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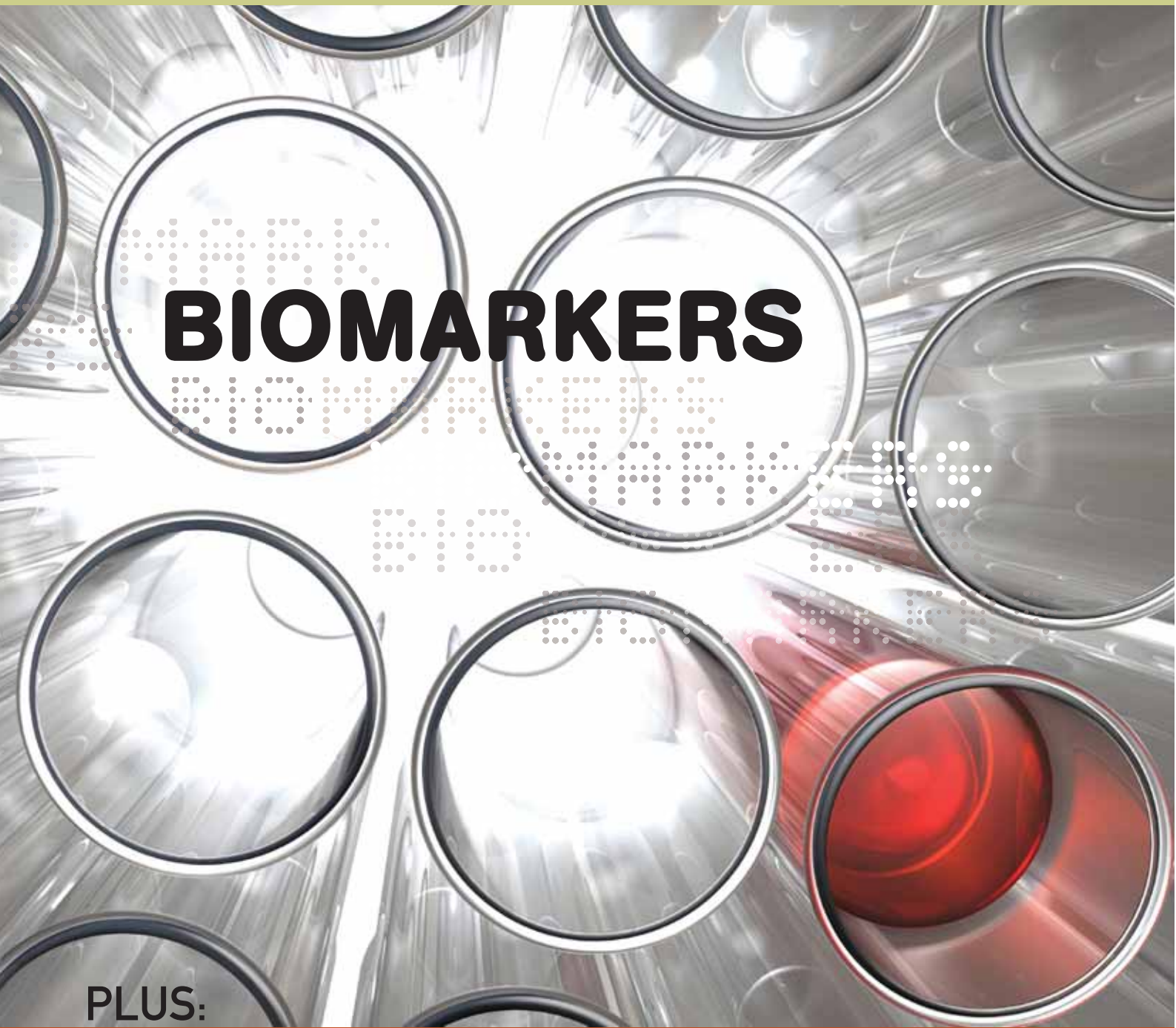

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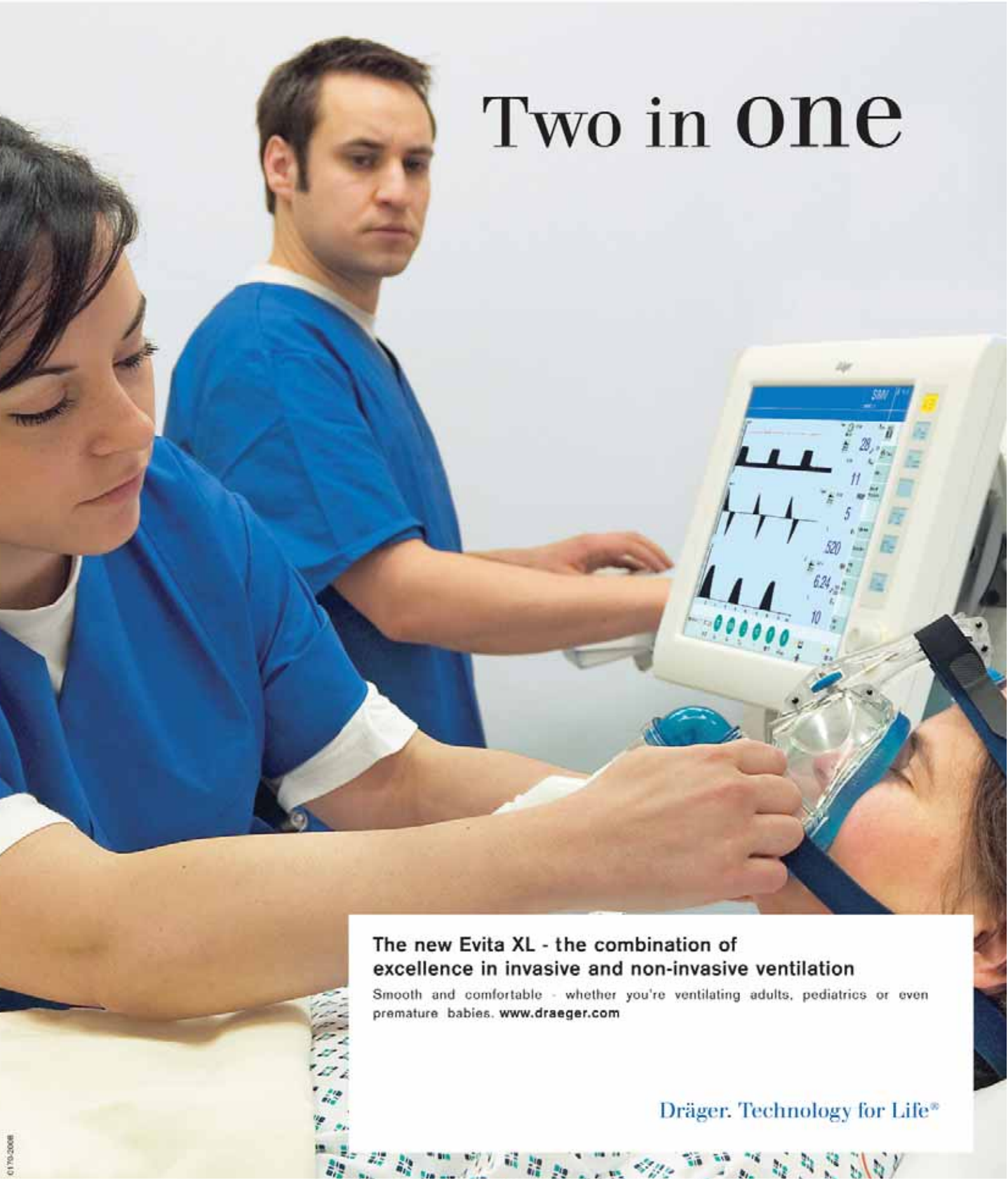

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EDITORIAL

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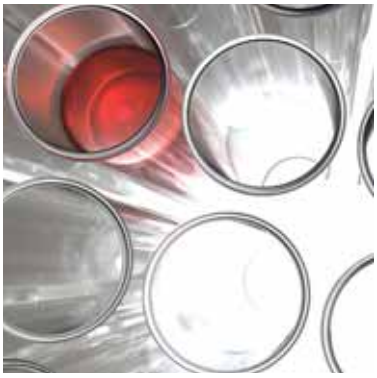

In critical care, there is no single answer, no magic solution - pharmaceutical or diagnostic that can cure all patients or improve their conditions simultaneously. In **ICU Management** we are always, however, in search of new diagnostic tools and medications, which we can add to our arsenal of weapons in fighting the deadliest of conditions that our patients face. While an ideal biomarker has not been identified, in recent years, several biomarkers have been highlighted in studies and research as possible tools in the early detection and treatment of certain infections.

In this issue of **ICU Management**, Dr. Povoa argues that biomarkers can provide additional information to the clinical evaluation in the diagnosis of infection, risk stratification, as well as in assessment of the response to antibiotic therapy. He looks at two such noted biomarkers: C-reactive protein (CRP) and procalcitonin (PCT), in addition to the newly proposed soluble triggering receptor expressed on myeloid cells-1 (sTREM–1) and evaluates their possible roles in the diagnosis of infection. Drs. Coelho and Pereira from Portugal focus solely on the use of serum biomarkers in the evaluation of infection response to antibiotics, while Dominique Vandijck from Ghent University Hospital examines the cost effectiveness of utilising biomarkers in the diagnosis of septic patients.

As the general population ages, so too does the number of elderly patients who come into our direct care in the ICU. Management of these patients - with their unique needs and treatment issues is a matter that requires renewed attention and increased vigilance of the part of ICU teams as a whole. Our special focus on care of the elderly begins with a thought-provoking article by Dr. Barraco from Pennsylvania, USA on how to reduce perioperative risk in your ICU; and will culminate in an issue of **ICU Management** next year on this timely and important issue for ICU managers and professionals.

ICU Management Editorial Board Member, Dr. Flaatten lends his time and expertise to outline the state of education and training in intensive care in Europe, a topic of much current study and discussion in the field.

In our continuing Hypothermia Series Dr. Polderman discusses fever control in critically ill patients, and in the Management segment of this issue, Rebecca Anas, Dr. Brunet and colleagues from Toronto, Canada return to **ICU Management** to introduce a framework to implement efficient, evidence based organisation of care in our units.

This time our Country Focus lands in Israel for a brief yet interesting visit: Dr. Gurman discusses the similarities and differences in the closely intertwined fields of anaesthesiology and intensive care in Israel, and in general. Freda DeKeyser Ganz outlines ongoing changes in intensive care nursing education in Israel, and Rabia Khalaila and team from Hadassah-Ein Kerem Medical Center in Jerusalem highlight the importance of physical assessments done by nurses in the ICU.

As we strive to provide the most efficient, accurate and favorable treatment for our patients-as critical care professionals, we look continuously toward science to provide more techniques to us in early diagnosis and treatments. A definitive, specific biomarker for sepsis is yet to be found, but as the authors in this issue concur, there are many beneficial uses for those markers that are readily accessible.

An added note - in this issue, we have elected to include references listed by contributing authors. We hope that this and our continuing evolution of format and style changes will continue to increase the interest and value **ICU Management**. Your comments and requests are always welcome. Please forward any correspondence to Managing Editor Sherry Scharff at **editorial@icu-management.org**

Jean-Louis Vincent

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TABLE OF CONTENTS

ICU Management is the Official Management and Practice Journal of the International Symposium on Intensive Care and Emergency Medicine and was previously published as Hospital Critical Care.

1

Lung Injury Still Too Common in Ventilation, Measures for Protection Insufficient

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Ventilator-induced injury in the lungs is responsible for a vast number of deaths in acute respiratory distress syndrome (ARDS). Even healthy surgical patients, who require temporary mechanical ventilation, are at risk of ventilator-induced lung injury. Although such injuries have been reduced tremendously over the last few decades, a new study suggests, they have much further to go.

"It is ironic, because for a large number of patients with ARDS, it is the treatment, rather the syndrome, which ends up killing them," says Luciano Gattinoni, M.D., lead researcher of the study, which was published in the second issue for August of the American Thoracic Society's American Journal of Respiratory and Critical Care Medicine.

Assessing patients' lung stress and strain appropriately could mean the difference between life and death. Overestimating stress may lead to carbon dioxide build-up in the blood and low ventilation with atelectasis—or lung tissue collapse. Underestimating stress may enhance the risk of ventilator-induced lung injury. The only bedside assessments currently available are to compute tidal volume and plateau pressure as surrogate measures for lung stress and strain in ARDS patients.

To determine whether those measurements are adequate, Dr. Gattinoni and colleagues analysed true stress—the internal counterforce that reacts to an external load—and strain, the structural change associated with stress—in a total 80 patients, including post-surgical patients, patients with ARDS, patients with Acute Lung Injury (ALI) and patients with a medical disease. They used a number of measurements of lung stress and strain, primarily oesophageal pressure and lung volume assessment with helium dilution technique. The investigators found that there was little correlation between plateau pressure and tidal volume and actual lung stress and strain in all four groups.

While plateau pressures and tidal volumes may be reflective of the chest wall elastance and lung volume of the population as a whole, in circumstances where patients require mechanical ventilation, those general guidelines are inadequate to assess the individual's lung stress and strain. For example, there are certain clear indicators that the chest wall elastance may be altered (e.g. severe obesity). In this case, the plateau pressure would overestimate the stress.

"The consequences are, of course, potentially more dangerous in patients in which the chest wall elastance is more compromised and the lung volume is more reduced," said Dr. Gattinoni. "The immediate clinical implications are that clinicians should not trust the conventional measurements."

Going forward, Dr. Gattinoni and colleagues would like to see improved measures of lung stress and strain, including routine assessment of oesophageal pressure and lung volumes to compute stress and strain in large populations of mechanically ventilated patients.

2

Silver-coated Endotracheal Tubes appear to Reduce Risk of Pneumonia Associated with Ventilator Use

http://jama.ama-assn.org

Among intensive care unit patients who require mechanical ventilation, use of a silver-coated endotracheal tube resulted in reduced incidence of pneumonia associated with ventilators, according to a report in the August 20 issue of JAMA.

Ventilator-associated pneumonia is associated with longer hospital stays, increased health care costs and infection with antibiotic-resistant pathogens, according to background information in the article. It is likely to develop when pathogenic bacteria colonise the aerodigestive tract or when patients breathe out contaminated secretions. "Prevention strategies often focus on modifiable risk factors for colonisation and aspiration and can successfully reduce ventilator-associated pneumonia rates, but no single strategy completely eliminates ventilator-associated pneumonia," the authors write. "Adherence to prevention guidelines is variable due to costs and lack of education, resources and leadership."

Silver has displayed antimicrobial activity in the laboratory and has blocked the formation of harmful pathogens on ventilator tubes in animal models. Marin H. Kollef, M.D., of the Washington University School of Medicine, and colleagues in the NASCENT Investigation Group report on a randomised controlled trial involving patients at 54 centers expected to require mechanical ventilation for 24 hours or longer. Between 2002 and 2006, 2,003 patients were randomly assigned to undergo intubation with either a silver-coated tube or a similar tube that was not coated. Of 1,509 patients who were intubated for 24 hours or longer, 4.8 percent of those with silver-coated tubes developed ventilator-associated pneumonia, compared with 7.5 percent of those with uncoated tubes—a 35.9 percent relative reduction in risk. Among 1,932 patients who were on ventilators for any length of time, the silver coating was associated with a 34.2 percent relative reduction in risk of developing pneumonia (3.8 percent of those with silver-coated tubes vs 5.8 percent with uncoated tubes).

