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Reducing Ventilator-Associated Pneumonia Rates Through Staff Education

ABSTRACT & COMMENTARY

Synopsis: *A focused-education program dramatically decreased the incidence of ventilator-associated pneumonia.*

Source: Zack JE, et al. *Crit Care Med*. 2002;11:2407-2412.

THE PURPOSE OF THIS PRE- AND POSTINTERVENTION OBSERvation study was to evaluate the effect of an educational initiative on ventilator-associated pneumonia (VAP) rate. The educational program was directed towards respiratory therapists and critical care nurses. The patient population consisted of those developing VAP during a 2-year period. A multidisciplinary task force developed policies and an educational initiative to reduce VAP rates. The educational program consisted of a self-study module, lectures, and pre- and post-testing. The focus of the self-study module was coverage of general topics related to VAP and specific emphasis on risk reduction strategies. Successful completion of the program was required of all respiratory therapists and made available to critical care nurses on an elective basis. Posters related to VAP were posted throughout the ICU. The pre-intervention period occurred from October 1, 1999, to September 30, 2000, and the postintervention period occurred from October 1, 2000, until September 30, 2001. The diagnostic criteria for VAP were a modification of those established by the American College of Chest Physicians.

A total of 114 respiratory therapists completed the educational program. The average correct score on the exam increased from 80% to 91% ($P < 0.001$) after completing the educational module, and the average score 6 months after implementing the intervention was 85%. The educational module was also completed by 146 critical care nurses and their scores on the test increased from 81% to 91% ($P < 0.001$). During the 12-month period before the intervention, the VAP rate was 12.6 per 1000 ventilator days. Following the intervention, the VAP rate was

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5.7 per 1000 ventilator days—a decrease of 57.6% ($P < 0.001$). The cost saving associated with this intervention was calculated to be at least $424,000. Zack and colleagues concluded that an educational program focused on respiratory therapists and critical care nurses resulted in significant reductions in VAP rate.

COMMENT BY DEAN R. HESS, PhD, RRT

Nosocomial infections are an important cause of morbidity and mortality. Pneumonia is the most common nosocomial infection and 86% of nosocomial pneumonia is associated with mechanical ventilation. Respiratory therapists and intensive care nurses are intimately involved in the care of mechanically ventilated patients and are thus uniquely positioned to affect VAP rates. Significant opportunities exist to improve VAP prevention practices.[1-3] These include decreasing the frequency of ventilator circuit changes, increasing the use of noninvasive ventilation, and elevation of the head of the bed.

Despite considerable evidence that has emerged in recent years, approaches to the prevention of VAP remain archaic in many intensive care units. Although there is considerable evidence of the benefit of the semi-recumbent position for the prevention of VAP, I frequently observe mechanically ventilated patients who are not positioned accordingly. Despite considerable evidence[4] that changing ventilator circuits and in-line suction catheters at regular intervals does *not* decrease VAP rate (and a meta-analysis suggests that this might actually *increase* VAP rate), the practice of changing circuits at regular intervals continues in many hospitals. I know of instances where Infection Control Departments blocked the plans of Respiratory Care Departments to implement the practice of as-needed ventilator circuit changes because adopting such a practice "does not make sense"! Unfortunately, what makes sense in the minds of some (dare I call this 'expert' opinion?) still trumps high-level evidence in many hospitals. Despite evidence that it decreases intubation rate, increases survival, and decreases VAP rate, noninvasive ventilation in appropriately selected patients remains underused in many hospitals.

This study by Zack et al shows that an educational intervention directed primarily at respiratory therapists and critical care nurses can significantly reduce ventilator-associated pneumonia rates and associated costs. However, Zack et al have not reported whether this intervention affects other important outcomes such as antibiotic use, length or hospital stay, or mortality. In spite of these limitations, an education program such as the one described in this study should be considered—particularly for hospitals with a higher than expected ventilator-associated pneumonia rate. ■

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Editorial E-Mail Address: robin.mason@ahcpub.com

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Decision Rule Improves Cardiac Triage

ABSTRACT & COMMENTARY

Synopsis: *The clinical decision rule tested in this study reduced unnecessary hospital admissions in patients with suspected acute cardiac ischemia without affecting safety.*

Source: Reilly BM, et al. *JAMA*. 2002;288:342-350.

Among patients admitted from the emergency department (ED) with possible acute cardiac ischemia, as few as 25% are diagnosed with unstable angina or acute myocardial infarction (MI) and less than 5% experience a life-threatening complication. Concurrently, 2% to 5% of at-risk patients are improperly diagnosed in the ED and not triaged to cardiac care units.

To test ability to improve triage decisions, Reilly and associates compared outcomes in consecutive patients admitted from the ED with suspected acute cardiac ischemia during 2 periods: prior to using a clinical decision rule (pre-intervention group: n = 207) and after implementation (intervention group: n = 1008). The study took place in a 700-bed urban teaching hospital (Cook County) with an ED staffed by full-time emergency medicine attending physicians and residents. Patients were enrolled if they had an admitting diagnosis of acute MI, "rule-out MI," unstable angina, acute cardiac ischemia, or coronary artery disease if cardiac enzyme tests were ordered. Patients were followed after discharge from the ED if they presented with complaints of chest pain, epigastric pain, or dyspnea, and a 12-lead ECG was performed to evaluate possible acute cardiac ischemia.

The prediction rule stratified patients into 4 risk groups (high, moderate, low, and very low) according to ECG findings and the presence or absence of 3 "urgent factors:" systolic blood pressure < 100 mm Hg, rales heard above both lung bases, and known unstable ischemic heart disease. Safety was defined as the proportion of all patients who experienced major cardiac complications within 72 hours who were triaged to a coronary care unit or telemetry unit after ED evaluation. Efficiency was defined as the proportion of all patients who did not experience major cardiac complications who were triaged to a ED observation unit or an unmonitored unit.

