ICU MANAGEMENT

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Beyond Pulse Oximetry: The Future of Non-Invasive Monitoring

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Location: Room Gold Hall, Brussels Meeting Center (SQUARE)
Date and Time: Tuesday, March 17 • 12:30 – 13:30, Lunch will be provided
Chairperson: Michael Pinsky
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Presenters

Can We Monitor Everything Non-Invasively?

Michael R. Pinsky, MD, CM, Dr hc, FCCP, FCCM

Professor of Critical Care Medicine, Bioengineering, Anesthesiology, Cardiovascular Diseases, and Clinical & Translational Sciences
Vice Chair for Academic Affairs UPMC, Pittsburgh, Pennsylvania

Oxygen Reserve and Early Warning

Michael Ramsay, MD, FRCA

Chairman Department of Anesthesiology and Pain Management,
Baylor University Medical Center and Research Institute
President Baylor Research Institute, Dallas, Texas

Functional Hemodynamic Monitoring to Drive Resuscitation and Improve Outcomes

Maxime Cannesson, MD, PhD

Professor of Anesthesiology and Vice Chair – Research
Director, Cardiac Anesthesia
Department of Anesthesiology & Perioperative Care
University of California Irvine

Latest Strategies in the ICU: How to Improve Patient Management and Still Remain Non-Invasive

Location: Room Gold Hall, Brussels Meeting Center (SQUARE)
Date and Time: Thursday, March 19 • 12:30 – 13:30, Lunch will be provided
Chairperson: Azriel Perel
Please register at www.masimo.com/ImprovingOutcomesICU

Presenters

How Should We Monitor the Sedated Non-Intubated Patient?

Michael Ramsay, MD, FRCA

Chairman Department of Anesthesiology and Pain Management,
Baylor University Medical Center and Research Institute
President Baylor Research Institute, Dallas, Texas

Patient Blood Management and Transfusion Optimization

Keith J. Ruskin, MD

Professor of Anesthesiology and Neurosurgery
Yale University School of Medicine, New Haven, Connecticut. USA

How to Best Guide Fluid Management and the Role of Non-Invasive Assessment of Fluid Responsiveness

Azriel Perel, MD

Professor of Anesthesiology and Intensive Care,
Sheba Medical Center, Tel Aviv University, Tel Aviv, Israel

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A warm welcome to Brussels for the 35th International Symposium on Intensive Care and Emergency Medicine. In 1980 we welcomed just a few hundred delegates to Brussels - pre-mobile phones and pre-Internet! While networking has become even easier with mobile and online technology, nothing beats meeting our colleagues in person. This year more than 6,300 participants will convene for ISICEM. Allow us a little nostalgia as we look back over the years. In this issue we asked Symposium stalwarts for their memories of ISICEM.

Our cover story this issue is "The Lung." In their review of nosocomial pneumonia Leonel Lagunes and Jordi Rello discuss some of the key advances from the 2005 ATS/IDSA guidelines publication and emphasise future research for unsolved issues. Next, Alexandre Demoule explains when and why noninvasive ventilation should be used in mild ARDs, but stresses that as a therapeutic option it awaits confirmation in prospective clinical trials. Peter Thomas and Jeffrey Lipman outline the role of physiotherapists as key members of the Australian ICU multidisciplinary team, providing respiratory management, exercise and mobilisation. Finally, Jean-Louis Teboul and Xavier Monnet address the therapeutic dilemmas of fluid management in ARDS. Fluid administration in case of ARDS is a real therapeutic challenge since there are risks of worsening of pulmonary oedema even in preload responsive patients. Assessment of the benefit/risk ratio in each individual patient is of utmost importance, they argue.

Our Series this year is Infections. We start with an article by Christopher Lockie and Duncan Wyncoll on infection prevention. They focus on four simple, evidence-based, cost-effective interventions to combat healthcare-associated infection, which are not yet widely implemented in clinical practice.

The Matrix section opens with Jean-Charles Preiser discussing water intake in the ICU patient, in particular the challenge of correcting hydration status while avoiding an increase in extracellular volume (interstitial and intravascular), including infusions via the enteral route. Next, Thomas Berlet argues that it is time to rationalise standard laboratory measurements in the ICU. He describes an approach to developing and implementing the use of rationalised laboratory measurements.

Our Management section is devoted to social media. Three renowned Spanish medical bloggers take us through getting started with a health blog, and we also interview Gabriel Heras La Calle about his "Humanizing Intensive Care" blog. Adrian Wong and Steve Mathieu outline how to get started with Twitter and how to use it as a convenient, online record of continuing medical education.

Julia Wendon, the liver intensive care specialist, is our Interviewee this issue. She discusses the advances and challenges in liver intensive care as well as the setup of the Liver Intensive Care Unit at Kings College Hospital London.

We visit Israel for our Country Focus. Julie Benbenishty writes about the Israeli Society of Cardiac and Intensive Care Nursing, which is actively engaging in research and best practice to improve intensive care in Israel.

As always, if you would like to get in touch, please email editorial@icu-management.org

Jean-Louis Vincent

Jean-Louis Vincent

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ICU MANAGEMENT WELCOMES NEW EDITORIAL BOARD MEMBERS

Editor-in-Chief, Professor Jean-Louis Vincent, has welcomed three distinguished intensivists to the ICU Management Editorial Board.

Prof. Jan de Waele, MD, PhD (Belgium)

Prof. De Waele is an intensivist at the Surgical ICU of the Ghent University Hospital in Ghent, Belgium. As the current President of WSACS – the Abdominal Compartment Society, he will host the 2015 World Congress on the Abdominal Compartment in Ghent, Belgium in May 2015. Prof. De Waele serves as Deputy of the Infection section in the European Society of Intensive Care Medicine (ESICM) and Councillor-at-Large in the Surgical Infection Society – Europe (SIS-E). He is President-Elect of the Belgian Society of Intensive Care Medicine and Senior Clinical Investigator (FWO – Research Foundation Flanders). Read Prof. De Waele's Zoom On Profile on the ICU Management website at http://bit.ly/1C36mUC

Dr. Bin Du, MD, Professor (China)

Dr. Du is Director of the Medical ICU, Peking Union Medical College Hospital in Beijing, China. Dr. Du is a Member of the Council of the World Federation of Societies of Intensive and Critical Care Medicine; President, Asia Pacific Association of Critical Care Medicine (APACCM) and President, Chinese Society of Critical Care Medicine (CSCCM). His research interests are sepsis and nosocomial infection. Dr. Du is on the Advisory Board of Critical Care.

Prof. Eliezer Silva, MD, PhD (Brazil)

Prof. Silva is Director of the High Complexity Hospital affiliated to The Albert Einstein Hospital in São Paulo, Brazil and founding President of the Latin American Sepsis Institute. His research and professional interests are critical care medicine, management and economic analysis. Prof. Silva is on the Advisory Board of Critical Care.

ICU Management

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"Second wind" from Vienna – 25 Years of Lung Transplants

25 years of lung transplantation was marked at the Medical University of Vienna and Vienna General Hospital (AKH Wien) on 6 March with a celebration and symposium. The first lung transplantation was performed at the medical faculty of the University of Vienna in November 1989. 25 years later the Medical University of Vienna/ AKH Wien is one of the four world-leading centres for lung transplantation along with Hannover, Toronto and Cleveland. 120 patients a year receive their "second wind" from Vienna, and all donated lungs from Slovakia, Hungary, Croatia, Slovenia, Greece, Cyprus, Romania and Estonia are also transplanted here, as these countries do not have transplant centres themselves. Around two-thirds of the lungs transplanted in Vienna come from these eight cooperating countries with a total of 63 million inhabitants.

"Since we receive more lungs than we require, it is a win-win situation for all. For patients in Austria, for those affected in these countries and for the Eurotransplant region. The whole world is envious of us for this reason," said Walter Klepetko, who was appointed Head of the Lung Transplantation Programme of MedUni Wien and the AKH Wien and Head of the Clinical Department for Thoracic Surgery from the outset.

The large quantity of donor lungs is also conducive for researchers at the Medical University of Vienna to perform studies and develop or apply new operation techniques. Around four years ago, for example, an ex-vivo lung perfusion was applied for the first time at the Clinical Department for Thoracic Surgery at the Medical University of Vienna / AKH Wien. Austria is among the first countries in which this concept has been successfully employed. With the ex-vivo lung perfusion system, the lung can be accurately assessed and "repaired". Lungs which would previously not have been used for transplantation are connected to a ventilator and rinsed, after which they display in this system an impressive improvement in organ function, and can therefore be transplanted in an optimum condition.

The indications that can be remedied through the use of a donor lung have greatly expanded. COPD and emphysema are the largest group at around 35 percent. Around 20 percent of those affected suffer from pulmonary fibrosis, and 15 percent of these patients also suffer from cystic fibrosis and pulmonary hypertension.

Stroke Care Out of Reach for One-Third of Americans

One-third of the U.S. population does not have access to a primary stroke centre within one hour by ambulance, according to a new study published online in the March 4 issue of *Neurology*. Even under optimal conditions, a large proportion of the U.S. populace would be unable to access a stroke centre within this timeframe.

Certification of hospitals as stroke centres includes primary stroke centres and comprehensive stroke centres, the highest level. Certification of comprehensive stroke centres began in 2012. The study examined data from 2010, when there were 811 primary stroke centres and no comprehensive stroke centres in the United States.

Study author Michael T. Mullen, MD, from the Perelman School of Medicine at the University of Pennsylvania in Philadelphia, and colleagues created models to estimate what proportion of the population would have access to a comprehensive stroke centre within an hour under optimal circumstances.

They found that converting up to 20 optimally located primary stroke centres per state into comprehensive stroke centres would result in 63 percent of the population living within a one-hour drive and an additional 23 percent within a one-hour flight of a centre. There was however substantial variability in access, with some states lagging behind the national average.

"Even under optimal conditions, many people may not have rapid access to comprehensive stroke centres, and without oversight and population level planning, actual systems of care are likely to be substantially worse than these optimised models," said Mullen. He also noted that access to care in the models was lowest in the southeastern United States, an area often referred to as the "Stroke Belt."

"There are geographic differences in stroke incidence, especially in rural areas and in the Stroke Belt," Mullen said. "Reduced access to specialised stroke care in these areas has the potential to worsen these disparities. This emphasises the need for oversight of developing systems of care."

Mullen said he is hopeful that optimisation modelling studies, such as this could help policymakers and health planners identify areas of need, with the ultimate goal of ensuring that specialised stroke care is accessible throughout the U.S.

Reference

Mullen MT, Branas CC, Kasner SE et al. (2015) Optimization modeling to maximize population access to comprehensive stroke centers. Neurology, 4 March. Published online before print, doi: 10.1212/WNL.0000000000001390 Neurology 10.1212/WNL.0000000000001390

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35 YEARS OF ISICEM

As we celebrate 35 years of the International Symposium on Intensive Care and Emergency Medicine, we asked Symposium stalwarts for their memories.

Prof. Antonio Artigas
Director, Critical Care Centre, Sabadell Hospital, Barcelona, Spain
ICU Management Editorial Board Member

1. What were you doing 35 years ago?
I was working in the Intensive Care Service at Hospital de la Santa Creu i Sant Pau in Barcelona.

2. What do you love about ISICEM?
ISICEM is a good opportunity to meet friends and for international scientific exchange.

3. Do you have a most memorable moment from ISICEM's 35-year history?
The most memorable moments were the round table conference on Acute Lung Injury in 1987 and the 25th anniversary of ISICEM.

Prof. Michael Pinsky
Professor of Critical Care Medicine, Bioengineering, Anesthesiology, Cardiovascular Diseases, and Clinical & Translational Sciences; Vice Chair for Academic Affairs, University of Pittsburgh, USA

1. What were you doing 35 years ago?
I was finishing my second fellowship in Pulmonary Medicine and Physiology at Johns Hopkins Medical Institutions and learning the large animal experimental techniques I would apply then and afterward to further characterise heart-lung interactions.

2. What do you love about ISICEM?
The broad knowledge base of scientific presentations, the dynamic and changing faculty reflecting the thought leaders in the field and the enthusiastic participants who crowd into every lecture hall and conference room.

3. Do you have a most memorable moment from ISICEM's 35-year history?
My most memorable moment was when I did a friendly roast of Jean-Louis Vincent at the opening ceremony of the 25th annual meeting, reviewing his life from training to the then present.

Prof. Jukka Takala
Chairman, Department of Intensive Care, Emergency Medicine and Anaesthesiology, University Hospital, Bern, Switzerland
ICU Management Editorial Board Member

1. What were you doing 35 years ago?
I was a 3rd year Anaesthesiology resident at Turku University Hospital in Finland, and had just started my training in intensive care at the paediatric ICU.

2. What do you love about ISICEM?
The mix of hearing the new and upcoming research (unless Prof. Vincent keeps you too busy…) and meeting colleagues and friends.

3. Do you have a most memorable moment from ISICEM's 35-year history?
In the early years of mobile phones Prof. Vincent interrupting his talk in the main hall to answer his mobile phone.

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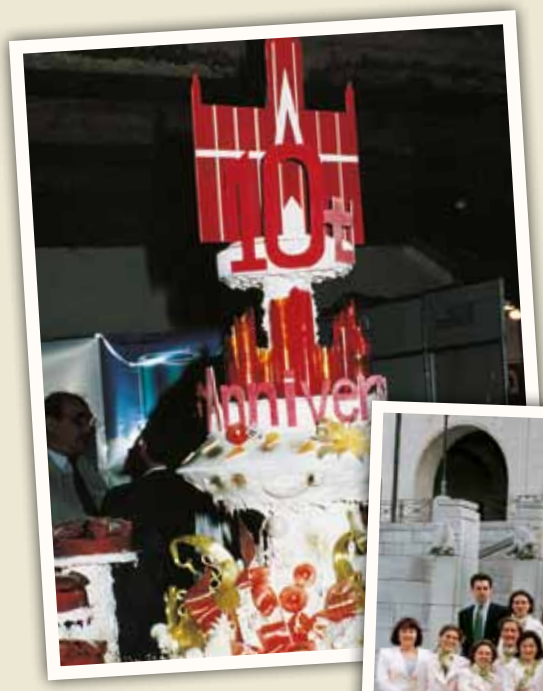

ISICEM over the years - the team, the people, the cake!

An idea, a symposium, a city.
Thank you Professor Vincent for 35 Years of ISICEM

NOSOCOMIAL PNEUMONIA

WHERE SHOULD WE GO NOW?

This review discusses some of the key advances from the 2005 ATS / IDSA guidelines publication and emphasises future research for unsolved issues.

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Ten years have passed since the publication of the American Thoracic Society (ATS)/ Infectious Diseases Society of America (IDSA) guidelines on nosocomial pneumonia (NP) (2005), which defined three different conditions regarding where or when the infection was developed. NP was defined as:

- a lower respiratory infection that develops in a hospitalised patient 48 hours or more after admission;
- and no evidence of presence or incubation of this was noticed at the time of admission.

Hospital-acquired pneumonia (HAP), ventilator-associated pneumonia (VAP) and healthcare-associated pneumonia (HCAP) were defined by expert opinion regarding clinical, image and laboratory findings. Recently, new data in respect to epidemiology, aetiology, diagnosis and treatment have been published. Some authors disagree on the definition of HCAP (Ewig et al. 2012). We believe that this group of patients represents a heterogenous population associated to specific comorbidities that should be taken into account.

NP increases costs, mechanical ventilation days (MVD) and hospital and ICU length of stay (LOS), so there should be no surprise that efforts from hospital administrations are aimed at preventing NP. In spite of these efforts, NP remains the second most common cause of nosocomial infection worldwide (Vincent et al. 2009).

Mechanisms of Disease

The lung gets infected via aspiration, inhalation or by haematogenous spread. The most common route of infection in NP is, by far, microaspiration from oropharyngeal and upper digestive tract secretions into the trachea. A dysregulation between normal host defences and the ability of microorganisms to colonise and invade the lower respiratory tract occurs. This becomes more evident in patients with an endotracheal tube that overcomes these defences, impairs mucociliary function, and accumulates secretions above the endotracheal cuff, favouring repeated microaspiration.

A depression of complement, cyclic adenosine monophosphate and calcium signalling pathways during preinfection phase were noticed in VAP patients when compared to ventilator-associated tracheobronchitis (VAT) patients (Martin-Loeches et al. 2012). Recently Rautanen et al. (2015) found some variants in the FER gene that were associated with a reduced risk of death from sepsis due to pneumonia. Further research should elucidate whether this is associated with NP.

Organisms

Microbiology on NP, as with any of the nosocomial infections, has evolved in the last years. Older patients and a global rise in multidrug resistant pathogens (MDR) have contributed to this. An international surveillance programme of NP in Europe, North and Latin America has identified the top six pathogens isolated: *Staphylococcus aureus* (28%) *Pseudomona aeruginosa* (21.8%) *Klebsiella* species (9.8%) *E. coli* (6.9%) *Acinetobacter* species [6.8%], and *Enterobacter* species (6.3%) (Jones 2010). Four of the ESKAPE pathogens (*Enterococcus faecium*, *S. aureus*, *Klebsiella pneumoniae*, *Acinetobacter baumannii*, *P. aeruginosa* and *Enterobacter* species) constitute around 80% of ventilator-associated pneumonia (VAP) episodes (Sandiumenge et al. 2011; Koulenti et al. 2009; Eperatti et al. 2010; Kollef et al. 2005; Lee et al. 2013; Canadian Critical Care Trials Group 2006)

According to most guidelines NP should be empirically treated with broad-spectrum antibiotics trying to cover for MDR pathogens. Local high prevalence of potentially resistant microorganisms (PRM) and the presence of severe sepsis/ septic shock without the classical risk factors for PRM according to the 2005 ATS/IDSA guidelines have been associated as independent risk factors for PRM as the causative pathogen in HAP/VAP patients, reducing inappropriate therapy and improving outcome (Martin-Loeches et al. 2013).

The previous division based on time of onset of VAP can be improved, as recent studies reported that microorganisms involved in both early and late VAP were no different regarding time of onset (Gastmeier et al. 2009), nor even when MDR are involved (early-onset 27.8%, late-onset 32.3%, p=0.33) (Restrepo et al. 2013). Even in immunosuppressed populations, such as lung transplant recipients, organisms causing VAP and VAT remain similar (Riera et al. 2014). This could lead to delay in the start of adequate treatment, which is associated with worse outcomes.

