ICU MANAGEMENT

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PLUS:

- **Applying Transpulmonary Pressure:** A Valuable Clinical Tool
- **Viewpoints:** What Were the Hot Topics for Critical Care in 2011?
- **Simulation Training:** Improving Clinical Skills and Patient Outcomes
- **Data Centre Trends:** Balancing Growth, Budget and Compliance
- **ICU in Bulgaria:** Current Goals & Future Challenges

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As medical professionals, we are always seeking new, improved ways to save lives and provide a high quality of care. Coupled with the increasing pressure being applied during these increasingly unstable economic times, it comes as no surprise that one of the growing topics is that of addressing and achieving cost-effectiveness. How can we create an optimally financially sustainable environment in the critical care department, in a way that also benefits our patients?

Decreasing the duration of patient stays is one of the most powerful and direct tools we, as medical professionals, have at our disposal, to impact on cost-effectiveness. But, of course it goes without saying that this can only be considered beneficial when a shorter duration of stay provides the same positive outcome and excellence of care as if the patient's stay were governed by no economic limits whatsoever. Our cover story asks: how can we balance economic pressures with the delivery of high quality in patient care? What methods are at our disposal, and what do we know about their cost-effectiveness?

Therefore, in this edition's cover story, we take a look at three innovative ways in which cost effectiveness can be measured and improved. One paper, authored by Kees H. Polderman, is entitled "Therapeutic Temperature Management in Critically Ill Patients: Indications for Cost-Effective Outcomes". In it, Polderman posits that the use of hypothermia in certain patient groups can effectively deal with fever, explains in which cases this is so, and covers some interesting and significant data that demonstrates the current knowledge regarding its cost effectiveness. He also cites the European Resuscitation Council (ERC) and the American Heart Association (AHA), who are now fully behind the use of hypothermia in survivors of witnessed cardiac arrest, regardless of the initial rhythm.

This focus on reducing length of stay without negatively impacting mortality rates, is dealt with by expert Robert Barraco, who tackles the case of delirium, one of the main drivers of costs in the treatment of the elderly population. As he reports, delirium is strongly associated with poor outcomes in ICU patients and he lists the complications and poor outcomes associated with delirium, which, if neither properly nor early enough identified, can lead to longer stays. Delirium itself is reported to increase nursing time per patient as well as drive up hospital costs, making it an important focus for this cover story. In this paper, Barraco demonstrates effective prevention strategies for delirium, as well as describing the ways in which it can be identified, to aid detection and ensure control over its severity and thereby improving the prognosis for patients.

Another significant tool for reducing costs, that of treating the patient in such a way as to require less medication, is described by author Arzu Topeli Iskit, who covers a recent multi-centre trial that demonstrates a novel way to reduce the number of days a patient spends in the hospital by the utilisation of procalcitonin measurement to assess antibiotic requirements more precisely. In her article, she provides evidence that such a treatment tool can reduce costs in a way that does not increase mortality, neither does it increase length of stay, and importantly, it does not cause a relapse in infection.

Our country focus this issue covers the structure and provision of ICU care in Bulgaria. The usefulness of our country focus section cannot be underestimated; each country we profile is facing separate but no less important challenges in meeting its health goals. The fact of sharing such challenges is, however, not this section's continuing goal, but to share the ways in which its contributors are coping with and addressing those challenges. In Bulgaria, there are key political problems that are applying pressure to all practitioners and institutes of healthcare, including the ICU. Notably, for Bulgaria this means a shortage of trained practitioners, an exodus of trained residents to other economic regions, the lack of continuing medical training in the face of an outdated system that relies heavily on mentorship from the older generation, and the need for greater modernisation.

This edition's Viewpoints section interviews four luminaries in the critical care field, who each communicate their opinion on what the hot topics were for ICU during 2011. This threw up some interesting and provocative responses, notably the growing role of technology in driving high quality care, the difficulty in assessing whether or not increasing the number of ICU beds improves care, and quality assessment and evaluation. As readers, your opinions are valuable: we welcome your feedback to any of the papers published in the journal, and particularly your thoughts on what the most significant 'hot topics' of 2011 were for you, professionally, and what they tell us about what is needed for the future of critical care for 2012 and beyond. Please send your responses to me at **editorial@icu-management.org.**

Jean-Louis Vincent

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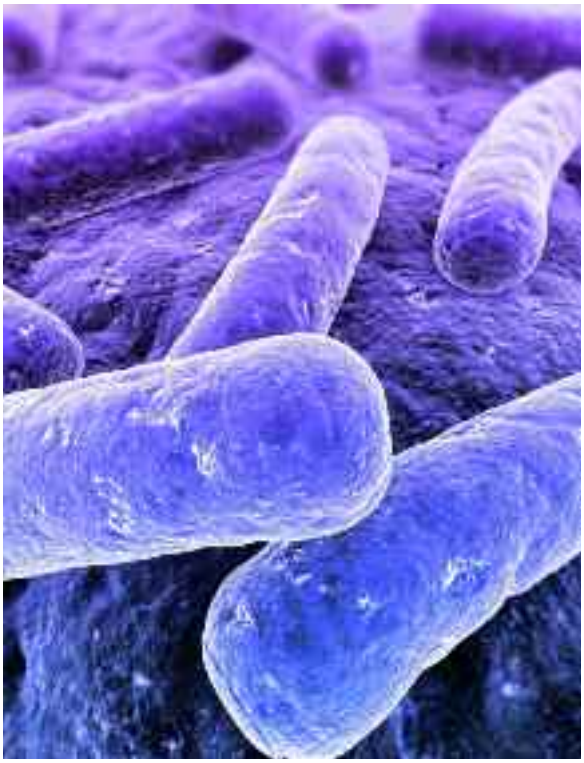
JOHNS HOPKINS & LOCKHEED MARTIN
COLLABORATE FOR NEXT GENERATION ICU UNIT
Cite Systems Integration and Virtual Simulation

The Armstrong Institute for Patient Safety and Quality of Johns Hopkins Medicine is collaborating with the Lockheed Martin Corporation, a global security and technology company, to create a safer and more efficient hospital intensive care unit (ICU) model. The two organisations will work to streamline complex and fragmented clinical systems and processes to reduce medical errors and improve the quality of care for critically ill patients.

"A hospital ICU contains 50 to 100 pieces of electronic equipment that may not communicate to one another nor work together effectively," says Peter Pronovost, M.D., Ph.D., Armstrong Institute director and senior vice president for patient safety and quality for Johns Hopkins Medicine. Pronovost, who often contrasts the healthcare and aerospace industries, says, "When an airline needs a new plane, they don't individually select the controls systems, seats and other components, and then try to build it themselves." The piecemeal approach by which hospitals currently assemble ICUs is inefficient and prone to error, adding risk to an already intricate environment. "Lockheed Martin has the expertise to integrate complex systems to help us build a safer and more efficient ICU model not just for Johns Hopkins but for patients around the world," Pronovost says.

"A single system that could prioritise patient alarms based on individual risk of cardiac or respiratory arrest, for example, could prevent alarm fatigue, when clinicians sometimes are inundated with a chorus of competing alarms. This could help us understand risks on a personal level based on each patient's age, diagnosis and family history."

ANTIBIOTIC RESISTANCE CONTINUES TO RISE
Risk Assessment Reports on Dangers



The European Centre for Disease Prevention and Control (ECDC) is releasing new European-wide surveillance data showing that the percentage of carbapenem-resistant Klebsiella pneumoniae is increasing within the European Union. Several Member States are now reporting that between 15 and almost 50 percent of K. pneumoniae from bloodstream infections are resistant to carbapenems. Carbapenems are the major last-line class of antibiotics to treat infections with multidrug-resistant Gram-negative bacteria such as Klebsiella pneumoniae, a frequent cause of pneumonia and urinary tract infections in hospitals.

On the occasion of the launch of a European Commission strategy to combat antibiotic resistance, ECDC Director, Marc Sprenger, said: "The need for concerted action to curb growing resistance to antibiotics is now critical with the establishment of resistance to the last line of antibiotics being reported to ECDC from several European countries for the first time. Failure to act will mean that treatment options for patients with bloodstream infections, pneumonia, and urinary tract infections in hospitals will be severely limited. That is why ECDC is working very closely with the European Commission to support the implementation of its multi-disciplinary approach to combat antibiotic resistance".

For a large part, antibiotic resistance is being driven by misuse

of antibiotics in humans and animals. According to the latest data released by ESAC (European Surveillance of Antimicrobial Consumption), the vast majority of human consumption of antibiotics occurs in the community. Resistance to last-line antibiotics like the carbapenems, however, cannot be explained only by the use of antibiotics outside hospitals. Studies show that 50 percent of all antibiotic use in hospitals can be inappropriate. Prudent use of antibiotics is paramount to prevent and control resistant bacteria. Additionally, compliance with good hand hygiene by healthcare workers is the most effective way to prevent the spread of infections in hospitals. Finally, there is a particular lack of new antibiotics with new targets of mechanisms of action, in particular against carbapenem-resistant Gram-negative bacteria.

Following an increasing number of outbreaks and the spread of carbapenemase-producing enterobacteriaceae (CPE) in healthcare facilities across Europe, ECDC recently published a risk assessment to evaluate the risk to the citizens of Europe of CPE spread through patient mobility. According to ECDC, the transfer of patients across borders poses a clear risk for the transmission of carbapenem-resistant bacteria, especially when patients are transferred from areas with high rates of such bacteria to healthcare facilities in another country or have received medical care abroad in areas with high rates of carbapenem-resistant bacteria. Another ECDC risk assessment on the spread of New Delhi metallo-β-lactamase (NDM) stresses that NDM and other highly antibiotic resistant bacteria represent a particular risk for Europe because EU Member States lack systematic surveillance systems and policies to detect carriage or infection deriving from these bacteria.