Of the 973 intervention-group patients who did not experience major complications, 350 were sent to an observation unit or unmonitored ward. Thus, efficiency during the intervention was 36% (350/973), significantly higher than in the pre-intervention period (21% [42/198]; $P < 0.001$). Of 35 intervention-group patients who experienced major cardiac complications, 33 were triaged to a coronary care unit (n = 18), or telemetry unit (n = 15). Thus, safety in the intervention group (94% [33/35]) was not significantly different from pre-intervention (89% [8/9]; $P = 0.57$). Subgroup analysis indicated higher efficiency when physicians used the decision rule ($P < 0.01$). Improved efficiency was explained solely by different triage decisions for very low-risk patients. Attending physicians evaluated the decision prediction rule favorably (68%), and 84% believed it improved patient care.

COMMENT BY LESLIE A. HOFFMAN, PhD, RN

The major finding of this study was that use of the clinical decision rule reduced unnecessary admissions to inpatient-monitored beds without increasing complications among patients who were triaged to short-stay or unmonitored units. This change was achieved primarily by improving the identification of very low risk patients, and not admitting these patients to telemetry units.

In 1996, Goldman and colleagues[1] published a prediction rule for major cardiac complications within 72 hours after evaluation in the ED in patients who present with suspected acute cardiac ischemia. The rule was derived and validated in more than 15,000 ED patients; however, its effect on patient outcomes was never measured prior to this study. Prior to implementing the present study, the research team created a 1-page summary (available on request) that incorporated the risk-stratification algorithm and guidelines for its use. The study's primary outcome measures—safety and efficiency—link the decisions made using the prediction rule with a critical outcome of the decision—occurrence of a life-threatening complication within 72 hours.

The prediction rule used by the team was concise and appeared to reliably guide practice in this setting. It included prompts for physicians to provide the clinical data necessary to apply the rule accurately and included space for an explanation if the decision made differed from recommendations. Physicians used the decision rule in 832 (83%) of the 1008 intervention-group patients and evaluated it favorably. To secure this high level of approval, the team preceded use of the prediction rule by baseline data collection and 3-months of pilot testing and simulated effect analysis, a process described as essential groundwork to ensure physician support.

The study used several strategies to eliminate bias. Research assistants, blinded to the risk stratification process, enrolled all eligible patients, identified the triage site, and interviewed patients to obtain contact information for post-hospital follow-up. Patients who could not be contacted by phone were visited at their residences. If patients were lost to follow-up, death records were searched for 12 months. Follow-up was complete in 994 (98.6%) of cases. No deaths were documented in the remaining 14 patients. Two physicians blinded to the risk stratification process, reviewed records to determine possible complications and, if there was disagreement, a third physician helped to resolve the disagreement. Sample size was chosen based on a power analysis that indicated a sample of 1000 patients provided > 80% power to detect a 10% difference.

There is no precise risk threshold that can uniformly dictate which patients should be admitted from the ED to a specific hospital unit. Pending future research, the clinical prediction rule tested in this study appears to provide a reliable evidence-based foundation for decision-making in this challenging area. ■

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Intensivist Care Improves ICU Outcomes

ABSTRACT & COMMENTARY

Synopsis: *This carefully done systematic review of the existing literature shows that overall mortality and ICU length of stay are better with increasing involvement of critical care physicians in patient care.*

Source: Pronovost PJ, et al. *JAMA*. 2002;288: 2151-2162.

Pronovost and associates performed a comprehensive review of reported studies on the effects of ICU physician staffing on mortality and length of stay (LOS). After screening all published articles captured by a large number of relevant medical subject heading terms, along with 2590 abstracts presented at meetings, Pronovost et al identified 26 studies that met their criteria, all of them observational in design. They grouped physician staffing into low-intensity (no intensivist or elective intensivist consultation at the discretion of the primary physician) vs high-intensity staffing [all care directed by intensivists (closed ICU) or mandatory intensivist consultation].

High-intensity staffing was associated with lower hospital mortality (pooled relative risk, 0.71; 95% confidence interval, 0.62-0.82) and lower ICU mortality (RR, 0.61; 95% CI 0.50-0.75). High-intensity staffing was also associated with reduced hospital LOS in 10 of 13 studies and reduced ICU LOS in 14 of 18 studies; in 4 studies that adjusted for case mix, 2 showed reduced hospital and ICU LOS and 2 did not. Although not every study showed positive effects, there were no studies that found increased LOS with high-intensity staffing after case-mix adjustment.

■ COMMENT BY DAVID J. PIERSON, MD

Although it does not tell us why, this study pretty convincingly demonstrates that mortality and LOS are better the more intensivists are involved in the care of critically ill patients. An inherent problem with this literature is the inability to make care by intensivists vs nonintensivists the only variable. Pronovost et al were unable to find any randomized controlled trials of intensivist- vs nonintensivist ICU care. While such trials would be more scientifically rigorous than the observational studies currently available, it is pretty unlikely that they will be done. Thus we cannot be certain about the reasons for the improved outcomes in units heavily staffed by intensivists. In all probability it is not just the intensivist per se, but also the multiple organizational and system features present in ICUs with high-intensity intensivist exposure, that makes the difference.

This notion is especially important in interpreting "before-and-after" studies, in which there was typically less organization, standardization, and scrutiny of ICU care before the intensivists took over the unit. This is a limitation of the present study if the presence of an intensivist is the specific variable one is trying to study, but much less so if one's interest is in the process of care. The intensivist is the catalyst, or at least a marker, for the constellation of things that happen with present-day ICU organization, which also appear to improve mortality and LOS.

Also of concern in "before-and-after" cohort studies is the possible effect of temporal trends. Outcomes may progressively improve over time because of things unrelated to ICU organization. At my institution, a substantial, progressive improvement in survival among patients with ARDS was documented during the decade ending in 1993, despite the absence of identifiable changes in patient population or approaches to management.[1] The organization of our ICUs did not change

during that time, but if it had—say, with adoption of a closed-ICU system midway through the study period—this temporal trend might have been interpreted as evidence of the positive effects of the new staffing system on ARDS survival.