Some considerations must be taken into account regarding Methicillin-resistant *Staphylococcus aureus* (MRSA) VAP. Previous antibiotic exposure, extended admission to hospital, underlying chronic obstructive pulmonary disease and steroid use have been associated as risk factors. MRSA has been independently associated with an almost 50% higher likelihood of hospital death when compared with methicillin-susceptible strains (Hanberger et al. 2011), but local prevalence should be considered to initiate empirical treatment. American and European guidelines recommend vancomycin or linezolid for treatment of MRSA VAP, but which one to start with is still a dilemma. Linezolid has shown better clinical cure and survival (Kollef et al. 2004), but no differences in mortality (Wunderink et al. 2012). Vancomycin adverse events are an important reason to recommend linezolid in immunosuppressed patients, those receiving concomitant administration of nephrotoxic drugs, for severe sepsis and elderly patients (Rello et al. 2014).

P. aeruginosa is the second most isolated pathogen in VAP (PA-VAP), and patients at risk for *P. aeruginosa* infection should receive combination treatment at onset to decrease probability of wrong initial treatment. Risk factors for MDR *P. aeruginosa* infection are prior antibiotic exposure, admission from chronic care facilities, old age, diabetes, long-term treatment in hospital, use of invasive devices, recent surgery, extended ICU stay, extended ventilation periods and higher illness severity scores (Rello et al. 2013a). Vasopressors on the day before PA-VAP, delay to treatment <12 days and susceptibility of pathogen have been associated with discharge without recurrence of VAP. Interestingly *Pseudomonas* resistance is not significantly associated with death or VAP recurrence, but delays ICU discharge (Planquette et al. 2013). Serotype of *P. aeruginosa* has been associated with mortality and clinical resolution. Outcomes tend to be worse in patients infected by serotype O1 or O11 and better in patients infected by serotypes O2, NT [not typeable] and O6 (Lu et al. 2014). This might be associated with distribution of virulence factors.

Diagnosis

NP represents a daily challenge to clinicians, due to subjectivity and lack of a gold standard, particularly in patients with mechanical ventilation. Purulent secretions are a cornerstone in the diagnosis of lower respiratory tract infection – ventilator-associated respiratory infection (VARI). Some milestones have been proposed throughout the years (see Figure 1). Stevens and colleagues (2013) found almost no agreement among hospitals about the presence or absence of VAP in each case presented, suggesting that the previous Centers for Disease Control and Prevention (CDC) definition of VAP had the same precision as flipping a coin.

In recent years increasing concern has been directed to ventilator-associated tracheobronchitis (VAT). Patients with VAT must have clinical signs (fever, leukocytosis and purulent sputum), microbiologic findings, but no new opacities on the chest x-ray. It could be a precursor of VAP or present as a different entity, as shown by Dallas et al. (2011), reporting a median onset of VAT of 7.5 days after intubation and mechanical ventilation, compared to five days for the development of VAP. Antibiotic treatment directed to VAT has been associated with greater number of days free of mechanical ventilation (Nseir et al. 2008), and might prevent later VAP episodes (Nseir et al. 2014).

In an effort to improve accuracy and objectivity, the CDC has launched a new surveillance programme (Centers for Disease Control and Prevention 2015). It shifts the focus not only to pneumonia, but also towards a syndrome characterised by respiratory worsening while on mechanical ventilation. This approach provides three major advantages: it sidesteps the limited accuracy of VAP surveillance definitions, broadens the focus to include additional morbid events, beyond just pneumonia, and allows objective surveillance based on objective and measurable parameters. It ignores pathogens. Unfortunately, the correlation between new surveillance categories with the previous definition of VAP seems poor (Muscedere et al. 2013; Klein Klouwenberg et al. 2014), whereas the presence of these complications has been associated with a worse outcome. Whether these complications are preventable is yet to be assessed. A large multicentre validation is ongoing (European Society of Clinical Microbiology and Infectious Diseases 2014). Currently, this tool should be used only for surveillance.

Old techniques have erupted with new enthusiasm in pneumonia diagnosis, such as lung ultrasound: in community-acquired pneumonia (CAP) it showed a sensitivity of 93.4% and specificity of 97.7% in diagnosis (Reissig et al. 2012). A recent meta-analysis suggests that in expert hands it performs well in diagnosing pneumonia, and its use should be encouraged (Chavez et al. 2014). The newly proposed score, Chest Echography and Procalcitonin Pulmonary Infection Score (CEPPIS), combining clinical, oxygenation, microbiological, procalcitonin (PCT) levels and lung ultrasound to diagnose pneumonia showed promising results (sensitivity 80.5%, specificity 85.2%) when compared to Clinical Pulmonary Infection Score (CPIS) >6 (sensitivity 39.88% and specificity 83.3%) (Sinoff et al. 2013).

Prompt identification of the causative pathogen is an area of constant research. We believe that a point-of-care test able to identify quickly and accurately resistance genes should improve right initial treatment and outcome. This should be a priority area of research.

Treatment for NP

Treatment of NP should never be delayed. Initiation according to the guidelines has been widely studied, favouring adequacy of treatment (Ferrer et al. 2010), clinical improvement, lower costs and better survival in the adherent group (Wilke et al. 2011) The Improving Medicine through Pathway Assessment of Critical Therapy in Hospital-Acquired Pneumonia (IMPACT-HAP) investigators showed that non-adherence to guidelines decreased 28-day mortality compared to guideline-compliant

1985: BAL Intracellular organisms
1990: Quantitative cultures
1995: ATS/IDSA Guidelines
1999: Consideration of local variability
2003: The Tarragona Strategy
2006: One versus two weeks of AB treatment
2009: EUVAP Study
2012: VAT paradigm

NP=nosocomial pneumonia, BAL=bronchoalveolar lavage, ATS/IDSA=American Thoracic Society/Infectious Diseases Society of America, AB=Antibiotic, EUVAP=Pneumonia in Patients requiring mechanical ventilation in European Intensive Care Units, VAT=Ventilator-associated tracheobronchitis

Figure 1. Milestones in Management in NP

Directed to expected pathogen
Targeting optimal dosage
Consider susceptibility (MIC)
Take into account penetration (lung)
Remember safety and interactions
Include costs in rationale

NP=nosocomial pneumonia, AB=Antibiotic, MIC=minimal inhibitory concentration

Figure 2. Main Drivers to Prescribe AB in NP

patients in 303 patients in four centres in the United States (Kett et al. 2011). Starting treatment of HCAP according to the presence of risk factors for MDR microorganisms demonstrated in 321 patients that only 53% received broad-spectrum antibiotic (AB) empiric therapy, yet 92.9% received appropriate therapy (Maruyama et al. 2013). We know that bacterial burden is high within the first hours of pneumonia onset, whereas persistent inflammatory response remains in spite of eradication of organisms. An effective AB prescribing bundle should be based on the right drug, at the right time, at the right dose and right duration (Rello 2013b) (See Figure 2).

Reports regarding VAT and its impact on outcome and LOS suggest the need to initiate treatment with the same criteria, but further studies are required to assess duration.

Most patients are underdosed, particularly young trauma patients after pneumonia onset. Therefore antibiotic dosage should be personalised in critically ill patients. Low therapeutic levels with standard doses of betalactams have been reported, and associated with worse outcomes (Roberts et al. 2014), especially with multiple organ dysfunction syndrome (Ulldemolins et al. 2011).

Nebulised antibiotics are a promising approach, and they achieve high concentrations in lung tissue-minimising systemic absorption. High doses of colistin (5 millions of international units [mIU]/ 8 hours) are safe and effective in

VAP caused by non-fermenter Gram-negative bacteria (Lu et al. 2012), whereas low doses (1 mIU/ 8 hours), effective for VAT or cystic fibrosis could be insufficient to treat it (Magret et al. 2010). A standardised administration protocol requiring vibrating mesh nebulisers might optimise outcomes. More evidence and guidelines are required before implementing this promising way to overcome MDR organisms. Adverse events, such as systemic penetration and restricted use in severe hypoxaemic patients are a limitation of implementation.

Outcome

NP increases hospital LOS, mechanical ventilation days and ICU LOS. Mortality of NP is controversial. A prospective observational study in European ICUs reported mortality of 42.6% in patients without trauma and 17.2% when trauma was present (Lu et al. 2014). Another large study concluded that only 4.4% of deaths in the ICU on day 30 and 5.9% on day 60 could be attributable to VAP (Bekaert et al. 2011). However, a large meta-analysis reported an estimated attributable mortality of VAP around 13% (Melsen et al. 2013); high attributable rates were noticed in patients undergoing surgery and with an intermediate Acute Physiology and Chronic Health Evaluation II score (APACHE II) between 20 and 30. The lack of a gold standard method to diagnose VAP and variability in treatment can explain these results. Future studies to prevent VAP and therapeutic randomised control trials should incorporate this information in inclusion and exclusion criteria for enrolment.

Prevention

VAP bundles have proved to lower VAP rates in ICUs where implemented (Rello et al. 2013c; Sinuff et al. 2013). Outcome parameters should be the endpoints. Elective *P. aeruginosa* vaccination or immunotherapy to block virulence in high-risk patients for PA-VAP is a potential approach that requires further research. Genomics and new specific biomarkers should be investigated in order to improve initiation treatment and outcome.

Conclusion

VAP management requires an individualised approach. Incorporation of biomarkers, molecular diagnosis techniques and echography might improve diagnosis. A new paradigm of ventilator-associated respiratory infections (VARI), incorporating tracheobronchitis is required. Preventive measures should focus on improving outcomes. ■

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The authors have no conflict of interest regarding this paper.

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NONINVASIVE VENTILATION IN ACUTE RESPIRATORY DISTRESS SYNDROME

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In less than two decades noninvasive mechanical ventilation (NIV) has become a cornerstone therapy of acute respiratory failure (ARF). It is now well established that NIV can reduce intubation and mortality rates in patients with acute-on-chronic respiratory failure (i.e. severe acute exacerbation of chronic obstructive pulmonary disease) (Brochard et al. 1995) or acute cardiogenic pulmonary oedema (Masip et al. 2000). However, the beneficial effects of NIV remain unclear in patients with de novo acute hypoxaemic respiratory failure, that is non-hypercapnic patients having acute respiratory failure in the absence of a cardiac origin or underlying chronic pulmonary disease. This is all the more true in acute respiratory distress syndrome (ARDS), the most severe form of de novo acute hypoxaemic respiratory failure.

Physiologic Rationale for NIV in ARDS

In ARDS inflammation within the alveoli and surfactant abnormalities lead to a lung collapse, which in turn causes a major right-to-left intrapulmonary shunt and a dramatic decrease of lung compliance. This intrapulmonary shunt is responsible for hypoxaemia, while the alteration of lung mechanics increases the work of breathing.

Figure 1 summarises the physiological impact of NIV in ARDS. The application of positive airway pressure opens collapsed alveoli and increases functional residual capacity, thus decreasing right-to-left intrapulmonary shunt, which in turn leads to a major improvement of hypoxaemia (Katz and Marks 1985). The increase of functional residual capacity improves lung mechanics and thus reduces respiratory load. In combination with the inspiratory unloading that provides positive inspiratory pressure, NIV reduces the work of breathing (L'Her et al. 2005). Together these improvements of hypoxaemia, lung mechanics and respiratory muscle loading are associated with a reduction of dyspnoea (L'Her et al. 2005).

Results of Main Studies and Meta–Analyses

To date only five randomised controlled studies have been conducted in patients with de novo hypoxaemic ARF (Confalonieri et al. 1999; Antonelli et al. 2000; Delclaux et al. 2000; Martin et al. 2000; Ferrer et al. 2003). Two of these included hypercapnic patients (Confalonieri et al. 1999; Martin et al. 2000), and one was performed on immunocompromised patients (Antonelli et al. 2000). Only two randomised controlled studies evaluated NIV in non-hypercapnic and immunocompetent patients with de novo ARF. One suggested that NIV may reduce intubation rate and even mortality in a very select population of patients (Ferrer et al. 2003), and the other reported no beneficial effects of continuous positive-end expiratory pressure (Delclaux et al. 2000).

> "for mild ARDS, NIV still requires confirmation in prospective clinical trials"

A meta-analysis that included studies on NIV in de novo ARF concluded that, once immunocompromised and hypercapnic patients were removed, the benefit of NIV to prevent intubations was modest, and there was no benefit of NIV on mortality (Keenan et al. 2003). Another meta-analysis focused on the three randomised controlled studies that evaluated the impact of NIV in ARDS (Antonelli et al. 2000; Delclaux et al. 2000; Ferrer et al. 2003). This meta-analysis, that was limited by its sample size, suggested that the addition of NIV to standard care in patients with ARDS did not reduce the intubation rate or ICU mortality (Agarwal et al. 2006).

Despite the lack of evidence for benefit of NIV in de novo hypoxaemic ARF, recent surveys show that NIV is increasingly used in these patients. NIV is initiated as first-line ventilatory support in 10% to 30% of such patients (Demoule et al. 2006; Esteban et al. 2008; Schettino et al. 2008). In ARDS patients a recent proportion meta-analysis of studies that evaluated NIV used as first-line ventilatory support showed an overall success rate of 48% (from 30% to 86%) and mortality of 35% (from 15% to 71%) (Agarwal et al. 2010). However, this success rate was much higher in mild ARDS (66%) than in moderate or severe ARDS (32%) (Thille et al. 2013). As a consequence, survival without intubation was also much higher in mild ARDS than in moderate or severe ARDS (Thille et al. 2013).

However, it is important to remain that NIV is more likely to fail in de novo hypoxaemic ARF as compared to acute-on-chronic ARF or acute cardiogenic pulmonary oedema (Demoule et al. 2006).

What is the Risk of Using NIV in ARDS Patients?

Large cohort studies have demonstrated that NIV is globally beneficial in acute-on-chronic ARF and acute cardiogenic pulmonary oedema (Demoule et al. 2006; Schnell et al. 2014). In addition NIV failure is not a predictor of mortality in these causes of ARF (Demoule et al. 2006). By contrast, NIV failure is an independent predictor of higher hospital mortality in de novo acute respiratory failure. In other words, in de novo acute respiratory failure, NIV failure is associated with a higher mortality regardless of the severity of ARF (Demoule et al. 2006) (see Figure 2). Finally, cohort studies have observed that, in patients with de novo acute respiratory failure, the use of first-line NIV is not associated with better survival (Demoule et al. 2006; Schnell et al. 2014).

The reasons why NIV failure is a risk factor for death in de novo hypoxaemic respiratory failure remain unclear. First, intubation may be delayed and therefore performed at the last moment and in catastrophic conditions rather than in early, good conditions. Second, a high level of pressure support in combination with deep inspiratory efforts generates a high level of transpulmonary pressure, which could cause ventilator-induced lung injury.

LOW-FLOW EXTRACORPOREAL CO_2 REMOVAL: ENHANCING LUNG PROTECTION IN ARDS

NEW TECHNIQUE PROVIDES SIMPLE, MINIMALLY INVASIVE EXTRACORPOREAL LUNG SUPPORT.

The challenge of optimizing lung protection in ARDS

Despite many advances, ARDS mortality remains between 27-45%.[1] Few interventions have proven effective at improving outcomes in ARDS, a notable exception being the use of low tidal volume (≤ 6 mL/kg PBW) along with limiting plateau pressure to less than 30 cmH_2O and providing adequate PEEP. The goal of this strategy is to limit ventilator-induced lung injury which has been shown to reduce mortality in ARDS patients by 23%.[2] Practically, however, implementing protective ventilation can be challenging. Reducing minute ventilation can lead to respiratory acidosis and a range of potentially adverse physiologic effects including cardiovascular instability and non-pulmonary organ damage. Additionally, patient discomfort due to tachypnea and concerns about oxygenation are frequently cited as practical barriers to delivering protective ventilation. A recent study found only a 32% compliance with protective ventilation protocols.[3] As a consequence, the risk of mortality was shown to increase 23% for every 1 mL/kg PBW increase in the initially delivered tidal volume.

Low-flow $ECCO_2R$ facilitates ultra-protective ventilation

Low-flow extracorporeal CO_2 removal ($ECCO_2R$) is characterized by a blood flow rate of less than 550 mL/min which is achieved through a 15.5 Fr venous catheter. Providing CO_2 removal on the order of 30-50% of production, this technique effectively facilitates lung protective ventilation strategies while mitigating the adverse effects of respiratory acidosis and hypercapnia that can develop when minute ventilation is reduced. Protective tidal volumes and pressures can be achieved while maintaining control of CO_2 levels. Evidence even suggests that "ultra-protective" ventilation, with tidal volume < 6 mL/kg and P_{PLAT} < 30 cmH_2O, may further reduce ventilator induced lung injury.[4]

Our understanding of protective ventilation has recently improved with the publication by Amato et. al which showed a strong correlation between mortality and driving pressure (P_{PLAT} minus PEEP), regardless of plateau pressure or end expiratory pressure alone.[5] Even when tidal volumes are limited to 6 mL/kg PBW, and plateau pressure to less than 30 cmH_2O, there was a 36% increase in mortality risk for an increment in driving pressure of 7 cmH_2O. Low-flow $ECCO_2R$ can enable use of low driving pressures, while minimizing the deleterious effects of reduced minute ventilation and resulting hypercapnia.

"If correctly performed, mechanical ventilation 'buys time' to allow other therapies to take effect; if performed incorrectly, it may kill the patient." Gattinoni L, Protti A. CMAJ. 2008,178(9):1174-1176

Getting started with $ECCO_2R$

Extracorporeal CO_2 removal with the Hemolung RAS from ALung Technologies provides an alternative or supplement to mechanical ventilation by removing carbon dioxide directly from the blood, reducing the risk of ventilator-associated events and facilitating lung rest, protection, and ultimate recovery. The system provides a simple, minimally invasive approach to $ECCO_2R$, removing 30-50% of metabolically produced CO_2 to allow a reduction of ventilation requirements in patients who are either failing noninvasive ventilation (NIV) or who are already invasively ventilated.

The Hemolung RAS from ALung Technologies will be on exhibit at the ISICEM in Brussels, March 17-20, 2015 at stand 1.45-1.46. For additional information, please visit **www.alung.com.**

Caution: Federal law (USA) restricts this device for sale by or on the order of a physician. Not for sale in the USA.

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Can we Predict NIV Failure in ARDS?

Because NIV failure is associated with a higher mortality in de novo hypoxaemic ARF, it would be interesting to predict early NIV failure and to therefore avoid a delayed intubation. For that purpose, risk factors that would allow the early prediction of NIV failure are of great interest.