In addition, the silver-coated tubes were associated with a delayed occurrence of ventilator-associated pneumonia. No differences were seen between the two groups in median (midpoint) duration of intubation, length of stay in the intensive care unit (ICU) or in the hospital, death rates or frequency and severity of adverse events.

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THE ROLE OF BIOMARKERS IN THE DIAGNOSIS OF INFECTION

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Biomarkers, namely CRP and PCT, can help clinicians at the bedside since when used in combination with the clinical examination they add useful information in the diagnosis of infection.

Introduction

In clinical practice a biomarker can serve several objectives. In a quick review of the published literature, it is easily perceived that a large number of studies assess the value of biomarkers in the prognosis of infection and sepsis. Though, one could wonder, what the point is at the bedside, of utilising a prognostic biomarker. Ascertaining if a particular patient has a high risk of dying, is pointless especially when the attending physician can do nothing to change that prognosis! However, biomarkers can provide additional information to the clinical evaluation namely in the diagnosis of infection, risk stratification, assessment of the response to antibiotic therapy and finally in antibiotic stewardship (Povoa et al. 2002; Povoa et al. 2008). In this review we are going to discuss the role of biomarkers in the diagnosis of infection.

Biomarkers in the Diagnosis of Infection

Physicians are often faced with the following questions; whether a patient is infected or not; what is the primary source of infection and what is/are the infecting organisms as well as their sensitivity patterns. However, non-infectious clinical situations can be associated with a sepsis-like syndrome that makes sepsis diagnosis even more difficult. Consequently, antibiotics are frequently prescribed without a definite diagnosis of sepsis because of the fear of missing an infection.

The correct diagnosis represents our ability to identify in a target population those with the disease. A diagnostic test is something that indicates that a particular clinical condition will occur. The quality of the information provided by a diagnostic test, and consequently its usefulness, depends of the accuracy with which it identifies the target disorder. Since the ideal biomarker has not yet been identified, clinicians should know their limitations and strengths, namely sensitivity, specificity, areas under the receiver operating characteristics (AUC) curve and finally, the likelihood ratios (LR) (Table 1) obtained from high-quality studies.

Diagnostic accuracy	+LR	–LR	AUC
High	>10	<0.1	>0.9
Intermediate	5 – 10	0.1 – 0.2	0.7 – 0.9
Low	2 – 5	0.2 – 0.5	0.5 – 0.7
Very low	<2	>0.5	<0.5

Table 1 +LR – positive likelihood ratio; –LR – negative likelihood ratio; AUC – area under the ROC curve

From a very large number of investigations on biomarkers I will select three, C-reactive protein (CRP) and procalcitonin (PCT), probably the more studied biomarkers, and finally, soluble triggering receptor expressed on myeloid cells-1 (sTREM–1), recently proposed.

Plasma CRP rises whenever an inflammatory process is present and, characteristically, its serum concentration depends only on the intensity of the stimulus and on the rate of synthesis (Povoa et al. 2002). Conflicting results have been reported from studies assessing the value of CRP as a diagnostic marker of infection, which are a consequence from differences in inclusion criteria (Simon et al. 2004; Tang et al. 2007). However, using more strict inclusion criteria CRP has been shown to be a valuable marker of infection. Recently our group showed that CRP of infected patients (N=76) was significantly higher than that of controls (N=36) (Povoa et al. 2005). A CRP concentration > 8.7 mg/dl was associated with infection with sensitivity of 93.4% and specificity of 86.1% (AUC 0.93; positive LR 6.71 and negative LR 0.08). Interestingly, Sierra et al., using similar inclusion

criteria (infected N=70; non-infected N=80), came to almost identical findings (cut-off 8.0 mg/dl; AUC 0.94; positive LR 7.41 and negative LR 0.065) (Sierra et al. 2004). A recent study showed that the appropriateness of antibiotic therapy was associated with a reduction of tracheal bacterial load in monomicrobial ventilator associated pneumonia (VAP) (N=168) (Lisboa et al. 2008). Even though, diagnosis of infection was not the primary aim of this study, it nicely demonstrated a good correlation between CRP values and tracheal bacterial load indicating again that CRP could be used as a surrogate marker of infection.

Procalcitonin is classified as hormokine since it has simultaneously hormone and cytokine properties (Christ-Crain et al. 2007). In a classic paper, in a paediatric patient population (N=79), PCT was much higher in infected children and severe bacterial infections elicit much higher PCT concentrations than viral or localized infections (Assicot et al. 1993). However, the cut-off of PCT for infection diagnosis has not yet been definitively established (de Werra et al. 1997; Ugarte et al. 1999) due, at least in part, to the diverse inclusion criteria (Cohen et al. 2001; Povoa et al. 2008). Using strict criteria, namely the presence of documented infection (N=111) versus no infection and no antibiotic therapy (N=79), Ugarte et al. found that the AUC of PCT for diagnosis of infection was 0.66 (positive LR 1.74; negative LR 0.53) (Ugarte et al. 1999). In patients undergoing cardiac surgery, Aouifi et al. found that, after cardiopulmonary bypass (N=36), PCT increase to levels above 1 ng/ml irrespective of the type of surgery and that a PCT > 5 ng/ml was suggestive of complications (N=10) either of infectious or non-infectious origin (N=7) (Aouifi et al. 1999). In another study (Aouifi et al. 2000), the same group found that patients with postoperative infectious complications showed PCT values significantly elevated (positive LR 17; negative LR 0.16). However, patients with mediastinis (N=9) presented similar PCT values to the non-infected group, 0.8 ± 0.58 ng/ml and 0.41 ± 0.36 ng/ml, respectively. Similarly, Luyt et al. in a study to assess the value of PCT kinetics in the evaluation of documented VAP course, found a good correlation with clinical severity. However, some patients presented undetectable PCT levels (Luyt et al. 2005).

The sTREM-1 is a member of the immunoglobulin family. In the original study, Gibot et al. measured sTREM-1 in bronchoalveolar-lavage fluid finding that it could be a very accurate marker in the diagnosis of pneumonia (Gibot et al. 2004). These results were reproduced by Determann et al. in 28 critically ill patients (AUC=0.829) (Determann et al. 2005). However, plasma sTREM-1 levels remained almost unchanged both in VAP as well as in controls. Phua et al. found that serum sTREM-1 was significantly elevated in 150 patients with community-acquired pneumonia, chronic obstructive pulmonary disease and asthma exacerbation (Phua et al. 2006). However, the AUC for serum sTREM-1, as a surrogate marker for the need of antibiotics in lower respiratory tract infections, was marginal, 0.77.

To overcome the limitations of a single biomarker some studies evaluated the relative accuracy of panels of biomarkers. Gaini et al. evaluated the accuracy of four biomarkers in 194 patients, in particular CRP and PCT, to identify patients with infection (Gaini et al. 2006). They found that CRP was the biomarker with the highest diagnostic performance, whereas PCT presented the lowest (AUC = 0.83 vs. 0.77, respectively). Similarly, Kofoed et al. evaluated six biomarkers, in particular CRP, PCT and sTREM-1, in the diagnosis of community-acquired sepsis (N=151, 96 with documented infection) (Kofoed et al. 2007). Again, CRP was found to have the best diagnostic performance for bacterial infection (AUC=0.81), well above the performance found for PCT (AUC=0.72) and sTREM-1 (AUC=0.61).

"Biomarkers are not static but dynamic, presenting marked changes in response to different inflammatory stimulus, specifically, bacterial infections.... serial measurements could be more informative than a single one."

Biomarkers are not static but dynamic, presenting marked changes in response to different inflammatory stimulus, specifically, bacterial infections. Consequently serial measurements could be more informative than a single one. Our group showed that daily CRP monitoring could be useful in the

early prediction of intensive care unit-acquired infections during the five days before infection diagnosis (Povoa et al. 2006). We identified four patterns of CRP course with different correlations with infection (Figure 1). A steady increase in and a persistently elevated CRP concentration (patterns

"...biomarkers, namely CRP and PCT, can help clinicians.... when used in combination with a good clinical evaluation, they add useful information in the diagnosis of infection."

A and B) were associated with high risk of infection. In contrast, a decrease in and continuously low CRP value (patterns C and D) were associated with low risk of infection. Furthermore, a maximum daily CRP variation >4.1 mg/dl was a good marker of infection prediction (sensitivity 92.1%, specificity 71.4%; positive LR 3.22 and negative LR 0.11), and, in combination with an absolute CRP concentration >8.7 mg/dl, its discriminative power increased even further (sensitivity 92.1%, specificity 82.1%). In a retrospective study (N=105), Vandijck et al. showed that both Gram-negative and Gram-positive bloodstream infections showed significant CRP increases in the days before diagnosis and that these changes were significantly higher with Gram-negatives (CRP d-2 to d+1 GPB vs GNB 3.1 vs 6.2 mg/dl, p=0.025) (Vandijck et al. 2007). In patients with suspected VAP, Luyt et al. evaluated changes in PCT in the five days before diagnosis (Luyt et al. 2007). The authors were unable to find any significant change both in concentration as well as delta PCT (positive LR 2.73; negative LR 0.69).

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BIOMARKERS IN THE ASSESSMENT OF RESPONSE OF INFECTION TO ANTIBIOTIC THERAPY

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Serial measurements of biomarkers, namely CRP and PCT, used in combination with the clinical examination are very useful in the monitoring of infection response to antibiotics.

Introduction

After diagnosis of infection and prescription of antibiotics, the assessment of clinical response is based on either clinical or microbiological criteria, mostly the same used in diagnosis (Dennesen et al. 2001). However clinical parameters can be influenced by a number of non-infectious factors, such as the drugs used in critical care settings (Povoa et al. 2005a). Moreover microbiological criteria are of little help, because of the delay of culture results, the interference of antibiotics with bacterial growth in vitro and the difficulties in obtaining some microbiological samples (e.g. from central spine fluid or peritoneum). On the other hand, treatment failure may be wrongly presumed, in the presence of a slow improvement or the appearance of a superimposed problem, such as drug fever, inflammatory conditions or a new hospital-acquired infection (Niederman et al. 2001).
In this context, the use of serum markers, namely C-reactive protein (CRP) and procalcitonin (PCT), has been shown to help in the assessment of response to therapy, and thereby contribute to clinical decision (Povoa, 2008).

Serum Biomarkers in the Evaluation of Infection Response to Antibiotics

A marker of infection should: (i) be absent if the patient is not infected; (ii) appear concomitantly and ideally precede the clinical manifestations of the infection; (iii) disappear with successful therapy or (iv) remain elevated if infection is refractory to treatment (Marshall et al. 2003). To evaluate the clinical response, the marker should also exhibit large amplitude of variation and have a non 'exhaustion' or 'fatigue' behaviour in prolonged septic episodes.

C-reactive protein has first order elimination kinetics. Therefore the withdrawal of the inflammatory stimulus is followed by a sharp decrease in its serum concentration. As a result, a decreasing concentration is related to clinical improvement whether rising levels are associated with a non-resolving inflammatory process.

We were able to show that these relative variations of CRP concentration correlated with the patient outcome. Using CRP-ratio, that is its daily concentration divided by the one measured on the day of infection diagnosis, we were allowed to identify four different patterns of response to therapy (Povoa et al. 2005a, Povoa et al. 2005b). The first, a fast response pattern, consists on a rapid decline of the CRP-ratio to less than 0,4 by day 4. The second, slow response pattern, is a continuous decline of the CRP-ratio, being its value, by day 4, less than 0,8 (but more than 0,4). The third is a non-response pattern, which is defined by a CRP-ratio course persistently above 0,8 (and sometimes even increasing), and the last, a biphasic response pattern, characterized by an initial drop of the CRP-ratio bellow 0,8, followed by a secondary rise, to a value above that threshold (Figure 1).

In a study of our group, 47 documented ventilator-associated pneumonia (VAP) patients (Povoa et al. 2005a) were classified according to these CRP patterns criteria. None of the 30 patients with one of the two first described CRP-ratio decreasing patterns died, whereas only 4 of the 17 patients with persistently elevated CRP levels survived. Besides this correlation with prognosis, we found that CRP kinetics also correlated with the adequacy of initial antibiotic therapy: those with an adequate empiric therapy showed a marked drop of CRP-ratio, whilst in patients with inadequate antibiotics CRP-ratio were always above 1. Using the same methodology, we obtained similar findings in 44 patients with bloodstream infections (Povoa et al. 2005b).

We also found in patients with severe community acquired pneumonia (CAP), a correlation between CRP-ratio and outcome (Coelho et al. 2007). Failure to decrease the CRP-ratio to less than 0,5 by day 3 of therapy was predictive of a bad outcome. Moreover in this study a decline of more than 31% of CRP levels in two consecutive days predicted recovery (of 29 patients with this finding, 27 survive).

Yentis et al. found CRP to be elevated in patients with microbiological proven infection, with no differences in peak concentration between single or multiple septic episodes (Yentis et al. 1995). Additionally, the relative variation of CRP concentration, that is a decrease in its level by 25% in one day, was highly predictive of sepsis resolution (sensitivity of 97%, specificity of 95%).

Similarly, in a 28 CAP inpatient population a sharply decrease in CRP-ratio (to less than 0,32) after 96 hrs of therapy was noted (Smith et al. 1995). All the four patients considered to be antibiotic failures had persistently elevated CRP-ratios.

Lisboa et al. evaluated in 68 VAP patients not only CRP-ratio but also its correlation with microbiological burden (measured by quantitative tracheal aspirates) (Lisboa et al. 2008). In patients with adequate antibiotic therapy, the CRP-ratio at day 4 felt to 0,58 (±0,32) while, with inadequate antimicrobial therapy, CRP-ratio eventually rose (1,36±1,11), as we have already noted (Povoa et al. 2005a). These results correlate with bacterial load that also stayed high in patients with inadequate antibiotic therapy.

No study was accomplished to evaluate the performance of CRP-ratio within the first 2 days of therapy. However, its serial measurements may provide some degree of confidence that antibiotics are adequate (or not), well before the culture results are made available. Also, even in patients with microbiological identification, a lack of a decreasing CRP-ratio, may provide information about an ongoing complication (like endocarditis or an abcess), or another hidden infection (Eisenhut, 2008).

Therefore, in high risk patients failure to reduce CRP-ratio as soon as by day 2 or 3 of antibiotic therapy, should prompt an aggressive diagnostic and therapeutic approach, with source control efforts (e.g. removing central lines, debriding necrotic tissues) and performance of a full diagnostic approach (repeating microbiological cultures, performing ultrasound or CT scan) (Coelho and Povoa 2008). Additionally enlargement of antibiotic spectrum should be considered, as these patients have a very high risk of death (Kollef et al. 1999).

The value of PCT kinetics was also assessed in a population with documented VAP. A good correlation with clinical severity was found (Luyt et al. 2005). However some patients with documented VAP presented undetectable PCT levels at the day of diagnosis and, as a result, in these patients PCT relative variations could not be used to monitor response.

In another study, PCT was proposed to diagnose and guide the duration of antibiotic therapy in CAP. Patients in the PCT-guided group reduced their antibiotic therapy to 5 days, compared with 12 days in patients treated according with the guidelines (Christ-Crain et al. 2004). However an almost undetectable level of PCT on the day of diagnosis was also found in 29% of these patients. Consequently, in those patients, it was virtually impossible to evaluate the rate of PCT decline.