PREDICTORS OF POOR HAND HYGIENE IN THE EMERGENCY DEPARTMENT

Study Identifies Risk Factors

The Society for Healthcare Epidemiology of America shared that a new report studying hand hygiene of healthcare workers in the emergency department found certain care situations, including bed location and type of healthcare worker performing care, resulted in poorer hand hygiene practice. The study was reported in the November issue of Infection Control and Hospital Epidemiology, the journal of the Society for Healthcare Epidemiology of America.

"We found that receiving care in a hallway bed was the strongest predictor of your healthcare providers not washing their hands," said Dr. Arjun Venkatesh, an emergency medicine resident at Brigham and Women's hospital in Boston, and author of the study. Dr. Venkatesh believes this finding will focus attention on infectious risks that are created by the national trend of emergency department crowding.

The study, which is the largest to date to evaluate hand hygiene in an emergency department, confirmed many known contributors of poor hand washing practices. For example, the researchers observed providers wearing gloves during patient care instead of washing their hands, an inappropriate substitution for infection control purposes. The study also found that workers who transport patients between hospital departments and rooms were less likely to wash their hands compared to other healthcare workers. This may be because these workers receive less training in hand hygiene procedures than other workers.

The researchers collected data on over 5,800 patient encounters in the emergency department. Overall, appropriate hand washing practices were used 90 percent of the time. The authors hope the study will lay the foundation for future research and quality improvements in understanding the role of the emergency department in healthcare associated infections. ■

IMPACT OF PROCALCITONIN MEASUREMENT ON ANTIBIOTIC ADMINISTRATION

Evidence Points to Overall Cost-Effectiveness

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Procalcitonin (PCT) is a biomarker which is used extensively, both as a surrogate marker to distinguish bacterial infections from other causes of infection (such as viral infections), and to distinguish sepsis from other causes of systemic inflammatory response syndrome (SIRS), especially in the intensive care setting (Kibe et al. 2011; Uzzan et al. 2006). Serum PCT levels have also been shown to have prognostic value in critically ill patients; particularly in patients with severe sepsis and multi-organ failure (Jensen et al. 2006). However, as with other prognostic methods such as APACHE and SOFA scores, it does not add much to clinical decision making at the bedside, but rather it is useful for research purposes. In addition, a rising PCT level may suggest that the patient is not improving in terms of the infectious problem and he or she requires further source control or meticulous control of the infectious condition.

Diagnostic Value of PCT

Although there are conflicting results, PCT has shown to be a reasonably good diagnostic marker for sepsis syndromes in the intensive care setting (Uzzan et al. 2006). The American College of Critical Care Medicine and Infectious Diseases Society of America have recommended that serum PCT levels can be used as an adjunctive diagnostic tool for discriminating infection as the cause of fever or as a tool for the diagnosis of sepsis, grading the evidence as level two (O'Grady et al. 2008). Since PCT is also elevated in non-infectious conditions, its main role is to rule out infection in cases where levels are too low. In addition, repeated measurements are more useful since basal PCT levels may be low early in the course of infection.

The utility of PCT levels to improve the early diagnosis of ventilator-associated pneumonia (VAP) has also been evaluated in some studies. Ramirez et al, (2008) reported a cohort study with sequential measurement of PCT in patients with VAP. The results of this study showed that PCT levels were statistically higher in patients with confirmed VAP. The combination of the simplified clinical pulmonary infection score (CPIS) and serum PCT had a 100 percent specificity excluding all false-positive diagnosis of VAP.

PCT has also been studied in acute exacerbations of chronic obstructive pulmonary disease (COPD) in the differentiation of bacterial from other causes. COPD exacerbations not only increase mortality in patients, but also impose great burdens on medical resources. An estimated 50 – 75 percent of expenditures are due to COPD disease. Determination of etiologic reasons in COPD exacerbations pose a great challenge to the clinician. Since it is difficult to determine the exact cause and especially the bacterial pathogen, almost all patients with acute exacerbations receive antibiotics empirically. Exposure to antibiotics not only increases the cost but also increase toxicity, antibiotic resistance, etc. Therefore, it is very important to differentiate bacterial causes from others.

> *"A recent multi-centre randomised trial revealed that critically ill patients whose antibiotherapy was managed according to baseline and follow-up PCT levels had fewer days on antibiotics than those who received the usual care"*

Several studies address this issue, and reveal that a PCT value < 0.1 mcg/L on

admission and on follow-up excluded the presence of bacterial infection (Daubin et al. 2009). We have conducted a similar study in our unit to determine the role of PCT in identifying the presence of bacterial infections in COPD exacerbations requiring mechanical ventilation. We studied 63 patients with a median age of 71 years. We found a negative predictive value of 89 percent for PCT if admission and follow up values are < 0.25 mcg/L (Topeli and Ergan-Arsava 2010).

Value of PCT in Antibiotherapy Plan at the Bedside

Antibiotic stewardship at the bedside is probably the most important area where PCT is useful. One of the most important challenges the intensivist faces is ICU-acquired infections due to multidrug resistant pathogens. There is a clear association between antibiotic exposure and development of resistance. Therefore current strategies advocate less antibiotic consumption. However, with this approach intensivists face the risk of causing resistance by using perhaps unnecessary antibiotics on one hand and on the other hand they might put their patients at risk of sepsis or unresolved infection by avoiding antibiotics. Therefore use of PCT in antibiotic stewardship has become a very popular subject in the last few years.

In a randomised study, Nobre et al. (2008) showed that patients with sepsis assigned to PCT-guided antibiotic treatment groups had a duration of four days of antibiotic therapy and a two-day shorter length of stay in the ICU with a similar mortality and infection recurrence rate compared to a standard care group. A recent multi-centre randomised trial (PRORATA trial) revealed that critically ill patients whose antibiotherapy was managed according to baseline and follow-up PCT levels had shorter days without antibiotics (about two - three days) than patients who received the usual care (Lila Bouadma et al. 2010). No increase in mortality and emergence of resistance were observed. Unfortunately, cost-effectiveness analysis was not performed.

Despite this, some may argue that the antibiotherapy duration in the control group is somewhat longer than some recent findings in studies, where a shorter course of antibiotherapy (such as eight days) was found to be as effective as longer duration (with the exception of infections due to Pseudomonas) (Chastre et al. 2003). However, clinicans need individualised strategies rather than fixed empirical ones. Therefore, PCT should still be regarded as one of the key markers among several clues in decision-making, and it should not be accepted as a single definite marker in determining antibiotic duration. Among several randomised controlled studies, repeated PCT measurements were used and antibiotic treatment has been discouraged when levels are <0.25-0.5 mcg/L and encouraged if levels are >0.5-1 mcg/L. In addition, recommendations for discontinuing antibiotics were made if PCT levels dropped to a range of less than 0.25-1.00 mcg/L or by at least 80 - 90 percent. PCT based algorithms reduced antibiotic treatment by about two days (Lila Bouadma et al. 2010; Hochreiter et al. 2009; Petros Kopterides et al. 2010; Schuetz et al. 2011).

PCT is also considered to be a useful tool for the determination of antibiotic treatment duration both in pneumonia and in exacerbations of COPD (Blasi et al. 2010). Schuetz et al. (2009), revealed that patients who received PCT guided treatment in lower respiratory tract infections including COPD exacerbations and community acquired pneumonia had less antibiotic exposure without any adverse out-

come. Stolz et al (2007) showed that PCT guided therapy resulted in less antibiotic exposure in patients with COPD exacerbations and interestingly this reduction in total antibiotic exposure persisted for up to six months. PCT guided therapy might also be promising in ventilator associated pneumonia (Stolz et al. 2009).

Cost-Effectiveness of PCT

There is no study addressing the cost-effectiveness of PCT use in antibiotic therapy directly. Schroder et al. (2009) found that the cost of antibiotic treatment was significantly reduced in the PCT-guided group compared with the control group. Heyland et al. (2011), performed a systematic review of five randomised controlled studies including the above mentioned study in critically ill patients. First, they found that based on these studies a PCT guided strategy was associated with a reduced antibiotic use by about two days. Since this strategy did not increase mortality or length of stay and did not cause recurrence or relapses in infection, the cost model based on these findings revealed a reduction in cost of care.

Conclusions

In summary, while accepting its limitations, the technique of procalcitonin levels measurement for antibiotic administration decisions in patients with respiratory tract infections and sepsis appears to reduce antibiotic exposure without worsening the outcome. In addition, trends in its repeated measurements might give prognostic information as to whether PCT might also be useful as an adjunctive parameter for the diagnosis of bacterial infections in case of fever, or lower respiratory tract infections including COPD exacerbations in critically ill patients.

Repeated PCT measurements might also help to identify whether the patient is responding to treatment or needs further infection management. Given the fact that it might shorten length of ICU stay and antibiotic usage for up to six months in COPD, PCT guided antibiotic therapy may also be considered as cost-effective. However, further studies are needed to determine the following:

- Cut-off values in different disease settings;
- Effectiveness in antibiotic stewardship in ICU acquired infections due to multi-drug resistant microorganisms, and
- Its cost-effectiveness comparing PCT guided therapy with a control group who received relatively shorter duration of antibiotics than conventional 10 - 14 days of therapy or with cheaper markers such as CRP guided therapy (Shehabi et al. 2008). ■

"Since this strategy did not increase mortality or length of stay and did not cause recurrence or relapse in infection, the cost model based on these findings revealed reduction in cost of care"

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THERAPEUTIC TEMPERATURE MANAGEMENT IN CRITICALLY ILL PATIENTS

Indications for Cost-Effective Outcomes

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Therapeutic temperature management is an increasingly important therapeutic intervention in critical care, particularly in patients with neurological injuries. This applies both to induced therapeutic hypothermia and fever management. It has been conclusively demonstrated that patients with any type of neurological injury who develop either infectious or non-infectious fever have a significantly increased risk of adverse outcome. In addition, patients who develop fever also incur stays of increased length in the ICU and hospital, and higher costs of care. Therapeutic hypothermia has been shown to improve outcomes in patients with post-hypoxic brain injury, particularly newborn babies with neonatal asphyxia and patients with out-of hospital cardiac arrest. Recent literature suggests that therapeutic cooling is cost-effective in these categories of patients.