A first and major risk factor for NIV failure is the severity of the respiratory failure. Indeed in ARDS patients the success rate of NIV is much higher in mild ARDS (66%) than in moderate or severe ARDS (32%) (Thille et al. 2013).

A second crucial factor is the addition of an extra respiratory failure to ARF. For instance, an altered level of consciousness defined by a low Glasgow Coma Score is an independent predictor of NIV failure in ARDS patients (Thille et al. 2013). Shock is also a clear risk factor for NIV failure and subsequent intubation in ARDS patients (Rana et al. 2006; Carrillo et al. 2012; Thille et al. 2013).

Finally, the response to NIV after two hours provides interesting information regarding the future success or failure of NIV. Indeed a prompt improvement of oxygenation is a good predictor of NIV success (Antonelli et al. 2007). By contrast, a poor tolerance, a high level of leaks or a full dependence on NIV are clear risk factors for NIV failure (Demoule et al. 2006).

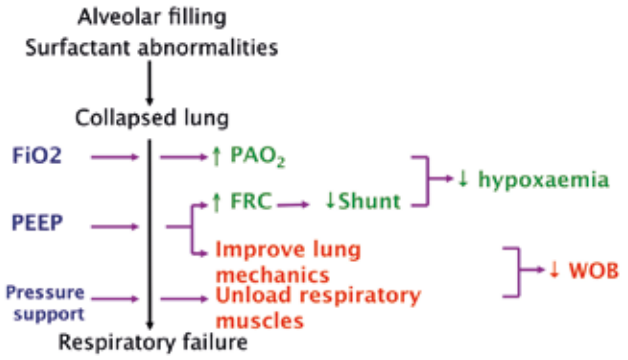

Figure 1. Physiopathologic Rationale for NIV Use in Acute Respiratory Distress Syndrome (ARDS).

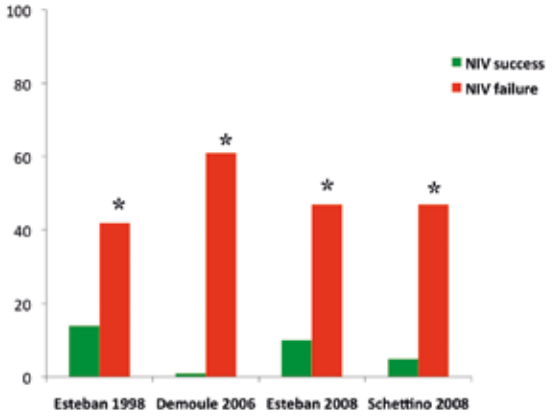

Figure 2. Impact of NIV Success or Failure on Mortality Rate Observed in Surveys.

NIV in ARDS Patients: Let's be Practical

The few studies devoted to NIV in ARDS suggest that NIV should only be used in mild ARDS and should not be instituted in case of extra respiratory organ failure. Indeed NIV should not be started in case of an abnormal level of consciousness, severe sepsis or in any case of shock.

In the case of mild ARDS with no extra respiratory failure, NIV can be started, but its tolerance and the response of the patient to NIV should be monitored closely. If tolerance is poor, the level of leaks is important, or if the patient becomes dependent on NIV, then NIV should be stopped immediately and intubation performed promptly. Intubation should also be performed if no improvement is noticed after one to two hours of NIV.

In the Berlin definition of ARDS, NIV is a therapeutic option for mild ARDS that in the opinion of the panel still requires confirmation in prospective clinical trials. These trials are now needed. ■

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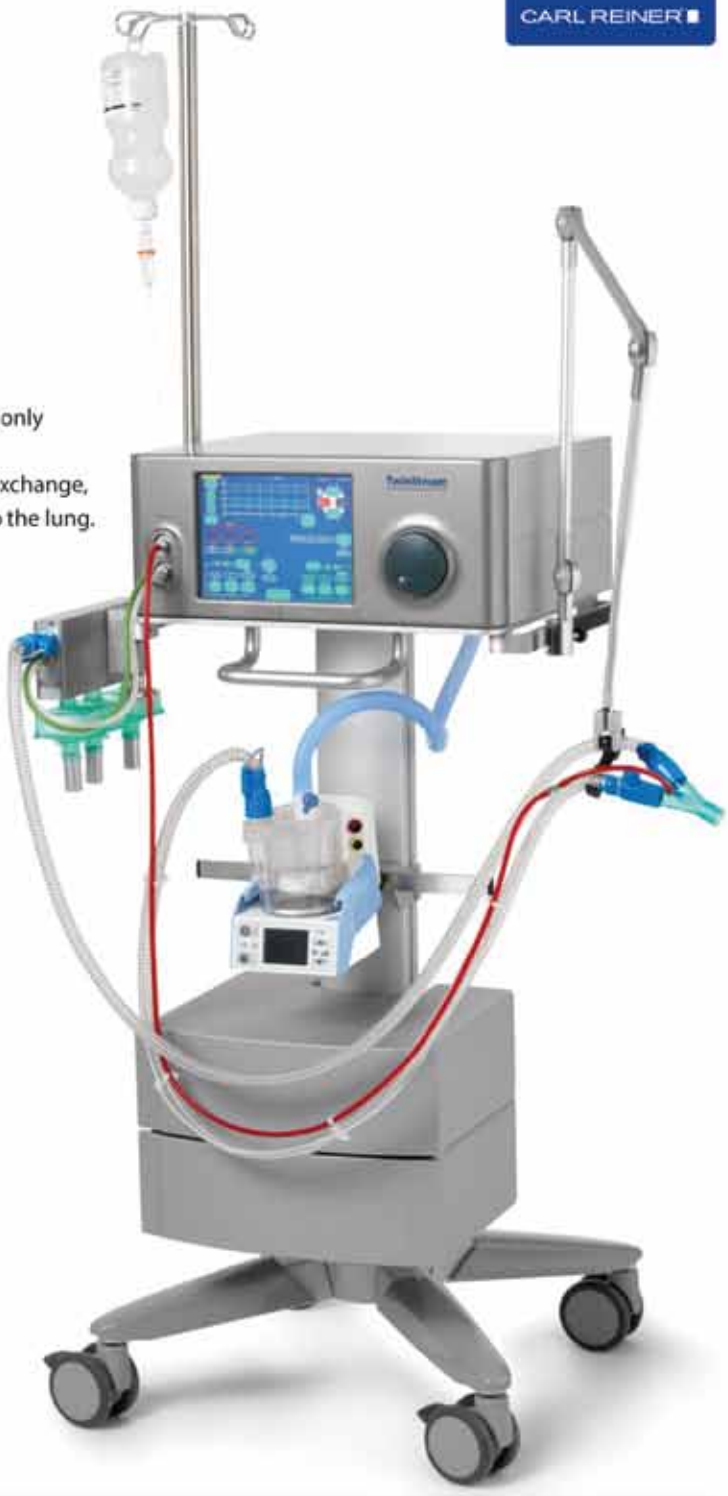

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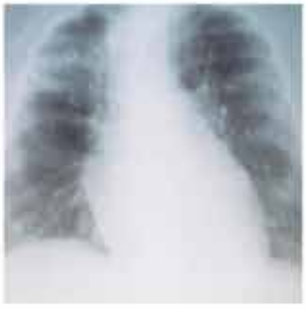

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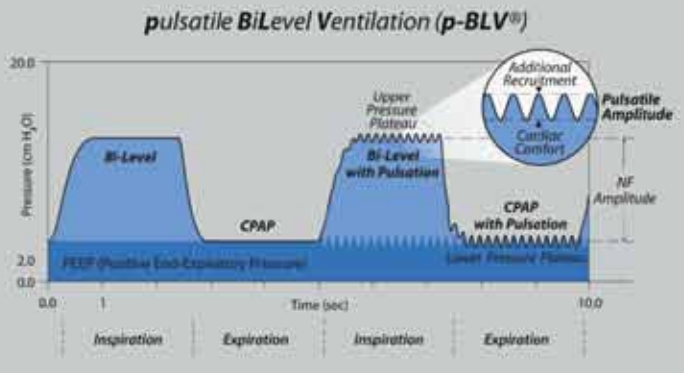

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PHYSIOTHERAPY SERVICES IN THE AUSTRALIAN ICU – CLINICAL PRACTICE AND RESOURCES

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ICU Management Editorial Board Member

Physiotherapists are key members of the Australian intensive care unit multidisciplinary team, providing respiratory management, exercise and mobilisation. Here, evidence underpinning the roles of physiotherapists and future challenges are highlighted.

Physiotherapists have provided services to intensive care units from the early period of their establishment within the Australian healthcare system. They are an integral member within intensive care units that provide complex critical care for patients. Through their university education and registration, physiotherapists are able to be primary contact practitioners, giving them a foundation for autonomous, evidence-based practice in patient assessment and patient care, with or without medical or nursing referral.

Within the ICU of an Australian hospital, physiotherapists often maintain this autonomy while working together within the ICU multidisciplinary team and recognising the "closed" model of care that is often practised, where the intensivist leads the management and delivery of all care provided to the patient (Hackner et al. 2009).

Physiotherapists possess an extensive knowledge of human anatomy, physiology and movement that allows them to provide comprehensive patient assessment and treatment across a large range of clinical areas. In the ICU a physiotherapist's education and skills can be extended to include the conduct of comprehensive multi-system assessments of the neurological, respiratory, cardiovascular and musculoskeletal systems to formulate individualised treatment plans for patients across the spectrum of admission categories and throughout the various stages of critical illness.

The focus of physiotherapy treatment has traditionally included the provision of respiratory treatment to ventilated and non-ventilated patients and the generalised provision of exercise, mobilisation and rehabilitation. In recent years, the importance of early mobilisation and rehabilitation has been highlighted (Kayambu et al. 2013; Needham et al. 2010; Schweickert et al. 2009), leading to a greater emphasis on this component of clinical practice.

Respiratory Physiotherapy Management

The main goals of respiratory physiotherapy management in the ICU are to promote airway clearance and optimise ventilation, lung volume and oxygenation in order to prevent or manage respiratory complications. To meet these goals a range of treatment options may be used, often in combination. This includes patient positioning, breathing exercises, percussion and vibrations, and positive expiratory therapy (Pryor 1999; Thomas et al. 2006). To facilitate secretion clearance, physiotherapists use techniques that assist or stimulate coughing, including the use of mechanical insufflation-exsufflation, and perform nasal, oral and endotracheal suctioning. In the intubated, mechanically ventilated patient, manual hyperinflation (MHI) has traditionally been utilised, and more recently ventilator hyperinflation has emerged as an alternative to MHI, with surveys suggesting it is practised within 20% - 40% of tertiary hospitals within Australia (Dennis et al. 2010; Hayes et al. 2011). MHI when combined with positioning/postural drainage can increase sputum yield (Hodgson et al. 2000). Positioning and MHI combined with percussion, vibration and suctioning can be an effective treatment for acute lobar atelectasis (Stiller et al. 1990), and possibly used as an alternative to bronchoscopy (Marini et al. 1979). However, it is difficult to determine the effect of respiratory physiotherapy on clinical outcomes like the incidence of or duration of ventilator-associated pneumonia, ventilator-free days and intensive care or hospital length of stay, due to the limited research conducted specifically in ventilated patients (Ntoumenopoulos et al. 1998; Ntoumenopoulos et al. 2002; Patman et al. 2009). However, respiratory physiotherapy is widely practised in Australia and is considered safe (Zeppos et al. 2007).

In many hospitals, physiotherapists will independently review all ICU patients and participate in daily ward rounds. In order to maximise the potential benefits gained from physiotherapy, resources are often directed towards patients with actual evidence of pulmonary complications like atelectasis or nosocomial pneumonia, patients with increased sputum load, or interventions are targeted at certain high-risk populations. For example, in patients with acute quadriplegia, extubation and intensive physiotherapy treatment, including use of an overnight after-hours service may reduce

ICU length of stay compared to performing a tracheostomy in these patients (Berney et al. 2002). The knowledge and skills in respiratory management held by physiotherapists are also recognised through their inclusion in tracheostomy outreach teams (Cameron et al. 2009) and roles in delivering noninvasive ventilation (Holland et al. 2003; Menadue et al. 2010).

practice and perceptions around exercise in the critically ill to ensure its safe, yet assertive implementation (Berney et al. 2013; Hodgson et al. 2014; Stiller 2007).

The services provided by physiotherapists in the Australian healthcare setting are similar to those in the United Kingdom, but often differ from other parts of Europe and America (Hodgin et al. 2009; Norrenberg and Vincent 2000). While evidence-based practice is embedded within the Australian physiotherapy curricula, there is some variability between Australian states and centres in ICU clinical practice. This may be due to the quality of available evidence, but also differences in physiotherapy staffing levels and education and training for ICU practice.

The minimum standards for intensive care units produced by College of Intensive Care Medicine (2011) outline medical, nursing and ancillary staff requirements according to three levels of ICU services (see Table 1). While medical and nursing workforce recommendations include patient to staff ratios and education requirements, recommendations for physiotherapy services are limited. For Level II and III ICUs, the minimum recommendation outlined is access to physiotherapists on request 24 hours. No other nationally accepted or professional affiliated guidelines exist. Empirical evidence linking specific allocations of staff resources to patient outcomes is often limited across health professions (West et al. 2009), and

> "Respiratory physiotherapy is widely practised in Australia and is considered safe"

Mobilisation and Rehabilitation

The use of mobilisation strategies has long been held as a core component of physiotherapy, particularly for mobilisation of postoperative, spontaneously breathing patients. While pulmonary complications and postoperative mortality may not be lowered by the provision of routine physiotherapy (Patman et al. 2001; Reeve et al. 2010), early ambulation is considered a core component of respiratory care, and in postoperative caseloads is safe and reduces hospital length of stay (Browning et al. 2007; O'Connor and Walsham 2009). Exercise, mobilisation and rehabilitation strategies are also frequently employed in other ICU caseloads, and Australian physiotherapists have shown leadership in research and education on this topic (Berney et al. 2013; Hodgson et al. 2014; Kayambu et al. 2013; Parry et al. 2014; Skinner et al. 2008; Stiller 2007; Thomas et al. 2014; Thomas et al. 2006).

Mobilisation and rehabilitation strategies that are used include the prescription of bed exercises, mobilisation out of bed into a chair either passively or functionally, sitting balance activities, tilt table standing, and the use of functional activities (e.g. standing, walking, squatting) (Berney et al. 2013; Chang et al. 2004; Denehy et al. 2013; Skinner et al. 2008; Thomas et al. 2014). Recently, novel approaches like functional electrical stimulation combined with cycle ergometry have also been trialled (Parry et al. 2014). With international research emphasising the importance of exercise in preventing long-term sequelae in survivors of critical illness (Kayambu et al. 2013; Needham et al. 2010; Schweickert et al. 2009), Australian physiotherapists continue to review their

ICU Level	Capability	Capacity and caseload
Level III	A tertiary referral unit capable of providing comprehensive critical care including complex multi-system life support for an indefinite period. Level III units should have a demonstrated commitment to academic education and research.	At least eight staffed/equipped beds, providing → 400 mechanically ventilated patients per annum.
Level II	Capable of providing a high standard of general intensive care, including complex multi-system life support, which supports the hospital's delineated responsibilities. Provides mechanical ventilation, renal replacement therapy and invasive cardiovascular monitoring for an indefinite period providing appropriate specialty support is available within the hospital.	At least six staffed/equipped beds, providing → 200 mechanically ventilated patients per annum.
Level I	Capable of providing immediate resuscitation and short-term cardiorespiratory support for critically ill patients. Major role in monitoring and prevention of complications in "at risk" medical and surgical patients. Capable of providing mechanical ventilation and simple invasive cardiovascular monitoring for a period of at least several hours.	The number of ICU beds and number of patient admissions should be sufficient to maintain clinical skills by both medical and nursing staff.

Table 1. Minimum Standards for Intensive Care Units in Australia

Source: College of Intensive Care Medicine of Australia and New Zealand (2011)

ICU Management 1 - 2015

official recommendations for physiotherapy staffing of ICUs or for services to be delivered in rehabilitation in the ICU are also lacking internationally (Nava and Ambrosino 2000). It is important for each profession in ICU to establish staffing recommendations based on expert clinical practice, research and recognised professional responsibilities, including education, quality and administrative requirements. Considerations about patient safety, the quality of care, the clinical effectiveness and efficiency of healthcare interventions are paramount in this. Hospital-based healthcare in Australia is provided by both private and government institutions that includes a universally free hospital system. In the private sector physiotherapy services are often not covered, and the patient must pay for services or it may be covered under private health insurance. Most Level 3 intensive care units are within the public sector, and while physiotherapy services are generally available, without specific guidelines to standardise staffing levels the services provided to ICUs are varied. Future guidelines need to expand recommendations for physiotherapy resources to ensure the benefits of these services are realised.

Additional factors that can impact on the service provided within Australian ICUs include the level of experience, education and training of physiotherapy staff. While comprehensive workforce data for Allied Health professionals in Australian ICUs is lacking, most Level 3 ICUs have at least one senior physiotherapist on staff, who often has more than five years of critical care experience. The remaining ICU workforce tends to consist of less experienced staff, who often rotate through varied rosters within the hospital. Junior staff are often required to contribute to ICU services, due to the size and caseload of each unit and need to provide after-hours services.

While entry-level physiotherapy education and training is comprehensive across the fields of cardiorespiratory, musculoskeletal and rehabilitation practice, it is generally acknowledged that the entry-level qualification does not provide adequate skills to enable junior staff to work autonomously in ICU, and therefore further education and training is required. Despite this, there is no specific training programme for physiotherapists to work in ICU in Australia. Physiotherapy departments frequently provide internal training for staff, and/or staff may access lectures, seminars or formal courses, including simulation-based education delivered by professional bodies or clinical leaders. This varied training and education further contributes to the differences in the role and practice of physiotherapists across Australia, and may impact on the ability to achieve desired outcomes from respiratory and rehabilitation therapies. ■

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REVOLUTIONIZING INTENSIVE CARE VENTILATION

Salvia medical used to be known among major providers and insiders primarily as an innovative development company for anesthesia ventilators, intensive care ventilators, and clinical respiratory therapy devices. All of that changed when Salvia medical presented its new ventilator family at the European Anaesthesiology Congress in Sweden in 2014. The integration of the latest EIT technology by Swisstom into a state-of-the-art intensive care device moved Salvia medical into the limelight of intensive care ventilation. Christian Hartmann has been the CEO of Salvia medical, located in the Frankfurt metropolitan area, for the past 2 years.