In 75 VAP patients the decrease of both PCT and CRP at day 4 of therapy was predictive of survival, with odds-ratio (OR) of 4.4 and 7.4 respectively (Seligman et al. 2006). In that study the CRP-ratio at day 4 of therapy was 0,67 for survivors and 0,88 for nonsurvivors.

To overcome the limitations of a single biomarker some studies evaluated the relative accuracy of panels of biomarkers. Gaini et al. evaluated the accuracy of four biomarkers in 194 patients, namely CRP and PCT, to identify patients with infection (Gaini et al. 2006). They found that CRP was the biomarker with the highest diagnostic performance, whereas PCT presented the lowest (AUC = 0,83 vs. 0,77, respectively).

Another unsolved issue is the optimal duration of antibiotic therapy. Eventually it should vary with the severity of the infection as well as with the clinical course. Serum markers may help to identify patients who can benefit from a short antibiotic course. In a 425 neonatal paediatric population, CRP was used to define length of therapy: its peak levels were used to define the duration of treat-

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SEPSIS BIOMARKERS IN EARLY DIAGNOSIS AND TREATMENT PLANNING: AN ECONOMIC APPRAISAL

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The approach of using biomarkers for diagnosing and assessing illness severity and treatment response has become a new hype in modern intensive care medicine. Procal-citonin, and to a lesser extent, C-reactive protein, may have, beside the considerable cost and other non-economic implications as well, substantial value with regard to the earlier mentioned goals in case of rational usage in well-selected severely ill patients admitted to the intensive care unit.

Diagnostic and Treatment Planning Potential of Serum Biomarkers in Septic Severely Ill Patients

Sepsis is a major problem in severely ill patients (Martin et al. 2003). It is responsible for high morbidity and mortality and poses a substantial economic burden at the individual, institutional, and national levels (Angus et al. 2001; Vandijck et al. 2007b). Accurate risk stratification, appropriate and institution-specific triage to interventional or medical strategies, and optimal anti-infective therapy constitute major goals in the management of septic patients. In addition, delays in diagnosis and/or treatment often result in rapid progression to haemodynamic collapse, multiple organ failure, and eventually death. Hence, timely detection will limit morbidity, reduce costs, and decrease unwelcome patients' outcome (Kumar et al. 2006; Warren 1997).

In an attempt to improve current sepsis definitions, biomarkers were put forward as additional diagnostic tools to optimise and expedite the clinical diagnosis (Levy et al. 2003). Aside from conventional risk factors, physicians have taken a substantial interest in the use of novel biomarkers to identify which of their patients are at increased risk for or are actually developing sepsis, and who could thus benefit from life saving therapies. As such, the search for specific sepsis biomarkers has been intensified, and to date, ca. 80 markers of sepsis have passed the revue (Vincent and Abraham 2006). The markers provide information about one or more of the following: diagnosis, prognosis, and response to therapy. Obviously, any severe systemic infection is far too complex to be reduced to a single cut-off of any surrogate marker. Different aetiology of invading germs might induce a distinct host response resulting in a variable repertoire of circulating biomarkers and infectious mediators (Muller et al. 2007). Among the almost non-exhaustive list of biomarkers that have been proposed, two, respectively C-reactive protein (CRP) and procalcitonin (PCT), have received particular attention (Christ-Crain and Muller 2005; Vandijck et al. 2006).

C-reactive Protein

Determinations of CRP serum concentration, an acute phase protein, are widely used as a relatively non-specific marker of inflammation, and salient studies have found increased serum concentrations in patients with sepsis; however, some could not demonstrate such a relationship (Povoa et al. 1998; Smith et al. 1995; Yentis et al. 1995; Vandijck et al. 2007c). Likewise, CRP has been found valuable to monitor response to treatment (Povoa et al. 2005).

Also, the kinetics of a prospective biomarker should be considered along with its sensitivity and specificity. CRP secretion begins within 4 to 6 hours after stimulation, and peaking after 36 hours (Enguix et al. 2001). The assay for determining CRP concentrations is easy to perform, frequently automated, and less expensive (ca. €5) (Simon et al. 2004). This low associated cost is a commonly raised argument for the low threshold among physicians to order the latter test.

Procalcitonin

Determinations of PCT serum concentration, a propeptide of calcitonin, is one of the most upcoming biomarkers and described as a potential marker of infection, but yet not routinely used. PCT has been considered as an effective marker of bacterial sepsis, and as such, is providing a new tool for early diagnosis (Harbarth et al. 2001). PCT is stable in samples, and the assay is relatively easy to perform - with moderate to quite high costs (ca. €10, with a ca. €45 share to be paid by the patient). As compared to CRP, PCT has more rapid kinetics in terms of production and clearance. So, PCT may be better to identify sepsis at an earlier stage, to assess the severity of sepsis, and to monitor its progress (Castelli et al. 2004). However, also in the absence of evidence of infection elevations of PCT serum concentrations have been observed, limiting its usefulness in the clinical diagnostic assessment (Dorge et al. 2003). In an aim to clarify the ambiguity regarding the diagnostic accuracy of PCT in sepsis diagnosis in severely ill patients, Tang and collaborators recently conducted a systematic review and meta-analysis (Tang et al. 2007). The authors found that the diagnostic performance of PCT was low, and could not reliably differentiate sepsis from other non-infectious causes of systemic inflammatory response in this patient

cohort. As such, Tang and collaborators could not lend support to the widespread use of PCT testing to diagnose sepsis in severely ill patients (Tang et al. 2007). However, PCT probably has the best potential in guiding anti-infective treatment, more particularly in shortening the duration of therapy, because of several advantages over other inflammatory markers, including CRP, tumor necrosis factor-, interleukine-1 and 6 which may be only increased briefly (Nobre et al. 2008; Christ-Crain et al. 2006).

General Thoughts

The biomarkers currently available in the critical care setting lack sensitivity and specificity so the diagnosis of sepsis cannot exclusively be made based on the presence of one of these biochemical parameters alone. Nonetheless, the best potential can probably found in either combining several markers together into a predictive algorithm or by following their respective trends over time rather than single determinations (Vandijck et al. 2007c; Vincent and Abraham, 2006). The dynamics of biomarker serum concentrations have prognostic implications, as persistently elevated or increasing concentrations can be associated with adverse outcomes. Conversely, decreasing biomarker concentrations suggest a favourable outcome (Muller et al. 2007).

Given the relatively high costs associated with biomarker determinations and considering increasing cost constraints in healthcare, estimated expenses do not justify systematic application of biomarker determinations in all severely ill patients (Vandijck et al. 2007a). On the other hand, taking in mind the overuse of anti-infective agents, a well-considered use of biomarkers in well-selected severely ill patients might help to shorten duration of treatment and/or may as such avoid the unnecessary use of anti-infective agents. Consequently, this policy might result in a decrease in the side-effects related to the use of anti-infectives, lower costs, and reduce emergence of drug resistance (Vandijck et al. 2008a; 2008b). Similarly, earlier diagnosis of septic patients will allow earlier anti-infective management, which on its turn will improve patients' outcome. As well, the latter may save money otherwise allocated to the higher use of resources due to extra therapies, and longer length of critical care and hospital stay because of sepsis-related complications.

Conclusion

As with all diagnostic tests, biomarkers must also be interpreted in the context of a careful clinical and microbiological assessment. To date, a 100% specific biomarker for sepsis is yet to be found - the major limitation includes false-positive and false-negative results, and the time-kinetics of the test, with its' substantial clinical and cost implications. Considering the scarceness of resources in healthcare, currently there is no evidence for routinely using biomarkers. However, in well-selected patients, single determinations, but in particular their respective evolutions over time may significantly help to monitor one's progress and may as such, help a physician to more rapidly intervene - with better clinical and economic outcome as a result. ■

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France's Second Largest Cancer Hospital Credits Spacelabs Healthcare with Improving Patient Care

By Nina David, Marketing Communications Manager, Patient Monitoring & Connectivity

Institut Paoli Calmettes

Installing Spacelabs Healthcare's monitors in the Critical Care Unit has helped the staff make faster treatment decisions while easing the nurses' workload. That is the consensus at the Institut Paoli Calmettes (IPC), the second largest cancer treatment center in France, after just a few months of using the products.

Located in Marseille, IPC is a regional university hospital that is part of a network of 20 regional cancer treatment centers in France.

The staff can spend more time at their patients' bedsides, since the Spacelabs monitors bring the information they need right to the point of care.

Institut Paoli Calmettes at a Glance

2007 statistics
- 18,250 patients, average age 58-61
- 207 beds, 55 ambulatory beds (40 for chemotherapy and 15 for surgery)
- 20 chemotherapy Home Hospitalization beds
- 1,200 employees

Main cancers treated in 2007
- 4,750 breast and gynecology cancers
- 3,830 hematological cancers
- 2,070 digestive cancers

Treatments
- 18,730 chemotherapy
- 1,300 radiotherapy
- 4,810 surgeries
- 360 bone marrow and stem cell transplants
- 720 cytapheresis

The Critical Care Unit – 16 beds

Opened in 1994
- 8 critical care beds
- 7 continuous monitoring beds (without mechanical ventilation)
- 1 trauma bed

Patients
- 500 patients/year
- Average length of stay in unit: 10 days
- 88% occupancy

Nurses
- 18 during the day
- 12 at night

Conditions
- All patients come exclusively from IPC
- Cancer treatment complications from chemotherapy, bone marrow transplants, heavy surgery, infectious complications such as pneumonia or septic shock.

CCU Special Needs
- The most complete monitoring solution to quickly provide a clear picture of the patient's condition and treatment.
- Full access to information from anywhere on the hospital network. All doctors and specialists outside the CCU require access to the patient's CCU records at any time, as the patient's medical team meets regularly to discuss the care plan.

Products Purchased
- 8 Ultraview SL 2800 with WinDNA and Citrix Thin Client
- 8 Ultraview SL 2600 with WinDNA and Citrix Thin Client
- 2 wireless Ultraview SL 2600 with WinDNA for transport
- 2 Ultraview SL 3800 with WinDNA
- Masimo Sp02, Sv02 module,
- Intesys Clinical Suite
- iMDsoft MetaVision MVICU
- Full service contract

IPC is pursuing its goal of becoming a reference center for innovation in all areas – technological, pharmacological, research, and patient care. As part of that process, the hospital selected Spacelabs monitors to replace its Merlin Philips monitors in the 16-bed CCU last year. The hospital evaluated equipment from three other vendors, but after just one week of its trial, selected Ultraview monitors.

Why IPC selected Spacelabs Healthcare

When asked why they moved so quickly, Dr. Jean Louis Blache, chairman of anesthesia and the CCU, replied that Spacelabs monitors "clearly came out as the most intuitive and easy-to-use monitors on the market." He further explained that the clinicians can access the parameters or the alarm menus a lot faster than with competitors' monitors because they do not have to go to a lot of sub-menus. The nursing staff also appreciates the convenience of the modularity of the system. Dr. Blache stressed the need to be able to train nurses to use the monitors in a few hours, since there is a shortage of nurses in France, resulting in a high turnover and the need to frequently use temporary nurses.

Another factor was that the hospital greatly valued Spacelabs' offer of the Intesys Clinical Suite and the MetaVision clinical information system from iMDsoft. They told us that the competitors' information system solutions did not even come close to Spacelabs' in terms of enterprise-wide patient data management capabilities.

Laurent Demontis accessing all the data needed from the patient's room

CCU Head Nurse Laurent Demontis appreciates having available whatever data he needs wherever he is on the hospital network.

CCU head nurse describes benefits

After 8 months of use, Laurent Demontis, Head Nurse for the CCU, summarized for us the advantages of Spacelabs monitoring system, the Intesys Clinical Suite, and the MetaVision system. Here are his comments – in his own words:

Monitoring system:

- **Intuitive and easy-to-learn user interface** helps our staff to make easier and faster decisions at the point of care. This is particularly important with our high turnover of nursing teams.
- **The flexible, modular system** helps us to easily adapt the monitoring to the needs of the patient. For example, it's easy to switch from a large screen monitor to a more compact transport monitor, or to add modules if the patient's condition worsens.
- **Easy customization** means our users can easily configure their alarms, the color of their waveforms or parameters, etc.

The Wifi 2600 Monitor

- **The wireless 2600 monitor** gives us continuous monitoring even during transport, which has greatly improved our quality of care. It is also especially useful when patients are in isolation. Also, it can easily replace non-working monitors while still providing data to the central monitor. Our staff feels that we could no longer live without the "wifi 2600 monitor," as we call it.
- **Bed-to-bed communication** allows our clinicians to manage the alarms remotely, which saves us time by reducing the need to go to the patients' rooms and disturb them. It saves us even more time when the patient is in isolation, since the clinicians do not have to put on their protective gear (gown, mask and gloves). This increases patient safety and patient care.

WinDNA:

- **Access to Windows-based applications** directly from bedside monitors helps our caregivers quickly retrieve the hospital's clinical protocols, get lab results, or enter orders without leaving the patient. By providing double access to the patient file and the hospital information system (HIS), the nurse and doctor can simultaneously review the information they need in critical situations. We also use a wireless 2600 monitor with WinDNA as a mobile central monitor to get double access (VCRR) to the bedside monitor and the HIS (PACS, medical files, lab results). Faster access to critical data at the bedside not only saves us time but also improves patient care.

WinDNA

Intesys Clinical Suite and MetaVision:

- **ICS Full Disclosure** gives us 72-hour recordings of patient waveform histories, allowing our clinicians to thoroughly review and analyze any cardiac events.
- **ICS Print Manager** permits our nurses to print strips, trends, calculations and 12-lead reports from the bedside monitor at any network printer, which is very useful. It also saves all print jobs to the network for a permanent record.
- **ICS and MetaVision** the ICS collects and stores real-time patient information from the Spacelabs monitors and external devices, enabling integration of all the data into the iMDsoft MetaVision Suite. This gives us bedside access to comprehensive patient information (vitals, labs, dialysis data, medicine orders, care plans, scoring, queries, alerts on multifactor events, etc.) and speeds decision-making at the bedside. By eliminating the need for the nurse to enter the data, this feature greatly alleviates her workload and also reduces the risk of errors. Together the ICS and MetaVision clinical information systems provide a complete and seamless picture of the patient's condition and help speed up the decision process.

Laurent Demontis scanning to log in to MetaVision

Admitting a new patient to the MetaVision software is very easy, explains CCU Head Nurse Laurent Demontis. "First you connect to the MetaVision screen, then you open the 'admission' module, and scan the barcode off the patient file with the scanner." The advantage here, he says, is "you don't enter any patient ID, so there is no risk of errors."

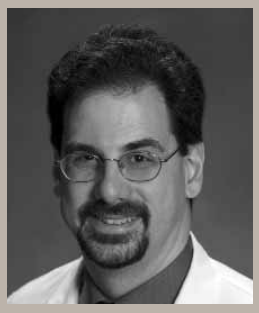
In closing, both Dr. Blache and Mr. Demontis stressed how smooth and fast the installation of the system was: it only took two weeks to connect all the monitors and other medical devices to the ICS and MetaVision. They also complimented the professionalism and support of the Spacelabs Healthcare and iMDsoft teams every step of the way. "Indeed, it is a real partnership between the hospital and the two companies, working together to achieve the best integrated data management system in order to help the hospital improve patient care," said Dr. Blache. Thanks to Mr. Demontis' leadership, the nursing team accepted and adopted the new system very quickly and smoothly, which highly contributed to its success.