These caveats notwithstanding, the Pronovost study is rigorous and strongly supportive of the conclusion that ICU care by intensivists improves outcomes. This paper is likely to be influential as discussions of healthcare organization, physician workforce, and ICU organization continue both locally and at the national policy level. ■

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Special Feature:

Current Antifungal Treatment in the ICU

By Stephen W. Crawford, MD

In a recent issue of *Critical Care Alert* (2002;10:30-32) I discussed the epidemiology and pathophysiology of invasive fungal infections that afflict patients in the ICU.[1] In this issue, I review the current treatment options.

Immunologic Aspects

First among the treatment approaches is correction of the factors that place the patient at risk. Most importantly, immune function (especially neutrophil-related immune function) should be restored. This may require decreasing corticosteroid dose or use, treating underlying hematological malignancy, or administering white cell transfusions or hematologic growth factors. Limitations in improving immune function present a major barrier to curing invasive fungal infection. Surgical options are discussed later in the article.

Antifungal Agents

Most of the treatment options include antifungal agents. As an overview, the presently available agents include amphotericin B, the imidazoles, the triazoles, and the echinocandins (*see Table 1*).

Table 2 summarizes some of the agents undergoing clinical investigations.

Table 1.
Current Antifungal Agents for Systemic Infection

Amphotericin B
- IV and lipid formulations

Azole agents, which include the imidazoles
- Clotrimazole
- Ketoconazole
- Miconazole

Triazoles
- Fluconazole
- Itraconazole
- Voriconazole

Echinocandins
- Caspofungin

Amphotericin B. For the most of the last 40 years, the primary agent available for treating deep-seated or systemic fungal in infections (and the only agent for treating aspergillus infections) was amphotericin B deoxycholate. Amphotericin B has the advantage of having a very broad spectrum for many fungal species, but its use is limited by its toxicity, especially renal dysfunction.

Recent advances in amphotericin B include the development of lipid formulations. The clinical responses to these formulations are as good (or as bad, depending upon your perspective) as those seen with conventional amphotericin B.[2-4] All of these formulations demonstrate reduced nephrotoxicity compared to the parent compound. The reduced toxicity profiles allow administration of significantly higher doses of amphotericin B. However, it is unclear that these higher doses lead to improved efficacy.[5] It is clear, however, that these newer formulations are more expensive.

The lipid-complexed amphotericin B preparations

Table 2.
Investigational Antifungal Agents

Azoles
- Ravuconazole
- Posaconazole

Echinocandins
- Micafungin
- Anidulafungin

Adapted from: *Klepser ME, et al. Ann Pharmacother. 1998;32: 1353-1361.*

are highly lipophilic, and have decreased toxicity to human cells due to affinity to fungal ergosterols. Although commonly referred to as "liposomal" agents, only one of these (AmBisome) is a true liposome (*see Table 3*). All of these preparations display decreased toxicity, especially nephrotoxicity, as compared to conventional amphotericin B. In general, AmBisome has the least toxic reactions reported, followed by Albecet and then Amphocil. Given their lipophilic natures, these preparations are preferentially taken-up by reticuloendothelial system. This makes the pharmacokinetics difficult to follow in serum.

Imidazoles. In general, the imidazoles have played a very small role in the treatment of deep-seated or invasive fungal infections and will not be discussed here. Ketoconazole may have a role in chronic suppression of *Candida* species.

Triazoles. Fluconazole is the major triazole anti-fungal agent in common use for deep-seated or invasive fungal infections. Fluconazole is water-soluble and its absorption is not dependent on gastric pH. The drug is almost completely absorbed after oral administration and can be given either intravenously or orally. Excretion is primarily renal. It is indicated primarily for treatment of candida and *Cryptococcus neoformans* infections. In addition, it is useful for the prevention of candida infections in high-risk patients. Fluconazole has marginal activity against *Candida krusei* and *C glabrata*. These organisms are inherently resistant and infections with these yeasts commonly increase when fluconazole is used prophylactically. Fluconazole is not active against *Aspergillus* species.

The most frequently used second-generation triazole antifungal agent is **itraconazole**. Similar to fluconazole, it inhibits cytochrome P_{450}-dependent synthesis of ergosterol. However, it has a broader spectrum. It demonstrates in vitro activity against *Candida albicans* and other *Candida* species, *Aspergillus fumigatus*, *Blastomyces dermatitidis*, and *Histoplasma capsulatum*. Itraconazole is available in capsule, oral solution, and IV formulations.

Table 3.

Lipid Formulations of Amphotericin B

Amphocil®—Amphotericin B Colloidal Dispersion ("ABCD")

- "Ribbonlike" drug-phospholipid complexes

Albecet®—Amphotericin B Lipid Complex ("ABLC")

- "Disklike" complex of Amphotericin B & cholesteryl sulfate

AmBisome®—Liposomal Amphotericin B

- True liposome of 2 phospholipids

Boogaerts and associates recently compared the efficacy and safety of intravenous itraconazole with amphotericin B as empiric antifungal therapy in patients with hematological malignancies.[6] This international, multicenter, open-labeled, prospective randomized study included 384 adults with hematological malignancies who had neutropenia expected to last for 7 days, had persistent fever of unknown origin, and were unresponsive to broad-spectrum antibiotics.

Response rates were better (but not statistically different) for itraconazole (47%) as compared to amphotericin B (38%). There were no differences in rates of breakthrough fungal infection or deaths. However, the amphotericin B patients experienced significantly more drug-related adverse effects (54% vs 5%) and premature discontinuations secondary to adverse events (38% vs 19%). In addition, responding patients receiving itraconazole could be switched to oral therapy. Such studies suggest that itraconazole may be a reasonable alternative to conventional amphotericin B for empiric therapy.