Christian Hartmann, CEO

ICU Management: Who and what is behind Salvia medical?

Hartmann: Our company was established in 1960 to develop and produce complex measurement and control technology solutions. In accordance with the conditions of that time, our first focus was on developing clinical dialysis devices. Gradually, the synchronization of patients and machines became a higher priority as intensive care ventilation grew into a standard medical procedure. Because our company had the control technology expertise to develop optimal solutions for patient ventilation, this opened up a new business arena, which would ultimately become our exclusive specialization–ventilation and anesthesia devices. The first intensive care ventilator was specifically designed for use in neonatology and quickly became an established name in the ventilator industry of the time. Based on its former business model, Salvia medical took on the role of a reliable OEM partner to serve as the external development and production unit of virtually all major providers. Accordingly, we acquired extensive expertise in complex intensive care ventilation. The company was restructured when management changed, which led to a greater boost of our own brand in addition to conventional OEM business. By now, our products are available virtually all over the world. In many countries, they are exclusively distributed by Heinen and Löwenstein.

ICU Management: What does your slogan "Breathing like nature" express?

Hartmann: In the 1980s, ventilation-related complications were primarily associated with barotrauma. Since then, we have developed a more differentiated understanding of the complex correlations, which are now referred to as "ventilator-induced lung injury" (VILI). While the dominant companies in the area of intensive care ventilation tend to offer a broad spectrum of different solutions for all aspects of medicine, our focus is solely on developing solutions for intensive care ventilation. Our exclusive emphasis on this area, together with our long-term experience in the field, has given us the necessary in-depth understanding to develop innovative approaches for reducing VILI and for optimizing the weaning process. Some of our employees have been with us for over 25 years and are experts in their field. Given the short communication paths in a company of our size, we are able to examine medical problems from many perspectives to find solutions. Our slogan, "Breathing like nature," therefore stands for our efforts to contribute to current and future problem solutions.

ICU Management: What are the benefits of integrating impedance tomography into an intensive care ventilator?

Hartmann: Although there has been much discussion about lung-protective ventilation, we have not had many options for the continuous bedside assessment of ventilation effects on patients until now. We see electrical impedance tomography (EIT) as a first step toward monitoring the individual lung status of patients with imaging technology to make statements about the adjustment of ventilation settings and the necessary positioning measures. Because the underlying technology has continuously improved since 1984, we now have user-friendly high-resolution systems that have addressed the problems of the past such as bruising, restrictive sensor belts, and lack of mapping capability. Thanks to the combination of this innovative EIT technology with the options of modern intensive care ventilators, the clinical statements are no longer restricted to regional ventilation distribution.

ICU Management: What are the future plans of Salvia medical?

Hartmann: We will continue to turn theoretical medical approaches into solutions and make them easy to use for clinicians. As our recent international IF Award clearly shows, that is absolutely compatible with outstanding design.

elisa 800 VIT–the first intensive care ventilator with non-invasive EIT monitoring and winner of this year's IF Award

FLUIDS FOR THE PATIENT WITH LEAKY LUNGS

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Acute respiratory distress syndrome (ARDS) is characterised by increased permeability pulmonary oedema (Ware and Matthay 2000). Patients with ARDS often experience haemodynamic instability, due either to an associated sepsis or to the consequences of mechanical ventilation with positive end-expiratory pressure (PEEP) (Fougères et al 2010). Clinicians can be tempted to administer fluids in such situations where cardiac preload is often reduced. However, in patients with ARDS, fluid management is a real therapeutic dilemma. On the one hand, failure to restore adequate cardiac preload and hence cardiac output can promote organ hypoperfusion and multiple organ failure. On the other hand, fluid administration can enhance pulmonary oedema formation in such conditions of increased pulmonary vascular permeability. This can result in worsening of hypoxaemia and of lung mechanics.

Back to Physiology: the Starling Equation

The transfer of fluid from the lung capillary vessels compartment to the lung interstitium across the capillary-interstitial barrier is classically described by the Starling equation: $Q_f = K_f (P_c - P_i) - \sigma(\pi_c - \pi_i)$, where Q_f is the net fluid movement across the lung capillary membrane, K_f is the filtration coefficient, P_c the capillary hydrostatic pressure, P_i the interstitium hydrostatic pressure, σ the reflection coefficient for proteins, the π_c the capillary oncotic pressure and π_i the interstitium oncotic pressure. Thus there are forces that promote fluid transfer such as the hydrostatic pressure gradient and forces that oppose fluid transfer such as the oncotic pressure gradient. It is noteworthy that K_f and σ are functions of vascular endothelial cell integrity and the intraluminal glycocalyx (Chelazzi et al. 2015; Lira and Pinsky 2014). The importance of the opposing forces (oncotic pressure gradient) depends on the permeability to proteins of the transvascular barrier, which is represented by σ. If vascular permeability is normal, σ is close to one and the net interstitial oedema formation will be minimal unless the capillary hydrostatic pressure reaches a certain critical level above which the interstitial oedema formation overwhelms the capacity of drainage by the lymphatic system. If vascular permeability is abnormally increased, σ decreases and tends to zero in cases of markedly leaky lungs. This can happen when excessive lung and/or systemic inflammation result in damaged intraluminal glycocalyx (Chelazzi et al. 2015; Lira and Pinsky 2014) and vascular endothelial tight junction disruption (Lira and Pinsky 2014). In such leaky lungs, the forces that oppose the fluid transfer are minimal and pulmonary oedema can develop even when the capillary hydrostatic pressure is not high. The higher the degree of alteration of vascular permeability, the lower the critical capillary pressure above which the capacity of lymphatic drainage is overwhelmed and thus pulmonary oedema develops (see Figure 1). Above this critical level, even a small increase in capillary hydrostatic pressure could result in a large increase in the amount of pulmonary oedema given that the K_f is abnormally increased in such a situation of increased vascular permeability (see Figure 2).

Fluid Therapy in ARDS

Many ARDS patients experience haemodynamic instability because of associated sepsis or the application of PEEP. In such conditions, central blood volume and cardiac preload can be reduced and fluid therapy can be beneficial. Alternatively, a depressed right ventricular dysfunction, either sepsis- or PEEP-related, or a sepsis-induced left ventricular dysfunction can be responsible for haemodynamic instability such that fluid infusion is not always the appropriate therapeutic solution. We have learned from studies in intensive care unit (ICU) patients that around 50% of patients are fluid responsive in terms of increase in cardiac output (Michard and Teboul 2002). This underlines the fact that fluid responsiveness must be assessed before any fluid administration in ICU patients, and particularly in patients with ARDS, where the lung vascular permeability is altered (see above). There is a lot of evidence that excessive fluid balance is an independent predictor of mortality in septic patients (Vincent et al. 2006; Boyd et al. 2011). In ARDS patients a liberal strategy of fluid management was demonstrated to be deleterious in terms of duration of mechanical ventilation and length of ICU stay, when compared to a conservative strategy in a randomised multicentre study (National Heart, Lung, and Blood Institute Acute Respiratory Distress Syndrome (ARDS) Clinical Trials Network et al. 2006). Given the uncertainty of the benefits and the potential risks of lung overload, the decision of fluid administration must be carefully made in each ARDS patient when a treatment is judged to be necessary to maintain or restore haemodynamic stability. The decision of fluid administration must be based individually on three elements:

1. The presence of haemodynamic instability or signs of peripheral hypoperfusion;
2. The presence of preload responsiveness, which can predict the benefits of fluid administration, and;
3. Limited risks of fluid overload.

It is thus important to assess the benefit/risk ratio of fluid therapy in each individual patient.

How Should we Assess the Benefit/Risk Ratio of Fluid Therapy?

Predicting the Benefits by Predicting Preload Responsiveness

The general issue of preload responsiveness and preload unresponsiveness has been extensively investigated over the last 15 years (Michard and Teboul 2002; Monnet and Teboul 2013). Schematically, there are two different approaches, the "static" and the "dynamic" approaches.

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The "static" approach, which is advocated by the Surviving Sepsis Campaign (SSC) (Dellinger et al. 2013), consists of administering fluids until a certain level of central venous pressure (CVP) is reached, assuming that beyond this level the heart is certainly preload unresponsive. The SSC recommends targeting a CVP of between 8 and 12 mmHg and between 12 and 15 mmHg in septic patients receiving mechanical ventilation, such as those suffering from ARDS associated with sepsis. The "dynamic" approach, which is advocated by the recent task force of the European Society of Intensive Care Medicine (Cecconi et al. 2014), consists of performing tests to predict preload responsiveness before making any decision on fluid administration. Heart-lung interaction indices based on the arterial pressure curve analysis such as pulse pressure variation (PPV) (Michard et al. 2000) and stroke volume variation (SVV) (Berkenstadt et al. 2001) have been shown to be superior to static indices such as CVP to predict fluid responsiveness (Michard and Teboul 2002; Michard et al. 2000; Berkenstadt et al. 2002; Marik et al. 2009). In many cases, especially in ARDS patients, PPV and SVV cannot be interpreted reliably (Teboul and Monnet 2013), because of the presence of spontaneous breathing activity, low tidal volume ventilation, reduced lung compliance or cardiac arrhythmias (Monnet and Teboul 2013). In such cases alternative tests such as passive leg raising (PLR) or end-expiration occlusion can be used (Monnet and Teboul 2013). The PLR test can accurately predict fluid responsiveness in cases of spontaneous breathing activity (Monnet et al. 2006), cardiac arrhythmias (Monnet et al. 2006), low tidal volume and reduced lung compliance (Monnet et al. 2012). This postural manoeuvre, which mobilises venous blood from the lower limbs and the abdominal compartment towards the intrathoracic compartment, mimics a fluid challenge, but unlike fluid challenge its effects are reversible (Monnet et al. 2006). The validity of PLR as a preload responsiveness test relies on strict rules, which need to be respected (Monnet and Teboul 2015): the postural manoeuvre consists of adjusting the bed (not manually raising the patient's legs) from a semi-recumbent position (not a horizontal position) to a position where the head and trunk are horizontal and the lower limbs elevated at 45°; the haemodynamic response to PLR must be assessed by real-time changes in cardiac output or stroke volume (and not by real-time changes in arterial pressure); the heart rate must not increase during the test, ensuring that no sympathetic stimulation occurs. Another possibility to predict fluid responsiveness in ARDS patients is to perform an end-expiration occlusion, which is a test consisting of interrupting the ventilator during 15 seconds and in measuring the real-time changes in cardiac output or in arterial pulse pressure (Monnet et al. 2009). This test can also be considered as a reversible preload challenge. Indeed it abolishes the impediment of venous return induced by mechanical insufflation, thus transiently mobilising venous blood to the heart. An increase in cardiac output or in pulse pressure greater than 5% during this test predicts fluid responsiveness with good accuracy. It is still reliable in case of ARDS and low tidal volume ventilation (Monnet et al. 2012).

> "Fluid responsiveness must be assessed before any fluid administration"

Predicting the Risks by Estimating Extravascular Lung Water (EVLW) and Pulmonary Vascular Permeability

The role of capillary hydrostatic pressure in pulmonary oedema formation is particularly important during ARDS, given that a small increase in pressure can result in a large increase in the amount of interstitial oedema in leaky lungs (see Figure 2). Although a high pulmonary capillary pressure should be associated with a high risk of pulmonary

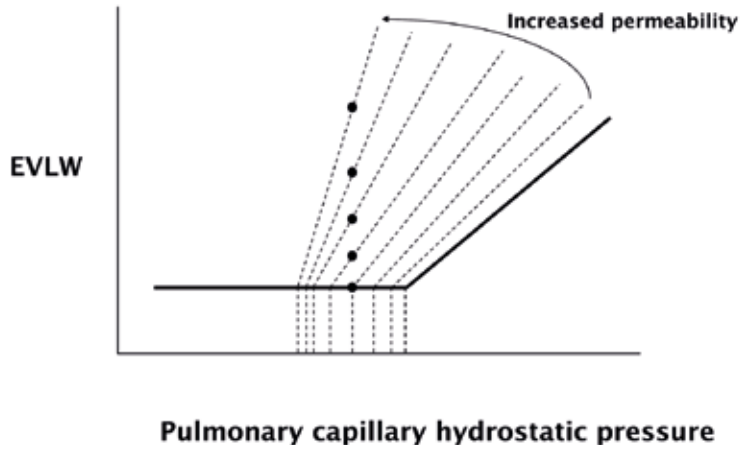

Figure 1. Relationship Between Pulmonary Capillary Hydrostatic Pressure and Extravascular Lung Water (EVLW)

In case of normal permeability of the transvascular barrier (bold lines), pulmonary oedema does not develop until a certain level of capillary hydrostatic pressure is reached. Beyond the critical capillary pressure, pulmonary oedema develops because capacity of the lymphatic system to drain the interstitial oedema is overwhelmed. In this case EVLW increases along with capillary pressure. In case of increased permeability of the lung transvascular barrier, the critical capillary hydrostatic pressure is lower than normal and the slope of the relationship is greater (dashed lines). The more altered the permeability, the lower the critical capillary pressure and the greater the slope. For a given capillary pressure, the more altered the permeability, the higher the EVLW (black circles).

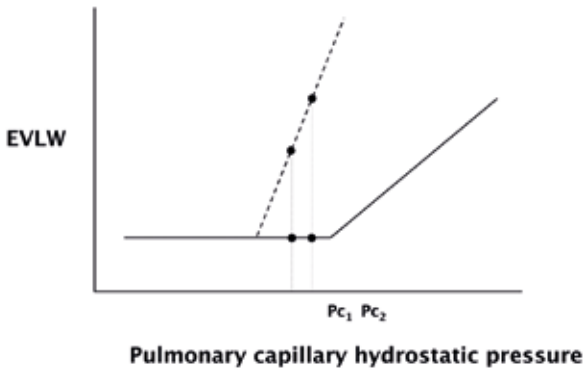

Figure 2. Effect of an Increase in Capillary Hydrostatic Pressure on Extravascular Lung Water (EVLW)

A similar increase from Pc_1 to Pc_2 results in a large increase in EVLW in case of increased vascular permeability but in no EVLW change in case of normal vascular permeability.

oedema formation and its worsening after fluid infusion, there is no magic value below which this does not occur. In addition pulmonary capillary pressure is difficult to measure at the bedside, and is not well reflected by the pulmonary artery occlusion pressure (PAOP) obtained after balloon inflation of a pulmonary artery catheter, especially during ARDS where the pulmonary venous resistance is abnormally increased (Nunes et al. 2003; Teboul et al.1992). Finally PAOP cannot reflect EVLW (Boussat et al. 2002), which is obviously in agreement with physiologic principles.

A more direct estimation of EVLW is obviously a better approach to evaluate the amount of pulmonary oedema already developed at the time of the therapeutic decision. For 15 years it has been possible to estimate EVLW in ICU patients by using transpulmonary thermodilution devices. The normal EVLW value is below 10 mL/kg (Tagami et al. 2013). The EVLW was demonstrated to be an independent predictor of mortality in ARDS patients (Jozwiak et al. 2014), confirming its validity and its relevance in this category of patients. The EVLW was also shown to be higher in severe versus moderate ARDS and higher in moderate versus mild ARDS when the Berlin definition of ARDS is used (Kushimoto et al. 2013). Interestingly, baseline EVLW and not PaO_2/FiO_2 can predict the progression to acute lung injury in patients with increased risks (LeTourneau et al. 2012). Finally, in cardiac surgery and in aortic vascular surgery patients, the maximal value of perioperative EVLW was recently shown to predict clinically significant postoperative pulmonary oedema (Kor et al. 2015). All these arguments support the interest in estimating EVLW before making any decision on fluid infusion in patients with ARDS or even at risks of ARDS. Transpulmonary thermodilution also allows the automatic calculation of pulmonary vascular permeability index (PVPI), which is assumed to reflect the permeability of the pulmonary transvascular barrier. The PVPI was demonstrated to distinguish well between pulmonary oedema of hydrostatic origin and ARDS with a cut-off value of 3 (Kor et al. 2015). It is also an independent predictor of mortality in ARDS patients (Jozwiak et al. 2013), and is well linked to the severity of ARDS according to the Berlin definition (Kushimoto et al. 2013). Knowledge of both EVLW and PVPI are of major importance, since they allow the clinician not only to evaluate well the severity of the lung injury (PVPI) and its consequences (EVLW), but also to predict what would be the lung tolerance to a subsequent fluid administration. In case of a moderately high EVLW (e.g. 14 mL/kg) but a high PVPI (e.g. 5), there is a high risk of excessive lung oedema formation with fluid infusion. In case of a moderately high EVLW (e.g. 14 mL/kg) associated to a moderately high PVPI (e.g. 3.5), fluid could be carefully infused if there are both haemodynamic instability and preload responsiveness conditions.

> "Knowledge of both EVLW and PVPI are of major importance"

In some patients a high EVLW value and high PVPI value can be associated with a high degree of fluid responsiveness (e.g. high PPV or large CO response to PLR). This situation represents a therapeutic conflict, and the decision of administering fluids or not would be based on the respective degree of lung injury and its consequences (hypoxaemia, hypercapnia, etc) versus the degree of circulatory failure and its consequences (hypotension, organ failures, etc). Thus similar values of EVLW, PVPI and PPV can result in opposite decisions in terms of fluid administration, depending on the presence and the severity of organ dysfunctions. This underlines the importance of taking into consideration the complete and often complex picture of the patient's state rather than reducing the patient's care to a too simplistic protocol based on three to four numbers only.

Conclusion

Fluid administration in case of ARDS is a real therapeutic challenge since there are risks of worsening of pulmonary oedema even in preload responsive patients. Assessment of the benefit/risk ratio in each individual patient is thus very important before making any therapeutic decision. Use of dynamic indices of preload responsiveness allows assessment of the potential benefits (the numerator), whereas the risks (the denominator) can be assessed at best by measurements of EVLW and PVPI. It must be emphasised that assessment of the benefit/risk ratio should be continued during fluid administration to help to make the decision to stop fluid infusion. ■

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IMPROVED MICROBIAL DIAGNOSTICS FOR THE CRITICALLY ILL PATIENT WITH PCR/ESI-MS

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Sepsis is a constant challenge facing those who care for critically ill patients. Sepsis and septic shock contribute substantially to morbidity and mortality in this group, and in 2012 authors of guidelines for appropriate management of these conditions highlighted demand for rapid, reliable microbiological tests (Dellinger et al, 2013). 'In the near future, rapid, non-culture-based diagnostic methods (polymerase chain reaction, mass spectroscopy, microarrays) might be helpful for a quicker identification of pathogens and major antimicrobial resistance determinants.' While speculating that such techniques could be applied to detect fastidious pathogens, and under circumstances where empirical antimicrobials had been given before taking blood cultures, they also cautioned that '… more clinical studies are needed before recommending these non-culture methods as a replacement for standard blood culture methods.'

