that patients who have had the benefit of better health care overall. Restricting critical care based on the potential for a good outcome may leave out those patients, he notes.

"There are also questions about what weight should be given to patient age," Brock continues. "Should priority be given to younger patients rather than to the old?"

Discussions Guide Rationing Model

The task force is made up of ICU physicians, nurses, bioethicists, hospital CEOs, chairs of hospital departments of medicine, and other policy-makers.

Initially, they will sponsor conferences and meetings designed to establish a common taxonomy, Levy says. "We need a unified terminology—when I say the word 'rationing,' does it mean what others think it means?" he says. "Then, we need to develop some examples of what we mean, some models of rationing."

At that point, they will initiate the national survey of critical care providers and other stakeholders to find out what methods of rationing and resource allocation currently are used.

The final phase will be a large consensus conference that will work on developing guidelines on critical care resource allocation, he notes.

The guidelines will not be a blueprint for how each treatment, medication, or service should be allocated in each setting, but an effort to guide facilities in determining how they will make their decisions.

Hospitals may end up choosing different criteria on which to base their decisions, depending on the values of their community and the patients that they see and

treat, Brock notes.

"It may be that there is not widespread consensus on any one issue," he notes.

The task force also intends to examine a number of factors related to critical care outcomes, however, and it may be that many of the guidelines will cover general issues not related to individual patient care at the bedside, say Levy and Brock.

For example, the role of nursing ratios and patient outcomes will be examined, as will allocation of hospital funding for critical care services.

"The third phase of our project will be to actually build a computerized modeling program that would allow us to figure out in a more careful way what is the impact of allocating different resources," says Levy. "If I am trying to decide between hiring new nurses or buying a new X-ray machine vs. getting expensive new drugs, where am I likely to see the most benefit? So, some of the rationing that is going to occur is going to occur up front and not have to trickle down to the bedside level."

More information on the VERICC project can be found on the group's web site at www.vericc.org. And information on rationing in critical care medicine at the national survey of critical care providers can be found on the web site of the Society for Critical Care Medicine at: www.sccm.org. ■

Reference

1. Levit K, et al. Trends in U.S. healthcare spending, 2001. *Health Affairs*. (January/February 2003); 154-164.

Sources

1. Dan Brock, PhD, Human Values in Medicine, Department of Philosophy and Program in Medicine, Brown University, Providence, RI 02912.
2. Mitchell Levy, MD, Box G-RIH, Brown University, Providence, RI 02912-G.

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Billing and Documenting Critical Care

By Myra Wiles, CPC

When does critical care become just another emergency department (ED) visit? When you fail to document it properly. You may do all the right things and have a patient in crisis, but if the paperwork isn't done properly, you don't get paid for your efforts.

Many physicians think that if the patient is in ICU or CCU, they should bill those services with critical care codes. Others imagine that you can bill critical care in the ED if the patient dies or comes in via ambulance in critical condition. This is not true. Critical care is not a *place* of service; it is a *type* of service. While the care most often occurs in ICU or CCU, it can occur in the ED, a regular hospital floor, or a skilled nursing facility. We personally know of one instance in which it occurred in a clinic waiting room. And while the patient's condition must be critical (or imminently so), it is not the only criteria to be met to bill critical care services.

Critical care codes should be used to describe situations in which the physician is personally caring for or directing care of a patient that is critically ill or injured. There should be highly complex decision making to assess, manipulation and management of this patient who likely has impairment of one or more vital organ systems and faces imminent life-threatening deterioration without your involvement.

Documentation

Proper documentation is not difficult, but is seldom found. Three things must be well documented. Omit any of them and you can't bill critical care.

- **Patient condition**—The chart should show that the patient's condition is deteriorating or is likely to do so without intervention. The auditor will look for conditions such as circulatory failure, central nervous system failure, shock, renal, hepatic, metabolic and/or respiratory failure, etc.
- **Time spent in care**—How long were you there? The time doesn't have to be continuous, but it must exceed 30 minutes for the day during which you devoted your full attention to the patient. You can show this as your exact times in and out or approximate how long you were involved in care. (Caution: Don't rely on your nursing staff or anyone else to document this fact for you.)