Voriconazole is a newer triazole antifungal with broad-spectrum of activity against most human fungal pathogens, including *Candida*, *Aspergillus*, and *Cryptococcus* species, filamentous fungi, and dimorphic fungi. Cross-resistance with fluconazole for some *Candida* species has been reported. Twice daily dosing (both IV and oral) is available.

There are 2 international, randomized trials comparing voriconazole to amphotericin B. Herbrecht and associates compared voriconazole to conventional amphotericin B for treatment of documented invasive aspergillus infection.[7] The voriconazole cohort had a higher success rate (53% vs 31%; $P < 0.0001$) and a lower death rate (29% vs 42%; P = NS). Walsh et al compared voriconazole to liposomal amphotericin as empirical therapy in neutropenic fever.[8] Success rates were similar for the 2 cohorts (26% vs 31%; $P < 0.0001$), and the voriconazole cohort had fewer breakthrough fungal infections (2% vs 5%; $P = 0.02$).

Review of these studies illustrates several confounders in the study of aspergillus treatment. Treatments were based either on empirical evidence of aspergillus infection or on proven (documented) infection. Also, newer pharmacological interventions can be compared to either conventional amphotericin B or to a lipid preparation. Thus, interpretation and application of these studies can be confusing. At this time, one can justify using any of the available agents.

Other triazoles undergoing investigation include

ravuconazole and **posaconazole**. Both are active against *Candida albicans* and nonalbicans *Candida* species, *Cryptococcus* species, *Aspergillus* species and fluconazole-resistant strains of *Candida* species.

Echinocandins. In an apparent advance in the treatment of fungal infections, caspofungin acetate (Cancidas) represents the first of a new class of antifungal drugs (echinocandins or glucan synthesis inhibitors) that inhibit the synthesis of ß-(1,3)-D-glucan, an integral component of the fungal cell wall.[9] Of note, ß-(1,3)-D-glucan is not present in mammalian cells. Caspofungin is not an inhibitor of any enzyme in the cytochrome P450 (CYP) system, unlike the triazoles. The agent has *in vitro* and *in vivo* activity against *Candida* species, *Aspergillus* species, and *Histoplasma capsulatum*. Also, it is effective against fluconazole-susceptible and fluconazole-resistant *Candida* strains. However, it is not effective against *Cryptococcus neoformans*. Caspofungin is available in intravenous formulation only and has a very low toxicity profile. Because it has a different site and mechanism of action there is reason to believe that it may be useful in combination with currently available antifungals, such as amphotericin or the triazoles. This possibility of multi-drug therapeutic approach is very exciting and may present a significant breakthrough in treatment. Empirical successes have been reported, however controlled trials are lacking.[10]

Managing Invasive Pulmonary Aspergillosis

Invasive pulmonary aspergillosis (IPA) in the immunosuppressed bears many epidemiological similarities to bronchogenic carcinoma: the presentation is most often localized; the patients have identified risk factors; and "chemo" (drug therapy) alone is of limited value. Also, the causes of death for both are similar: spread to brain or heart, or erosion into thoracic vessels causing massive hemoptysis. For these reasons, I consider IPA to be the "Bronchogenic Carcinoma Equivalent."

For the same reasons we believe that surgical resection is the best treatment option for localized non-small cell bronchogenic carcinoma, I think we should consider surgical resection of IPA. Such resection is potentially curative, and may serve to "debulk" devascularized tissue that does not permit distribution of antifungal agents to the organisms. Although numerous reports suggest that surgical resection can be carried out safely, it is difficult to prove that outcomes are improved. Regardless, I think resection should be considered in any case of localized IPA (proven or suspected) in which continued immunosuppression is anticipated.

Alternative (or adjunctive) strategies to the treatment of invasive pulmonary aspergillosis are advisable since the prognosis with the usual approaches is so dismal. There are anecdotal reports of success with granulocyte transfusions, however no controlled studies to support the practice. Alternatively, I believe that the use of hematopoietic growth factors to augment phagocytic numbers and function has a potential sound rationale in neutropenic patient. Again, this is difficult to support with controlled trials. There are mixed reports of success when used prophylactically for lung cancer treatments.

Conclusions

In summary, there are new drugs approved for the treatment of serious invasive fungal infections. These have primarily been studied in the neutropenic patient population. Compared to those of conventional amphotericin B, the safety and toxicity profiles of these new agents are favorable. Response rates are at least equivalent to conventional treatment. The most novel of the new agents is the first of the echinocandin class, caspofungin. Its novel mechanism of action raises the possibility (so far, supported only by anecdotes) that combination therapy with amphotericin or triazole compounds may have increased efficacy. Despite these advances, the major limitation to recovery from serious invasive fungal infection for most patients remains the underlying disease that produced their immune suppressed state.

***Note**—The views and opinions expressed are not necessarily those of the US Navy or US Government. Dr. Crawford is a member of the Ortho-Biotech, Inc speaker's bureau.* ■

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36. In the study by Zack et al, the effect of an educational initiative on ventilator-associated pneumonia rate was to:
a. decrease ventilator-associated pneumonia rate
b. increase the knowledge of respiratory therapists and critical care nurses on topics related to prevention of ventilator-associated pneumonia
c. decrease the costs associated with ventilator-associated pneumonia
d. All of the above
e. None of the above

37. Which of the following measures decreases the incidence of ventilator-associated pneumonia?
a. Increasing the rate of ventilator circuit changes
b. Increasing the rate of in-line suction catheter changes
c. Elevating the head of the bed
d. All of the above
e. None of the above

38. When a clinical decision rule was used to triage patients with suspected acute cardiac ischemia, improved outcomes in the intervention group were explained by:
a. more rapid decision-making regarding patient unit destination.
b. more patients discharged to home.
c. fewer patients sent to short-stay or observation units.
d. fewer laboratory tests which reduced costs.
e. different triage decisions for very low-risk patients.