Increasing Temperature Worsens Injury

Elevations in temperature can stimulate destructive processes that occur after tissue injury; this applies in particular to ischaemia-reperfusion injury and brain oedema. Conversely, decreases in temperature can inhibit these processes. Numerous animal studies, in particular in neurologic injury models, have found that increasing temperature worsens injury, while reducing core temperature mitigates such injury. This observation was made in regards to different animal models across various types of injury. This in turn, led to numerous clinical studies addressing the possible effect of temperature on neurological outcomes. Although not every issue has been resolved, a number of important findings have been made.

Controlled Normothermia

Fever is a strong independent predictor of adverse neurological outcome and mortality in ischaemic stroke, traumatic brain injury, post-anoxic injury, subarachnoid haemorrhage, and intracranial haemorrhage. This has been consistently demonstrated in more than 20 large observational studies, and persists on multivariate analysis (Azzimondi et al. 1995; Castillo et al. 1998; Hajat et al. 2000; Kammersgaard et al. 2002; Polderman 2008; Reith et al. 1996; Schwarz et al. 2000). Fever can be detrimental even when it is mild, even if it is of short duration, and even when it occurs long after the initial injury, although the effects become more pronounced if hyperthermia coincides with an episode of ischaemia, suggesting that ischaemic brain cells are more susceptible to the harmful effects of fever (Castillo et al. 1998).

> *"Fever can be detrimental even when it is mild, even if it is of short duration, and even when it occurs long after the initial injury"*

The link is extremely powerful; for example, fever developing within 24 hours after onset of ischaemic stroke has been independently linked to larger infarct volumes with an odds ratio of more than three (Castillo et al. 1998), and in another study has been associated with a more than threefold risk of adverse outcome in patients with acute ischaemic stroke. Others have reported that each 1°C increase of admission body temperature independently predicted a 30 percent relative increase in risk of long-term mortality (Azzimondi et al. 1995). Several studies have demonstrated that fever is a strong predictor of adverse outcome for both in-hospital and out of hospital cardiac arrest (Suffoletto et al. 2009; Zeiner et al. 2001). With regards to cost-effectiveness, a large study by Diringer and co-workers demonstrated that elevated body temperature was associated not only with increased mortality and morbidity, but also with higher costs and increased length of stay both in the ICU (average of 3.2 additional days) and in the hospital (4.3 additional days) (Diringer et al. 2004).

Although it remains to be conclusively determined whether treatment of fever can

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improve outcome and decrease length of stay, this would appear to be an excellent target in attempting to decrease length of stay. The costs of temperature management will depend on the type of device that is used, but would in no case exceed a total of 1,000 Euros when using the most expensive equipment for a short period of time; in most cases the costs would be substantially lower. Thus, if length of stay could be reduced even by a single day the intervention would already be highly cost-effective.

Therapeutic Hypothermia

The positive effects of therapeutic hypothermia have been most convincingly demonstrated in two categories of patients with global post-ischaemic brain injury.

The first category, with the strongest evidence for the efficacy of therapeutic cooling, is in newborn babies with neonatal asphyxia. Five multi-centred randomised controlled trials and a number of additional studies have demonstrated that neurological outcome in these babies can be improved by therapeutic cooling (Azzopardi et al. 2009; Eicher et al. 2005; Gluckman et al. 2005; Shankaran et al. 2005; Zhou et al. 2010). A recent meta-analysis concluded that the number needed to treat (NNT) for the combined endpoint of increased survival with normal neurological function was eight, with a 95 percent confidence interval (CI) of five to 17 (Edwards et al. 2010). In addition, in survivors there were significant reductions in the incidence of severe disability (P = 0.006) and cerebral palsy (P = 0.004), as well as other indicators of permanent brain injury (Edwards et al. 2010). A recent analysis of costs concluded that therapeutic cooling led to a cost increase of around 5,000 Euros, with a 95 percent CI from minus 3,400 Euros to 17,000 Euros.

The incremental cost per deficit-free life year gained was 26,920 Euros (Regier et al. 2010). This is well within traditional limits for cost-effectiveness per QALY. In addition, substantial parts of the costs may be offset by the decrease in later costs for caring for patients with permanent neurological injuries.

The second category is in patients with cardiac arrest with post-anoxic encephalopathy. Two randomised trials and more than twenty non-randomised studies have shown the benefits of therapeutic cooling in adult patients who remained comatose after a witnessed cardiac arrest with an initial rhythm of ventricular fibrillation (VF) or ventricular tachycardia (VT) (Bernard et al. 2002; Polderman 2008; The Hypothermia after Cardiac Arrest Study Group, 2002). Both the European Resuscitation Council (ERC) and American Heart Association (AHA) now recommend using hypothermia in survivors of witnessed cardiac arrest, regardless of the initial rhythm (level 1 recommendation for VT VF, level 2b for asystole/PEA) (Peberdy et al. 2010). A recent study from Europe found that mortality is decreased by 20 percent with this treatment (van der Wal et al. 2011). The NNT is six, according to a meta-analysis(Holzer et al. 2005). The average rate of good outcome in patients with OHCA and initial rhythm of VT/VF treated with therapeutic cooling in all randomised and non-randomised studies is around 50 percent, giving a one in two survival rate.

Hypothermia & Intracranial Pressure Reduction

Hypothermia can also be used to decrease intracranial pressure (ICP) in patients with traumatic brain injury or ischaemic stroke, to mitigate myocardial injury following myocardial infarction, to reduce the inflammatory response in ARDS, and in numerous other situations (Polderman 2008). These need to be further studied to assess the effect of cooling and no firm conclusions regarding efficacy or cost effectiveness can be made at this time.

However, it seems clear that therapeutic temperature management, including fever control and therapeutic hypothermia, will play an important role in critical care medicine in years to come, mainly but not exclusively in patients with neurologic injuries.

The prices of the currently available cooling devices range from around 10,000 to 40,000 Euros. The price of disposables ranges from 120 to 1,000 Euros per patient. There is a considerable variation in efficacy, which can be summarised from a combination of properties including speed of cooling, ability to maintain target temperature within a narrow range, ability to achieve slow and controlled re-warming, and low incidence of side effects (Polderman 2009; Polderman and Herold 2009). Another factor that should be taken into account is the effect on nursing and physician workload. Maintaining hypothermia or normothermia using an automated cooling device has a significantly lower workload compared to non-automated devices and/or non-device cooling with ice packs (Polderman 2009; Polderman and Callaghan 2006; Polderman and Herold 2009).

Another consideration in this regard is the difference between low-volume and high-volume ICUs. Obviously, write-off costs for a cooling device will be much lower in high-volume units and units that use the devices more frequently, in different cat-

> *"Both the European Resuscitation Council (ERC) and American Heart Association (AHA) now recommend using hypothermia in survivors of witnessed cardiac arrest, regardless of the initial rhythm"*

In a recent analysis of cost-effectiveness in the United States it was concluded that post-arrest patients treated with therapeutic hypothermia gained an average of 0.66 quality-adjusted life years compared with conventional care, at an incremental cost of 31,254 USD, yielding an incremental cost-effectiveness ratio of 47,168 USD per quality-adjusted life year, well below the general norm for the price per QALY in the US of around 100,000 USD (Merchant et al. 2009). This number would likely be more favourable in Europe, where outcome rates for cardiac arrest tend to be better, where implementation of therapeutic cooling is more widespread, and where costs of healthcare are significantly lower compared to the United States. In addition, if cooling is initiated in a post-cardiac arrest patient the same cooling device/disposables (either surface cooling pads of cooling catheters) can be used subsequently to control fever, making the overall intervention more cost-effective.

egories of patients. Thus the per-patient costs will vary considerably, and will be determined by the factors listed above. However, regardless of the setting and precise indication adopted by individual units, it seems clear that therapeutic temperature management will be a highly cost-effective treatment, comparing favourably with many routine interventions in critical care. ■

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MANAGEMENT OF DELIRIUM IN ELDERLY PATIENTS

How to Lessen Length of Stay and Improve Outcomes in the ICU

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Delirium was described in the first century AD by Celsus as *"mental disorders such as hysteria, depression or mania, during fever or head trauma"*. The word delirium comes from the Latin de - away from and lira - furrow, meaning 'the plough is out of the furrow' or in more modern terms, 'the train is off the track'. An even earlier description of a disorder with these features was known to Hippocrates as phrenitis and occurred in febrile patients. Delirium can be defined as a transient, reversible syndrome that is acute and fluctuating, and which occurs in the setting of a medical condition. The American Psychiatric Association's Diagnostic and Statistical Manual of Mental Disorders defines delirium as a disturbance of consciousness and cognition that develops over a short period of time and fluctuates over time.

Epidemiology

The incidence has been shown to range from 14 – 56 percent of all hospitalised elderly patients. Postoperative delirium occurs in 15 – 53 percent of surgical patients over the age of 65 and up to 70 – 87 percent of the elderly in the ICU. At least 20 percent of the hospitalised patients over 65 each year in the U.S. experience complications due to delirium.

There are few studies looking at pathophysiology and risk factors for delirium in the ICU. Among the hypotheses are neurotransmitter imbalance and inflammation. Neurotransmitter imbalance may include either an excess of dopamine or a depletion of acetylcholine. Inflammatory changes from endotoxins and cytokines likely contribute to delirium in the ICU.

There are many factors associated with delirium. They are divided into potentially modifiable and non-modifiable risk factors (*see table 1*). In the elderly, dementia is the most common risk factor, though non-modifiable risk factors can be present in up to two-thirds of

Table 1: Risk factors associated with delirium

Potentially modifiable risk factors	Non-modifiable risk factors
Sensory impairment (hearing or vision)	Dementia or cognitive impairment
Immobilisation (catheters or restraints)	Advancing age (>65 years)
Medications	History of delirium, stroke, neurological disease, falls or gait disorder
Acute neurological diseases	Multiple comorbidities
Intercurrent illness	Gender
Metabolic derangement	Chronic renal or hepatic disease
Surgery	
Environment	
Pain	
Emotional distress	
Sustained sleep deprivation	

cases. Other non-modifiable risk factors include age, history of neurologic disorders and multiple medical illnesses, especially chronic renal and liver disease. Gender may also play a role, as males are more predisposed to delirium than females.