Clinical studies have been undertaken, supporting the use of molecular-based, non-culture techniques, not only for the rapid detection of microorganisms causing sepsis and septic shock, but also for the rapid detection of bacteria, viruses, fungi and yeasts across the infectious diseases spectrum. This diagnostic step-change could potentially improve patient outcome through better-targeted antimicrobial therapy, thus having the potential to minimise antimicrobial resistance and cost.

IRIDICA, a new platform in the vanguard of this diagnostic revolution relies on the polymerase chain reaction (PCR) coupled to mass spectrometry. Essentially, a broad-spectrum PCR amplifies selected conserved regions of pathogenic nucleic acid; the mass of the amplicons is determined by electrospray ionization mass spectrometry (ESI-MS) allowing to determine their base compositions with a specific database; and a presumptive pathogen's base composition is compared to those stored in a database holding details of over 1,000 species (Ecker, 2014). The turnaround time is typically six to eight hours. The currently commercially available PCR/ESI-MS technology, Abbott's IRIDICA system can detect 780 bacteria 4 antibiotic resistance markers with a single test, 207 molds and yeasts with a single test and 131 viral species in 13 reporting groups with a single test. (Abbott Diagnostics, 2015).

Bacconi et al (2014) reported the analysis of 331 blood samples of patients with suspected sepsis from a single centre with PCR/ESI-MS and compared the molecular results to blood culture. The positivity rate of PCR/ESI-MS (10.6%) was almost double compared to the positivity rate of blood culture (5.4%). The 20 PCR/ESI-MS detections in blood-culture negative samples were repeatedly tested by another operator on another instrument to exclude potential contamination events. In 17 cases the original detection could be confirmed, in 3 cases it was not possible, but in all 3 of these cases the initially detected bacterial load was very low. PCR/ESI-MS was 83% sensitive 94% specific compared to culture. After replicate testing of PCR/ESI-MS samples which initially gave results deviating from culture corroborating the initial findings in most cases, an increased sensitivity of 91% and specificity of 99% was determined (considering the repeated additional detections true positives). The detection of pathogens took 6 to 8 hours from sample to result, a significantly decreased time to result against culture-based methods.

Rising numbers of immunocompromised patients have wrought a concomitant increase in fungal and bacterial lung infections, representing a further diagnostic challenge to clinicians. Again, PCR/ESI-MS has addressed these needs. Shin et al (2013) used PCR/ESI-MS to evaluate a series of 691 bronchoalveolar lavage (BAL) samples that had been cultured and identified by standard procedures, they concluded that it '… provides an advanced tool for rapid and sensitive detection, identification, and determination of the distribution of fungal organisms directly from BAL fluid specimens. Moreover, it detected fungal organisms in specimens in which cultures failed because of bacterial overgrowth.'

Platforms such as PCR/ESI-MS permit detailed exploration of the role of virus infections in diverse pathological processes. For instance, in a study of idiopathic dilated cardiomyopathy (IDCM), Nguyen et al (2013) used PCR/ESI-MS to detect and semi-quantify common cardiotropic viruses in 67 explanted heart samples of 31 IDCM patients. They '… identified single or mixed enterovirus and Parvovirus B19 cardiac infections as potential causes of IDCM.' The system was considered '… to be a valuable tool to rapidly detect and semi-quantify common viruses in cardiac tissues and may be of major interest to better understand the role of viruses in unexplained cardiomyopathies.'

Finally, the cost savings made by such diagnostic platforms are significant. Thus, when Perez et al (2013) addressed the challenge of bloodstream infections caused by Gram-negative organisms, they sought to determine the extent to which a combination of mass spectrometry-mediated technology and antibiotic stewardship would improve on conventional laboratory methods. They found that it shortened the time to optimal therapy; decreased time in hospital; and in a 1000-bed quaternary care hospital there were projected annual savings of around $18 million.

Perhaps the 'near future' alluded to by Dellinger et al (2013) above is here. ■

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INFECTION PREVENTION IN THE ICU

SIMPLE THINGS THAT WORK

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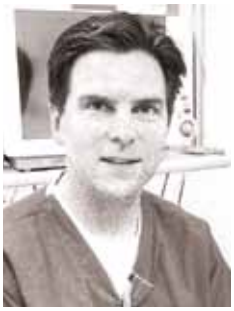

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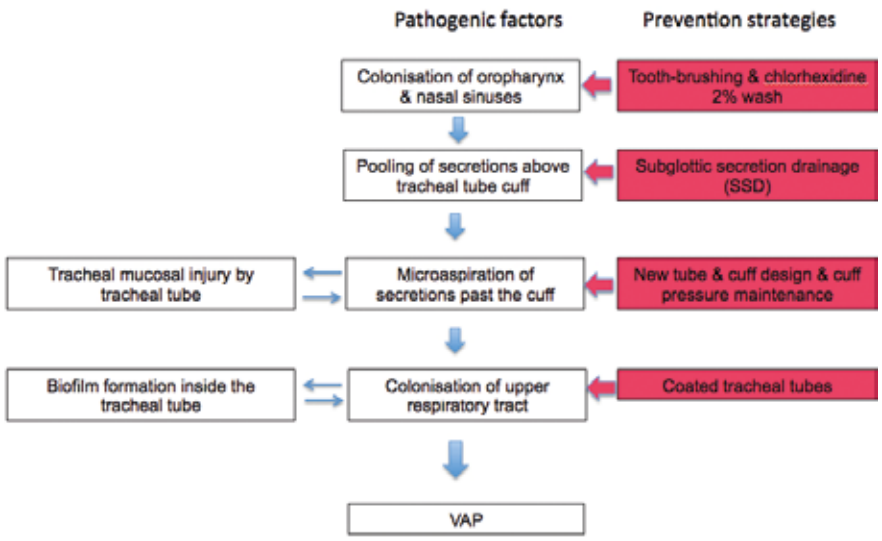

Figure 1. Diagram summarising the pathogenic processes leading to VAP (in black) and the preventative measures to combat each step (in red)

Source: Zolfaghari and Wyncoll 2011

This article highlights four interventions that combat healthcare-associated infections (HCAI), have a good evidence base, and are relatively inexpensive and cost-effective. However, they are not widely implemented into clinical practice.

HCAI, such as ventilator-associated pneumonia (VAP) and catheter-related bloodstream infections (CRBSI), are serious, expensive and continue to present a major challenge for intensive care units (ICU) worldwide. They have the power to undermine some of the most significant medical and surgical advances in patient care.

VAP is the most common infection occurring in mechanically ventilated patients after admission to ICU. It is associated with a modest attributable mortality (Melsen et al. 2013), increased ICU length of stay and cost. VAP also contributes significantly to the burden of antibiotic prescribing, and may add to the emergence of multi-drug resistant bacteria.

The difficulties of defining VAP may well explain some of the observed differences in incidence seen internationally. It is possible to 'define VAP away' by making the definition so specific. Partly with this in mind, the Centers for Disease Control recently suggested new definitions to reorientate the focus of surveillance from pneumonia alone to more general complications of mechanical ventilation (Klompas 2013). Introduction of high-impact interventions or bundles has gone some way to reducing VAP rates, but with no clear associated mortality reduction (Morris et al, 2011; Roquilly et al 2015). The aetiology of VAP is predominantly micro-aspiration of microbial pathogens past the endotracheal cuff of contaminated material from the oropharynx into the lower respiratory tract (Zolfaghari and Wyncoll, 2011) (see Figure 1).

Considerable progress has been made in the last decade in reducing CRBSI. Increased awareness and simple interventions in central venous catheter (CVC) insertion and management have reduced the number of BSI, but there is still opportunity for further improvement (Bion et al. 2013).

In a recent UK-based national survey, the prevalence of BSI was reported as 0.5%, comprising 7.3% of all HCAI detected. More than two-thirds of BSI occurred in patients with a vascular access device (Health Protection Agency 2012). There remains a considerable attributable mortality (up to 11%) and cost associated with CRBSI, including an additional ICU length of stay of between 9 and 12 days (Schwebel et al, 2012).

In this article, four simple interventions are highlighted below.

1) Subglottic Secretion Drainage (SSD)

SSD removes secretions that pool above the endotracheal tube cuff and cause micro-aspiration. Specially designed endotracheal tubes are widely available, which allow continuous or intermittent drainage of secretions via a separate lumen that opens above the cuff. The latest meta-analysis of 13 randomised controlled trials (RCT) involving ~2,500 patients, showed a reduced ICU length of stay, decreased duration of mechanical ventilation and increased time to first occurrence

of VAP with SSD. There were no increased adverse events, concluding that SSD is effective for the prevention of VAP (Muscedere et al. 2011). The most recent RCT, involving 352 critically ill patients in five ICUs within a single centre, showed a 50% reduction in microbiologically-confirmed VAP with SSD. Importantly, a marked reduction in antibiotic use was also observed (Damas et al. 2015).

Although incorporated into some recent VAP prevention bundles (Department of Health 2010) SSD uptake into clinical practice has been sluggish. This is possibly due to previous conflicting clinical trial evidence, concerns over endotracheal tube design and the higher acquisition cost associated with these tubes (~10 Euros versus 1 Euro). With newer generation tubes, early concerns about increased stiffness and size have been overcome. Similarly, concerns over suction damage to the tracheal mucosa have been mitigated, now that intermittent suctioning is possible because of more effective cuff design. Hopefully with novel innovation and more compelling evidence, the implementation of SSD may become more widespread (Zolfaghari and Wyncoll 2011).

2) Continuous Cuff Pressure Control

Maintaining correct endotracheal tube cuff pressure is important in intubated patients, as low pressures (< 20mmHg) predispose to micro-aspiration and high pressure (>30mmHg) causes tracheal ischaemia. Despite routine manual control of cuff pressure with a manometer, in one study only 18% of patients had cuff pressures within normal range throughout an eight-hour period. Under-inflation was observed in 54% of patients, with at least a single over-inflation in 73% (Nseir et al 2009). Manual checking of cuff pressure may cause deflation or over-inflation, and aspiration of secretions frequently occurs during this manoeuvre. Devices are now available which control cuff pressure continuously and automatically; they are easy to use and save staff time. A RCT, proof-of-concept study, showed continuous cuff pressure control resulted in reduced micro-aspiration as measured by tracheal pepsin aspirates, reduced tracheobronchial bacterial counts and reduced VAP (Nseir et al. 2011). A previous underpowered RCT showed a non-significant, 24% reduction in VAP, between intermittent and continuous cuff pressure monitoring (Valencia et al. 2007). The most recent 284-patient, pseudo-randomised trial, suggested that continuous cuff pressure control, compared with intermittent control using a manometer, reduced VAP by 49%, particularly when used in conjunction with SSD (Lorente et al. 2014).

A number of continuous cuff pressure monitors are available. These may be pneumatic (Nosten®, Leved, St-Maur, France, used in Nseir 2011) or electronic (VBM Medizintechnik GmbH, Sulz am Neckar, Germany, used by Lorrente 2014). A recent study of 64 patients showed the pneumatic device was effective in controlling cuff pressure in patients intubated for more than 48 hours with reduced incidence of cuff under-, or over-inflation (Jaillette et al. 2013). Improving technology may increase the use of continuous cuff pressure monitoring, with the availability of modules incorporated into the ventilator (Hamilton Medical Inc., Bonaduz, Switzerland) or disposable devices (Portex®, Smiths Medical St Paul, MN, USA). This is an evolving area. Devices used to regulate the cuff pressure, and also the endotracheal tube cuff itself, may be important in determining the effectiveness of cuff pressure monitoring.

> "...could make a substantial difference in reducing the burden of secondary infection"

Selective digestive tract decontamination and selective oropharyngeal decontamination have a good evidence base, and are associated with a reduction in hospital mortality (de Smet et al. 2009). However, there remains an ongoing fear about its introduction and widespread systemic antibiotic use, particularly with the increasing emergence of highly resistant gram-negative infections (Klompas 2015).

3) Chlorhexidine-Impregnated Dressings

CRBSIs may increase mortality and ICU length of stay. They also have a considerable financial impact, costing approximately $24,000 per infection (Schwebel et al. 2012). Implementation of evidence-based 'bundles' for insertion of CVCs and their subsequent management has reduced the rate of CRBSI. Chlorhexidine gluconate-impregnated dressings release chlorhexidine on to the skin and reduce bacterial colonisation of the skin at the catheter insertion site, reducing extra-luminal infection. Large multi-centre RCTs involving nearly 8,000 catheters have shown that chlorhexidine gluconate-impregnated sponges and dressings (Timsit et al. 2009; 2012) reduce CRBSI. A recent meta-analysis identified nine studies, including 6,067 patients and 11,214 catheterisations, showing that use of chlorhexidine-impregnated dressings prevents catheter colonisation and CRBSI by 48% and 45% respectively. The benefit is greatest in short-term catheters where the extra-luminal route of infection predominates (Safdar et al. 2014). These data suggest the use of such dressings, alongside usual preventative measures, should be incorporated into best practice guidelines. A dressing or sponge costs approximately 5 Euros; when weighed against the attributable cost of CRBSI, it is difficult to justify not using them.

4) Chlorhexidine Daily Washes

Patient colonisation with multi-drug-resistant-organisms (MDRO) such as MRSA, MSSA, *E. coli* and *Klebsiella* may lead to HCAIs. Although improved awareness, screening and recognition of these bacteria have been effective in reducing their prevalence, daily washing of all patients with chlorhexidine cloths may improve this further. Chlorhexidine gluconate has antiseptic and residual antibacterial activity. Its use may decrease the cutaneous microbial burden, preventing secondary environmental contamination. Decontamination of the skin reduces the entry of organisms into the blood through CVCs and may reduce hospital-acquired BSI. A multi-centre RCT of 7,700 patients found that daily washing with chlorhexidine-impregnated cloths significantly reduced hospital-acquired BSI, and also the presence of MDRO (Climo et al. 2013). Similar results have been seen amongst paediatric ICU populations, where a 36% reduction in BSI was observed with daily chlorhexidine bathing in 4,947 children greater than two-months old (Milstone et al. 2013). A large, multi-centre, cluster RCT compared screening and isolation, targeted, and universal decontamination, to prevent infection in the ICU. Nearly 75,000 patients from 74 different ICUs were enrolled and randomised into each of the three groups. Decontamination was achieved by daily bathing with chlorhexidine-impregnated cloths and intranasal mupiricin. Universal decontamina-

tion reduced rates of MRSA, clinical isolates and BSI from any pathogen more effectively than in the other groups (relative risk reduction 37% and 47% respectively; Huang et al. 2013).

Interestingly a recent randomised, crossover study looked at 9,340 patients in a single centre, and found no benefit from daily chlorhexidine bathing in the reduction of CRBSIs, catheter-associated urinary tract infections, VAP or *Clostridium difficile* infection (Noto et al. 2015). It is important to note though that the effectiveness of chlorhexidine bathing against urinary tract infections, VAP and *clostridium difficile* infection is limited, and their use as clinical end-points is therefore very unconventional. Genuine concerns exist as to chlorhexidine resistance, allergy and the added cost (Pittett and Angus 2015). However, the current benefits, particularly where MDRO incidence is high, would appear to override these concerns.

Recent national evidence-based guidelines for preventing HCAI in the UK now recommend consideration of chlorhexidine-impregnated sponge dressing and daily bathing with chlorhexidine in patients with CVCs to prevent CRBSI (Loveday et al. 2014).

Cost–Effectiveness

Considerable financial investment in sophisticated ventilators in the ICU, to optimise ventilator support and minimise adverse effects, may well be justifiable given the significance and value of human life. At the vital interface between these two is the endotracheal tube. For a comparatively small cost, this interface can be improved to incorporate features that may reduce the risk of VAP. The cost-effectiveness of these interventions can be calculated assuming one knows the baseline event rate (Wyncoll and Camporota, 2012). Assuming a baseline VAP rate of 8% and an intervention that reduces VAP by 45% (such as SSD by Muscedere 2011), the number needed to prevent one VAP is just 28. Additional money spent to prevent an episode of VAP to achieve cost-neutrality (assuming VAP cost of ~13,000 Euros) in this example is calculated as ~350 Euros per patient per 10 days of mechanical ventilation (Wyncoll and Camporota, 2012); the cost of an endotracheal tube capable of SSD is less than 15 Euros.

Conclusion

HCAIs remain serious and expensive. This paper highlights four simple interventions that could make a substantial difference in reducing the burden of secondary infection within the ICU. These interventions do not work in isolation, but when used in conjunction with good, basic infection control measures and 'bundles' of care, may provide simple and cost-effective solutions. ■

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WATER ADMINISTRATION IN THE ICU

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The management of fluids in critically ill patients is a continuing challenge. Although the infusion of generous amounts of intravenous fluids is usually required during the early stage of resuscitation, fluid restriction is often desirable after the initial phase and stabilisation. Indeed several groups reported a poorer outcome when intravenous fluids were administered following a liberal policy, as opposed to a restrictive policy, in different clinical circumstances, including acute respiratory distress syndrome (National Heart, Lung, and Blood Institute Acute Respiratory Distress Syndrome (ARDS) Clinical Trials Network et al. 2006; Lobo et al. 2011; Sakr et al. 2005), renal failure requiring replacement therapy (Vaara et al. 2012; Teixeira et al. 2013; Silversides et al. 2014) and after surgery (Varadhan and Lobo 2010). Hence several recommendations and clinical routines have been adapted, and now aim at the minimisation of the risk of fluid overload after the initial resuscitation phase. However, the infusion of small amounts of balanced crystalloid solution carries the risk of depletion of free water, haemoconcentration and cell shrinkage as a result of the distribution of water in the body (see Figure 1). The challenge is then to correct the hydration status while avoiding an increase in extracellular volume (interstitial and intravascular). In patients unable to drink for any reason, hypotonic water ('free-water') solutions can only be infused by the enteral route.