39. A clinical decision rule applied to the emergency department triage of patients with suspected acute cardiac syndromes had which of the following effects?
a. Decreased mortality among patients with acute MI
b. Decreased incidence of acute MI
c. Decreased use of invasive cardiac diagnosis
d. All of the above
e. None of the above

40. Compared to low-intensity intensivist care or no care by intensivists, management of critically ill patients that either takes place in a closed unit run by intensivists or that requires intensivist consultation results in:
a. reduced ICU mortality.
b. reduced hospital mortality.
c. decreased ICU length of stay.
d. decreased hospital length of stay.
e. All of the above

41. The newest class of antifungal agents to be approved is:
a. triazoles.
b. lipid formulation amphotericins.
c. liposomal amphotericin.
d. echinocandins.
e. None of the above

42. The following antifungal agents have been shown to have clearly superior efficacy compared to conventional therapy for suspected invasive aspergillosis:
a. Itraconazole
b. Liposomal amphotericin
c. Caspofungin
d. All of the above
e. None of the above

Answers: 36. (d); 37. (c); 38. (e); 39. (e); 40. (e); 41. (d); 42. (e)

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Physicians and nurses participate in this continuing education program by reading the article, using the provided references for further research, and studying the questions at the end of the article. Participants should select what they believe to be the correct answers, then refer to the list of correct answers to test their knowledge. To clarify confusion surrounding any questions answered incorrectly, please consult the source material. **At the end of the testing period, you must complete the evaluation form provided and return it in the reply envelope provided in order to receive a certificate of completion.** When your evaluation is received, a certificate will be mailed to you.

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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:

Practice Guidelines Reduce Unnecessary Testing in the CCU

CRITICAL CARE Plus

EXPANDING YOUR FOCUS IN INTENSIVE CARE

Eight ICU Core Measures Move Forward

By Julie Crawshaw, Critical Care Plus Editor

The Joint Commission on Accreditation of Healthcare Organizations (JCAHO) is pilot testing 8 of the 11 standardized intensive care core measures initially put forth for public comment. The ICU core measures are JCAHO's latest move in the ORYX initiative to integrate performance measurement into the accreditation process. Core measures permit comparisons of performance in hospitals across the nation.

JCAHO is working with the Leapfrog Group, a consortium of Fortune 500 companies committed to improving patient safety, and other interested parties to reach agreement on a set of consensus performance measures for intensive care provided in hospitals.

"When Leapfrog came out more than a year ago with the standard that intensivists provide better care, we were a little concerned that the standard might be used as a proxy for outcomes and direct processes of care," says Jerod Loeb, JCAHO vice president for research and performance measurement. "That's why we decided to partner with Leapfrog to get a little more precision into measuring issues around ICU outcomes instead of just using a metric of how many intensivists a hospital has."

Loeb says that these measures will be used in the context of already existing accreditation activities that cover a variety of other aspects of health care, including a group of 600+ standards designed to reduce the risk of bad things happening in hospitals.

"These measures are not JCAHO's final word on ICU metrics," Loeb says. "They will change over time in accordance with changing clinical and scientific literature."

Subjective Measures Not in Pilot Test

Nancy Lawler, RN, BSN, JCAHO's associate project director says that the 15-member advisory panel began its work by consolidating 45 measures into the 11 that were posted for public comment. The eight measures now being pilot tested constitute less than one-fifth of those originally proposed.

One of the measures not going forward involved optimal pain management. "The major issue was lack of consensus on pain scale to be used," Lawler says. "There are lots of valid pain scales, and no one wanted us to dictate which one they had to use."

Another measures thrown out concerned family satisfaction, for which no agreed-upon survey tool was available. "This measure scored rather low on how the data would be used because it's based on subjective information," Loeb notes. "We're not saying satisfaction isn't important, just that we don't have a tool to measure it."

Lawler says that 41.9% of the 1600 respondents were nurses, 30% were physicians and of those 77.4% were board-certified or board-eligible in critical care medicine. Well-qualified audience lent credibility to the comments received.

Lawler adds that the final set contains individual performance measures interrelated and designed to help other stakeholders, such as government agencies and business communities, assess the overall care provided in an ICU.

Measures are a First for Care Setting

Loeb observes that the ICU measures mark an important change for the Joint Commission. "Until this point all the measure sets and core measure complements we have come up with have addressed physical conditions," Loeb says. "This is the first time a set of measures has been proposed that address a setting of care."

He adds that the conflict between using hospitalists and intensivists in the ICU is an issue JCAHO will ultimately

have to address. "There's a fair amount of data that strongly suggests a link between the training of the physicians practicing in the ICU setting and patient outcomes," he says. "The problem is that there's a much greater demand than supply for intensivists and it's an economic issue for many hospitals because the costs of having an intensivist present on a 24/7 basis."

The ICU core measures recommended for initial pilot testing are:

- Ventilator Associated Pneumonia (VAP) Prevention
- Appropriate Peptic Ulcer Disease (PUD) Prophylaxis
- Appropriate Deep Vein Thrombosis (DVT) Prophylaxis
- Appropriate Sedation
- Central Line-Associated Bloodstream Infection (BSI) rate by type of ICU
- Intensive Care Unit (ICU) Length of Stay (LOS) by type of ICU
- ICU Mortality (Risk Adjusted)
- Use of Intensivists

Overall Reception to Measures Less than Positive

Loeb describes reception to the measures as "less than positive" but says the negativity has little to do with the notion that what gets measured gets managed and everything to do with "don't make me do yet another unfunded mandate." He says the response is hardly surprising in the current healthcare environment with its escalating cost and workforce pressures.

"We're trying to come up with a set of measures that will be fairly simple, have a great bearing on positive outcomes for ICU patients, be beneficial from a quality improvement standpoint and also provide information for interested stakeholders," Loeb says. "The measures are complementary to the existing standards. You can't look at them as singular tools used for decision-making-they are one in a large armamentarium of information gathered for accreditation."