Nurses' lunch room

Laurent Demontis accessing MetaVision from his desk

THE AGING OF OUR ICUs

PART I:
A NEED FOR A NEW PARADIGM IN OUR SICU



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The Baby Boom has become the Elder Explosion. According to U.S. Census figures, the population age 85 and over will grow five-fold by the year 2030 (Figure 1). By 2050, up to 50% of U.S. income tax dollars could go to pay for Medicare.

This is the first in a series of articles in ICU Management concerning the impact of the aging population on our hospitals. These changes are beginning to be felt in our operating rooms and intensive care units and these areas will be examined in our first installment. In 2005, over 13.2 million persons aged 65 and older were discharged from short stay hospitals. This is a rate of 3,596 for every 10,000 persons aged 65+, which is over three times the comparable rate for persons of all ages (Department of Health and Human Services 2007). The rates of ICU admission and utilisation in those ≥85 years old were 58.2 admissions/1,000 residents and 195.8 days/1,000 residents compared with 3.8 admissions/1,000 residents and 11.5 days/1,000 residents in those 18 to 44 years old (Seferian and Afessa 2006). Surgery in the elderly is also on the rise. One out of five of those over age 60 will undergo surgery and anesthesia as compared with only one in ten of those aged 45 to 60 years by 2030. One out of five open-heart surgeries are performed on those over age 70.

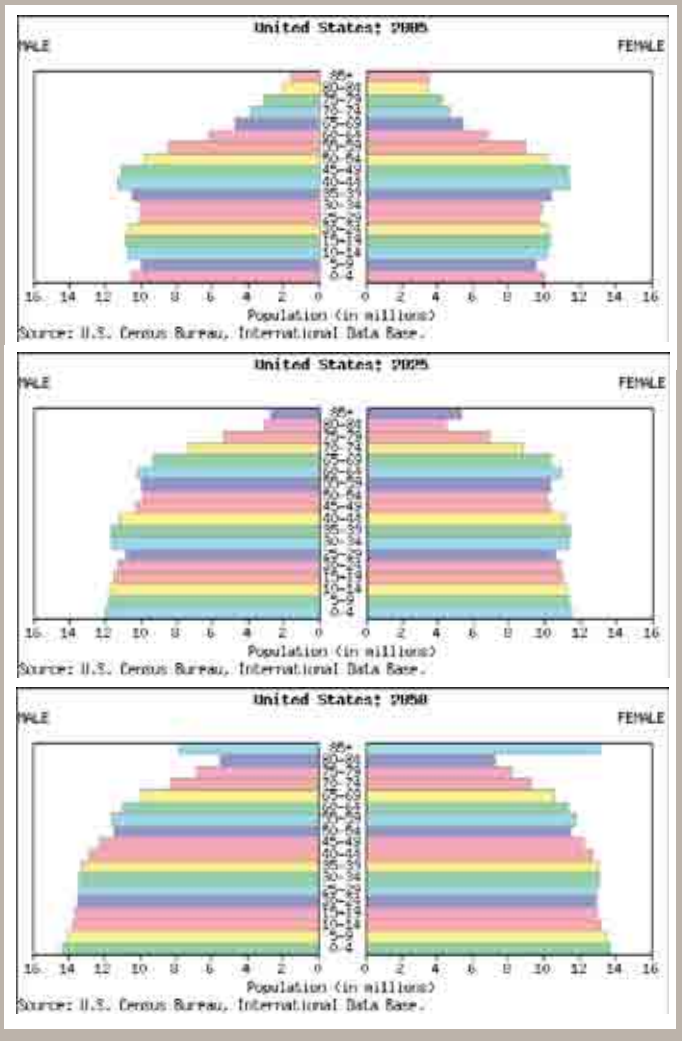

Figure 1
Population

Reducing Surgical Risk in our ICUs

There have been several strategies to reduce perioperative cardiac risk. Pharmacologically, the perioperative use of statins has been supported in recent literature. Studies suggest that statins are protective, but only one article can be used to base clinical recommendations (Williams et al. 2008). Also, there seems to be a rebound effect with statins and, therefore, they should not be discontinued postoperatively. It is unclear whether this effect is independent of lipid status of the patient.

Beta blockade has also been popularised and is now driven by the Centers for Medicare and Medicaid Services in the Surgical Care Improvement Project. The therapeutic goal is to control the patient's preoperative heart rate at or below 60. However, many patients do not or cannot reach this goal for various reasons. These include nature of the surgery as emergent and symptomatic bradycardia. One recent meta-analysis calls this practice into question (Biccard et al. 2008). The authors "…cannot confirm that heart rate control with beta-adrenergic blockade is cardioprotective."

A recent paper from the anaesthesia literature questions both practices, of perioperative beta

blockade and statin use (Daumerie and Fleisher 2008). The authors suggest that "based upon the available evidence and guidelines, patients currently taking [beta-]blockers should continue these agents. Patients undergoing vascular surgery who are at high cardiac risk should also take [beta-]blockers. The question remains regarding the best protocol to initiate perioperative [beta-]blockade. Statins should be continued in patients already taking these agents prior to surgery. The optimal duration and time of initiation of statin therapy remains unclear."

So what else is at our disposal to reduce perioperative risk in our ICU? Preoperative cardiac and pulmonary evaluations are routinely performed. Clearly, preoperative optimisation of respiratory function is important in decreasing adverse pulmonary events. This optimisation includes cessation of smoking. Preoperative cardiac evaluation can improve outcomes but generally focuses on only the cardiac issues. This is perhaps why systems developed to follow American College of Cardiology and American Heart Association guidelines perform well, perhaps even more efficaciously, in the hands of non-cardiologists (Cinello et al. 2007; Almanaseer et al. 2005).

Recent literature points to a new way to clear elderly patents preoperatively that may follow from the cardiac clearance literature mentioned above. A preoperative comprehensive geriatric assessment (CGA) takes into account the above measures as well as those which, to date, have been relatively ignored. This type of assessment is not limited to a history, physical, and tests. A comprehensive variety of items are examined including functional ability, mental health, social support, and environment. Special issues addressed in the history include sleep, alcoholism, abuse, pain, continence, nutrition, mobility, gait, balance, driving, and sexuality. The physical portion adds functional and cognitive evaluations. These may include functional independence measures (FIM), activities of daily living (ADLs), and instrumental ADLs, Mini Mental Status Exam, or Mini-Cog. Other areas evaluated include caregivers, social support, home safety, values, goals of treatment, and advance directives.

"Factors outside the usual cardiac and pulmonary clearance, such as cognitive and functional performance, have been shown in many studies to influence outcomes."

The literature in support of CGA includes use in thoracic surgery (Fukuse et al. 2005). In thoracic surgery patients, dependence for the performance of ADLs and impaired cognitive conditions are important predictors of postoperative complications, especially when the operation time is long. CGA was deemed necessary in addition to the conventional cardiopulmonary assessment in elderly patients. This also applies to cancer patients (Repetto et al. 2002). Factors outside the usual cardiac and pulmonary clearance, such as cognitive and functional performance, have been shown in many studies to influence outcomes.
A 2007 study from the United Kingdom showed improved outcomes using CGA in the preoperative setting (Harari et al. 2007). "A proactive evidence-based CGA service for at-risk older elective surgical patients was developed. Pre/post comparison in elective orthopaedic patients showed improved (within methodologi
cal limitations) postoperative outcomes indicative of better clinical effectiveness and efficiency..."
The American Geriatrics Society has issued a position statement concerning interdisciplinary care of the elderly (Mion et al. 2006). It states:
(1) Interdisciplinary care meets the complex needs of older adults with complex comorbidities.
(2) Interdisciplinary care improves healthcare processes and outcomes for geriatric syndromes.
(3) Interdisciplinary care benefits the healthcare system and the caregivers.
(4) Interdisciplinary training and education effectively prepares healthcare providers to care for older adult.

Conclusion

As the above literature and data reflect, there should be a new way to treat the elderly in our SICU. This new paradigm could include a preoperative comprehensive geriatric assessment in addition to cardiopulmonary clearance. New risk reduction strategies should be employed as per recommendations. Geriatric consultations should be obtained in all cases, emergent or elective. They, in addition to the primary team and intensive care team, should be a part of an interdisciplinary group that manages the care of the elderly patient. We will look more specifically at the data supporting this team approach in our next article in this series in ICU Management on Eldertrauma Care.

Through adherence to the above principles, can we achieve better outcomes when cure is possible and better, more dignified palliative care when cure is not possible. ■


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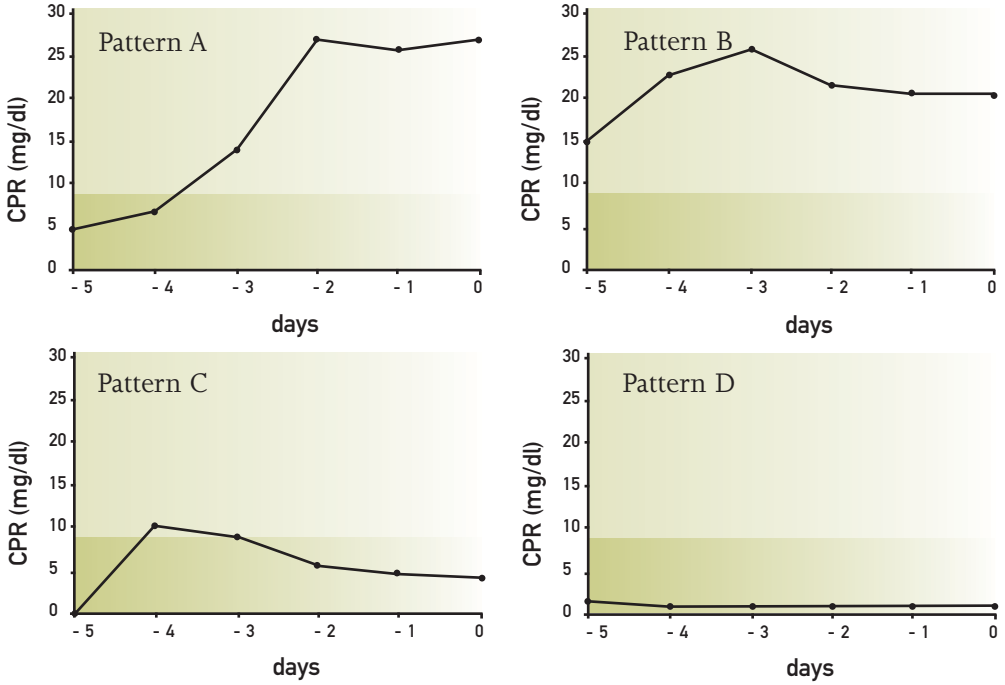

Figure 1 – Patterns of C-reactive protein (CRP) course before infection diagnosis or intensive care unit discharge according to a previously identified CRP cut-off value for infection diagnosis of 8.7 mg/dl (data from four different patients) (Povoa et al. 2005): Pattern A occurred when the day 0 CRP was >8.7 mg/dl and, in the previous days, was at least once below the cut-off; Pattern B occurred when CRP was always >8.7 mg/dl; Pattern C occurred when the day 0 CRP was ≤8.7 mg/dl and, in the previous days, was at least once above the cut-off value; Pattern D occurred when CRP was always ≤8.7 mg/dl. Dashed line, CRP cut-off value for infection diagnosis; day 0, day of infection diagnosis or intensive care unit discharge in controls. (Reproduced from: Povoa et al. 2006).

Conclusions

The ideal biomarker has not yet been found and probably the ongoing research will unveil new and potentially more useful serum biomarkers or panels of biomarkers. Presently, biomarkers, namely CRP and PCT, can help clinicians at the bedside since when used in combination with a good clinical evaluation they add useful information in the diagnosis of infection. ■

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MATRIX FEATURES

EDUCATION AND TRAINING IN INTENSIVE CARE

EUROPEAN PERSPECTIVE

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Bergen, Norway

Education and training have increased its importance the last decades. Twelve years ago European Society of Intensive Care (ESICM) published a paper concerning training in intensive care (Int Care Med 1996) and the society efforts to improve training within intensive care have expanded considerably since that time.

Intensive care is an established medical field in all European countries with units found in most hospitals. A large part of the hospital budget is used on intensive care. Yet, intensive care is not recognised as a primary, or even a secondary speciality in many European countries. Not surprisingly, there is a vide variation throughout Europe with regards to how training and education devoted to intensive care are organised (Barrett 2005). The time documented doing specific intensive care training varies from 3 to 36 months. In many countries there is no official examination required for physicians to become intensivists.

In many countries intensive care still is firmly established within the speciality of Anaesthesiology, and this is also the case in Scandinavian countries. Here, a period of between 6 and 9 months (during an average 5 year training) is dedicated to intensive care training. In 1997 we decided to establish a two-year voluntary supra-speciality training, which would be standard for all five countries (Flaatten 2006) and would result in the awarding of the Scandinavian Diploma of Intensive Care.

There have been efforts to have intensive care recognised as a speciality within the UEMS, since the European Directive on recognition of professional qualifications (Directive 2005/36/EC of the European Parliament) does not identify intensive care medicine as a medical speciality. A new initiative was recently begun that aims to have intensive care recognised as an area of "particular competence" and to have this recognised by the European Parliament. This would mean that at least on this level, intensive care would be visible within UEMS. A new board was established within UEMS (EBICM) consisting of intensive care physicians from the ESICM and physicians from relevant established UEMS specialities.

The board is led by Professor Julian Bion, a former president of the ESICM. On April 18th of this year they agreed to propose to the European council that "*Intensive Care Medicine be included in Directive 2005/36/EC of the European Parliament & Council on the recognition of professional qualifications, as a Particular Medical Competence*"

If accepted, this would mean a breakthrough of having intensive care recognised as somewhat more than an integrated part of another speciality. An interesting part of the proposal is to use the competencies defined by the CoBaTrice project (Bion 2006). In this comprehensive work, supported by a grant from the Leonardo da Vinci programme (European Union) and from ESICM, a total of 102 competencies vital to the practice of intensive care have been defined. The competencies have been divided into 12 main groups, all with a number of subgroups (see Table 1). In many ways this is a completely new way of defining a medical field, or a medical speciality, and has garnered a great deal of interest. A follow up project on how to implement competencies into the national training programmes in Europe is at present under development (CoBaIT). Further information can be found at **www.cobatrice.org.**

ESICM will start to use the competencies in different ways. From the congress in Vienna 2009 and onward, the Clinical Competency Sessions will use the CoBaTrice competencies as a part of the educational component of the programme. The second version of the ESICM distant learning programme (PACT), that will be launched later this year, will also in a larger degree have these competencies as a natural element of their content. The continuing work with the European Diploma of intensive care also will find the competencies useful, not at least

▶▶ continued on p. 42

continued from p. 10

ment and its normalization were used to stop antibiotics (Philip and Mills, 2000). Only 19 patients received antibiotics for more than 5 days and there were no readmissions within a month.

Conclusion

Considering CRP kinetics, serial determinations of this marker can be very useful for monitoring inflammatory activity, the onset of infections and patient responses to antimicrobials and sepsis therapies. On the other hand, PCT seems to be a better indicator of illness severity and prognostic marker. Both these markers are dynamic, so their concentration should be measured on a daily basis, since changes in concentration over time, particularly in their ratios, are more informative than a single value.