Water Absorption by the Gastrointestinal Tract

The absorption of water along the gastrointestinal tract is a highly regulated process. Dietary or exogenous water plus endogenous water contained in saliva and digestive juices (about 10 litres per day in adults) is mainly absorbed in the small intestine, along with sodium, itself co-transported with glucose and amino acids. Water can also be absorbed in the colon. In both locations the absorption of water is driven by osmotic pressure. Even though intestinal aquaporin channels can play a role in this process, their physiological importance is still incompletely understood. In critically ill patients with a functioning gut the absorption of water is similar to that in healthy individuals. Therefore the co-administration of water and nutrients is also possible by the enteral route and obviously desirable. The water content of commercially available enteral nutrition formulas meets recommended daily allowances for a healthy population, e.g. 75-90% of the volume. For instance, a caloric intake of 25 kcal/kg/day from a standard enteral nutrition formula implies the co-infusion of 1600ml of water, which can be insufficient to restore a normal hydration status in case of depletion.

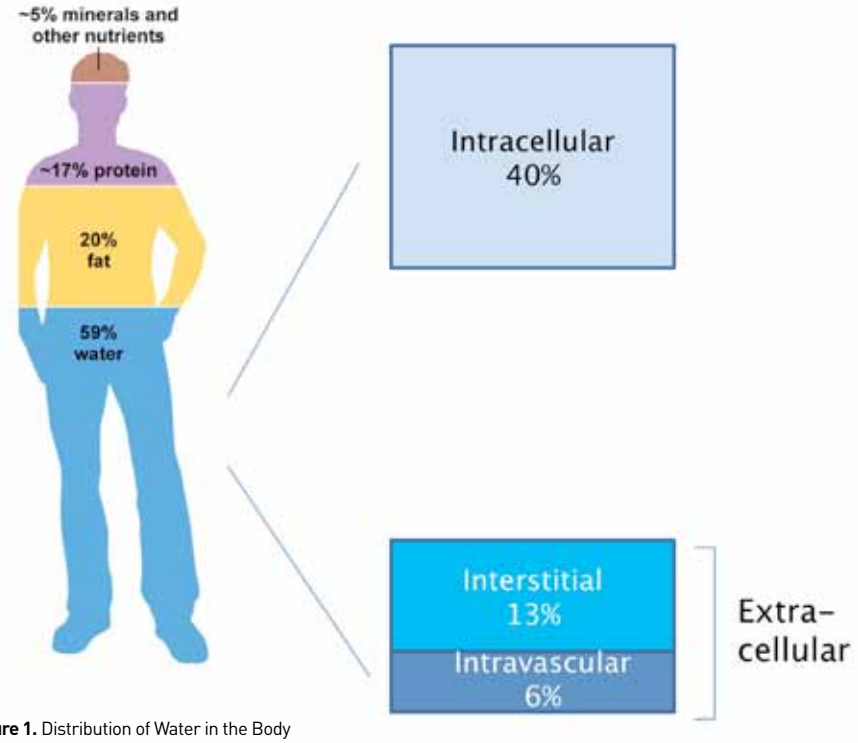

Figure 1. Distribution of Water in the Body

Sensing of Dehydration and Assessment of Hydration Status

Physiologically dehydration is rapidly sensed, as plasma osmolality rises sharply (above 280 mOsm/kg in healthy subjects). The sensing of raised osmolality by the hypothalamus triggers the release of antidiuretic hormone (ADH) and the feeling of thirst. In addition a feeling of dry mouth induced by a lowered output from the salivary glands will further amplify the thirst. As a result renal reabsorption of water following the activation of type 2 vasopressin receptors and increased water intake in response to thirst will increase the circulating volume and restore osmolality.

In the critically ill these physiological responses can be impaired. In case of altered consciousness or sedation, the feeling of thirst can be absent, while diabetes insipidus and inadequate secretion of ADH frequently complicate the course of the critically ill. On the other hand, numerous medications and the presence of orotracheal tubes can increase the feeling of dry mouth, thereby inducing thirst. Several medications can also increase plasma osmolarity. Fluid balance and weight can also be influenced by several factors unrelated to the body water, especially in case of capillary leakage, digestive losses, fever, or use of diuretics or ultrafiltration. As a result of these changes the hydration status and the water content of a critically ill patient cannot be

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assessed clinically, and will be indirectly estimated by a daily monitoring of electrolytes (especially sodium) and osmolality. More sophisticated techniques, such as isotopic tracers, in vivo neutron activation, dual x-ray absorptiometry or multiple frequency bioimpedance are not useable at bedside, or are not yet validated as reliable methods to assess body composition in the critically ill.

Compensatory Mechanisms

Not infrequently, after the acute resuscitation phase, critically ill patients experience swallowing disorders and numerous impairments of the regulatory mechanisms of food and water intake (Massanet et al. 2015). Interestingly the feeling of thirst is the most common complaint of conscious patients (nutritionDay in ICU, unpublished data – www.nutritionday.org)

As a result the amount of water ingested may not match the actual requirements, by excess or most often by default. Hence using the enteral access to compensate for the lack of nutrients and water intake is the most physiological approach, especially in case of swallowing disorders. Using a pump-driven infusion for enteral nutrition is the safest way to ensure a continuous flow, with additional administration of water when required.

> **"Administration of free water via the enteral route is feasible, efficient and not risky in the critically ill patient"**

From a practical viewpoint the co-administration of water together with enteral nutrition is likely to prevent tube occlusion, when free water is regularly flushed, and to prevent impairments in gastric emptying, in relation with the lowered osmolarity of a diluted nutrient solution. The monitoring of plasma sodium can be used to adapt the daily infusion rate of water, as recently described in cases of hospital-acquired hypernatraemia (Varun et al. 2013).

Practical Recommendations

Even in the absence of interventional controlled studies, current experience consistently indicates that administration of free water via the enteral route is feasible, efficient and not risky in the critically ill patient, in the absence of contraindication to enteral nutrition. The prescription of enteral free water should be considered in cases of overt dehydration or in cases of hypernatraemia, and monitored by the course of plasma sodium concentration. Whenever required, the co-administration of water with enteral feeding is appropriate. ■

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RATIONALISING STANDARD LABORATORY MEASUREMENTS IN THE INTENSIVE CARE UNIT

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Laboratory measurements are widely used in the Intensive Care Unit (ICU). This review describes an approach to developing and implementing the use of rationalised laboratory measurements.

Drawing blood and requesting laboratory measurements is probably one of the most frequently performed interventions in critically ill patients. There is probably not a single diagnosis that can be established in the Intensive Care Unit (ICU) or treatment adjustment made that does not benefit from some type of laboratory measurement.

The range of available laboratory parameters is huge and ever increasing (Laposata 2014), and turnaround times for results are shorter than ever, because of improved information technology infrastructure, and, more recently, the increased availability of point-of-care testing. As a result laboratory measurements may appear to be an unlimited resource to the intensivist. However, mindfulness is needed about the limited benefit to patient care and, more importantly, their potential negative impact. Blood drawing aggravates critical care anaemia, which in turn may require blood transfusions with its inherent costs and risks (Vincent et al. 2002). Pathological laboratory results, although not necessarily relevant to a patient's current illness, may prompt further diagnostic or even therapeutic interventions that would otherwise not have been selected (Thomas 2014). Finally, laboratory costs contribute to a substantial proportion of overall intensive care costs (Marini and Wheeler 2006).

Reasons for Laboratory Tests

Laboratory tests may be ordered for a variety of purposes:

- **Diagnostic workup of a critical illness:** laboratory markers play a pivotal role in the diagnostic workup in common problems in the ICU (Vincent 2011);
- **Severity scoring:** commonly used intensive care scoring systems, such as Acute Physiology and Chronic Health Evaluation (APACHE) III-IV, Simplified Acute Physiology Score (SAPS) II and III, the Intensive Care National Audit & Research Centre (ICNARC) score or European System for Cardiac Operative Risk Evaluation (EuroSCORE), require the input of laboratory data to calculate disease severity and probability of mortality (Palazzo 2014);
- **Treatment monitoring:** the treatment of most types of critical illnesses can be guided by laboratory measurements. Examples are: serial determination of inflammation markers in the course of antimicrobials to treat sepsis, or the evolution of renal markers in kidney failure;
- **Daily screening** during the course of a critical illness with the intention of monitoring recovery or for the early detection of complications; most intensivists will request regular, if not daily, routine laboratory tests for this purpose.

Current Practice

The current practice of requesting laboratory measurements is poorly described. Little is known about the rationale for the current use of laboratory measurements in the ICU. Even comprehensive critical care medicine manuals do not dedicate chapters to laboratory testing (Irwin and Rippe 2012). No recommendations or practice guidelines relating to the selection and timing of laboratory measurements have been issued by professional bodies or learned societies (Core Standards Working Party of the Joint Professional Standards Committee 2013). It appears that the choice of laboratory tests is both highly variable, and is influenced by local practice, physician-related factors, such as seniority and level of expertise, location, teaching status, characteristics of the ICU, and patient factors that are not necessarily related to the diagnosis and severity of the critical illness, such as sex, time of admission and age. An increase over time in the number of laboratory tests performed per patient day has been observed (Spence et al. 2014; Smellie 2012).

Economic Impact of Laboratory Measurements

The economic burden of obtaining laboratory measurements is substantial. It is estimated that laboratory costs may be as high as US $1,000 per patient day. They may account for up to 15% of ICU charges, particularly during the early stages of the treatment (Marini and Wheeler 2006; Garland et al. 2006).

Despite the absence of consensus regarding the most appropriate selection of laboratory tests in any given clinical scenario, there is a commonly held notion that routine laboratory measurements are an overused resource, which should, and can be, curtailed without any negative impact on the overall quality of patient care (Peixoto et al. 2013).

Roadmap Towards Rationalisation of Laboratory Measurements in the ICU

The aim of rationalising laboratory measurements is to promote reasonable and well-balanced use of this valuable yet pricey diagnostic tool. Several steps are necessary to develop and implement a rationalised approach, and secure long-term adherence by clinicians. For a number of reasons the guiding principle throughout the entire process should be "less is more":

- The number of irrelevant or chance results that are of no significance to a patient's care should be reduced to a minimum, thus reducing the incidence of unnecessary, costly and/or potentially harmful follow-up interventions;
- Fewer laboratory measurements cause less iatrogenic anaemia and reduce transfusion requirements;
- Direct laboratory tests costs and indirect costs such as labour costs can be better contained.

How to Design and Develop Rationalised Laboratory Panels

A multi-faceted approach is required. Consensus should first be reached among responsible clinicians as to the type of clinical scenarios laboratory panels should be made available for, and which

	Daily panel for Intensive Care	Daily panel for High-Dependency & Step-down	Liver panel	Infection panel	Post-cardiac surgery panel
Red cell count & haemoglobin	x	x		x	x
White cell count	x	x			x
Differential white cell count				x	
Platelet count	x	x		x	x
International normalised ratio	x		x		
AST			x		
ALT	x		x		
Albumin			x		
Alkaline Phosphatase			x		
Sodium		x			
Potassium		x			
Bilirubin (total)			x		
γ-GT			x		
Creatinine-Kinase					x
Creatinine-Kinase MB isoenzyme					x
Creatinine	x				
Troponin					x
Urea	x				
Point-of Care: Arterial Blood Gas Analysis, Oximetry, Lactate, Glucose Sodium, Potassium, Calcium Chloride	x				x
Glucose		x	x		
C-reactive Protein	x			x	
Costs CHF (USD)	74 (81)	29 (32)	32 (35)	42 (46)	77(85)

Table 1: Laboratory Panels for Typical Scenarios in a Multidisciplinary Intensive Care Unit

laboratory measurements should be included in each test panel.

The Delphi method is a suitable tool to capture clinician opinions and preferences regarding useful laboratory tests, and to develop rationalised sets of laboratory panels (Lang and Secic 2006). During this process the costs of each laboratory parameter should be considered. Depending on local reimbursement schemes and internal cost allocation, the costs of routine parameters may vary substantially. Even supposedly 'cheap' laboratory parameters can contribute to substantial annual costs if requested frequently. Performing an ABC analysis is helpful for identifying the most costly items of an existing laboratory inventory (Vollmann 2005).

Examples of rationalised laboratory panels as in current use in multidisciplinary ICU are shown in Table 1.

Guidelines and Laboratory Request Forms

Written laboratory testing guidelines should be developed and proactively implemented, using appropriate educational interventions. They should remain readily available at the bedside (Kumwilaisak et al. 2008). Laboratory guidelines have been shown to significantly reduce the number of tests performed per patient (Mehari and Havill 2001). Laboratory request forms should be redesigned to reflect the recommended laboratory panels (Smellie 2012). It may be beneficial to implement a policy of senior clinician approval for advanced testing (Thomas 2014).

Staff Education

Staff education aims to create awareness and understanding about the need to rationalise laboratory measurements and their practical use. The

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significance of this cannot be overstated. Educational activities should be initiated prior to implementing rationalised laboratory panels, and continue during and after the implementation phase.

Staff should be educated to develop a balanced view about the merits and disadvantages of laboratory testing:

- More diagnostic testing does not equate to high quality care (Marini and Wheeler 2006). It is better to thoroughly examine a patient rather than order routine laboratory tests;
- Prior to ordering a laboratory test, the consequences of a positive or negative result need to be considered: if any test result, either positive or negative will have no consequence, then the test should not be done (Marik 2010);
- Knowledge of basic statistical principles is required to correctly interpret positive and negative test results: if the pre-test probability of any given disease is low, a positive test result is unlikely to indicate the presence of disease. Likewise a negative test result does not prove the absence of disease (Haynes 1981).

Developing Positive Staff Attitude and Promoting Behavioural Change

Multifaceted educational interventions are reportedly more effective than single interventions for changing staff behaviour (Greco and Eisenberg 1993). As soon as sets of rationalised laboratory panels and laboratory-testing guidelines have been developed, they should be disseminated through the appropriate communication channels, such as staff meetings, peer group educational discussion meetings, email and the hospital intranet.

Securing Long-Term Adherence

One-off interventions do not produce sustained change (Smellie 2012). Ongoing usage of rationalised laboratory measurements can be achieved using a combination of: continuing education in the form of 'top-up' educational interventions (Larsson et al. 2009), teaching during the orientation of new nursing and medical staff, and simply by facilitating guideline accessibility at the bedside (Mehari and Havill 2001). Outreach visits by experts, combining personalised feedback, education and small group discussion is an additional, albeit costly, method for promoting the use of rationalised laboratory measurements (Verstappen et al. 2004).

Information Technology and Decision Support Systems

Rationalisation of laboratory measurements can be developed further by using neural modelling and fuzzy logic. These technologies can be employed to select the most useful laboratory tests for a given clinical scenario (Cismondi et al. 2013). Automated decision support systems, involving computer prompting connected to the electronic laboratory order form, have also been shown to improve the appropriateness of laboratory requests (Kawamoto et al. 2005).

Conclusion

- The aim of rationalising laboratory measurements is to improve the efficiency of patient care and reduce costs;
- Laboratory panels should be developed at the local level by consulting with expert clinicians;
- Staff education plays a pivotal role when implementing the concepts of rationalised laboratory measurements, as well as with supporting long-term adherence;
- Information technology can contribute significantly to the improved use of rationalised laboratory measurements. ■

GETTING STARTED WITH TWITTER

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If you want to know how we practised medicine 5 years ago, read a textbook.

If you want to know how we practised medicine 2 years ago, read a journal.

If you want to know how we practise medicine now, go to a (good) conference.

If you want to know how we will practise medicine in the future, listen in the hallways and use FOAM.

— From International EM Education Efforts & E-Learning by Joe Lex 2011

The growth of social media for medical CPD has been astronomical over recent years. More and more healthcare professionals are taking to Twitter to share useful papers and educational resources. The emphasis on encouraging Free Open Access Medical Education (FOAM) is embedded throughout these interactions. We have no intention of reinventing the wheel with this one, but have tried to combine the wealth of information already out there with a few of our own experiences. Hopefully this will help newcomers to Twitter, and perhaps persuade those still resisting to come on board.

What is Twitter?

- Online social networking/microblogging platform enabling users to send and read text-based messages ('tweets').
- Limited to 140 characters [see highlighted text below to see how long that is!].
- Photos can be tweeted.
- You only read tweets of people you follow.
- Anyone can follow you, although you can block them if you wish.

Benefits

- Global conversation with like-minded individuals interested in the latest medical practice and literature.
- It's acceptable just to watch if you prefer.
- Follow conferences even if you are not there.
- Social networking and friendships develop and can be consolidated at conferences, with colleagues across the globe.

What does it mean to follow someone on Twitter?

This means that you've chosen to subscribe to their Twitter updates. You can unfollow them at any time. Similarly, anyone is able to follow you. If you decide that you do not wish for them to do this, you can always 'block' them. You can easily see who is following you.

Who should I follow?

Have a look at someone you know, who is already using Twitter for medical education purposes, and look at their list of people they are following. You will quickly learn to recognise the Twitter characters who are reliable and useful, and after a period of Twitter interaction, you should start building up your own following.

What's @ and # all about?

@TwitterID directs your message to that person. You can add other names if you want to send to multiple, but beware the character limit. If '@' appears at the start of the tweet it will go to that person AND anyone who is following both you and them. If '@' appears later in the tweet, it will go to that person and ALL of your followers.

To illustrate this, if you send the following tweet '@avkwong this blog is rubbish' - I will receive this message and anyone that is following both of us. If you send 'This blog is rubbish @avkwong' or 'This blog by @avkwong is rubbish' - I will receive this message and also ALL of your followers – thanks!

A Direct Message (DM) This is a private message and visible only to you.

 # (hashtag) is used to mark keywords or topics in a tweet. Anyone can make a hashtag at any time, simply by typing a phrase of the form '#topic' in a tweet (again no spaces). This creates a page specific to that hashtag and whenever someone tweets and includes this hashtag, it will be visible on this page as well as to anyone who follows them.

Many hashtags have already been created, and medical conferences will advertise the ones they are using e.g. #isicem15 (International Symposium on Intensive Care and Emergency Medicine 2015), #ISCSOA2015 (State of the Art Meeting, ICS 2015) and #smaccUS (Social Media and Critical Care Conference 2015). The days of writing notes at conferences (if you did in the first place) have also gone if the conference is well covered by avid Twitter users. Photos of conference slides, posters and equipment at trade exhibitions can also be tweeted and shared.

What's Twitter not so good for?