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Loeb describes an ICU a setting that sucks up enormous resources and stresses that the proposed measures are not intended as a panacea for stopping death in the ICU. He quotes Ian Morrison, president of the Institute for the Future, who said, "The Scots believe that death is imminent. Canadians believe that death is inevitable. But Americans believe that death is optional."

Technology to the Rescue

Loeb expects that at some point technology will become the white knight that overworked and understaffed ICUs need. "We're fast approaching a time when monitoring patients from afar using boarded intensivists and giving input to the care giving staff is routine," he notes.

He anticipates that measures for end-of-life care will be the next additions to the core set. Loeb expects that advisory panel member Mitchell M. Levy, MD, FCCM, FCCP, medical director of MICU at Rhode Island Hospital/Providence, will bring forth an end-of-life proposal when the end-of-life project he heads for the Robert Wood Johnson Foundation is complete. "We need to think about end-of-life care, but right now we don't have good, well-tested measures," Loeb says. "Within six months I expect we'll have some meat on these bones." *(For more information contact Jerod Loeb or Nancy Lawler at [630] 792-5920.)* ■

VAP: High Costs in More Ways than One, says CDC Guideline

The fatality rates for hospital-associated pneumonia in general, and of ventilator-associated pneumonia (VAP) in particular, are high. For hospital-associated pneumonia, attributable mortality rates of 20% to 33% have been reported, according to the draft pneumonia prevention guideline by the Centers for Disease Control and Prevention (CDC).[1] Here are some other findings gleaned from the draft document:

In one study, VAP accounted for 60% of all deaths due to hospital-associated infections. In studies in which invasive techniques were used to diagnose VAP, the crude mortality rates ranged from 4% in patients with VAP—but without antecedent antimicrobial therapy—to 73% in patients with VAP caused by Pseudomonas or Acinetobacter species. Attributable mortality rates ranged from 5.8% to 13.5%.

The wide ranges in crude and attributable mortality rates strongly suggest that a patient's risk of dying from VAP is affected by multiple other factors, such as underlying disease, organ failure, receipt of antimicrobial agent, and the type of infecting organism.

Analyses of pneumonia-associated morbidity have shown that hospital-associated pneumonia can prolong ICU stay by an average of 4.3 days and hospitalization by four to nine days. A conservative estimate of the direct cost of excess hospital stay due to pneumonia in

1993 was $1.2 billion a year for the nation.

Pneumonia accounts for approximately 15% of all hospital-associated infections and 27% and 24% of all infections acquired in the medical ICU and coronary care unit, respectively. It is the second most common hospital-associated infection after that of urinary tract.

The primary risk factor for the development of hospital-associated bacterial pneumonia is mechanical ventilation (with its requisite endotracheal intubation). The CDC's National Nosocomial Infection Surveillance System (NNIS) reported that in 1986-1990, the median rate of VAP per thousand ventilator-days in NNIS hospitals ranged from 4.7 in pediatric ICUs to 34.4 in burn ICUs. The median rate of nonventilator-associated pneumonia per 1,000 ICU days ranged from zero in pediatric and respiratory ICUs to 3.2 in trauma ICUs.

Studies indicate that patients receiving continuous mechanical ventilation have six to 21 times the risk of developing hospital-associated pneumonia compared with patients who are not vented. Because of this tremendous risk, in the last two decades, most of the research on hospital-associated pneumonia has been focused on VAP. ■

Reference

1. Centers for Disease Control and Prevention. Healthcare Infection Control Practices Advisory Committee. Draft Guideline For Prevention Of Healthcare-Associated Pneumonia. Atlanta; 2002.

Deaths, Injuries Often Come From Multiple Failures

VENTILATOR-RELATED DEATHS AND INJURIES OFTEN are caused by multiple system failures, especially in the ICU, according to a recent report from the Joint Commission on Accreditation of Healthcare Organizations.

As of January 2002, the Joint Commission had reviewed 23 sentinel events that involved deaths or injuries related to long-term ventilation. Nineteen resulted in death and four in coma. Of the 23 cases, the Joint Commission says 65% were related to the malfunction or misuse of an alarm or an inadequate alarm; 52% were related to a tubing disconnect; and 26% were related to a dislodged airway tube.

"A small percentage of the cases were related to an incorrect tubing connection or wrong ventilator setting," the Joint Commission reports. "None of the cases were related to ventilator malfunctions. As the percentages indicate, ventilator-related deaths and injuries are often related to multiple failures that lead to negative outcomes. The majority of the cases occurred in hospital ICUs, followed by long-term care facilities and hospital chronic ventilator units."

When the root causes were analyzed, 87% of the incidents involved inadequate orientation or training processes and 35% included insufficient staffing levels. Seventy percent of the cases involved a communication breakdown among staff members; 30% were related to improper room design that limited the observation of the patient; and staff did not respond immediately to ventilator alarms in 22%.

"In addition, several organizations found that during the use of low airway pressure alarms only, some ventilators did not always respond to tubing disconnects at all levels of the airflow circuit," the report states. "For example, the disconnected airway tube may fall into the bedding or against the patient's body, ventilation cycling continues, and the ventilator continues to receive indications of correct air pressure."

The Joint Commission advises risk managers to ensure that their organizations adhere to guidelines from the Food and Drug Administration and the American Association of Respiratory Care (AARC) for testing and evaluating ventilators. The AARC Clinical Practice Guideline for patient ventilator systems recommends that:

- Professionals responsible for application, adjustment, and monitoring of ventilators, alarm systems and airways, possess relevant education, and have undergone validated competency testing;
- Systems are in place to check ventilator and monitoring system performance before and during clinical use;
- All devices and systems are maintained according to manufacturers' specification. This includes medical gas systems;
- A tracking system is in place to identify, analyze, and remedy all ventilator-related incidents that lead to serious injury or death;
- Protocols for the application and discontinuance of mechanical ventilation are in place;
- A mechanism is in place to track outcomes of all ventilator patients;
- Organized, periodic, ventilator-related continuing education is accessible to those professionals responsible for the many components of care directed to ventilator patients.