What activities can be included in the time calculation? Services such as:

- Time spent at bedside caring for the patient.
- Time spent in the unit or at the nurse's station engaged in work directly related to care of the patient. This includes reviewing test results, documenting charts or discussing care with other medical staff. (Note: Time spent in activities that occur outside of the unit or off the floor may *not* be included in the critical care calculation since you were not immediately available to the patient.)

If the patient is unable or clinically incompetent to participate in discussions, time spent with family members or other decision makers to obtain a history, reviewing prognosis or discussing treatment limitations or options, *provided that the conversation bears directly on the management of the patient*. However, time spent in activities that do *not* directly contribute to **care** of the patient (team conferences, courtesy or compassionate care for the family) may not be included—even if they happen in the unit.

- Time spent performing procedures that will be separately reported (such as CPR, endotracheal intubation, insertion of Swan-Ganz catheter, etc.) should be excluded from your time calculation.
- **Activities involved**—It's not enough to just show the patient's condition was critical. Critical care can be billed only if both the patient's condition and the treatment provided meet the above criteria. Thus, your note should specifically state which of the above services were provided during your encounter.
- **Who can record it and where**—Some facilities keep very detailed logs of activities occurring during critical care times—much like the *Code Blue* logs that are kept. Those critical care notes document who was present and what was being done. While this certainly helps, it should not be relied on to document your physician services since many of those services occur away from the patient bedside and without involvement of other team members. Thus, the physician should record in the progress note those facts necessary to support his/her services.

Bill it Right

Codes 99291 and 99292 should be used to bill for critical care activities. The CPT has an excellent chart that shows what codes should be billed based upon how long you were with the patient. Use it, but keep these rules in mind when billing those codes.

Only one physician can bill for a specific episode of critical care. This is true even if two physicians of different specialty are involved at the same encounter. If two physicians bill for different episodes of critical care on a given day, they should be prepared to submit notes documenting that care was provided at separate times. (Don't forget that different episodes of the same specialty in the same clinic are considered one physician.)

Code 99291 represents the first hour of critical care and should be billed only once per day by the physician.

Do NOT bill extra for services such as reading chest X-rays or EKGs, ventilator management, pulse oximetry, blood gases, analyzing data stored in computers, gastric intubation, temporary transcutaneous pacing, and insertion of simple vascular access devices such as IVs.

DO bill extra for services such as CPR (that you do), endotracheal intubation, insertion of complex vascular access devices and similar services. Be sure to add modifier -25 to the critical care codes if you bill any of these procedures to avoid denial of the critical care as a bundled service.

Don't bill separately for a hospital visit on this date *unless that other visit occurred at a separate encounter during the day that was not included in this critical care calculation*. Such a visit must be fully documented to support the E&M code you bill for the visit.

Be sure the diagnosis code you use on your claim reflects the severity of the patient's condition. It may have a bearing on coverage.

Don't bill the 99291 or 99292 for time the physician spends during the transport of critically ill or injured patients to another facility. Instead, use 99289 and 99290.

Sample Note

"Patient critical with multiple trauma due to MVA. I directed CPR and inserted T-tube. X-rays and labs reviewed. Orders written & IVs placed. Discussion with family about pt's condition and decision made to proceed with care. Calls were made requesting consults from orthopedics, neurosurgery, and pulmonology. Dr. Smith called to admit. Total time in care: 80 minutes, excluding time spent in above procedures."

What can you bill? You bill for:

- CPR (92950);
- Placement of T-tube (31500);
- Critical care (99291-25 and 99292-25). ■

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Readers are Invited. . .

Readers are invited to submit questions or comments on material seen in or relevant to *Critical Care Alert*. Send your questions to: Robin Mason, *Critical Care Alert*, c/o American Health Consultants, P.O. Box 740059, Atlanta, GA 30374. For subscription information, you can reach the editors and customer service personnel for *Critical Care Alert* via the internet by sending e-mail to robin.mason@ahcpub.com. ■