However, the use of laboratory markers should not preclude a correct and thorough clinical evaluation. ■

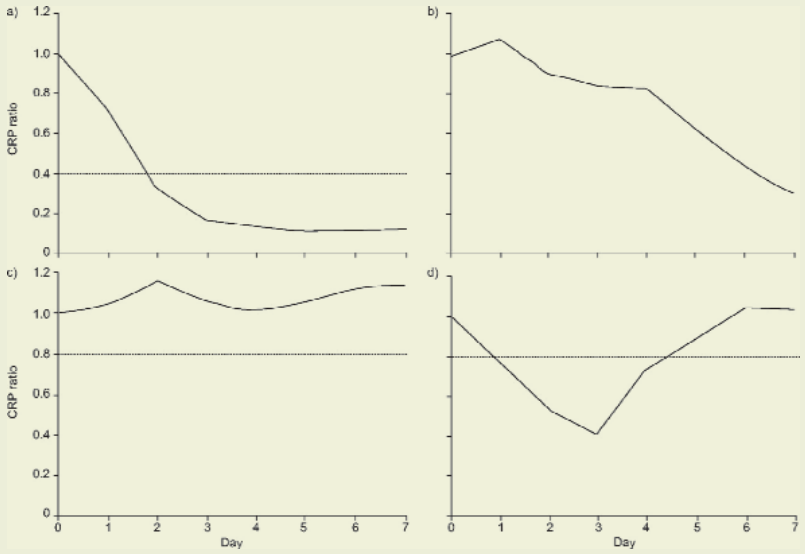

Figure 1. C-reactive protein (CRP) ratio patterns of response of four different ventilator-associated pneumonia patients after prescription of antimicrobials: a) fast response (CRP ratio at day 4 <0.4); b) slow response (continuous and slow decrease in CRP ratio); c) nonresponse (CRP ratio remains 0.8); and d) biphasic response (CRP ratio decreases to <0.8, followed by a secondary rise to 0.8). CRP ratio: CRP concentration relative to day 0 CRP concentration (Povoa et al. 2005a).

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ECRI Institute is pleased to provide readers of ICU Management with sample information on Basic Intensive Care Ventilators from its Healthcare Product Comparison System (HPCS), which contains over 280 reports. The HPCS reports contain extensive information about the technology, its purpose, its principles of operation, stage of development specifications and reported problems. The Basic Intensive Care Ventilators comparison charts include ECRI Institute's 'Recommended Specifications' (generic templates) which can be used for comparison and tendering purposes. The comparative tables overleaf are extracted from ECRI's 2005 database and have additionally been reviewed and updated by the respective manufacturers.

Publication of all submitted data is not possible. For further information please contact editorial@icu-management.org or visit www.icu-management.org.

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Footnote used in pages 23/24

* These recommendations are the opinions of ECRI Institute's technology experts. ECRI Institute assumes no liability for decisions made based on this data.

SUPPLIER	ECRI INSTITUTE'S RECOMMENDED SPECIFICATIONS *	Dräger medical
MODEL	**Basic IC Ventilators**	**Evita XL**
WHERE MARKETED		Worldwide
FDA CLEARANCE		Yes
CE MARK (MDD)		Yes
PATIENT TYPE		Adult, pediatric, neonatal
CONTROLS		
Tidal volume, mL	50-800	3-2,000 with NeoFlow
Inspiratory flow, L/min	3-180	6-120
Inspiratory pressure, cm H2O	0-80	0-95
Respiratory rate, bpm	6-120	0-150
Inspiratory time, sec	0-3 pause	0.1 - 10, 0.1 - 30 (APRV)
Expiratory time, sec	1-8	0.1 - 10, 0.1 - 30 (APRV)
IE ratio	1:4 to 4:1	1:300 to 300:1
Inspiratory hold/plateau	0-3 sec	Yes
Expiratory hold	0-3 sec	Yes
FiO2, %	30-90	21-100
Manual breath	Yes	Yes
PEEP/CPAP, cm H2O	0-45	0-50
Pressure support, cm H2O	0-45	0-95
Nebulizer	Optional	Yes
Trigger mechanism	Pressure, flow, both	Flow, pressure
Bias/base flow range, L/min	1-20	6 L/min (only neonatal)
Pressure slope/ramp adjustment	Yes/yes	Yes/yes
Sigh	Optional	Yes
100% O2		Yes
Others		None specified
OPERATING MODES		
Assist/control		
Volume breaths	Yes	Yes, AutoFlow
Pressure breaths	Yes	Yes
SIMV		Yes
Volume breaths	Yes	Yes
SIMV Pressure breaths	Optional	Yes
Pressure support	Yes	Yes
Apnea-backup vent	Yes	Yes
Responsive valve		Yes
Bilevel/APRV		Yes
MONITORED PARAMETERS		
Pressure		
PIP	Yes	Yes
MAP	Yes	Yes
PEEP	Yes	Yes
Volume		
Tidal	Yes	Yes
Minute	Yes	Yes
Spontaneous minute	Optional	Yes
FiO2	Yes	Yes

HEALTHCARE PRODUCT COMPARISON SYSTEM

SUPPLIER	ECRI INSTITUTE'S RECOMMENDED SPECIFICATIONS *	Dräger medical	Dräger medical	Dräger medical
MODEL	**Basic IC Ventilators**	**Savina**	**Carina**	**Oxylog 3000**
WHERE MARKETED		Worldwide	Worldwide	Worldwide
FDA CLEARANCE		Yes	Yes	Yes
CE MARK (MDD)		Yes	Yes	Yes
PATIENT TYPE		Adult, pediatric, neonatal	Adult, pediatric	Not specified
CONTROLS				
Tidal volume, mL	50-800	50-2,000	100-2,000	50-2,000
Inspiratory flow, L/min	3-180	0-180	Decelerating flow	100 maximum
Inspiratory pressure, cm H2O	0-80	0-99	5-40 mbar (LeakV) 5-50 mbar (ExpV)	3-55 (Pmax = 20-100)
Respiratory rate, bpm	6-120	2-80	5-50	2 to 60
Inspiratory time, sec	0-3 pause	0.2-10	0.3 - 8.0	0.2-10
Expiratory time, sec	1-8	No	N/A	Not specified
IE ratio	1:4 to 4:1	1:150 to 150:1	1:3 to 2:1	1:4 to 3:1
Inspiratory hold/plateau	0-3 sec	Yes	No	Yes
Expiratory hold	0-3 sec	No	No	No
FiO2, %	30-90	21-100	21-100	40-100
Manual breath	Yes	Yes	No	Yes
PEEP/CPAP, cm H2O	0-45	0-35	3-20 mbar (LeakV) 1-20 mbar (ExpV)	0-20
Pressure support, cm H2O	0-45	0-35	2-40 mbar (LeakV) 2-50 mbar (ExpV)	0-35 above PEEP
Nebulizer	Optional	Yes	Yes	Not specified
Trigger mechanism	Pressure, flow, both	Flow, pressure	Pressure, flow, flow gradient	Flow
Bias/base flow range, L/min	1-20	No	Yes; Pressure depending	Not specified
Pressure slope/ramp adjustment	Yes/yes	Yes/yes	Yes/yes	Yes/yes
Sigh	Optional	Yes	No	Not specified
100% O2		Yes	No	Yes
Others		5-200 mbar/sec flow acceleration	SyncPlus function and Auto Ramp functionality	O2 inhalation (0-15 L/min O2)
OPERATING MODES				
Assist/control				
Volume breaths	Yes	Yes, AutoFlow	No	Yes
Pressure breaths	Yes	Yes	Yes	Yes
SIMV		Yes		
Volume breaths	Yes	Yes	Yes	Yes
SIMV Pressure breaths	Optional	Yes	Yes	Yes
Pressure support	Yes	Yes	Yes	Yes
Apnea-backup vent	Yes	Yes	Yes	Yes
Responsive valve		Yes	Not specified	Not specified
Bilevel/APRV		Yes (with BIPAP)	Yes	Not specified
MONITORED PARAMETERS				
Pressure				
PIP	Yes	Yes	Yes	Yes
MAP	Yes	Yes	Yes	Yes
PEEP	Yes	Yes	Yes	Yes
Volume				
Tidal	Yes	Yes	Yes	Yes
Minute	Yes	Yes	Yes	Yes
Spontaneous minute	Optional	Yes	No	Yes
FiO2	Yes	Yes	No	Yes

	GE Healthcare	GE Healthcare	HAMILTON MEDICAL	HAMILTON MEDICAL	HAMILTON MEDICAL
	iVent201	**Engström Carestation**	**HAMILTON-C2**	**G5**	**GALILEO GOLD**
	Worldwide	Worldwide	Worldwide	Worldwide	Worldwide
	Yes	Yes	Submitted	Yes	Yes
	Yes	Yes	Yes	Yes	Yes
	Adult to Pediatric	Adult to pediatric, optional neonatal	Adult, pediatric	Adult, pediatric, neonatal	Adult, pediatric, neonatal
	50ml to 2.0 liters	20-2,000 (2 - 350 ml with Neo option)	20-2000	2-2,000	10-2,000
	3-120 mandatory breaths, up to 180 lpm for spontaneous breaths	2-160 (0,2 to 30 l/min with Neo option), 200 maximum peak flow	0-240	1-180	1-180
	0-80	1-98 cm H2O	0-60	0-100	0-100
	6-120	3-120 for control modes (3-150 with Neo option), 1-60 for support modes	1.0-80.0	1-150	0.5-120
	0.2 to 3.0 seconds	0.25-15 (0.1 - 10 sec with Neo option)	0.3-9.9	0.1-10	0.1-10
	0.2 minimum allowed	0.25-59.75	0.2-59.7	0.2-59.9	0.2-59.9
	1:4 to 4:1	1:9 to 4:1; 1:72 to 60:1 in BiLevel (1:180 to 40:1 in BiLevel with Neo option)	1:9 to 4:1	1:9 to 4:1	1:9 to 4:1, 150:1 in DuoPAP mode
	0-3 sec	Yes, adjustable 2-15 sec	0-15 sec	0-70% cycle time	0-70% cycle time
	0-3 sec	Yes, adjustable 2-20 sec	Not specified	10 sec maximum	10 sec maximum
	Room air to 100%/ low flow bleed in if high pressure oxygen unavailable	21-100	21-100 sec	21-100	21-100
	Yes	Yes	Yes	Yes	Yes
	0-40	Off, 1-50	0-35	0-50	0-50
	0-60	0-60 above PEEP/CPAP	0-60	0-100	0-100
	Integral, standard, compensated, programmable from 10 to 240 minutes duration	Built-in Aeroneb Pro nebulizer system	Yes	Yes	Yes
	Flow trigger and pressure trigger	Pressure, flow	Flow	Pressure/flow	Pressure/flow
	Flow trigger from 1 to 20 lpm; no base flow required so gas consumption LOW	2-10 l/min (2-20 l/min with NIV option)	4-20, Off	1-30, automatic	1-30, automatic
	Yes/yes	Rise-time adjustment for pressure, flow, and pressure support 0-500 ms	50-200 msec	25-200 msec	25-200 msec
	Standard	No	Yes	Yes	Yes
	Yes	Yes, suction maneuver	Yes	Yes	Yes
	Adaptive Flow in Volume Ventilation, adaptive I-time in SIMV	Automatic tube resistance compensation with tube type/size selectio; Expiratory trigger: 5-80% of inspiratory time; (Tsupp 0 - 4 sec with NIV option)	Automatic leakage compensation	% tube resistance compensation, tube type/size	% tube resistance compensation, tube type/size
	Yes	Yes			
	Yes	Yes	Yes	Yes	Yes
	Yes	Yes	Yes	Yes	Yes
	Yes	Yes			
	Yes	Yes	Yes	Yes	Yes
	Yes	Yes	Yes	Yes	Yes
	Yes	Yes	Yes	Yes	Yes
	Yes	Yes	Yes	Yes	Yes
	Yes	Yes, active exhalation valve	Yes	Yes	Yes
	Adaptive Bi-Level for NIV	Yes	Yes	Yes	Yes
	Yes				
	Yes	Yes		Yes	Yes
	Yes	Yes		Yes	Yes
	Yes	Yes	Yes	Yes	Yes
	Yes				
	Yes	Yes	Yes	Yes	Yes
	Yes	Yes	Yes	Yes	Yes
	Yes	Yes	Yes	Yes	Yes
	Yes	Yes	Yes	Yes	Yes

HEALTHCARE PRODUCT COMPARISON SYSTEM

SUPPLIER	COVIDIEN	COVIDIEN	COVIDIEN	COVIDIEN
MODEL	**[840+]**	**840**	**760**	**740**
WHERE MARKETED	EMEA	Worldwide	Worldwide	Worldwide
FDA CLEARANCE	Yes	Yes	Yes	Yes
CE MARK (MDD)	Yes	Yes	Yes	Yes
PATIENT TYPE	Adult to neonatal	Adult to neonatal	Adult, pediatric	Adult, pediatric
CONTROLS				
Tidal volume, mL	5-2,500	5-2,500	40-2,000	40-2,000
Inspiratory flow, L/min	3-150	3-150	3-150	3-150
Inspiratory pressure, cm H2O	5-90	5-90	5-80	No PCV
Respiratory rate, bpm	1-150	1-150	1-70	1-70
Inspiratory time, sec	0.2-8	0.2-8	0.2-8	No PCV
Expiratory time, sec	≥0.2	≥0.2	>0.2	>0.2
IE ratio	1:299 to 4:1	1:299 to 4:1	1:99 to 4:1	1:99 to 4:1
Inspiratory hold/plateau	0-2 sec	0-2 sec	0-2 sec	0-2 sec
Expiratory hold	0.5-3 sec automatic pause	0.5-3 sec automatic pause		Not specified
FiO2, %	21-100	21-100	21-100	21-100
Manual breath	Yes	Yes	Yes	Yes
PEEP/CPAP, cm H2O	0-45	0-45	0-35	0-35
Pressure support, cm H2O	0-70	0-70	Yes (0-70)	0-70
Nebulizer	Works with external nebulizers	Works with external nebulizers	Yes	Yes
Trigger mechanism	Pressure, flow	Pressure, flow	Flow	Flow
Bias/base flow range, L/min	1.5lpm above flow trigger setting, 21,5lpm	1.5 lpm above flow trigger setting, 21,5lpm	N/A	N/A
Pressure slope/ramp adjustment	Yes/yes 1 to 100%	Yes/yes 1 to 100%	Yes/yes	No/no
Sigh	No	No	No	No
100% O2	Yes; 2 min	Yes; 2 min	21-100	21-100
Others	Expiratory sensitivity: Esense%; PAV+ %support	Expiratory sensitivity: Esense%	Rise time%, Esense%	None specified
OPERATING MODES				
Assist/control				
Volume breaths	Yes	Yes	Yes	Yes
Pressure breaths	Yes	Yes	Yes	No
SIMV				
Volume breaths	Yes	Yes	Yes	Yes
SIMV Pressure breaths	Yes	Yes	Yes	No
Pressure support	Yes	Yes	Yes (0-70)	Yes (0-70)
Apnea-backup vent	Yes	Yes	Yes	Yes
Responsive valve	Yes, active exhalation valve	Yes, active exhalation valve	Not specified	Not specified
Bilevel/APRV	Yes	Yes (optional)	Not specified	Not specified
MONITORED PARAMETERS				
Pressure				
PIP	Yes	Yes	Yes	Yes
MAP	Yes	Yes	Yes	Yes
PEEP	Yes	Yes	Yes	Yes
Volume				
Tidal	Yes	Yes	Yes	Yes
Minute	Yes	Yes	Yes	Yes
Spontaneous minute	Yes	Yes	Yes	Yes
FiO2	Yes	Yes	Yes	Yes

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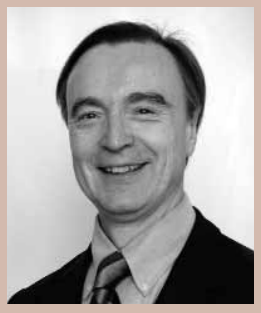

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Implementing evidence is the basis for improving organisation of care in the intensive care unit. As this can be a challenging task due to human and system barriers, we propose an innovative framework to facilitate knowledge translation at the bedside.