In addition, the Joint Commission makes these recommendations:

- Review orientation and training programs for job-specific, ventilator safety-related content and include in competency assessment process;
- Review staffing process to ensure effective staffing for ventilator patients at all times;

- Implement regular preventive maintenance and testing of alarm systems;
- Ensure that alarms are sufficiently audible with respect to distances and competing noise within the unit;
- Initiate interdisciplinary team training for staff caring for ventilator patients.

Direct observation of ventilator-dependent patients is preferred in order to avoid overdependence on alarms. ■

CDC Catheter Guide Cites Change-Out Frequency

The Centers for Disease Control and Prevention (CDC) has issued updated guidance to help infection control professionals prevent costly intravascular catheter-related bloodstream infections (BSIs). Some 250,000 cases of central venous catheter (CVC) associated BSIs occur in hospitals annually, with attributable mortality ranging from 12% to 25% for each infection, and a minimum cost to the health care system some $25,000 per case.

The new guidelines are designed for both clinicians who insert catheters and infection control professionals who track and try to prevent them.[1]

Although intravascular catheters provide necessary vascular access, their use puts patients at risk for local and systemic infectious complications. One of the ongoing issues in the use of catheters is the frequency of replacement for the devices, dressings, administration sets, and the fluids being administered

The incidence of catheter-related BSIs varies considerably by type of catheter, frequency of catheter manipulation, and patient-related factors (e.g., underlying disease and acuity of illness), the CDC notes. Peripheral venous catheters are the devices most frequently used for vascular access. Although the incidence of BSIs associated with peripheral venous catheters is usually low, serious infectious complications produce considerable annual morbidity because of the frequency with which such catheters are used. However, the majority of serious catheter-related infections are associated with central venous catheters (CVCs), especially those that are placed in patients in ICUs. In the ICU, central venous access might be needed for extended periods of time, and patients can be colonized with hospital-acquired organisms. In addition, the catheter may be manipulated multiple times per day for the administration of fluids, drugs, and blood products.

Moreover, some catheters may be inserted in urgent situations, during which optimal attention to aseptic technique might not be feasible. Certain catheters (eg, pulmonary artery catheters and peripheral arterial catheters) can be accessed multiple times per day for hemodynamic measurements or to obtain samples for laboratory analysis, augmenting the potential for contamination and subsequent clinical infection.

Measures to minimize the risk for infection associated with intravascular therapy should strike a balance between patient safety and cost effectiveness, the CDC recommends. Reports spanning the past two decades have consistently demonstrated that risk for infection declines following standardization of aseptic care, and that insertion and maintenance of intravascular catheters by inexperienced staff might increase the risk for catheter colonization and infection.

Specialized "IV teams" have shown effectiveness in reducing the incidence of catheter-related infections. Additionally, infection risk increases when nursing staff reductions fall below adequate levels, the CDC adds.

For short peripheral catheters, good hand hygiene before catheter insertion or maintenance, combined with proper aseptic technique during catheter manipulation, provides protection against infection. Good hand hygiene can be achieved through the use of either a waterless, alcohol-based product or an antibacterial soap and water with adequate rinsing.

Appropriate aseptic technique does not necessarily require sterile gloves. A new pair of disposable nonsterile gloves can be used in conjunction with a "no-touch" technique for the insertion of peripheral venous catheters. However, gloves are required by the Occupational Safety and Health Administration as standard precautions for the prevention of bloodborne pathogen exposure. Compared with peripheral venous catheters, CVCs carry a substantially greater risk for infection. Thus, the level of barrier precautions needed to prevent infection during insertion of CVCs should be more stringent. Maximal sterile barrier precautions (eg, cap, mask, sterile gown, sterile gloves, and large sterile drape) during the insertion of CVCs substantially reduces the incidence of BSI compared with standard precautions (eg, sterile gloves and small drapes).

Although the efficacy of such precautions for insertion of PICCs and midline catheters has not been studied, the use of maximal barrier precautions also is probably applicable to PICCs, the CDC advised. ■

Reference

1. Centers for Disease Control and Prevention. Guidelines for the Prevention of Intravascular Catheter-Related Infections. *MMWR Morb Mortal Wkly Rep*. 2002;51(RR-10):1-32.

PHARMACOLOGY WATCH

Smallpox Vaccination Guidelines Published by CDC

The CDC published "Smallpox Vaccination and Adverse Reactions—Guidance for Clinicians" in the Jan. 24th edition of *Morbidity and Mortality Weekly Report.* The guidance is a thorough review of the smallpox vaccine with a well-illustrated compendium of complications. Some of the highlights include:

Inoculation is administered using a multiple-puncture technique with the bifurcated needle. The inoculation site progresses from papule to vesicle, eventually becoming a pustule within 10 days. The pustule scabs over within 2-3 weeks usually leaving a pitted scar. Development of a pustular lesion is considered a major reaction and a successful vaccine take. Lesser reactions are considered equivocal and are nontakes. Large vaccination reactions may occur in 10% of first-time vaccinees. Systemic reactions are common in all vaccinees and include fatigue, headache, myalgias, chills, nausea, and fever. The vaccine is made from live vaccinia virus (it does not contain variola virus) and transmission is possible from the vaccination site up to 3 weeks after vaccination. The shedding period may be less for revaccination. The inoculation site is generally considered infectious from the time just after vaccination until the scab separates from the skin. Vaccinia is transmitted by close contact and can lead to the same adverse events in an infected contact as in the vaccinee. The inoculation sites should remain covered and vaccinees should wash their hands immediately after touching vaccination sites or changing dressings. The smallpox vaccination is generally considered safe, but is contraindicated in patients who have, or are in close contact with, those who have atopic dermatitis (eczema) regardless of the severity, skin diseases that disrupt the epidermis, pregnant women or women who plan on becoming pregnant within 1 month after vaccination, and immunocompromised patients. Others who should not receive the vaccine include those who have an allergy to a component of the vaccine, are breast-feeding, are using ocular steroids, have moderate-to-severe intercurrent illness, or are younger than 18 years of age.