Key factors with iatrogenic effects that we can modify include immobilisation, medications and sleep deprivation. One of the biggest offenders is medication. Almost one-third of all hospital admissions in elderly patients may be linked to drug-related problems or toxicity. In 2000, it was estimated that medication-related problems caused 106,000 deaths annually at a cost of 85 billion dollars. The Beers criterion is a widely used consensus criteria for safe medication use in the elderly. The result is a list of drugs that should be avoided in the elderly patient for a variety of effects, to include mental status changes in addition to others. A more recent criterion is that of STOPP (Screening Tool of Older Person's potentially inappropriate Prescriptions) which is organised by physiological systems and focuses on potential drug interactions. Recent literature seems to indicate this tool may perform better than the Beers criteria. The bottom line is that practitioners must be aware of the impact of medications on the elderly.

Signs and Symptoms

Delirium can be hypoactive, hyperactive or mixed, depending on psychomotor behaviour. Symptoms can be misinterpreted and delirium mistaken for dementia, depression or psychosis (*see table 2*). Hypoactive type can be especially difficult to recognise in the ICU. Hypoactive type is characterised by lethargy and withdrawal. Hyperactive is associated with agitation and restlessness. A study by Peterson, et al. found that hyperactive delirium was rare in ICU patients and hypoactive and mixed accounted for about 50 percent each.

> "Studies further show that delirium results in increased nursing time per patient, higher hospital costs, and an increased length of hospital stay"

Diagnosis

In the ICU, there are two tools that allow critical care practitioners to diagnose delirium. The Confusion Assessment Method for the ICU (CAM-ICU) seems to be more commonly used. It is a variation on the Confusion Assessment Method so that it can be administered to intubated patients. First, a sedation scale is used to assess level of consciousness. Then the CAM-ICU is used to evaluate four features of delirium, including acute or fluctuating course, inattention, altered level of consciousness and disorganised thinking. ***More information on the CAM-ICU can be obtained at icudelirium.org.***

An alternative method is the Intensive Care Delirium Screening Checklist (ICDSC). Due to its sensitivity of 99 percent, it has become a recommended screening tool. Again, level of consciousness is assessed. Then seven items on a checklist are assessed in those not in coma or stupor. These include inattentiveness, disorientation, hallucination-delusion-psychosis, psychomotor agitation or retardation, inappropriate speech or mood, sleep/wake cycle disturbance and symptom fluctuation. A score of four or higher makes the diagnosis of delirium. The ICDSC also makes it possible to diagnose subsyndromal delirium, by scoring candidates on a 1 - 3 level scale, though little research is available on the topic. It is possible that subsyndromal delirium is a step along the continuum toward full-blown delirium.

Imaging is of little help in making the diagnosis. CT scan findings of cortical atrophy in the various regions of the brain, as well as the deep structures, can be non-specific. However, these findings may be a marker of increased susceptibility of the brain to insults.

Table 2: Differentiating delirium and other similar disorders

	Dementia	Psychosis	Depression	Delirium
Main finding	Memory loss	Lose touch with reality	Dysthymia	Confusion, inattention
Onset	Gradual	Variable	Gradual	Acute
Course	Chronic	Chronic with exacerbations	Chronic or episodic	Fluctuating
Attention	Normal till late	Possibly altered	Possibly altered	Short span
Orientation	Poor	Normal	Normal	Flu
Consciousness	Normal	Normal	Normal	Impaired
Hallucinations	Rare till late	Common	Not usually	Common
Reversibility	Rarely	Rarely	Possibly	Usually

Prognosis

Delirium is associated with poor outcomes in ICU patients. Complications and poor outcomes associated with delirium include self-extubation, failed extubation, removal of indwelling catheters and increased mortality. Long-term cognitive function in ICU patients with delirium may be affected as well. Patients with dementia and delirium suffer worse outcomes than with dementia alone. Non-ICU studies have suggested the more severe the delirium the worse the outcome. Delirium also increases further hospitalisation and institutionalisation. A recent study by Balas and co-workers showed delirium in surgical ICU patients was an independent predictor for being discharged to a place other than home. Patients in the study who were delirious also had a greater functional decline.

The Cost of Delirium

Delirium is now considered a quality measure by the National Quality Measures Clearinghouse™ of the Agency for Healthcare Research and Quality. Though it seems delirium correlates with lower quality of care, the analysis must take into consideration case mix index and severity of illness. In an article from 2000, delirium was identified as one of the twenty-one conditions targeted for quality of care improvement in the elderly.

Studies further show that delirium results in increased nursing time per patient, higher hospital costs, and an increased length of hospital stay. The cost of delirium in US hospitals is high. According to Inouye, the costs attributable to delirium are approximately 2,500 dollars per patient per hospitalisation. This leads to a figure of 6.9 billion dollars in Medicare expenditure using 2004 figures. This is only the beginning. This does not include the costs of long-term and rehabilitation care or in-home services. Leslie et al. studied one-year health costs associated with delirium. Per patient, it was estimated that total costs ranged from 16,000 to 64,000 dollars. This would result in a national figure ranging from 38 to 152 billion dollars per year. This is comparable to the costs for falls and diabetes and should drive measures to prevent delirium in hospitalised patients.

Prevention and Treatment

It is estimated that at least 30 – 40 percent of cases of delirium are preventable. Few studies have examined prevention strategies in the critically ill patient. As indicated previously, inappropriate medications in the elderly should be avoided. Lessons can be learned from non-ICU studies.

Multicomponent intervention was the focus of a landmark study by Inouye et al. The Hospital Elder Life Program (HELP) promoted by this work is an innovative strategy of hospital care for elderly patients, which uses tested delirium prevention strategies to improve overall quality of hospital care. In that controlled trial, delirium developed in 9.9 percent of the intervention group, compared with 15.0 percent of the usual-care group. The HELP interventions can also effectively reduce the total number of episodes and days of delirium.

Proactive geriatric consultation also reduces risk of delirium after acute hip fracture. In a study by Marcantonio and coworkers, geriatric consultation reduced delirium by over one-third and severe delirium by over 50 percent. In our trauma centre, we use such a geriatric consultation protocol and reported improved outcomes in a previous contribution to this journal.

Non-Pharmacologic Treatment Strategies

There are many non-pharmacologic measures that can help but are most effective as part of a multicomponent approach as above. The emphasis is on reorientation and behavioural intervention. Caregivers should use clear instructions and make frequent eye contact with patients. Sensory impairments, such as vision and hearing loss, should be minimised. Physical restraints should be avoided because they lead to decreased mobility, increased agitation, greater risk of injury, and prolongation of delirium. Attempts should be made to limit room and staff changes and providing a quiet patient-care setting. Use low-level lighting and minimal noise at night. The use of a non-pharmacological sleep protocol can reduce the use of sleeping medications from 54 percent to 31 percent. Such a protocol consists of a glass of warm milk or herbal tea, relaxation tapes or relaxing music and a back massage.

Pharmacologic Treatment

Pharmacologic treatment begins with the avoidance of inappropriate medications, something that cannot be stressed enough. Prior to instituting new medications, non-pharmacologic prevention strategies should be in place and life-threatening conditions such as shock, hypoglycaemia and hypoxia should be corrected.

A few words of caution are indicated before using pharmacologic treatment. Medications used to treat delirium can have paradoxical effect and thus worsen delirium or over-sedate the patient. The data is not good for the efficacy of such interventions. And remember the mantra of geriatric medication: start low, go slow…but GO. Use the minimum dose needed for the shortest duration necessary.

The drug of choice for delirium according to guidelines published by the Society of Critical Care Medicine and the American Psychiatric Association is still haloperidol. Through blocking D_2 dopamine receptors, haloperidol reduces hallucinations, thought disturbance and delusions. A randomised double blind, placebo controlled study in elderly hip fracture patients demonstrated a reduction in severity and duration of postoperative delirium with 1.5mg of prophylactic haloperidol per day. The incidence of delirium was unchanged compared to placebo. So far, the ICU literature has not supported the use of atypical antipsychotics.

Conclusions

In summary, delirium is a serious cause and complication of hospitalisation in the elderly patient and should be considered a medical emergency until proven otherwise. Delirium adversely affects the overall outcome and prognosis of critically ill patients as well as substantially increasing healthcare utilisation and costs. Prevention measures, especially multi-component interventions are effective in reducing delirium and should be employed in all acute care facilities caring for elderly patients so we can get the plough back on course. ■

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APPLYING TRANSPULMONARY PRESSURE IN THE ICU

A Valuable Clinical Tool

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RESPIRATORY DEFINITIONS	
Transpulmonary Pressure (Ptp)	airway pressure - pleural pressure
Crs	Respiratory system compliance
PC	Pressure control level above PEEP
PIP	Peak inspiratory pressure

Mechanical ventilation in the intensive care unit (ICU) is usually guided by arterial blood gases, and the parameters used to maintain these blood gases are limited by standards for lung protective ventilation (The Acute Respiratory Distress Syndrome Network, 2000). Airway pressures and tidal volume are minimised for lung protection despite evidence that they may be inadequate surrogates for lung stress and strain (Chiumello et al. 2008). Transpulmonary pressure represents true lung pressure, and physiologically is ≥ 0 cmH_2O at end exhalation. Transpulmonary pressure < 0 cmH_2O results in a lower functional residual capacity (FRC), lower compliance, and airways are prone to collapse on exhalation (Behazin et al. 2010). Our respiratory therapists hypothesised that a patient admitted to St. Joseph's Healthcare ICU from an external facility was being ventilated with insufficient positive end-expiratory pressure (PEEP), causing a negative transpulmonary pressure. Here we describe the case, and the outcome.