Apart from your social life, it is not a great platform for having extensive discussion and debate. This often is difficult to fit in 140 characters, and results in huge number of tweets about one topic, and the context of these key messages can often be lost in translation.

A word of caution with using Twitter

You should comply with the General Medical Council (UK)'s 'Good Medical Practice' (http://www.gmc-uk.org/guidance/good_medical_practice.asp) or equivalent in your country, and it is worth having a look at the brief GMC regulations (http://www.gmc-uk.org/guidance/ethical_guidance/21186.asp).

Personal experience

We have found Twitter a fantastic vehicle for learning, sharing and discussing the latest literature, resources and details at conferences. It still amazes us that we were able to have discussions about the TTM trial on Sunday 17 November 2013 as it was being discussed in Dallas (have we decided yet 33°C or 36°C?!). Access to information, working collaboratively and encouraging each other in a really friendly and supportive way must be credited to Twitter and all the incredible FOAMites involved (see Figure 1). Join now!

Summary

- Register at Twitter.com
- Install the App on your mobile device(s)
- Follow users and hashtags (#)
- No, you DO NOT have to contribute
- It is OK to watch

A few suggestions of who to follow to get you started….

Intensive Care Network
Twitter - @I_C_N
Website - intensivecarenetwork.com
Intensive Care Network is a site designed by Oli Flower and Matt MacPartlin as an educational and networking resource for critical care.

Life In The Fast Lane
Twitter – @sandnsurf
Website – lifeinthefastlane.com
"We are Australasian critical care physicians and nurses exploring the changing world of eLearning, emergency medicine, critical care and toxicology through clinical cases, fictionalized anecdotes and medical satire."

European Society of Intensive Care Medicine
Twitter – @ESICM
Website – esicm.org
European Society of Intensive Care Medicine is an international association promoting intensive care medicine, education, research, and professional development.

Wessex Intensive Care Society
Twitter – @WessexICS
Website – wessexics.com
Twitter feed for the Wessex Intensive Care Society (WICS). Supporters of#FOAMed. Twitter stream collated by@stevemathieu75

The Bottom Line
Twitter – @WICSBottomLine
Website – wessexics.com/The_Bottom_Line
Summary and Critique of the landmark papers in the Critical Care and EM literature #FOAMed #FOAMcc

Scott Weingart
Twitter – @emcrit
Website – emcrit.org
"I am an ED Intensivist in NYC. I host the EMCrit Podcast where I explore my obsession with all things ED Critical Care. Vociferous supporter of #FOAMed."

Rob MacSweeney
Twitter – CritCareReviews
Website – criticalcarereviews.com
Free updates and links to newly published critical care articles, plus the largest structured archive of free critical care review articles on the web.

Saint Emlyn's
Twitter – @stemlyns
Website – stemlynsblog.org
A virtual hospital in the heart of post industrial Virchester. Emergency medicine cases, BestBets and evidence based practice. Also @EMManchester#FOAMed.

The RAGE Podcast
Twitter – @RAGEpodcast
Website – ragepodcast.com
The Resuscitationist's Awesome Guide to Everything by @precordialthump @cliffreid @criticalcarenow @karelhabig @Mjcartner and @docjohnhinds#FOAMed #FOAMcc

Scan Crit
Twitter – @scancrit
Website – scancrit.com
Twitter feed of the http://ScanCrit.com website. A blog on anaesthesia, intensive care and emergency medicine. In-hospital and outside. #FOAM #FOAMed #FOAMcc

ICU Management
Twitter - @ICU_Management
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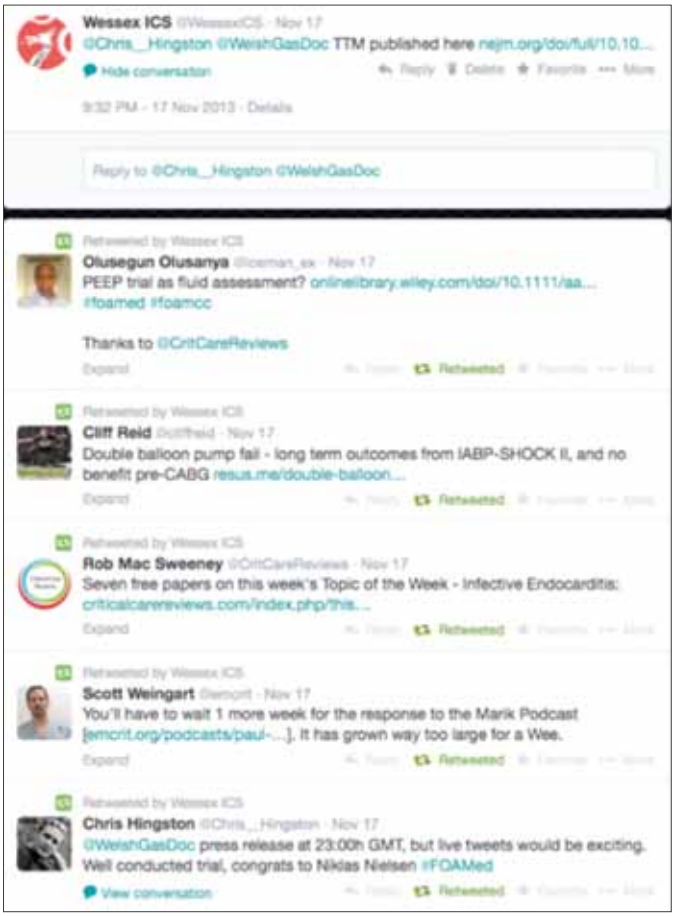

Figure 1. Twitter Discussion

PART 2: BEYOND THE BASICS - CPD RECORDS

The world of medical education is changing. Gone are the days of textbook learning. Medical developments and practice are evolving so quickly that print as a medium is becoming obsolete. So you've read the first part of the guide and are really enjoying the newfound source of information and education. You've even started communicating and engaging in lively discussions with colleagues from all corners of the globe.

You now need to convince your colleague/manager/organisation of its value. Despite the social media label, this is far from being a plaything, and is actually educational and relevant. The fact that it is fully electronic makes compilation of evidence and/or records possible. As part of the appraisal and revalidation process, doctors and other healthcare professionals must now provide evidence that they are keeping up with the latest medical developments. The GMC UK has defined five

domains in the Duties of a Good Doctor document (http://www.gmc-uk.org/guidance/good_medical_practice/duties_of_a_doctor.asp).

In this section we suggest a few ways of expanding the use of Twitter to support continual professional development beyond a simple reading list and conversation tool.

Journal Alert – the "ex–" Printed Press

We are expected to keep up-to-date, and reading journals has traditionally formed a large part of it. The more diligent amongst us may keep a record of the articles that we read. Some publications also have a short quiz accompanying the article in order to test understanding and act as proof that the article has indeed been read.

The Internet has revolutionised the spread of information. Traditional medical journals are now available online in addition to their printed forms. The use of smartphones, tablets and other mobile devices is now common in the medical workplace.

For the reader, articles can be downloaded and read whenever convenient. Such is the impact of social media, journals and professional societies/organisations now have their own Twitter accounts (see Figure 2). By following these accounts, you can access the articles immediately, and some of the latest articles are available online even before the printed edition. Greener colleagues amongst us would also welcome the paperless option.

The digital format means you can easily generate an electronic record of your activity. As evidence for keeping up-to-date, this is more credible and permanent than a written record (See Figure 2).

Figure 2. JAMA Twitter Page

Figure 3. Screenshot of Tweetdeck

The Conference Hashtag

From our initial guide, you've managed to follow the conference. At last year's ESICM LIVES congress, results of five major ICM trials were presented and discussed on Twitter by colleagues across the world. The use of social media at medical conferences has been increasing. Most major conference organisers have dedicated hashtags which are promoted to encourage delegates (and indeed non-delegates) to engage with colleagues and presenters. ISICEM 2015 has the hashtag #ISICEM15. The upcoming ESICM LIVES 2015 Conference in Berlin has the hashtag #ESICMLIVES2015, Social Media and Critical Care #smaccUS, and the ICS State of the Art Conference in London is #ICSSOA2015.

It's now time to put it all together as your record of the conference. You might want to share your notes with colleagues within the department. The organisers have even written a blog of the day to add to the myriad of tweets by delegates. You could use a pen and paper, but given that all of this is online and digital, there can be an easier way to compile this information.

The search function on Twitter can be used to produce a list of tweets with the appropriate hashtag. The Symplur website (www.symplur.com/) allows you to find relevant healthcare conference hashtags in your field of expertise. Most of us already use word-processing software to compile our notes. It is then a simple matter of reviewing the tweets, cutting/pasting and formatting. It does require a certain degree of discipline to look through the list of tweets, but it does provide insight from multiple delegates. Appraising the presentation/publication is immediate and of obvious value when compiling such notes. You no longer have to wait for next month's issue to read the correspondence section.

We have no doubt that as technology evolves methods of compiling notes will evolve. Last year's ESICM LIVES conference app had a note section, recorder function, etc. in addition to conference planning tools. It was a 1.0 form but a clear indication of future direction. Mobile apps for conferences are becoming a common occurrence – download them and see what you think.

Maintaining a CPD Diary

Electronic logbooks are common across a variety of specialties. These include simple procedural logbooks to more detailed diaries of meeting activities, teaching activities, courses and conferences. The Royal College of Anaesthetists in the UK has an online CPD diary for members who use their educational portal.

Cloud-based storage allows access to these regardless of location and device, provided there is online access. The record can be updated from your conference laptop or tablet device on the journey back home.

As an example, after your attendance at a conference, the following could form part of your appraisal portfolio:

- Conference attendance certificate;
- Conference handbook;

- List of tweets contributed which may include analysis of retweets;
- Notes compiled from various online sources – tweets, blogs, article references

Apps at Your Service

In addition to an Internet browser and word processor, there is a myriad of tools/apps to help you work more efficiently/smartly.

Cloud Storage

From tablets to smartphones, netbooks to desktops, we're using more devices on a daily basis than ever before, and toggling files between each of these devices can be cumbersome and complex. Not so with online storage services. You can access your account from any Internet connection, whether you're on a mobile browser or your work computer. Other advantages include:

- Syncing – all files automatically updated across your devices;
- Sharing/collaboration;
- Recovery/back-up.

Cloud services include iCloud (www.icloud.com), Dropbox (www.dropbox.com) and GoogleDrive (www.google.com/drive).

Online Organisers

Being an organised professional, we are sure that you already have your own way of organising your digital resources and files. Software such as Evernote (www.evernote.com) works on a variety of devices and complements the benefits of cloud storage.

3rd Party Twitter Tools

There is nothing wrong with the official Twitter app or website. However, apps such as Tweetdeck (web.tweetdeck.com) (see Figure 3) allow a greater degree of flexibility and an enhanced experience. Features include the ability to view multiple accounts at the same time and a dedicated column for each hashtag (especially useful during conferences) (See Figure 3).

We hope you have found this article useful. If you have any comments, we would love to hear from you. See you out there on the Twittersphere. ■

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GETTING STARTED WITH A HEALTH BLOG

The Internet is full of blogs. They are multi-themed sites, self-managed by the authors and demonstrative of, and only limited by, the authors' level of creativity. They are potentially accessible to anyone and everyone. There are numerous health blogs, but the proportion of health professionals who are bloggers is low. Having a blog is a cost-effective option to share health information, to promote interaction between professionals and patients, and for global communication.

What Is a Blog?

A blog is a website whose owner can edit and share the contents easily. The term 'blog' is a derivative of the original 'weblog', taken from 'web' (network) and 'log' (diary, daily account of events), whose publications are logged in chronological order. The owners of different blogs are known as bloggers.

Advantages

- Advanced computer know-how is not a requirement.
- It is the easiest way to have a digital presence.
- It can be run at minimum cost or even at no cost at all.
- Text, audio, video, attached files, presentations, and/or images can be shared.
- It allows interaction with readers through free comments or through the author's supervision.
- Readers can subscribe and receive information published in their email or via a content aggregator programme.

Before Starting a Health Blog

It is essential to work up a basic blog design before opening it, and to be able to answer the following questions:

- What is my reason for writing a blog about health issues?
- Who is my target audience?
- What information do I want to share?

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- How often will I publish?
- How much of my time do I want to invest in this endeavour?
- Do I want to or can I provide this blog in other languages?

How to Start a Blog in a Minute

There are many tools to create a blog, both free and at a cost. At the present time, two tools stand out above the rest: Blogger and Wordpress

Blogger is perhaps the most widespread free tool. The owner doesn´t need to buy a web domain or hosting package. It has the advantage of integration with other services offered by Google.

WordPress is constantly updated and very easy to use. It is chosen by many bloggers. It has a free version and has advanced options of payment also. There is an advanced platform that can be installed on private servers to which many services and applications can be added. It is very versatile.

Living with a Blog

The first bit of advice: once you have it opened and running, you need to write or share content frequently and regularly. A blog that does not publish content on a regular basis fades away and dies from lack of followers. Good quality content, interesting and reliable data ensure that your blog will be visited and endure over time.

If you want your blog to be known, you must share your posts on different social networks (Facebook, Twitter, LinkedIn, Google +).

Dealing with your Followers

You can decide whether to receive comments or not to your blog; whether they are published automatically as they reach you or supervised by you prior to publication. It may be advisable to establish a policy for publication of comments to orient the reader.

Good Reasons for Starting a Health Blog

Having a health blog benefits the health professional by allowing him/her to share and discuss health and medical issues with colleagues or patients.

Our professional visibility increases as we share content. By posting resources, quoting other websites, and referencing prestigious journals, we will be positioning ourselves higher in the rankings for the issues we discuss.

A good reputation on the Internet translates into greater confidence from patients and professionals. The confidence in the blog will increase as well, not to mention your reputation as an expert in your field.

A blog means connecting easily with other bloggers to exchange ideas, and to deepen your understanding on a specific topic, while providing a platform for the continuing education of its authors and readers alike.

Health Blogs Are Useful

- For professionals: as a training or educational tool, to share knowledge and experiences on different topics.
- For patients: as a health education tool; to take health questions and advice out of the limits of the family doctor´s office, ambulances or hospitals.
- For government institutions: to disseminate health contents for the population.
- For networks of patients: to offer information and support to other patients, based on personal experience.

The IC-HU Project: Humanizing Intensive Care
www.humanizingintensivecare.com

What Can Go Wrong With a Blog?

- Excessive time spent.
- Too much visibility.
- Errors and opinions are misinterpreted.

In our opinion…

Having a blog is a personal choice. If you like to write, if you feel that your voice needs to be heard and you want to reach a lot of people (professionals, patients, family), do not hesitate: this is your tool!

The authors of this article have become known thanks to our respective health blogs, three of the most popular blogs in Spain. As a result, communication between the different levels of public healthcare in Spain has increased.

Health Blogs We Read:

1. Kevin MD (English) www.kevinmd.com/blog
2. Open Innovation and Co-Creation in Health (Bilingual) https://healthcocreation.wordpress.com
3. Neuronas en crecimiento (Spanish) http://neuropediatra.org
4. Enfermería basada en la evidencia (Spanish) http://ebevidencia.com
5. The BMJ blog (English) blogs.bmj.com/bmj/
6. 33 Charts (English) http://33charts.com/

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HUMANIZING INTENSIVE CARE

INTERVIEW WITH GABRIEL HERAS LA CALLE

ICU Management interviewed Gabriel Heras La Calle MD (Intensive Care Physician, blogger of The IC-HU Project: Humanizing Intensive Care) about the blog. In just 8 months of existence, the IC-HU Project has been awarded the Best Health Ideas 2014 Award by Diario Médico in the legal, ethical and deontological section.

When and why did you start your blog?

I started the blog in February 2014, because I realised we could improve intensive care units (ICUs) in several respects that we do not usually focus on. I invite everybody to stop, to listen and to act for medicine and nursing focused on people, their families, and health professionals.

We started The IC-HU Project in the Intensive Care Unit of the Hospital Universitario de Torrejón, analysing patient and family satisfaction in a prospective study. I think we should pay attention as well to healthcare providers. We have detected nine areas to improve that include:

1. **Communication:** getting information to patients / families and among professionals.
2. **Burn-out** in professionals.
3. **Opening hours:** when the doors of the ICU are open, flexible schedules, presence, and family satisfaction and involvement in care.
4. **Listen to the views of patients and family in the ICU:** retrieve the clinical history.
5. **Integrative medicine:** including for example music therapy, activities, physiotherapy.
6. **Architectural improvements** to the ICU.
7. **Management of post-ICU syndrome:** psychological aspects, depression, pain management.
8. **Skills training for healthcare providers:** Resilience, teamwork, counselling, empathy, listening.
9. **Management of end-of-life situations:** "Death Code", limiting life support, palliative care.

Why is it called "Humanizing intensive care?"

During the last 20 years, the development of intensive care medicine in Spain has been huge, and we have reduced mortality to really impressive figures. But maybe we have displaced people out of the system's centre, and we want to regain this status for the patient.

When I say "humanizing intensive care", does this mean current care is inhuman? By no means. Survival rates in intensive care units are 85% in Spain and this figure might increase. In fact, we earned some criticism for employing the term "humanization", probably because many times it is not very clear what we mean by it. Humanizing means to us to become aware of oneself in a complex and multidimensional process that goes from politics and policies to culture, the healthcare organisation, the training of healthcare professionals, the development of care plans and so on. In the healthcare world, humanizing means to put the human being in the centre of every effort done to promote and protect health, cure diseases and provide an environment that ensures a healthy and harmonic life on all levels: physical, mental and spiritual. Also in the process of death, as a part of life. Using the word "humanization", we take ill people out of their passive status, and encourage healthcare professionals to do an excellent job for their patients.

In Spain one of the best examples is the Humanization Commission of the San Juan Hospital in Alicante. They have been working in the field for over 20 years.

How much time do you spend on your blog?

I usually write a daily post from Tuesday to Saturday from 6.30 to 7 AM. Then I share the post in the networks, and usually about 12 PM I translate it into English to give more diffusion. On Mondays I usually share "The phrase of the week", to re-encourage healthcare providers to recover their vocation.

Why did you choose blogging instead of traditional communication such as conference presentations and academic papers?

I did not choose. In fact, we have been invited to several Workshops and Conferences in Spain and probably in the next Congress in Latin America. The Research IC-HU Project applied for the last Research Awards of European Society of Intensive Care, and we have published three articles indexed in PubMed during 2014-15. (Escudero et al. 2014; Holanda Peña et al. 2015; La Calle and Lallemand 2014).