The CDC has an excellent web site for health-care providers who wish to learn more about the smallpox vaccine: www.bt.cdc.gov/training/smallpox-vaccine/reactions/default.htm

Nurses: Delay Vaccination Program

Meanwhile, not everyone is happy with the national smallpox vaccination program. Recently the American Nurses Association (ANA) requested that the Bush administration delay the smallpox vaccination program until certain safety issues can be addressed. Specifically, the ANA is seeking information regarding potential transmission of vaccinia virus to family members of vaccinated nurses, coverage of medical costs related to vaccination, safety of the vaccination materials, adequate educational materials and staffing issues, and job security issues related to the vaccination program. Others such as Thomas Mack, MD, MPH, argue in the Jan. 30 edition of the *New England Journal of Medicine* that

This supplement was written by William T. Elliott, MD, FACP, Chair, Formulary Committee, Kaiser Permanente, California Division; Assistant Clinical Professor of Medicine, University of California-San Francisco. Telephone: (404) 262-5517. E-mail: robin.mason@ahcpub.com. In order to reveal any potential bias in this publication, we disclose that Dr. Elliott reports no consultant, stockholder, speaker's bureau, research, or other financial relationships with companies having ties to this field of study.

smallpox is overrated as a bioterrorist weapon. His view is that the current vaccination policy would provide little protection and the cost from vaccine complications would outweigh any benefit (*N Engl J Med*. 2003;348:460-463). However, a special article in the same issue developed scenarios of smallpox attacks and reviewed possible outcomes of control policies. Their analysis favors a program of prior vaccination of health care workers but favors vaccination of the public only in the likelihood of a national attack, or multiple attacks is very high (*N Engl J Med*. 2003;348:416-425).

Viagra Effective for Depression Treatment

Sildenafil (Viagra) is an effective treatment for antidepressant-associated sexual dysfunction in men. The drug was tested in a multicenter randomized double-blind placebo-controlled trial. Ninety men with major depression in remission on SSRI antidepressants were randomly assigned to take sildenafil (50 to 100 mg) or placebo for 6 weeks. Men who were most affected by antidepressant-associated sexual dysfunction were significantly more likely to improve with sildenafil (24/44, 54.5% response rate) vs placebo (2/45, 4.4% response rate) ($P < .001$). Erectile function, arousal, ejaculation, orgasm, and overall satisfaction measures improved significantly with sildenafil compared with placebo (*JAMA*. 2003;289:56-64). This study is important because sexual dysfunction is a common cause of noncompliance with serotonin reuptake inhibitors, and use of sildenafil may improve compliance with antidepressant treatment.

Finisteride/Doxazosin no Better than Placebo for Urinary Obstruction

Finisteride (Proscar) is no better than placebo when used in combination with doxazosin for the treatment of urinary obstruction due to benign prostatic hypertrophy, according to the recently published Prospective European Doxazosin and Combination Therapy (PREDICT) trial. These findings come in contradiction to the Medical Therapy of Prostatic Symptoms (MTOPS) trial published in May 2002, which showed a benefit of the combination of finasteride and doxazosin. In the current study, more than 1000 men were randomized to doxazocin, finisteride 5 mg per day, the combination of both, or placebo. The groups receiving doxazocin alone or in combination with finisteride had significant improvements in total maximal urinary flow rates and International Prostate Symptoms Score compared to the finisteride alone group and placebo group ($P < .05$). There was no significant difference between treatment with finisteride and placebo. Doxazosin was initiated at 1 mg per day and titrated to a maximum of 8 mg per day. All treatments were well tolerated (*Urology*. 2003;61:119-126).

Sildenafil, however, may be effective of relieving obstructive urinary symptoms in men who use the drug on a regular basis. British researchers looked at 112 men with erectile dysfunction at 1 and 3 months after taking sildenafil as needed before sexual intercourse. Only 20 of the 112 men complained of lowered urinary tract symptoms, but of those men, improved urinary scores at 3 months strongly correlated with improvement in sexual function. The authors suggest that an increase in nitric oxide associated with the resumption of normal sexual activity may be responsible for the improvement in urinary symptoms (*Br J Urol Int*. 2002;90: 836-839).

Serevent Receives 'Dear Doctor' Letter

GlaxoSmithKline has issued a "Dear Doctor" letter regarding its asthma bronchodilator salmeterol (Serevent). The warning is based on interim results from a large study of salmeterol that was initiated in 1996. The Salmeterol Multi-center Asthma Research Trial (SMART) was a postmarketing study designed to investigate reports of several asthma deaths associated with use of salmeterol. Analysis of the interim results showed a trend "toward a greater increase in asthma deaths and serious asthma episodes" with the largest increase in African-American patients. Data on almost 26,000 patients were available for analysis. While there was no significant difference for the primary end point of combined respiratory related deaths and respiratory related life-threatening experiences including incubation and mechanical ventilation between salmeterol and placebo, a higher, but not statistically significant number of asthma related life-threatening experiences including deaths occurred in the salmeterol group. The number of adverse events reached statistical significance in African-Americans who represented 17% of the study. No other ethnic group drew any conclusions. The use of inhaled corticosteroids reached only 47% in the entire population of the SMART study. Because of these findings, GlaxoSmithKline has decided to discontinue the study and continue reviewing data from the interim analysis. The FDA is involved in this process and will likely require label changes for Serevent that will reinforce guidance on appropriate and safe prescribing. ■