Patient Case Overview

A 65-year old morbidly obese male (BMI 55.5 kg/m^2) with obesity hypoventilation and severe COPD was intubated for respiratory failure, secondary to pneumonia. He received a tracheostomy after 10 days of ventilation and was transferred on the 22nd day of invasive mechanical ventilation to St. Joseph's Healthcare facility to utilise our bariatric CT scanner to rule out abdominal sepsis.

The patient was sedated and apneic on arrival with ventilation settings as follows:

- Positive end-expiratory pressure (PEEP) of 10 cmH_2O;
- Pressure assist control of 20 cm H_2O above PEEP;
- Respiratory rate of 20 bpm;
- Inspiratory time of 1.0 seconds;
- FiO_2 of 1.0;
- Initial blood gas analysis was pH 7.16 $PaCO_2$ 50 mmHg PaO_2 215 mmHg HCO_3 17 mmHg SaO_2 0.99, and
- Haemodynamically, the patient was hypotensive and required norepinephrine to maintain an acceptable blood pressure.

Initial Patient Management

The first 12 hours of ventilation at our facility were challenging. The patient's ventilation requirements had increased to the following:

- Pressure assist control of 32 cmH_2O above PEEP;
- Respiratory rate was 30 bpm;
- Inspiratory time of 1.0 seconds;
- PEEP of 12 cmH_2O and FiO_2 of 0.5, and
- Blood gas analysis on these settings was pH 7.17 $PaCO_2$ 47 mmHg PaO_2 63 mmHg HCO_3 16 mmHg SaO_2 0.9.

Method and Management Using Oesophageal Pressure Manometry

An oesophageal balloon was inserted into the patient to determine transpulmonary pressure (Ptp). It was suspected that the patient might not have had the PEEP level needed to achieve a normal end-expiratory transpulmonary pressure (PtpPEEP > 0 cmH_2O). The oesophageal balloon catheter was inserted to a depth of 60cm and gentle compression of the abdomen was done to confirm placement. The catheter was then pulled back 40 cm after which cardiac oscillations were observed to be present, and the waveform clearly different than previously (*see fig. 1*). With the patient sedated and paralysed using a neuromuscular blockade, an expiratory hold was done to obtain a stable transpulmonary reading. The resulting Ptp value was −12 cmH_2O. To achieve a transpulmonary pressure close to what

would be physiologically normal (Ptp ≥ 0 cmH_2O), the PEEP was increased from 12 cmH_2O to 24 cmH_2O.

Patient Response

The 48-hour trend of PaO_2/FiO_2, respiratory system compliance and peak airway pressure are shown in figure 2. The blood pH improved as a result of HCO_3 increasing to a normal level. The respiratory rate and peak airway decreased significantly despite the CO_2 level remaining 45 - 47 mmHg over 48 hours. The PaO_2/FiO_2 ratio increased significantly from 126 to 370 as PEEP was titrated, according to Ptp, from an initial increase to 24 cmH_2O, and then to 18 cmH_2O 48 hours later.

Improved Outcome

The use of oesophageal pressure manometry to determine Ptp and set PEEP in this patient resulted in an individualised lung protective strategy. The end result was improved oxygenation, improved ventilation (lower minute ventilation required), improved respiratory system compliance and peak airway pressure below the limitations recommended by literature. The patient was returned to the sending facility two days later with a PEEP of 18 cmH_2O, FiO_2 of 0.30, PC of 12 cmH_2O and a respiratory rate set at 22 bpm.

Supporting Research

A study by Behazin et al. found that obese patients have higher pleural pressures than non-obese patients when sedated and paralysed for surgery (Behazin et al. 2010). This causes tidal breathing to occur at a lower FRC, lungs are less compliant and airways are prone to collapse during exhalation. It was also concluded that the pleural pressures were variable, and not predictable by BMI, making the measurement of Pes and Ptp a valuable clinical tool. The level of PEEP required to maintain a Ptp > 0 in this sedated patient was slightly higher than the normal range for surgical patients with BMI levels > 38. The cause of this patient's elevated pleural pressure may have been due to his fluid requirements secondary to hypotension caused by his sepsis.

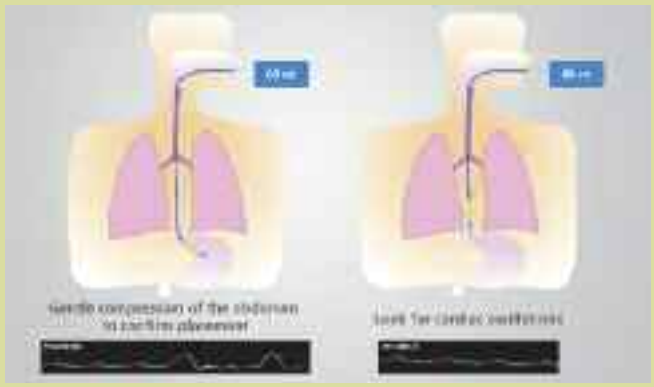

Figure 1: Insertion of the oesophageal balloon

Benefits To Measuring Transpulmonary Pressure

The benefit to measuring Ptp is having the possibility to understand the patient's true lung mechanics. Airway plateau pressure has become a standard in lung protective ventilation, but it is only one part of the Ptp equation **(airway pressure – pleural pressure = Ptp)**. This concern over airway pressure is that pleural pressures are variable and unpredictable. These differences are not distinguished by airway pressure alone. Therefore, the level of PEEP applied in a patient may be insufficient, or excessive. PEEP that is insufficient leads to a negative Ptp and would lead to atelectrauma; PEEP that is excessive can cause a positive Ptp that may lead to overdistension during tidal volume delivery. The benefit of knowing true lung mechanics is extremely valuable in ARDS patients.

> *"The use of oesophageal pressure manometry to determine Ptp and set PEEP in this patient resulted in an individualised lung protective strategy"*

In my experience, I have seen clinicians be less concerned with elevated PIP in obese patients assuming that the size of the patient implies that they don't "feel" the pressure. This study helps demonstrate that when PEEP is set optimally, high PIP may not be necessary.

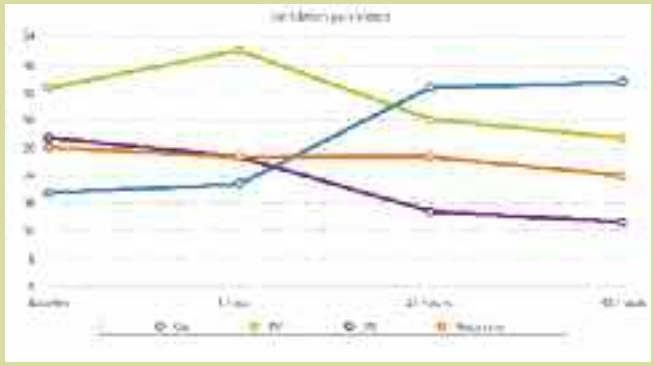

Figure 2: The 48 hour respiratory trend.

Patients with primary (pulmonary) or secondary (extra-pulmonary) causes of ARDS can be easily distinguishable. Once optimal PEEP is set (Ptp of 0 cm H_2O) patients with very stiff or non-recruitable lungs (pulmonary ARDS) may have high PtpPlateau pressures. Monitoring and making attempts to minimise pressures in these patients becomes very important (keeping PtpPlateau < 20 cm H_2O) (Chiumello et al.

Continues on page 37

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SIMULATION TRAINING

Key to Improving Clinical Skills and Patient Outcomes

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Advances in technology continue to have an impact on the healthcare system. With the focus on limiting and prevention of medical errors over recent decades, many of these technological developments have centred around the training of new physicians. The Clinical Skills and Simulation centre, or simply 'Skills Lab' located within the faculty buildings at UZ Brussels has become an integral part of the "Integrated Medical Campus Jette Assistance Landscape".

Background

Traditionally, the medical school at the Free University of Brussels devoted a considerable amount of attention to bedside clinical training and internships. For many years, this was accomplished by students preparing the preclinical patient contacts with clinics and clinically oriented summer seminars for students who succeeded in their first year of medical education.

In 1993, at the Etterbeek campus, the medical skills course was introduced to the first year curriculum as a nursing course and included practical work, plus a nursing observation and placement on various nursing units in UZ Brussel.

From then onwards, the concept of "problem-based learning" was implemented in the curriculum. Students were confronted with a range of multidisciplinary problems and various elements of knowledge needed to be integrated to find answers to the questions raised. In addition to the acquisition of separate theoretical and actual (practical, clinical) knowledge, students were given the opportunity to have earlier contact with realistic patient problems.

"…there is a great deal of motivation in knowing that you are preparing skilled doctors rather than just accomplished students"

Concept of Problem-based Learning

Within the constraints of being given a realistic problem to be solved with knowledge gained within the classroom and in a clinical setting, the learning process is thus initiated and is continuously stimulated by exposure to the changing variables inherent to the practice of medicine. This approach leads to the development of appropriate attitudes, develops social and communication skills in order to foster successful interactions between team members as well as between caregivers and patients. It also serves to promote the development of adequate skills needed to provide professional assistance through conversation, in addition to the preclinical development of cognitive and motor skills associated with actually performing the physical examination and procedures.

Rationale

The skills lab was designed with the intention of improving preclinical competencies and skills to learn and optimise simulation and training. These include: professional attitude, communication skills and interview techniques as well as cognitive and motor skills and physical examination procedures. The aim of incorporating this important programme into the curriculum is clear: Student doctors benefit greatly from a safe environment where they can hone their skills, deal

with simulated treatment situations; and should errors occur, they should be able to manage and critique their performance without undo danger to actual patients; thereby avoiding "rookie mistakes".

The skills lab also allows trainees to acquire competences in medical history, clinical research, technical research and treatment, physician-patient communication and clinical consultation.