Background

The mission of an Intensive Care Unit (ICU) may vary according to the type of unit, hospital and healthcare system involved (Walter et al. 2008). However, the universal objectives for all ICUs remain the same and are as follows:

- To provide compassionate and evidence-based care for critically ill patients and families,
- To optimise resource allocation and utilisation,
- To coordinate care and provide critical care services to hospital stakeholders, like the emergency room (ER), surgical and medical services,
- To provide regional critical care support for specialised services, like trauma or burns and
- To create, develop and translate knowledge, if the ICU belongs to an academic hospital.

The Challenge of the ICU Environment

Despite the wealth of evidence-based practice and the drive to improve organisation of care, failure to successfully implement protocols and guidelines in the ICU environment is frequently reported (Blackwood 2003; Ferrer et al. 2008; Ibrahim and Kollef 2001; Trujillo et al. 2008; Walter et al. 2008). This can be attributed to the high level of complexity of the patients and illnesses, as well as the model of care delivery, requiring highly trained caregivers to interact in a multifaceted way (Simpson and Doig 2007). The purpose of this article is to describe a framework we designed to better identify potential barriers to change and to develop targeted action plans.

Methods

We propose a methodology to effectively implement protocols, guidelines or other kinds of change strategies within the ICU environment.

For this purpose, we first identified that the failure to execute can be due to four categories of barriers found within the ICU setting [Fig1]:

- Complexity of information contained within protocols and guidelines that are often difficult to interpret in the local ICU environment and can contradict each other (Walter et al. 2008; Morris 2004; Morris 2003). In this paper, we will label this barrier as the "object".
- Complexity and heterogeneity of ICU patients that often limit the translation of direct evidence from randomised controlled trials. Indeed, many of these randomised clinical trials exclude a large portion of severely ill and complex patients (Hammond 2001). We will label this barrier as the "target".
- Complexity of change for the individual practitioner (-s) or healthcare team (-s), that will be the person (-s) required to implement this new evidence at the bedside. Cultural, interpersonal, and other change barriers fall into this category (Walter et al. 2008; Sinuff et al. 2007). We will label this barrier as the "effecter".
- Complexity of the model of healthcare delivery in which the new evidence will be implemented. Variance in complexity will be observed, dependent on the level of formal organisation of the health system (MacKenzie et al. 2006). We will label this barrier as the "system".

Each of these types of barriers has already been reported in the literature (Simpson and Doig 2008). However, a systematic framework that defines how one could tangibly overcome these obstacles in an articulated manner has not been described, as yet.

Second, the level of complexity of each of the four barriers is assessed and then categorized using a semi-quantitative tool developed by Westley and Zimmerman (Westley et al. 2007; Zimmerman

et al. 1998). This tool permits the level of complexity to be evaluated as "simple", "complicated" or "complex".

We then assess and categorise each scenario using a matrix approach [Fig1]. Each barrier is listed and in terms of one of the three levels of complexity. When this level has been determined, an action plan can be developed to deal with the most complex barriers and assign resources accordingly.

Lastly, the action plan is then targeted to simplify the obstacles through communication, education and management techniques, while using a problem-solving approach. The goal of this methodology is to achieve successful knowledge translation of evidence-based care at the bedside using a project management methodology.

Results

We will describe three scenarios to illustrate this concept

Scenario 1: Implementation of an evidence-based early extubation protocol in the Cardiac Surgery ICU for elective cardiac surgery patients.

During this process, few communication efforts were needed for the "object" and the "target" factors since the protocol and patient population were "simple" and well defined and similar to that reported in the literature (Flynn et al. 2004). However, more time and focus was required for the "effecter" and "system", which were assessed as "complicated" due to the number and the diversity of players involving the ICU, Operating Room and Ward teams. The objective of reducing delay in extubation by 2.5 hours was successfully achieved within three months, using a virtual electronic community tool to improve stakeholder communication, reduce the risk of inter-professional conflict, facilitate buy-in and realise synergies amongst the teams.

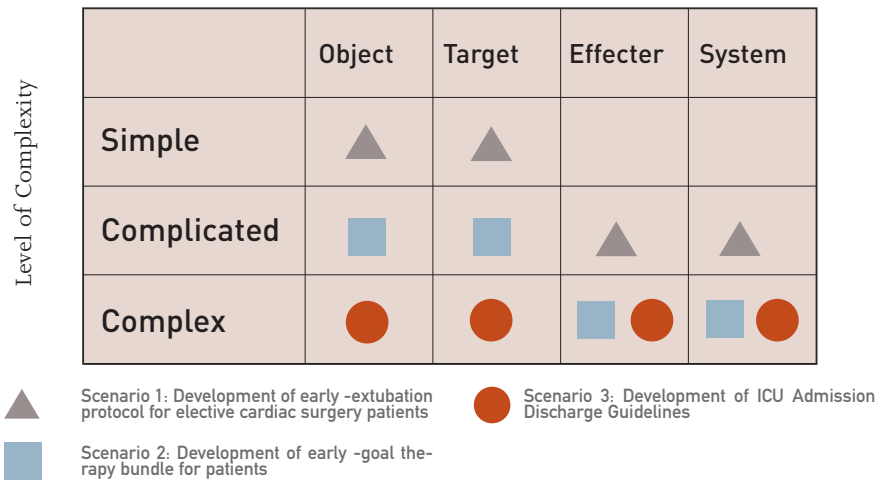
Scenario 2: Development and implementation of a sepsis bundle in the Medical Surgical ICU and ER.

This action plan required significant efforts with the "object", "target" and "effecter". Actions included simplification of the sepsis bundle (described in the surviving sepsis campaign guidelines, Dellinger et al. 2008; Dellinger et al. 2004) by the inter-professional steering committee, in order to adapt the intervention to the local environment. A refinement in the local definition of the target patient population focused directly on those patients who would significantly benefit from the use of the bundle. In addition, a clear definition of the role for each of the different individuals and teams was required. Lastly, an inter-professional training and communication program was created to improve continuity of care between the teams from the ER and ICU. Improvements in clinical uptake of the bundle occurred over time but were slow to build, as reported in other studies (Trzeciak et al. 2006; Ferrer et al. 2008).

Scenario 3: Development and implementation of admission and discharge guidelines for ICU patients.

Development and implementation of a standardised guideline to identify those patients most likely to benefit from ICU care is still challenging (Walter et al. 2008). System level challenges often compete with individual patient needs and decisions must be made quickly, often with limited information available. In our institution, after a two-year timeframe, the utilisation of ICU guidelines is still very low due to the complexity of all four types of barriers involved. Practical utility of the guidelines was difficult to define and a streamlined process was not possible with the multitude of care providers involved and the uniqueness of each patient. Lastly, the lack of coordination of the health system for patients moving into and out of the ICU contributed to the inconsistency in use of these guidelines to date. Nevertheless, efforts to improve efficiency of organisation in this area utilising our framework are ongoing.

Figure 1: **Evaluation of Barriers to Translate Knowledge at the ICU Bedside**



Conclusions

When implementing evidence at the bedside, our framework can help to optimise the organisation of care in the ICU. The methodology allows for the assessment of the complexity of the task, the detection of major obstacles and can guide the team's action plan. We recommend use of the tool prospectively to plan for implementing new protocols and guidelines. In addition, the tool can be used retrospectively, to detect the root cause of failure and at the same time, allow for alternative solutions. It can also facilitate organisational projects such as patient flow management, academic program development, teamwork training and response to disasters and pandemics.

Note of Appreciation

We would like to extend our thanks to the work of Dr. Brenda Zimmerman, Associate Professor, Schulich School of Business at York University in Toronto, Canada.

■

HYPOTHERMIA SERIES

FEVER CONTROL IN CRITICALLY ILL PATIENTS

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Regional temperature differences exist between various parts of the body under physiological conditions in healthy individuals. Traditionally, a temperature gradient between the "core comparment" and the "peripheral compartment" has been recognised. The core compartment basically comprises the organs and rump of the body, while the periphery consists of the arms and legs. Temperature differences between core and periphery may range from 2 °C to 10 °C, depending on the temperature of the environment and other circumstances.

It is less well known that small temperature gradients can also exist within the core compartment. Under normal circumstances (absent the presence of a local infection), the organ/area with the highest temperature within the core compartment is the brain.

In healthy individuals, brain temperature is only marginally higher than the measured core temperature; this difference typically ranges from 0.1-0.3 °C. In addition, there are small temperature gradients between different areas of the brain. These regional differences are related to activity (higher temperatures in more active brain tissue), blood flow (lower temperatures in areas with high flow due to increased capacity to dissipate and remove heat), and (to a lesser degree) to the distance from the skull (the latter being particularly important in newborns and very young children).

The differences in temperature between the brain and measured core temperature can increase significantly under pathological conditions, such as exist following various types of brain injury. Numerous studies have demonstrated that brain temperature in patients with traumatic brain injury, stroke, subarachnoid haemorrhage, encephalitis and other types of neurological injury exceeds measured core temperature by between 0.2 °C and 4 °C compared to the "gold standard", i.e. the blood temperature measured by pulmonary artery catheter, or compared to core temperatures measured at the oesophagus, bladder or rectum. Again, there are temperature differences between different areas of the brain; however, in contrast to the physiological situation these differences can be substantial, up to 2 °C, with the highest temperatures found in injured areas of the brain. Many authors have described this phenomenon, and it is a frequent occurrence although the extent may vary considerably.

The mechanism underlying this phenomenon is the generation of excess heat by the ongoing pathophysiological processes in injured areas of the brain. It is well recognised that a period of ischaemia or trauma can trigger a cascade of numerous destructive mechanisms. Some of these produce heat, in particular the activation of neuroinflammatory processes, the increase in blood brain barrier permeability, and a phenomenon known as "exitotoxicity", a self-destructive "hyperactivity" of injured cells caused by a combination of cell membrane leakage, mitochondrial dysfunction, and excessive influx of calcium (Ca^{2+}) into the cell, leading to intracellular calcium overload with excessive enzyme activation, continuous depolarisation and a permanent state of hyperexcitability. In addition, local or general oedema formation will complicate the removal of heat through lymph drainage and venous return, further adding to overheating of injured areas in a phenomenon known as "cerebral thermo pooling".

The differences between measured core and brain temperature can increase even further when a patient develops systemic fever, a problem that is frequently observed in patients with various types of neurological injury and which is associated with adverse outcome.

The clinical significance of these phenomena is that increasing evidence exists showing that high temperatures can be harmful, especially to injured (brain) cells. Numerous animal studies have demonstrated that (external) induction of hyperthermia significantly increases the risk and extent of neurological injury. Hyperthermia increases the risk that ischaemic areas will become necrotic or apoptotic; it can be detrimental even when it is of short duration, even when it is mild, and even when it occurs long after the initial injury. These effects become more pronounced if hyperthermia coincides with an episode of ischaemia, suggesting that ischaemic brain cells become even more susceptible to the harmful effects of fever.

Numerous clinical studies have confirmed that fever is indeed an independent predictor of adverse neurological outcome and increased mortality in various neurologic emergencies, including ischaemic stroke, sub-

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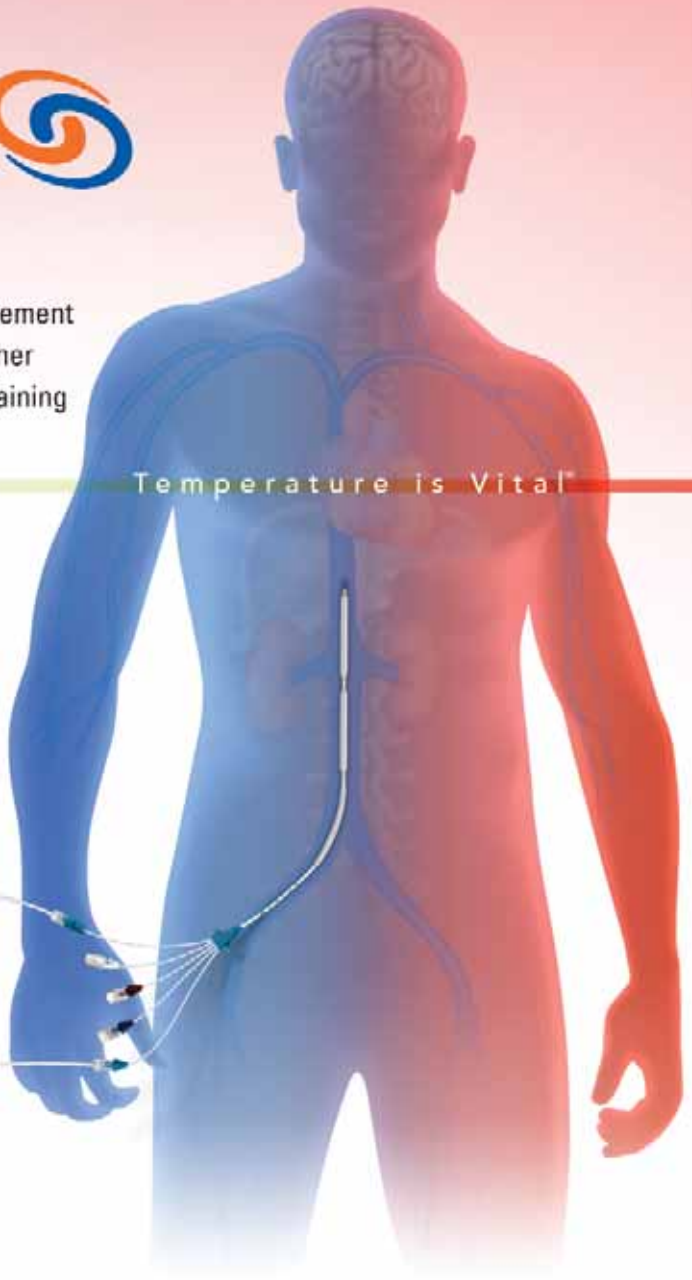

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arachnoid haemorrhage, intracranial haemorrhage, traumatic brain injury and post-anoxic injury. Azzimondi and co-workers performed a prospective observational study in stroke patients and observed that developing fever was associated with a 3.4-fold increase in the risk for adverse outcome, with a 95% CI of 1.2 to 9.5.❖ Castillo and associates reported that fever occurring within 24 hours after the onset of ischaemic stroke was independently related to larger infarct volumes (OR 3.23, 95% CI 1.63 to 6.43) and higher neurological deficits (OR 3.06, 95% CI 1.70 to 5.53) at 3 months. Kammersgaard et al. reported that each 1°C increase of admission body temperature independently predicted a 30% relative increase in long term mortality risk, with a 95% CI of 4% to 57%. Zeiner et al. observed that fever was associated with a 2.3-fold increase in the risk of adverse outcome in patients following cardiac arrest, with a p-value of 0.008.

Although these observations do not conclusively establish that the relationship between fever and increased neurological outcome is causal, i.e., that fever itself increases neurological injury rather than just being a marker, the temporal relationship, the fact that it persists after multivariate analysis, coupled with the results from animal experiments and the physiological data outlined above provide a strong and convincing framework for the existence of this relationship. This view is strengthened by observations from other animal studies showing that induction of mild hypothermia can prevent fever-related neurological injury, and can improve tissue tolerance for ischaemia.