My blog is a loudspeaker, which helps us to disseminate our message. This way of communication helps us to talk with ICU patients and families and hear their opinions. More than 95% people search about their illness in Google, and I think physicians should help them and have a more open-minded approach. The blog is a meeting point for everyone, and helps us in our researches to get in touch with people from different parts of the world. There are many healthcare workers around the planet with the same feeling, and I want to join everyone in a single project, to be more powerful.

What has been the response to your blog from other intensivists and from patients?

In the first year, the blog had more than 130,000 page views in Spanish and over 53,000 in English. We have visitors from every country of the world! Three editors are ICU patients, and it´s very interesting to put in value their opinions. Something is changing in Intensive Care Units.

And now you have your first video "Human Tools". What is the idea behind the video?

We needed to communicate with a sense of humour that probably we should change our attitude. We are used to admiration when someone researches about sepsis, acute respiratory distress syndrome or other pathologies. But I think researching in humanizing is an awesome field, and we should get in touch with the human being again, improving in empathy, team work, communication skills…As we say in 'Human Tools': Just BE SWEET, BE HUMAN.

What's next?

I am organising the National Conference on Humanization, centered in the Intensive Care Unit. It will be held in Madrid on 27-28 May. I am thinking with other intensive care professionals from different parts of the world, to organise an International Conference on Humanization in 2016. I have connected with people from everywhere: Australia, US, New Zealand, The Netherlands, other European Countries, Latin America… Let´s change the paradigm! ■

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LIVER INTENSIVE CARE

INTERVIEW WITH PROFESSOR JULIA WENDON

Professor Julia Wendon is a liver intensive care specialist and Clinical Director of the Critical Care Division at King's College Hospital in London, UK.

Are survival rates for acute liver failure (ALF) still improving? What can that be attributed to?

Yes, the outcome for ALF continues to improve, and this is seen both in those managed medically and in those who require transplantation. The reasons for this are multiple and depend largely on small incremental improvements, critical care management for the medically treated and surgical and anaesthesia management in addition to critical care for those proceeding to transplantation.

Acute liver failure has a relatively high mortality rate – what are the main challenges in improving survival and what should research focus on?

The mortality rate for ALF is indeed high, but within this group outcome is also dependent greatly upon disease aetiology and co-morbid factors. Patients presenting with an indolent subacute course have, ironically, a greatly higher mortality without transplantation than those with a rapidly progressive deterioration and much more severe organ failure (Bernal et al. 2013). From this we should, I believe, concentrate upon the drivers and determinants of effective liver regeneration and stabilisation of immune function. These co-factors are inherently linked with sepsis and inflammation, frequently appearing to inhibit or indeed prevent effective regenerative capacity.

What has been the most promising advance in prognosis of ALF patients?

Again I would say small incremental improvements in critical care – ensuring that the many studies that have come out of critical care over the last years are applied appropriately to sub-specialities alongside other focused management; and that care is consistent and delivered by a cohesive, motivated and enthusiastic multidisciplinary team. Specifics are difficult, but decreased infection through improved standards, less sedation after the risk of raised intracranial pressure has passed, recognition of the role of earlier renal replacement therapy (RRT) to facilitate ammonia clearance and metabolic stability (sodium, temperature), Hb triggers, appropriate fluids and vasoactive agents - these changes (all added together) over many years have impacted on improvements in so many critical care specialities. Perhaps in the future the hope will be greater understanding of systemic and regional immune function and manipulation of said factors to promote organ healing/regeneration.

> **"..specialist critical care under an umbrella of critical care...strong links to the base speciality"**

In terms of disease patterns, what are the major challenges for a liver intensive care unit – non-alcoholic fatty liver disease (with rising obesity), liver failure due to alcoholism, or other diseases/syndromes?

Really all the above; we are seeing steady numbers of patients with acute liver failure (ALF), but those with Acute-on-Chronic Liver Failure (AoCLF) (Moreau et al. 2013) are also a rapidly-growing group, alongside a large number of patients going forward for extensive liver surgery for cancer resection, often with a background of abnormal liver function (fibrosis and fatty liver). A subgroup of patients with acute alcoholic hepatitis is also sadly a growing problem, the patients often very young, but with severe disease and risk of rapidly progressive multiple organ failure. The challenges, for this group especially, are therapy to dampen hepatic inflammation, promotion of regeneration and limitation of the effects of systemic inflammation/sepsis on both hepatic and extra hepatic organ function.

The Liver Intensive Care Unit (LITU) at Kings College hospital in London is unique to the UK. What does it take to set up and run such a unit? What are the benefits of a centre of expertise such as this?

The LITU was the brainchild of my previous boss, Professor Roger Williams, and started life as a two-bed area off a corridor back in the early 1970s. It is now a 19-bed critical care service with facilties appropriate to manage patients with multiple organ failure; the changes have perhaps mirrored those of critical care growth and development over these decades. Perhaps what this service has allowed to develop is a concept of specialist critical care under an umbrella of critical care with strong links to the base speciality in addition. This has allowed for teaching and training, research and clinical care to be delivered, developing learning from hepatology and liver surgery whilst maintaining a strong and cohesive remit of critical care as the base speciality that underpins high quality care for patients with liver and other organ failures.

This interview will appear in ICU Management's Spring issue with a cover story on "The Lung." What are the main challenges in treating lung complications of liver disease?

Lung complications are a frequent issue in patients with liver disease (Machicao et al. 2014), and perhaps the most common, and potentially avoidable, is the high incidence of overt and covert micro-aspiration in patients with encephalopathy in a ward environment, and particularly so in those undergoing upper GI endoscopic procedures without airway control. Specific liver lung complications

are the development of hydrothoraces (important as just as one can see spontaneous bacterial peritonitis in the ascites, similar infection may also be seen in the pleural fluid), atelectasis and diaphragmatic splinting with resultant V/Q match. Hepatopulmonary syndrome (shunting through parenchymal arterio-venous shunts) should always be considered and may be diagnosed by considering the diagnosis, dysponea, platypnoea and orthodeoxia – all worse in the upright position. Confirmatory diagnosis would normally now be with contrast echocardiography. The links between hepatopulmonary syndrome and portopulmonary are fascinating, with the latter being the presence of portal and pulmonary hypertension. Following the finding of elevated right-sided pressures further investigations need to be undertaken to separate pulmonary venous or arterial hypertension and assess reversibility.

Are there liver patients that should not be admitted to the ICU e.g. cirrhotic patients, patients with hepatorenal syndrome? What is the basis for these difficult decisions?

This is always complex, and for me one of the issues is that outcomes are steadily improving for these patients over time, and thus the application of any scoring system on admission may result in limited options for an individual (Levesque et al. 2012). On a personal note I would prefer to offer admission and assess response to therapy over the next few days; having had an open and clear discussion with the patient, if possible, and certainly the patient's family. Recent scoring systems that have been examined are SOFA and Royal Free Score (McPhail et al. 2014; Theocharidou et al. 2014). The CLIF-SOFA score has also been shown to be a useful predictive score, and although initially derived from predominantly ward patients has applicability to critical care also (Jalan et al. 2014). It should always be remembered that for all of these scores – they are statistical models and apply to large groups as opposed to having the sensitivity and specificity for individual decision-making. Hepatorenal failure is something that is always associated with poor outcome; it should be recognised, however, that this is a diagnosis of exclusion and most patients are actually presenting with a hypovolaemic or septic acute kidney injury (Fagundes et al. 2013); the outcome for this being considerably better than that seen for true hepatorenal failure in association with end-stage cirrhosis. In this latter group it may be reasonable to consider admission to intensive care only if the patient would be considered for liver transplantation. ■

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ISRAELI CARDIAC AND INTENSIVE CARE NURSING SOCIETY

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The Israeli Cardiac and Intensive Care Nursing Society is very active and includes a sub-group, the evidence-based nursing (EBN) ICU group. This group meets once a month. The participants include bedside nurses, researchers, educators and head nurses from general ICUs, open heart surgery, intensive cardiac care and cath labs. For the past 10 years we have chosen cutting-edge issues to investigate the evidence on topics like "What does the evidence say about tooth brushing to prevent VAP?" We performed a nationwide study to investigate the level of ICU nurses' knowledge of the evidence. The findings were published in 2009 (DeKeyser Ganz et al. 2009).

The group was not satisfied with the level of knowledge and was determined to close the gap between science and practice, so we launched a national nursing intervention to improve practice. Articles in the national nursing journal were published, in addition to a paper submitted to the health section of the national daily newspaper; the EBN group members presented up-to-date science at staff meetings, and even found a sponsor to donate toothbrushes to the ICUs. We repeated the same study two years later and found significant improvement in nurses' knowledge regarding delivering mouth care using toothbrushes.

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Other projects include translating and publishing sepsis and weaning guidelines in the national nursing journal. One group of nurses is working on an early identification for mechanical ventilation weaning readiness score that will be validated using all the ICUs in the country.

Every two years we host international nursing speakers at our conference, which adds colour and widens our range of topics. Together with our visiting speakers we develop multi-centre, multi-country research studies. One example is the UNIQUE study, which will investigate nursing practice and rituals of caring for the patient who has died, all over the world.

> "We can transform and revolutionise Israeli ICU care"

One of our proudest achievements is our involvement as principal investigators (PI) in ESICM multi-country studies. In the past years we have performed as PIs in APPROPICUS, CONFLICTICUS, FENICE, IMPRESS. Our team was very pleased when we registered to perform as PI in each study and we all received letters addressing us "Dear Dr….." It was the fastest track to accomplishing a PhD.

Nurses can be PIs in many types of studies and possess the knowledge and skills to lead trials in our hospital ICUs.

All of us in the ICU have been witnessing the significant evolution of end-of-life care. The literature is overflowing with descriptive studies demonstrating areas that need improvement in guideline development, education, communication and many others. The ICU nurses in Israel believe that we should be the leaders in addressing this issue. This was our motivating factor in developing a postgraduate ICU palliative course specifically focusing on the ICU patient population. This is a 114-hour course created by Dr. Freda Dekeyser-Ganz, Maureen Bennun and sponsored by our national nursing society chairwoman Ofra Raanan. The graduates of the first course have already found themselves in positions as palliative care leaders in their units and hospitals. They are regarded as experts in ICU and palliative care and have started interventions in their units. We believe this is one of the ways palliative care will be disseminated to improve patient end-of-life care and advance family satisfaction. The second course has commenced and a third is opening soon.

We have created an Israeli-Palestinian nursing work group collaborating on professional issues like standardised protocols, knowledge exchange, and research projects.

Proactive leadership actions taken on by nurses can produce change. As a strong cohesive group of determined nurses we can transform and revolutionise Israeli ICU care delivered to our patients. ■

Statistics	
Total population (2013)	**7,733,000**
Gross national income per capita (PPP international $, 2013)	**32,140**
Life expectancy at birth m/f (years, 2012)	**80/84**
Probability of dying between 15 and 60 years m/f (per 1,000 population, 2012)	**72/39**
Total expenditure on health per capita (Intl $, 2012)	**2,239**
Total expenditure on health as % of GDP (2012)	**7.5**

Source: World Health Organization Global Health Observatory http://www.who.int/countries/isr/en/

WCACS 2015 PREVIEW

HIGHLIGHTS OF THE 2015 7TH WORLD CONGRESS OF THE ABDOMINAL COMPARTMENT SOCIETY, GHENT, BELGIUM, MAY 28-30, 2015

The 7th World Congress of the Abdominal Compartment Society in Ghent in May 2015 follows on the recent successful meetings in Cartagena, Colombia (2013), Orlando, USA (2011) and Dublin, Ireland (2009), and brings the meeting back to Belgium where the WSACS 2007 meeting took place.

The WSACS was formed in Australia after the second World Congress in 2004, and is a multidisplinary society of clinicians involved in day-to-day care of seriously ill and injured patients. The Society has recently updated its practice guidelines on intra-abdominal hypertensions (IAH) and abdominal compartment syndrome (ACS), fostering a greater understanding worldwide of intra-abdominal hypertension and ACS. Recently the Society adopted a new name "WSACS – The Abdominal Compartment Society" as the abdominal compartment syndrome is no longer the sole target for the society.

For this reason, the 2015 WCACS congress theme is 'Expanding our horizon'; the physiology and pathophysiology of the abdominal compartment as a whole better describes the current focus of the society's efforts, as well as the main topics covered in the 7th WCACS.

The WCACS2015 meeting in Ghent will host delegates from around the world to address issues relating to the care of critically ill patients.

Pre-Congress IAH and ACS Refresher Course

Prior to the meeting, an IAH/ACS refresher course will be organised. This half-day, intensive course is aimed at those who want an update on the basics of intra-abdominal pressure, IAH and ACS. It is intended to be the perfect introduction to the 7th WCACS for delegates who are not (yet) familiar with the fundamentals of IAH and ACS.

WCACS2015 Scientific Programme

There will be general sessions for those less experienced in abdominal physiology, cutting-edge research for the experts, pro-con debates, case discussions and much more. Interaction is crucial at every WCACS, and there will be ample time for discussions both during the sessions and breaks. Attending WSACS2015 will also allow attendees to understand the future directions of care in the diverse aspects of care of severe abdominal conditions in the critically ill.

Focus topics of the meeting will include

- Contemporary IAH;
- Treating ACS;
- Temporary abdominal closure - improving outcome;
- Inflammation and abdominal disease;
- Fluid resuscitation and monitoring;
- Abdominal wall reconstruction;
- Nutrition and the abdomen;
- Abdominal trauma - how to eradicate ACS;
- Diagnosis and management of abdominal infections.

The full scientific programme can be found on the WCACS2015 website **www.wcacs2015.org** where you can find other practical information as well.

At the meeting, there will be ample time for interaction with other delegates and faculty both during the meeting as well as during the social events.

More than 40 speakers from around the world will set out expert views, insight, debate and progress on such areas as open abdomen management, IAH treatment, abdominal wall reconstruction, abdominal infection, fluid management, haemodynamic monitoring and future perspectives in the care of these patients.

Endorsing Societies

WCACS has teamed up with several societies that are officially endorsing WCACS2015. Members of endorsing societies benefit from a 20% discount on the full registration cost. Endorsing societies include ESICM, the Pan-American Trauma Society, SBAIT, the World Society of Emergency Surgery, and the Belgian Intensive Care Society. Others will be added - check the meeting website for regular updates.

Meeting Venue

The 7th WCACS will be held in "het Pand" Congress Centre of Ghent University. 'Het Pand' is an old Dominican monastery located in the heart of the city on the banks of the river Leie, near the medieval port with the guildhalls as its remnants. It was recently acquired by Ghent University and converted to a congress centre. The venue is located in the heart of the historical city centre, within walking distance of all major hotels and touristic attractions.

Ghent, Belgium

Ghent is a vibrant city, nestled between Brussels and the coast, with a population of around 300,000 inhabitants. It has an extensive history and is well known as one of the Flemish Art Cities. Famous attractions include Jan Van Eyck's 'Adoration of the Lamb', the Castle of the Counts, and the Belfry among many others.

Ghent is host to one of the largest universities in Belgium and is home to over 38,000 students. The city has excellent connections to Brussels Airport with two direct trains per hour.

Note: All presentations may diverge from the descriptions above, in response to circumstances.

AGENDA

APRIL

9-11
11th Emirates Critical Care Conference 2015 (ECCC 2015)
Dubai, UAE
www.eccc-dubai.com

16-17
Network For The Advancement Of Transfusion Alternatives
16th Annual Symposium on Patient Blood Management,
Haemostasis and Thrombosis 2015 (NATA 2015)
Prague, Czech Republic
www.nataonline.com

23-24
12th Annual Critical Care Symposium 2015
Manchester, UK
www.critcaresymposium.co.uk

MAY

1-3
Resuscitation 2015
Las Vegas, USA
www.resuscitation-conference.com

3-6
Brainstorming Meeting
Madrid, Spain
www.intensive.org

7-9
German Society of Anaesthesiology and Intensive Care
62nd Annual Meeting 2015 (DAC 2015)
Dusseldorf, Germany
www.dac2015.de

7-10
EuroELSO 4th International Conference 2015
Regensburg, Germany
www.regensburg-euroelso2015.com

21-22
Sepsis Unplugged 2015
Nottingham, UK
www.eventsforce.net/sepsisunplugged2015

28-30
7th World Congress Abdominal Compartment Syndrome 2015
Ghent, Belgium
www.wsacs.org

30-2 June
Euroanaesthesia 2015
Berlin, Germany
www.esahq.org/euroanaesthesia

JUNE

2-3
Metabolic and Nutrional Issues in the ICU
Brussels, Belgium
www.intensive.org

4-5
2nd International Symposium on Postresuscitation Care 2015
Lund, Sweden
www.malmokongressbyra.se/postresuscitation

11-13
ESICM Regional Conference
Lungs: Getting to the Heart of It
Dublin, Ireland
www.esicm.org/events/summer-conferences

22-23
Brain Critical Care and Emergencies (BRACE)
Brussels, Belgium
www.intensive.org

IN OUR NEXT ISSUE

COVER STORY
Cost-Effectiveness

MANAGEMENT
Scoring Systems

MATRIX
Heart-Lung Interactions

COUNTRY FOCUS
South Korea

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Brainstorming: "Big Questions for the Experts"

Parador de Alcalá de Henares, Madrid, Spain, May 3-6, 2015

1 retreat
10 ICU experts,
20 questions for the
30 years to come,
60 participants.

Coordinator
Jean-Louis Vincent (Brussels, Belgium)

The 10 experts
Laurent Brochard (Toronto, Canada)
Jean-Daniel Chiche (Paris, France)
Daniel De Backer (Brussels, Belgium)
Luciano Gattinoni (Milan, Italy)
Charles Gomersall (Shatin, Hong Kong)
John Marini (St Paul, USA)
Marco Ranieri (Rome, Italy)
Mervyn Singer (London, UK)
Jean-Louis Vincent (Brussels, Belgium)
Tobias Welte (Hannover, Germany)

Concept
In this novel "brainstorming" meeting, 10 opinion leaders in intensive care medicine will form a panel of experts. Each expert will, in turn, introduce 2 questions of specific interest related to topics that are likely to play a role in the next 30 years of intensive care medicine. These questions will then form the basis for interactive discussions that promise to be thought-provoking and challenging.
This meeting will provide participants with a unique insight into how leading experts in the field envisage the future of intensive care medicine.

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