The "Clinical Skills and Simulation Centre" is coordinated and controlled by the Department of Critical Care, more specifically by the lecturers and instructors of the courses under the medical skills umbrella. However, as multidisciplinary consultations are a significant part of the process in the emergency room and critical care setting, teachers from other disciplines are also involved to enrich the experience.

The Clinical Skills and Simulation Centre focuses on basic medical training, further education and lifelong learning which includes the continuous application of new guidelines to healthcare providers and industry.

Training

During their third year, medical students work in small groups spread over a number of medical skills laboratory workstations, including:

- Hygiene;
- Nasogastric tube placement;
- Enema and bleeding nose;
- IV insertion in children;
- IV insertion in adults;
- Bladder catheterisation in men and women;
- Basic life support and choking in children;
- Airway management in adults and children;
- Basic life support and choking in adults;
- Feeling and judging the pulse, measuring blood pressure, use of the electrocardiogram;
- Communication and consultation techniques consisting of an interview, taking of clinical history of standardised patients (includes role play and video / DVD recording).

The training in the skills lab differs from some others in that each element and technique practiced is evaluated and critiqued not only by observing instructors, but also by the students themselves. Following the initial exercise, often the students insist on repeating the skills to be acquired.

The skills lab procedure is as follows:

The students are divided into small groups (4 - 7 per workstation). Each workstation has a tiered approach to acquiring competence or skill. This includes four phases:

Continues on page 26

OVERVIEW OF COST-EFFECTIVENESS ANALYSES OF IMMUNONUTRITION IN CANCER PATIENTS UNDERGOING A MAJOR GASTROINTESTINAL SURGERY

Dr. Hélène Chevrou-Séverac, Ph.D.;
Head of the Health Economics function, Global; Nestlé Health Sciences

Cost of post-surgical infectious and non-infectious complications

The cost of healthcare-associated infections (HAIs) in US Hospitals has been reported to be $25,546 for a case of surgical site infection, $36,441 for blood stream infection, $9,969 for ventilator-associated pneumonia and $1,006 for catheter-associated urinary tract infection[1] by the Centers for Disease and Control in 2010 (CDC). Infections are the most frequent cause of morbidity after surgery and up to 54% of all hospital-acquired infections occur in high-risk surgical populations[2]. Surgical site infections (SSIs) account for 14%–16% of all nosocomial infections in inpatients and are considered the most common form of nosocomial infection among surgical patients[2]. The incidence of incisional SSI in patients undergoing elective colorectal resection can account for up to 25%[3].

Immunonutrition containing arginine to curb the risk of post-surgical infections & complications

Immunonutrition (IN) containing arginine has been proven in numerous randomised clinical trials (RCTs) to reduce postoperative complications and LOS (length of hospital stay) in surgical patients. Immunonutrition is supported by Grade A recommendation by SCCM / ASPEN & ESPEN guidelines[4,5]. A recent meta-analysis of randomised clinical trials comparing immunonutrition to standard enteral nutrition (EN) in 2,730 gastrointestinal (GI) cancer surgical patients[6] demonstrated that use of IN prior to the surgery reduces significantly the risk of post-surgical infections by 52% (Relative Risk= 0.48 and Odds Ratio=0.36), the risk of post-surgical overall complications by 31% (RR=69, OR=0.48), and the length of hospitalisation by 2.42 days on average. When used peri-operatively, use of IN was demonstrated to decrease significantly the risk of infections by 50% (RR=0.50, OR=0.41), the risk of complications by 38% (RR=0.62, OR=0.39) and the LOS by 1.63 days on average.

The meta-analysis by Drover et al.[7] demonstrated, in elective surgical patients, that when compared to standard EN, the IN formula containing arginine, fish-oil (FO) and nucleotides decreased significantly the risk of infections than the other formulas, by 51% and 5% respectively (RR=0.49 and 0.95). Hospital LOS was also further reduced for patients taking the IN with arginine, FO and nucleotides, with a reduction of an average 2.62 days compared to control, versus 0.89 days for the other IN formulas compared to control (p<0.001).

Cost-effectiveness analyses of immunonutrition in surgical GI cancer patients

Due to reduction in infections and complications as well as length of hospital stay with the use of IN shown in clinical studies in surgical patients, cost reduction can be expected in their treatment's pathway. Five studies have assessed the cost-effectiveness and impact on hospitals' cost of IN in GI cancer surgical patients. Two of them[7,8] used the same data with hospital cost gathered from GI cancer surgical patients' record of the randomised clinical trial in Italy. They demonstrated that the use of IN pre-operatively in well-nourished patients allowed hospital to save €1,420* per patient due to reduction in post-surgical complications. Senkal et al. performed a cost-effectiveness analysis alongside their RCT on IN used perioperatively for the same patients' population[9]. They found that IN was a cost-savings nutritional intervention in GI cancer surgical patients and reduced hospital cost by €1,204* per patient.

Two recent cost-effectiveness analyses have been done in relation to the surgical GI cancer patients' population[9,10]. In Mauskopf's analysis[10], clinical data were adapted from the Waitzberg et al. meta-analysis[11]. Cost data were extracted from the HealthCare Utilization Project (HCUP)[12] 2008 from records of patients with the same diagnostics and interventions. Based on reduction in complication rates, IN used peri-operatively was demonstrated to reduce hospital costs by €3,188* per patient ($4,227 for 2010). However, in this analysis, it wasn't possible to isolate the cost of the surgery into the cost database. Although cost of surgery are expected to be equivalent in the IN and the control groups, and therefore not taken into account in the incremental cost analysis, savings may have been overestimated.

Chevrou-Séverac's study[9] was based on the recent meta-analysis of Cerantola[6]. Hospital cost data were obtained from Swiss diagnostic-related group database for patients with the same pathologies and surgeries as in the meta-analysis. In this cost-effectiveness analysis, the costs of surgery and the costs of care incurred by the case severity independently of the complications were retrieved from the hospital cost. This analysis demonstrated that the use of IN is more efficient and cost-saving than standard of care, with savings of €1,237* per patient-stay for peri-operative use and €2,025* per patient-stay for pre-operative use.

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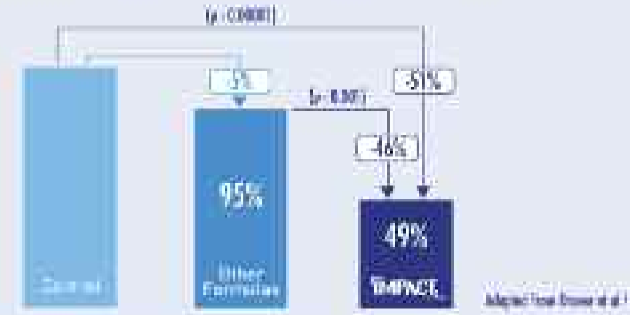

Supported with Grade A Recommendations from the European Society of Clinical Nutrition and Metabolism (ESPEN) and the 2009 ICU Critical Care Guidelines for[4,5]:

- **Abdominal Cancer Surgery**
- **Head and Neck Cancer Surgery**
- **Trauma**

Conclusion & Discussion

The costs of immunonutrition for surgical GI cancer patients were offset by the savings due to the decrease in infections. Despite difference in national medical practices or in costing methodologies, compared to standard oral or enteral nutrition, immunonutrition decreases risk of post-surgical infections and saves hospital budget in all countries considered. Although the clinical efficacy of immunonutrition is quite well established, it's striking to see the significant difference in the use of IN for GI cancer surgical patients between countries, hospitals and even surgeons of a same institution. A recent study[12] demonstrated that factors contributing to the lack of use of perioperative nutrition despite the guidelines[14] recommendations are: lack of reimbursement of IN to patients, financial restrictions in hospitals, lack of malnutrition screening, logistic gap between where nutrition is screened (outpatient) and where the intervention should be implemented (inpatient), lack of knowledge and understanding of IN and medical nutrition interventions.

This overview on cost-effectiveness analyses of immunonutrition brings additional arguments to promote its use in hospital settings. Integrating nutritional status screening and nutrition intervention in protocol of care and healthcare logistic are also important steps in the fight against post-surgical infections and HAIs.

* All values were converted into € for comparison purpose.

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Continues from page 23

- Preparatory phase of knowledge acquisition by syllabus and multimedia training (i.e. to know why and how);
- Training phase, under supervision (to show how);
- Evaluation phase, completed alone, and
- Repetition phase until student has sufficient mastery of the skill.

Within the evaluation phase, positive reinforcement techniques are utilised: i.e. "What was done well?" and "What can be improved?"

Reality Check

In the first years of study, medicine is not unlike other higher-learning courses, but as is often discussed; not all would-be physicians are well suited for the field. One of the important benefits of the hands-on curriculum is that students have the opportunity early on in their training to experience the realities of healthcare in practice and often they discover whether or not to have the required skills and personal characteristics for the future profession.

In addition, garnering an early, clear perception of how healthcare professionals work, provides students with attuned goals and a good insight into their work, and allows for early theoretical insights that may be useful later on in their medical career.

Facility

The skills lab is also utilised by other programmes of the Faculty of Medicine and Pharmacy and the VUB (e.g. IDLO, physiotherapy, etc.), as well as Erasmus University (nursing and midwifery training), the University Hospital Brussels (airway management and ventilation techniques, basic and advanced life support, training for updates of guidelines, etc.) and industry (e.g. ventilation workshops are temporarily made available to industry partners who are interested in a training simulation environment).

Materials

The skills and simulation center is equipped with high technology modules, software and simulation equipment. Maintenance is done by the users and instructors and on an annual basis through a maintenance contract with suppliers. The scenarios and learning objectives for each workstation are written in a syllabus and are also available in video / DVD the skills lab so that students can readdress any issues they encounter in their initial training. ■

Q & A

Sherry Scharff with Saïd Hachimi-Idrissi, Coordinator of the Clinical Skills and Simulation Centre at UZ Brussels

SS- What is the central motivation for coordinating the skills lab?