All this suggests that lowering fever burden and lowering body temperature in febrile patients with neurological injuries could significantly improve outcome. Unfortunately, the use of anti-pyretic drugs is not very effective in this category of patients; various studies have shown that core temperatures decrease by (only) 0.1-0.7°C when adult patients with neurological injuries are treated with acetaminophen, aspirin or other anti-pyretic drugs. Therefore, mechanical cooling (with surface cooling devices or intravascular catheters) will usually be required to effectively control fever in these patients.

If this strategy could indeed prevent or reduce (additional) neurological injuries these interventions would obviously be tremendously cost-effective. Translating the observations and insights outlined above into feasible, practical and cost-effective protocols presents a worthy challenge to physicians caring for critically ill ICU patients. ■

"Numerous clinical studies have confirmed that fever is indeed an independent predictor of adverse neurological outcome and increased mortality in various neurological emergencies."

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❖ The *odds ratio* (OR) is a way of determining and comparing the probability of a certain event in two groups. For example: a survey taken among a sample of 100 hospital managers shows that 90 of them read ICU Management. A survey among 100 ICU physicians shows that in this group only 20 read this journal. The odds of a hospital manager reading ICU Management are 9 to 1; the odds of an ICU physician reading the journal are 1 to 4, or 0.25 to 1. The odds ratio is thus 9 divided by 0.25, or 36, showing that hospital managers are much more likely to read ICU Management than ICU physicians.
The *confidence interval* (CI) is a statistical range with a specified probability that a given parameter lies within the range. Confidence intervals are used to indicate the reliability of an estimate or measurement, i.e. to assess the likelihood that the difference is genuine with a likelihood of 95% (the 95% CI) or 99% (the 99% CI).

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AN OVERVIEW OF HEALTH-CARE IN ISRAEL

Hospitals

In 2000 Israel had 48 general hospitals, with approximately 14 200 beds, spread throughout the country. The overall general care bed-population ratio is 2.2. Compared to OECD countries Israel is characterised by a low bed-population ratio, an extremely low average length of stay, a mid to high rate of admissions per thousand population and a high occupancy rate. The low bed population ratio is the result of deliberate government policy based on the view that resources should be focused on community care and on the assumption that the greater the number of beds the larger the hospitals' share of total health resources.

In recent decades the average length of stay has declined dramatically, from 6.8 days in 1980 to 4.3 days in 2000, while the admission rate has increased dramatically, from 145 per thousand population in 1980 to 175 per thousand population in 2000, and the number of hospital beds per thousand population has declined slightly. As the decline in average length of stay has been greater in percentage terms than the increase in admission rates, the rate of patient days per thousand people declined somewhat between 1980 and 2000. The volume of day care and ambulatory surgery has increased dramatically over the past decade. Since the outbreak of the intifada in September 2000, hospitals have had to mobilise to care for the casualties, including victims of shock, which requires an increase in both medical and psychiatric services.

While Israel does have a few small 'single specialty' hospitals, particularly in the maternity area, the vast majority of the beds are in general hospitals. Almost all Israeli hospitals have university affiliations and operate training programmes for medical students, interns and residents. The range and depth of these university affiliations varies. Of Israel's 30 general hospitals, 6 have been recognised as supra-regional hospitals and they tend to have the greatest concentration of research and training activities as well as centres for complicated and expensive treatments.

Proposals for Hospital Reform

Key issues currently on the agenda regarding hospital care include:

- Whether public hospitals should be allowed to offer private medical services;
- How quality of care should be monitored and improved;
- Whether appointments to department chairmanships should be time-limited and subject to rotation-the current system of open-ended appointments is widely believed to have led to over-concentration of power and to have slowed innovation;
- Whether hospital patients should be assigned a personal hospital physician who will coordinate their care-the present situation of 'ward patients' is not conducive to effective communication with the patient and has also raised questions regarding quality and continuity of care; and
- The extent to which resources should be invested in expensive and highly sophisticated end-of-life care.

Management Training

There has been a dramatic expansion and improvement in healthcare management training over the past decade. Several major universities now offer degree programmes in healthcare management and the number of staff and students involved has grown substantially. Key employers such as health plans and hospitals are encouraging large numbers of their mid-career employees, including physicians, nurses, administrators and others, to participate in these programmes by offering time off from work to pursue studies and partial to full coverage of tuition costs. There is also an understanding that this sort of training can improve the employee's career opportunities in the current job and beyond. ■

This information has been adapted from data obtained from the World Health Organisation (WHO).

ISRAEL: FACTS AND FIGURES

Population	6,810,000
Gross national income per capita (PPP international $)	Not available
Life expectancy at birth m/f (years)	79/82
Healthy life expectancy at birth m/f (years, 2003)	70/72
Probability of dying under five (per 1 000 live births)	55
Probability of dying between 15 and 60 years m/f (per 1000 population)	89/48
Total expenditure on health per capita (Intl $, 2005)	2,143
Total expenditure on health as % of GDP (2005)	7.8

Figures are for 2006 unless indicated. Source: World Health Statistics 2008

THEN AND NOW:

CONNECTIONS BETWEEN ANAESTHESIOLOGY AND CRITICAL CARE

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Most practitioners would agree that there lie inevitable connections between the fields of anaesthesiology and intensive care, as the tasks that define them are almost identical (Table 1). This collusion came to light more vividly while the author was drafting his book about the Israeli founding fathers of anaesthesia (Visionaries and Dreamers- The Story of Founding Fathers of Israeli Anaesthesiology, Ben Gurion University printing house, in press). Out of the 12 personalities who represented "heroes" in the book, two have also been pioneers in the field of critical care in this country and the majority of them significantly contributed to the opening of the critical care units in their own hospitals.

So, what in fact, is the true picture of anaesthesiology and critical care currently in Israel? Does it resemble one body with two heads, or two separate bodies, each having its own structure, leadership and organisation?

History

The history of Israeli anaesthesiology started in the early 1950s, with emigration of the first physicians, mainly from Europe (as in the USA), dedicated to this new domain of medicine. In 1952 there were less than 20 anaesthesiologists in Israel, and only seven or eight members of the newly created Israel Society of Anaesthesiologists. At that time there was no evidence of a special interest in the pre-operative preparation or postoperative management, since only "healthy" patients had surgery and nobody would dare to operate in a case with the presence of a serious co-morbidity.

But gradually the need for a special framework for treating the critically ill patients became evident and the first three Intensive Care Units (ICU) opened in the late 60s, one after another, in Jerusalem, Tel Aviv and Haifa. Only the last one (the unit at Haifa Rambam Hospital) began as an independent department. The other two were part of the anaesthesia departments.

When the Ministry of Health established the criteria for recognition of ICUs in Israel finally in 1974, the opening of these specialised units in every single general hospital was just a question of time. Today, each one of the 20 general hospitals in Israel has its own well-designed and equipped General ICU, which admits surgical and medical adult patients. In addition, each hospital has opened specific critical care units (paediatric, cardiologic, neurosurgery, cardiac surgery) and some of them have decided to also have special areas for intermediate care (the so-called step down units).

For years, critical care was considered a medical field without strong theoretical support. The first series of scientific papers dealing with respiratory support were published in the early 70s. On the contrary, anaesthesia offered a large basic sciences background, especially in physiology and pharmacology, but also in chemistry, physics and of course anatomy. Internal medicine and general surgery, two main fields with special interest in critical care did not have the possibility to allocate manpower to the new opened units and only a few specialists outside anaesthesia found the time to dedicate to their patients admitted to an ICU. Also Respirology as a distinct specialty showed up rather late in Israel, and initially there was no definite connection between the two domains. Finally, Critical Care offered no incentive to those practitioners who were looking for an additional financial reimbursement coming from private practice.

Current Organisation

In the early 90s the Scientific Council of the Israel Medical Association recognised critical care as a separate specialty, with the mention that in order to become a specialist in Critical Care one needed first to pass the Exam Board in one of the following medical fields: anaesthesia, general surgery, orthopaedic surgery and internal medicine. A special board for paediatric critical care was also created.

The new legislation changed dramatically the relationship between anaesthesia and critical care in this

country. Soon, there was a significant increase in the percentage of physician specialists in critical care coming form other professions than anaesthesia.
In parallel, more ICUs organised their own activity outside anaesthesia departments, so as per today (Table 2) only a little more than one third of the ICUs in the general public hospitals in this country are part of anaesthesia departments. As a result, the demographic characteristics of the Israel Society of Intensive Care Medicine (ISICM) changed in the last years, more specialists from other medical fields than anaesthesia joined the specialty.

But even in this new context, anaesthesiology in Israel still seems to see itself closely related to critical care. In all four Israeli medical schools critical care is taught in the framework of anaesthesia curriculum. Anaesthesia residents are the only ones who are obliged to pass a six-month compulsory rotation in critical care. Neurosurgery demands only a three-month compulsory rotation for residents. In general surgery, internal medicine or gynaecology, a critical care three-month rotation is only an option. The Anaesthesiology Board is the only one that demands that the oral examination syllabus include critical care items and case discussions. Finally, more than 50% of the current critical care residents in Israel still have anaesthesiology as their primary specialty.

Table 1. **Definition of Anaesthesiology as a Profession (After "Standards of Patient Care"-American Society of Anaesthesiologists) (1)**

Rendering a surgical patient insensible to pain
Support of life functions *
Management of the unconscious patient*
Management of problems in pain relief
Cardiopulmonary resuscitation*
Inhalation therapy *
Management of fluid, electrolyte, metabolic disturbances*

*Tasks with a direct connection to Critical Care

Table 2. **The current connection of the Israeli Intensive Care Units to Anaesthesiology**

Type of Units	Nr
Part of anaesthesia departments	8
Independent, but led by anaesthesiologists	7
Independent	5

The Israeli critical care field currently suffers from two main deficits. The first problem is the lack of beds. A recent survey (Simchen et al. 2004) showed some 50% of the critical ill patients in the Israeli general hospitals could not be admitted to a critical care area because of a shortage of beds.

The second issue is the manpower crisis, a part of the general problem of a serious shortage of physicians in this country. The permanent growth of the population, together with a significant decrease in the number of physicians emigrating from other countries is only two of the explanations for this situation.

Conclusion

In concluding our discussion of the current situation of Critical Care in Israel, one can emphasise the fact that in spite of difficulties, there remains a group of dedicated professionals who come from various medical domains and unite to deal with the management of critically ill patients. The strong connection of Critical Care with Anaesthesiology is weaker today than at anytime in the past and this new reality seems to negatively influence the situation of medical manpower in this field.
The latest developments related to patient management, unique not only to Israel but also worldwide, oblige healthcare administrations to find solutions to the dramatically increasing need for acute care beds in hospitals. The current universal trend is to transform general hospitals in acute care areas, in which case anaesthesiologists with a special training in critical care might represent the solution for adequate manpower in this new context. ■

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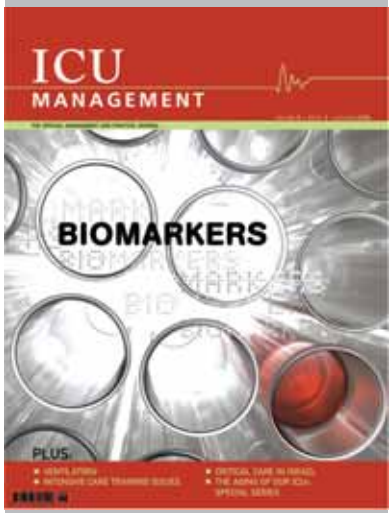

INTENSIVE CARE NURSING EDUCATION IN ISRAEL

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Nursing education in Israel has been undergoing academic upgrading, including a revised post-basic certification course in Intensive Care Nursing allowing nurses increased clinical privileges and responsibilities.

Introduction

Over 15 years ago the Israeli government through its Ministry of Health's Nursing Division enacted a major policy decision, determining that entry level into nursing practice in Israel would be at the registered nurse (RN), baccalaureate level. Since that time, major efforts have been underway to upgrade and increase the level of educational preparation of all nurses. Licensed Practical Nurse (LPN) programs have been slowly phased out while more programs to upgrade LPNs to RNs, RNs to baccalaureate nurses and non-nursing degree students to registered nurses have been encouraged. These courses are in response to the current shortage of registered nurses, projected to worsen in coming years, and the need to produce a minimum of 1300-1400 new registered nurses per year. The latest available statistics of the Ministry of Health Nursing Division (2007) show that over two thirds of the over 54,000 Israeli nurses are registered and almost a quarter have an academic degree.

Post-Basic Intensive Care Nursing Education

Professional development has also been encouraged at the post-basic level. Almost half of all registered nurses have this level of certification. Over 12 different post-basic certifications are available, including those related to the acute and critical patient. This area includes several sub-specialties including combined intensive care, paediatric intensive care, neonatal intensive care and emergency medicine. Graduates of the intensive care post-basic course are permitted to perform several advanced procedures not allowed to regular registered nurses, such as removal of arterial lines, administration of IV push drugs-including into central lines, removal and attachment of patients to ventilators, care of Swan Ganz catheters, and defibrillation, to name a few. While in previous years all registered nurses were able to register for post-basic certification, nurses must now hold a baccalaureate degree and pass a qualification exam in order to be accepted into a post-basic certification program.

The intensive care post-basic course consists of 3 different sections, a common theoretical module for all acute, critical post-basic certifications (168 hours), an individual module for intensive care (261 hours) and a clinical experience (up to 300 hours, depending on previous critical care clinical experience). The basic module includes review of pathophysiology and principles of treatment of the cardiovascular, respiratory and neurological systems; laws related to nursing practice; fluids and electrolytes; physical assessment and imaging; suturing and gluing of wounds; and infection control. Content of the intensive care module includes assessment of signs and symptoms in complex and critical situations, diagnosis, treatment and evaluation. Situations include respiratory distress, chest pain, changes in level of consciousness, urinary output dysfunction, shock, hematological disorders and skills related to support of families. Part of this module also includes an advanced cardiac life support course (ACLS). In order to receive accreditation for this post-basic course, nurses must sit for a national certification exam. The content and tone of this exam has been recently changed to an innovative format, which not only includes a computerised test of knowledge but also a simulation exam where students are tested on their clinical skills and decision making abilities.

At the present time there is no Nurse Practice Act in Israel. This fact has been described as one of the major reasons that the Advanced Practice Nurse role is also not officially recognised. However many nurses work in roles similar to those of Clinical Nurse Specialists or Nurse Practitioners without official recognition, usually in the community setting. There also is one Master's degree program in nursing in the country that trains advanced practice nurses for this potential position. It is hoped that such a role will be officially sanctioned in the future.

Conclusion

Nursing education in Israel has undergone increasing academisation and is expected to continue along this path leading to increased professionalisation and specialisation, including the area of intensive care, with the potential for advanced acute care practitioners in the future. ■

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PHYSICAL ASSESSMENT BY INTERNAL MEDICINE ICU NURSES: THEORY INTO PRACTICE

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Introduction

Physical assessment is an important tool in nursing in general and in intensive care in particular. It helps in the identification of patients' existing and potential nursing problems, and enables the staff to set care protocols accordingly. Despite the importance of physical assessment, many nurses have stated that this is not part of their job, and among some, assessment is perceived negatively.