SHI- It is the future. Well, at the very least, I believe the use of simulation in training is an integral part of modern medical education. And, it involves a completely different way of teaching. The traditional form of study involves a large class with teachers talking, using slides to demonstrate techniques and rationales, and students listening and taking notes. Skills lab is different in that it teaches by involving students in small groups in practicing the techniques rather than just talking about them; even beginning in first year where we ask them to take the histories of the patients.

SS- Would you say it is difficult to organise such a skills training programme?

SHI- It can be a very slow process, if you build it course by course as we have since our initial course in medical skills in 1993. However, we do utilise all of our resources, including using nurses who work with chronic critically ill patients to play the role of patients and we are always looking to develop, and expand the courses we offer and the departments and outside interests who may want to participate.

Currently, we have an excellent basis in terms of equipment and selection of courses, which I feel encompass the skills students need to hone, and help to eradicate many of the errors made in the clinical setting.

After the histories are taken, we practice the basic steps (diagnostic and technical) such as inserting an IV and clearing the airway, that are required for these patients. Of course, we use models rather than nurses for the technical skills practice, such as with CPR and intubation, but the role-play experience is integral in the success of this teaching style; in fact we even have dummy models that talk to test students' response.

So, to answer your question: Is it easy to coordinate this programme? Would it not be simpler to just teach in the traditional way? Of course! But there is a great deal of motivation in knowing that you are preparing skilled doctors rather than just accomplished students.

For more information and videos: **http://skillslab.vub.ac.be**

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POCKET-SIZED ULTRASONIC STETHOSCOPES

The Value of Bedside Skills

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Accurate First Impressions Crucial

Obtaining an accurate initial diagnostic assessment is the goal of every clinician, but has particular life and cost savings in the patient who presents acutely ill or in a remote location. Perhaps due to revealing features unique to the presentation and to optimise patient throughput, our initial patient assessment is typically "front-loaded." As time and clinical stability permit, we place more effort at the first encounter in obtaining historical data, admission lab testing and imaging as compared to subsequent visits. The provisional diagnosis that emerges from this interaction is therefore often unquestioned and treatment is usually initiated, often with ensuing consultation and confirmatory testing. Early diagnostic errors could have disastrous outcomes both in patient survival and costs, by resulting in inappropriate triage, tests, treatments, or extended hospital stays. Therefore, a more accurate "first impression" of the patient's illness could reduce time-to-diagnosis, which in turn would minimise costs and medical errors.

What Role Does Pocket-Sized Ultrasound Play?

It is against this background that pocket-sized ultrasound devices have emerged. Amidst other tools that appear simplistic in comparison, such as the sphygmomometer, traditional binaural "stethoscope" and reflex hammer, the ultrasonic stethoscope ultimately fulfills its own definition by allowing us to finally "see" pathology that centuries-old methods such as percussion and auscultation had us infer about the lungs, heart and intra-abdominal spaces. Laptop-sized, hand-carried ultrasound platforms have existed for years and have great versatility, inspiring the bedside use of ultrasound for limited exam and procedural guidance as in the case presented.

> *"Obtaining an accurate initial diagnostic assessment is the goal of every clinician, but has particular life and cost savings in the patient who presents acutely-ill..."*

Physical exam skills once relied upon for immediate diagnosis have deteriorated over the years, partly supplanted by sophisticated point-of-care lab testing and imaging. In particular, exam skills using the indirect methods of percussion or auscultation for cardiopulmonary or intra-abdominal pathology have been lost or abandoned. Few physical exam findings of these internal regions, other than pulselessness and wheezing, will elicit immediate treatment without more confirmatory testing. In addition, the difficulty of performing auscultation and percussion in noise-filled emergency rooms or intensive care units and the minimal time for patient exam limits the use of time-honoured physical exam techniques. This evolution away from older, traditional practices may be justifiable, as evidence-based scrutiny is lacking for many of these subjective exam techniques when applied in contemporary settings.

However, much like application of an electrocardiograph, these larger, luggable devices must be found in the corner of the department and wheeled by cart to a patient's

CASE STUDY

Paramedics found a 50 year-old man in his apartment, dishevelled and with altered mental status. Mildly hypothermic and hypotensive, he was brought into the emergency room where a brief initial cardiovascular physical survey found no pulmonary rales, wheezing, cardiac gallops or murmurs. The patient was intubated for airway protection.

A three-minute cardiovascular limited ultrasound exam (CLUE) using 2D imaging of six sites was performed at the bedside using a 3MHz transducer. The parasternal long-axis left ventricular cardiac view demonstrated depressed LV systolic function and mild left atrial enlargement, suggesting congestive heart failure. A "four-corner" exam (two apical and two basal views) of the lung, quickly showed bilateral ultrasonic lung comet-tail artifacts (see figure 1) and pleural effusions, consistent with pulmonary oedema and chronic heart failure. The subcostal view excluded a significant pericardial effusion indicative of tamponade, but demonstrated right ventricular enlargement, consistent with pulmonary hypertension. A midline abdominal scan showed a dilated intrahepatic inferior vena cava, suggesting ample central venous pressure and found an abdominal aortic aneurysm consistent with advanced atherosclerosis (see figure 2).

The patient underwent head, chest, abdominal and pelvic CT scanning, which were remarkable for subdural hygromas and a 5.5cm abdominal aortic aneurysm without signs of rupture. He was admitted to the intensive care unit where a 5MHz ultrasound venous exam was used to gain jugular venous access in the neck and then exclude subsequent pneumothorax by the presence of persistent lung sliding and comet-tail artifacts. Before venous compression stockings were applied, compression of the deep veins at femoral and popliteal sites was demonstrated by using the same ultrasound transducer.

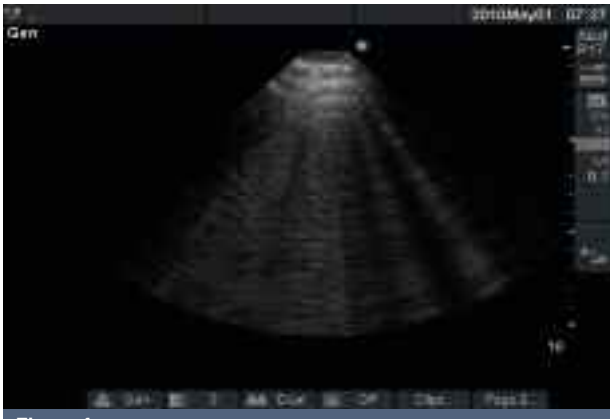

Figure 1.
Bedside apical lung view using a laptop device and a 3.5MHz cardiac transducer demonstrates the ultrasonic lung comet-tail artifact, consistent with pulmonary oedema or interstitial lung disease.

Figure 2.
Bedside longitudinal view of the abdomen demonstrates an abdominal aortic aneurysm, consistent with advanced atherosclerosis.

bedside that is already cluttered by personnel and equipment. The distinct advantage of the pocket-sized device is the on-the-spot immediacy and convenience of its use as part of the physical exam and not as a separate diagnostic procedure. The limitations of these devices when compared to standard equipment are yet to be fully understood and are likely related to its accuracy during difficult ultrasound applications, including difficult windows in need of advanced image optimisation techniques or in the detection of subtle findings such as wall motion abnormalities.

Getting a Clue to Diagnosis

Despite novelty, appeal and modest costs (less than 10,000 dollars per device), pocket-sized ultrasonography will encounter many challenges to widespread adoption. In order to generalise and standardise use, there will be the need for development of suitable imaging protocols for these smaller devices, akin to the cardiac physical exam. Prior cardiac hand-carried ultrasound studies have been biased by examining advanced imaging by cardiologists or use by highly-motivated noncardiologists and demonstrate limitations in accuracy and performance relative to the complexity of the imaging protocol employed.

The imaging protocol in the case presented, CLUE, is a prototypical applica-

tion for bedside ultrasound and is well-suited for pocket-sized devices. CLUE is brief, avoids the complexity of Doppler, and provides diagnostic and prognostic information. Although CLUE will miss subtle diagnoses such as endocarditis and isolated wall motion abnormalities, the application time (less than five minutes) and training requirements are comparable to that of auscultation, making it suitable for use by all physicians who need immediate bedside data on cardiopulmonary structure and function. CLUE will increase the sensitivity of the initial evaluation for cardiopulmonary disease and, particularly in patients with unexplained dyspnea or hypotension, could result in earlier, more accurate referral for echocardiography, CT imaging, and cardiac or pulmonary consultation.

Once full-body imaging protocols have been developed for pocket-sized ultrasonography, validation of the accuracy and clinical impact of this "ultrasonic physical" upon outcome can be performed, a requirement never fulfilled by currently employed physical exam techniques. Research, coupled with consensus opinion, could define the accuracy and competency requirements necessary to train a generation of physicians in bedside ultrasound. CLUE instruction can be successfully incorporated into the formal internal medicine curriculum as it has for years at the authors' institution, despite the recent mandatory reductions in residency hours (see figure 3).

Figure 3.
Two internal medicine residents, each with a different pocket-sized stethoscope, learn and demonstrate imaging techniques on their chief resident, during dedicated ultrasound training at our institution.

Implications for Standard Studies

In addition to the salutary influence on initial diagnostic impressions, limited or screening ultrasound exams may have profound consequences on referral for conventional ultrasound testing. Multiple studies have been performed to project the diagnostic and cost effects of a "limited" echocardiographic exam upon referral for a standard echocardiogram. These studies suggest that the advantage of more accurate limited bedside exams is in the reduction of unnecessary testing of low-risk subjects. In the utilisation of echocardiography for suspected mitral valve prolapse, a limited echo screening strategy in which only abnormal limited studies would invoke referral for a comprehensive exam projected a 50 percent reduction in echo costs through the elimination of essentially normal studies.