The professional literature on nursing physical assessment focuses on theoretical and practical training provided within various instructional frameworks however, there is no structured program for training nurses in their natural workplace at the patient's bedside. The following article is the first of its kind to present such a program.

Background

Although Israel has no Nurse Practice Act, nurses have been fighting to transform it into an independent profession. Some efforts have been invested in transferring some clinical procedures from physicians only to also include registered nurses. These efforts have met with much resistance from the Israel Medical Association.

Physical assessment is an important part of the definition of the physician's job, but is also an integral part of the definition of the nurse's job. It is expected and necessary that nurses carry out physical assessment as part of their work. Throughout the entire history of the profession, from Florence Nightingale to the present, nurses have been the ones to carry out the physical assessment of patients, gathering basic data on blood pressure, weight and temperature. Nurses are the ones who examine patients' bodies to make sure there are no bedsores or bruises (West 2006). However, some nurses do not consider these actions as physical assessment because they do not contain all of the details of a full physical assessment.

The literature points to a number of advantages to having nurses perform physical assessment:

- Improved communication between nurses and other members of the interdisciplinary staff;
- Improved nurse-patient communication;
- Rapid identification of changes in the patient's state of health;
- Determination of nursing diagnosis;
- Nursing interventions compatible with patient's needs; and
- Increased satisfaction of the nurses (Yamauchi, 2001).

Nevertheless, despite these advantages, some nurses object to making physical assessment part of their job duties, out of fear that they will be seen as threatening to physicians, or as a result of insufficient knowledge and training, or simply a lack of self-confidence among nurses.

In-service Education for Nurses on the Internal Medicine Intensive Care Unit

In Israel, the study of physical assessment is an integral part of the nursing curriculum and training in undergraduate studies, advanced courses and Master's Degree studies in clinical nursing. However, despite the theoretical and practical training that nurses receive during their studies, this practice by nurses is not outstandingly evident in the ICU of the Internal Medicine Department. The literature shows that in practice, most nurses carry out only partial physical assessment according to the needs of the specific patient, the nurse's own knowledge and sense of self-confidence in carrying out the assessment (Secrest, Norwood and DuMont 2005).

With the goal of improving the level of knowledge and skills of nurses in carrying out physical assessment, Wilson and Lillibridge (1995) proposed that three major elements should be included in each future training program:
(1) A broad, deep theoretical foundation;
(2) Clinical experience enabling nurses to apply the theoretical knowledge and improve know-how; and
(3) Storage of knowledge by assimilating it in an orderly manner in the day-to-day work with the patients.
Based on these elements an evidence-based training program for the nurses was developed on the unit.

▶▶ continued on p. 42

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EVIDENCE BASED ICU NURSING

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The population in Israel is a little above 7 million people. At the end of 2007 there were 54,899 registered nurses in the country; 4.4 registered nurses per 1000. There are a total of 12 919 nurses completing post graduate courses of which 52% have successfully completed the national 1 year intensive care for nurses course.

The Israeli Cardiology and Critical Care Nursing Society is a professional group encompassing many fields: general intensive care, cardiac, cardio-thoracic surgery, neurosurgery, paediatric, and post anaesthesia. The society has one national congress a year in collaboration with the Physicians Intensive Care conference. In addition, there is another nursing conference day organised at a different hospital each year. The hosting nurses organise the day focusing on the specialties of the nurses in that hospital. The society's active members have developed a specialty branch calling themselves the Evidence Based ICU Nursing (EBN) group. This group meets once a month with the objective of investigating nursing procedures that need to be refreshed and updated. The members are ICU nurses from 5 major Israeli hospitals. In the spring of 2004, the group began by identifying specific areas of evidence based investigation which representatives from all types of intensive care were interested in developing.

Several studies had been published that found that poor oral hygiene might be associated with increased risk for ventilator associated pneumonia (VAP) (Bergmanns et al. 2001; Hubmayr 2002; Kollef et al. 2004; van Nieuwenhoven et al. 2004) and that VAP was found to be a major cause of morbidity and mortality in the ICU (Bercault and Boulain 2001; Elward et al. 2002, Rello et al. 2002).

One specific article caught the attention of the group (Grap et al. 2003). The authors reported that ICU nurses' oral care practices were not documented nor were they in accordance with the most recent evidence. Oral care was then chosen as the topic for the project. After an exhaustive review of the literature, it was also found that nurses based their oral care practices on tradition, used many different techniques and products for oral care; had no uniform method of oral assessment and that there was no unified consensus as to an evidence based oral care protocol (Munro and Grap 2004; Munro et al. 2004; Stiefel et al. 2000; White 2000). Since there was no information as to the current state of practice in Israel, the group decided to conduct a survey describing the current oral care practices of ICU nurses with intubated patients and to compare those practices with the current evidence-based literature. A prospective survey was conducted to determine the oral care practices of critical care nurses of intubated patients. A convenience sample of 216 practicing ICU nurses was obtained.

While nurses ranked oral care of high priority, many did not implement the latest evidence into their current practice. The level of research utilisation was not related to the type of nursing education, age, work status or other factors. We also found that even nurses working on the same unit varied widely in their oral care practices partially due to the fact that there were no known written oral care protocols. Most did not brush their patients' teeth. The results of a survey of oral care practices in 59 European intensive care units were similar to those found in our study (Rello et al. 2007). We then proceeded to develop an oral care protocol based on our literature search, critical reading of the material and adaptation to our culture. We are currently in the process of distributing this protocol to all intensive care units in the country.

We are initiating 2 new projects. The first endeavour is to review the literature for the best evidenced based care protocols for the mechanically ventilated patient, including nurses driven weaning, tight glucose control, nutrition, sedation, and suction protocols. Our second project is investigating the relation between nurses' level of moral distress and the Israeli ICU work environment.

The Israeli EBN group was the driving force behind the international CONFLITICUS study preformed in Israel; all members were proactive in promoting this study in our country and data collection in our units which resulted in excelent Israeli representation in the research.

Conclusion

The Evidence Based ICU Nursing (EBN) group is a network of serious and expert ICU nurses devoted to excellence in intensive care nursing in our country. We are determined to strive for uniform, standardised and evidenced based level of nursing care for all severely ill. The Israeli EBN group would be very interested in networking with other such groups in other countries in order to broaden our scope and collaborate with like groups internationally. ■

continued from p. 39

The program included two stages: theoretical training for the entire nursing staff during a two-day program featuring a series of lectures on physical assessment of the respiratory, neurological, cardiovascular and gastrointestinal systems taught by clinical nursing specialists and specialist physicians and practical training at patients' bedside. Each nurse had to practice making a comprehensive physical assessment of a patient together with a physician participating in the project. All of the nurses sat for an examination of the theoretical subjects learned in the training program and each nurse underwent a practical exam in carrying out a comprehensive physical assessment and reporting the findings. Following the training program nurses were required to report their physical assessments made during each shift. Several physical assessment parameters were also added to the nursing records such as pupil status, state of consciousness, GCS, air intake into lungs for ventilated patients, location of the nasogastric tube, peripheral pulse check for patients on intropic drugs, and skin condition. Additional assessments were added according to the patient's condition.

Summary and Conclusions

A training program carried out in the workplace for nurses in the physical assessment of patients has empowered the role of nurses on the Internal Medicine Intensive Care Unit of the Hadassah Medical Center-Ein Kerem, Jerusalem. The nurses in the Unit feel more in control and more self-confident in carrying out physical examinations and reporting resulting findings. Furthermore, the training program has improved the quality of nursing care, expressed in identifying unusual findings by nurses such as pulmonary emphysema and urinary obstruction. Such symptoms were then reported to the attending physician and treated in a timely manner. In conclusion, training staff nurses in their workplace, with the professional cooperation of the physicians, facilitates more successful training and improves the capacity, skills and self-confidence of nurses in carrying out patient care. ■

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continued from p. 21

in the conduction of the oral part (Part II) of the examination. This examination has increased in its popularity in recent years, and for 2008 we expect 350-400 candidates to sit for Part I of the examination. The EDIC is now an established part of the training for several national programmes in intensive care in Switzerland, the Netherlands and the Scandinavian countries, and even outside Europe as well. In the future, all of these fore-mentioned activities (CoBaTrice, PACT and EDIC) will constitute a major component of the Education and Training committee within ESICM, thus indicating the increased effort by ESICM to devote time and resources to education and training within european intensive care.

With recent developments, intensive care in Europe may face a more harmonised training, not with regards to time spent on training, but certainly with regards to the aims of the training (competencies). There will also be an updated distance learning programme available from the ESICM (price not yet decided) and methods to document sufficient knowledge will be offered through the EDIC. ■

Table 1

Competencies in intensive care (main groups)

Resucitation	
Diagnosis	Comfort & Recovery
Disease Management	End Of Life Care
Interventions	Paediatric Care
Procedures (respiratory, cardiovascular, CNS,	Transport
Gastro-intestinal, Renal)	Safety & Management
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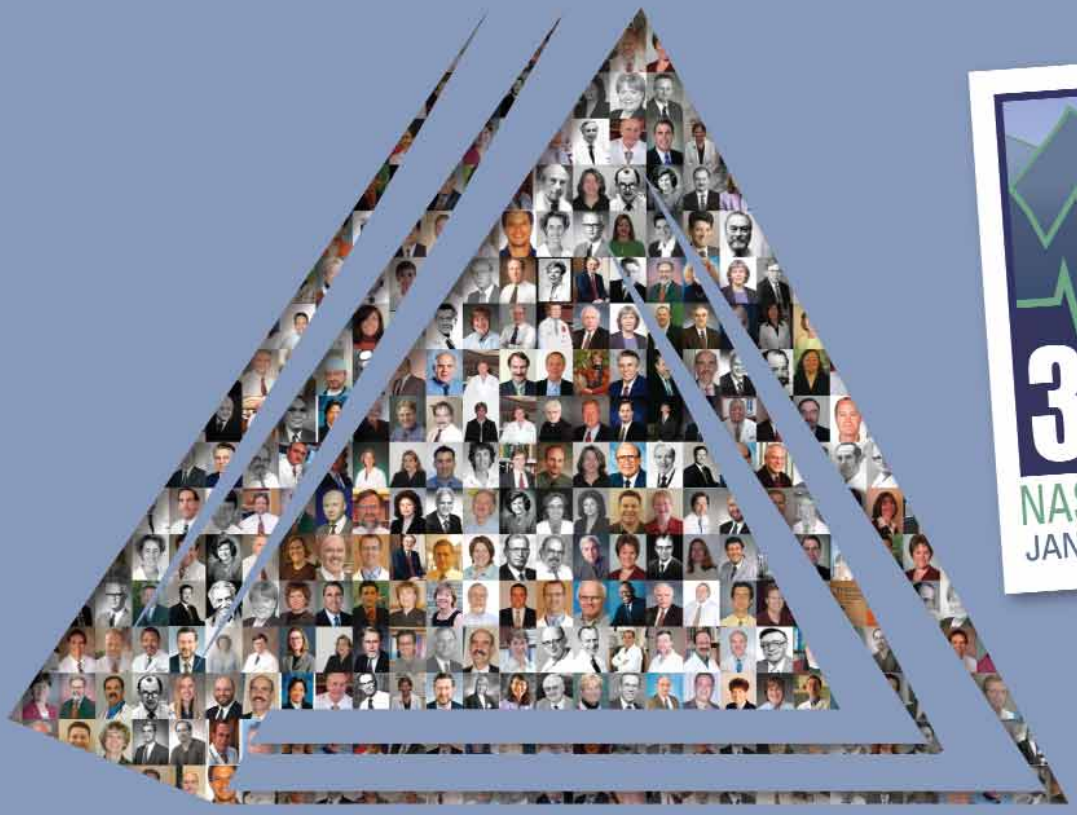

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Dr. Iain Moppett

Consultant Anaesthetist
Queen's Medical Centre
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Newsletter Editor
European Society of Anaesthesiology

EUROANAESTHESIA 2008

The annual scientific meeting of the European Society of Anaesthesiology was held at the Bella Centre in Copenhagen at the end of May this year.

The congress attracted around 5200 delegates over the 4 days in addition to industrial exhibitions. Similar to most large medical conferences, Euroanaesthesia has numerous parallel components: refresher courses, work-shops, interactive sessions, scientific updates, poster presentations and industrial symposia, not to mention providing the opportunity to visit one of Europe's finest cities.

The ESA prides itself on the high standard of its showpiece congress, and this year was no exception. The various subcommittees of the scientific programme committee, chaired by Professor Jennie Hunter, put together a very high-quality speaking faculty who covered a diverse range of topics. Most of the speakers were European, and Denmark, the host nation, provided a significant number. Many congress attendants would agree that the best talks given are not necessarily those from the biggest names, and I, personally found that the most informative and refreshing sessions came from presentors I hadn't come across before.

Euroanaesthesia is deliberately a general conference covering the whole range of anaesthesia related topics. Within that structure however, the various scientific subcommittees aim to provide sessions to satisfy all anaesthetists whether they are novices, occasional practitioners or dedicated experts in the field.

Unlike the ASA, Euroanaesthesia does not charge additional fees for sessions within the congress. The organisers therefore had to make early predictions on which sessions would be most popular so that room size could be matched to the audience. Although there was an occasional session where delegates had to be turned away, this year it seemed to be less of a problem than previous years. Inevitably with so many parallel sessions, delegates had to make choices about what to miss. Fortunately, following its successful pilot last year, the ESA continued to provide web access to the visual presentation and the sound from the conference room to delegates at the conference. ESA members can have access afterwards as well, which is certainly a useful resource.

A large number of the delegates were able to attend Euroanaesthesia courtesy of the reduced fees available for abstract presenters. 879 abstracts were presented as poster presentations this year. As with any large-scale abstract sessions the standard varies, with some workers presenting full-scale trials, and others presenting small case series and audits. There was something to learn in each session though. Looking at the faces of the presenters, most of them seemed to enjoy their session, at least after they had had their five minutes explaining their work. The poster sessions always feel more multi-cultural with colleagues offering to translate tricky questions in and out of a shared non-English language if the presenters got stuck. This year was better than last year for noise levels. Talking to one of the ESA secretariat staff members, they had listened to delegates comments last year, and deliberately tired to organise the sessions so that disturbance from other sessions was kept to a minimum. The 6 best abstracts were selected for a more traditional oral presentation with prizes for the top three. This year's winner, Rainer Haseneder (Germany) presented his work: 'Xenon Reduces NMDA-Receptor Mediated Synaptic Transmission in the Mouse Amygdala via Postsynaptic Mechanisms and Independent on the NR2A or NR2B Subunit'.

Away from the scientific presentations, delegates spent time browsing the industrial exhibition. More than 100 companies exhibited their latest products in the field of anaesthesiology. All the big names were there, tempting delegates with give-aways, prizes and live demonstrations. The remainder of the exhibition was made up of smaller companies, showcasing their wares. The number of ways of maintaining a patient's airway seems to be going up still, judging by the number of stands. A new addition to the exhibition this year was the ESA village. Sixteen different national societies had signed up to take part in the Village, informing delegates about the activities in their country. At the ESA stand it was also possible to take the European Diploma in Anaesthesia and Intensive Care (EDA) diagnostic test: many delegates took the opportunity to test their knowledge in anaesthesia, and asked questions of the examiners who were there to help candidates prepare for the exams.

Overall, delegates are positive about Euroanaesthesia. The ESA undertook a survey during the congress, and the results are available to see on the ESA website. Perhaps the most telling figure is that two thirds of delegates come to Euroanaesthesia because of its reputation for a high quality scientific programme.

■

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