Conversely, the high sensitivity of bedside ultrasound will increase the number of referrals for formal studies for suspected abnormalities that may be purely incidental or asymptomatic. The frequency of incidental echo abnormalities can be significant in certain populations, approaching 80 percent in elderly male inpatients. The cumulative effect on cost, missed diagnoses, and study volume will remain unknown until a screening bedside cardiac exam is formalised and minimal competency requirements are defined. However, the overall effect of an improved bedside exam may support a laudable, cost-neutral goal of shifting conventional ultrasound resources away from a healthy normal population and towards a more ill population with unsuspected disease.

Conclusions

Device application and novel ultrasonic exam "signs" will need to be elucidated in the coming years. Current medical practice is much more circumspect of the cost and effect of any additional diagnostic techniques, particularly those with accuracies that vary with physician skill, and will require evidence-basis for clinical application of these devices. The true determinant of the success of the ultrasonic stethoscope will be in whether it can disseminate into general medicine and not simply be a sophisticated tool for expert subspecialties. Although it seems likely that pocket ultrasound could improve any physician's immediate bedside impressions, questions remain regarding how the overall diagnostic accuracy and costs of this skill-dependent, subjective technique will integrate with the objective data of conventional laboratory and radiographic imaging. At the present time, further studies are necessary to formulate and test the accuracy of robust imaging protocols suitable for these smaller instruments. ■

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DATA CENTRE TRENDS IN THE HEALTHCARE SECTOR

Balancing Growth, Budget and Compliance

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Growing IT applications are taking a central position in the functioning of any healthcare facility. Existing sites are commonly relying on older IT and technical facilities, not able to support the new and demanding requirements of tomorrow's organisations. Cooperation with other similar healthcare companies allows for optimised investment and operational budgets, whilst this differentiated on-site/off-site approach ensures required speed and reliability for the critical services.

Identifying Trends

The healthcare sector has, over the past few years, seen an unprecedented evolution towards electronic applications. As broad a range of services as one can think of are currently in use, or being rolled-out on a large scale.

To list only a few significant applications:

- Electronic Patient Records (EPR);
- PACS Server & Storage;
- Nurse Call Stations;
- Patient and ICS Monitoring;
- Pharmacy Information & Recip-e;
- Patient Bedside Entertainment;
- Remote Applications;
- Geolocation Services

and even veterinary practices are run through local and larger networks.

Figure 1.
Imaging of a knee. One diagnosis: 250MB of data files

Reference healthcare projects in the USA have shown a 300 percent growth in power, and a 200 percent growth in IT space over the last three years. The impact the immense growth of these services has on the required facilities to manage and maintain such operations is staggering. This article aims at identifying some key challenges and attempts to suggest a few (out of many different) solutions that could offer means to address these challenges. To conclude this introduction, some examples of specific applications which have made international press coverage throughout Europe recently:

- Finland expects to have its National Medical Archives grown to a capacity of 550 PB by 2025;
- UZ of Leuven, Belgium, is introducing patient bedside terminals to offer monitoring, as well as entertainment stations;
- SMS alerting patients to take in critical medications;
- Remote Telepresence services cutting out the doctor to patient distance; and
- The training of aspiring surgical students with the Wii.

Challenge: IT and Applications

Applications that have grown out of different perspectives are increasingly expected to communicate with each other; or even to offer a single platform for all healthcare services. From the EPR archive to the imaging databases to hospital administrative services, these applications are becoming more and more integrated. A considerable effort in software and systems is needed to transfer existing single services into fully integrated application platforms.

Data can be critical, sizeable, "living" or dormant in archives. To correctly identify the required application's handling, one must assess the nature of the data and allocate the required resources.

- Critical data ("life or death"), like intensive care monitoring, imaging databases and medication management services need to be readily available. Speed and reliability are paramount.
- EPR archives and storage can be bulky, but needn't be kept in such critical environments as the critical data.
- Patient entertainment systems could be considered "obsolete"

in the case of system failure, but when integrated into patient monitoring systems, are immediately upgraded to semi-critical applications.

As far as IT related services are concerned, these critical requirements can be translated into Bandwidth (processing the data as fast as possible), Redundancy (allowing for timely and secure backups), and Disaster Recovery solutions. In any case, the strategy for each of these is to be nested deep in the overall site's Business Continuity Plan.

Would you invest all your capital into a single stock?

When applying this to significant medical infrastructures (hospitals, doctor/specialist co-ops, etc), the way forward is on one hand to maintain a relatively small, but very critical facility on-site or on-campus, and a second, larger and maybe even shared off-site "data warehouse". The on-site facility, with minimal latency delays to the end-users, manages critical data (intensive care, operating rooms, "active" patient records) being built for speed and reliability.

The off-site facility is mainly focused on archiving dormant patient records and medical information. Sharing the burden on campus, regional, national or even international level allows for optimal allocation of resources, reducing shared costs and outsourcing specialised services. This is where National Medical Archive type projects come into view. This off-site facility is also setup as a Disaster Recovery site, able to take of critical processes should the primary on-site facility fail. Required latencies/bandwidth for such scenarios is to be evaluated.

Taking it one step further, an even more diversified approach is adviseable. Duplicating archives over different sites (nationally, or why not, internationally diverse), mitigates many technical, natural and regional risks, and although perhaps counter-intuitive, can significantly reduce investment costs and operational expenses.

Looking toward private "Cloud"-type solutions could very well be the final step, but, as further discussed, will raise significant data security and compliance concerns.

Challenge: Facilities

The cumulative effect of the identified trends is placing an ever-greater demand on healthcare facilities to provide more data centre space, capacity and fit for purpose infrastructure. Space is at a premium, and where core-business is of a medical nature, supporting services are often driven underground.

> *"Accurately predicting growth for a 5 - 20 year period will remain, for the foreseeable future, a fool's errand"*

In existing sites, one can spend days in the basement, hopping from one department's "IT shed" to the next. None are designed for function, none are efficient in either space or energy consumption and more often than not, significant vulnerabilities to accidental mishandling can be quickly identified. Expanding and upgrading these legacy housings is challenging, costly, if not downright impossible, posing significant threat for the site to manage current and future evolutions.

The proposed solution as highlighted in the "IT and Applications" section, is relevant here as well. Integrating all critical applications at a site-wide level into a single designed-for-purpose location reduces operational costs, combines investment efforts and better manages current and future needs.

The key challenge for this to work lies with the company's CFO. All too often, budgets are spread out over different departments and it is difficult to identify available budgets for IT-related systems, let alone to get these departments get to see eye-to-eye when it comes down to the money talk. The care and management for the IT infrastructure needs to be centralised and must not be segregated between a number of departments.

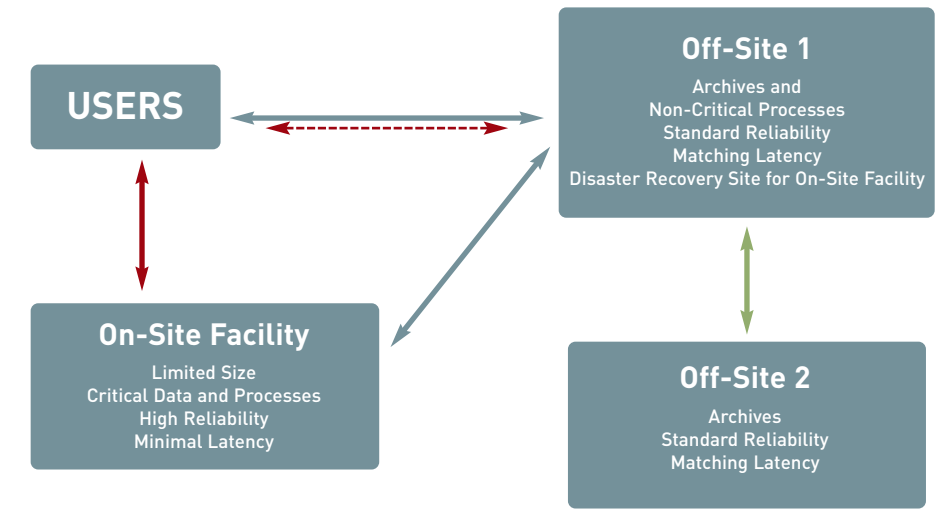

Figure 2.
Different sites with specific objectives each have their own resiliency, size and communication requirements

Returning to the on-site facility, one would expect a high-power density, very efficiently operated (electrically and mechanically) installation, built for speed and reliability. As mentioned, the off-site facility/facilities can be outsourced to specialised companies, providing infrastructure with relevant service level agreements.

Challenge: What Does the Future Bring?

Figure 3.
Cramped, inefficient, out of data IT shed.

Barring scientific breakthroughs in the research field of space and time, it is impossible to predict what the current evolution of e-services will look like in five, ten, let alone 20 years. Accurately predicting growth for a 5 - 20 year period will remain, for the foreseeable future, a fool's errand.

Building massively oversized installations, both in space, power, cooling and communications is costly, inefficient, and downright bad for business. Though looking back a couple years can prove helpful to understand what could happen, pinpointing what will happen is not possible. Therefore, it is imperative to design facilities to requirements and allow for quick and safe expansions in future. Modular data centres and scalable installations are buzzwords of the IT facilities sector, but are certainly worth looking into. The advantages are clear:

- Reduced investment costs;
- Improved efficiency;
- Optimal use of space and resources.

There are however dangers for scalable sites too. Again, the IT strategy needs to be controlled centrally, and any changes, upgrades or expansions of installations need to be well considered, and must not adversely impact future flexibility. A critical site needs to be thoroughly commissioned before release. How will you commission future expansion on, an at that point, live data centre? It's certainly not impossible, but it can be quickly made impossible.

Legal and Security

When integrating critical and confidential patient records, security and privacy must not be overlooked. Many national governments have implemented privacy and data protection acts. European regulations are also coming into view, such as:

- The Data Retention Directive;
- The Personal Data Processing Directive; and
- European Medicines Agency guidelines.

But apart from these market-specific guidelines, other issues need to be scrutinised as well. Local criminal law and law enforcement specifications can force your medical database facility to open its doors during investigation procedures.

Joining all data into a single medical archive raises further concerns. One advantage would seem that all emergency rooms possess full and relevant patient records, but do we allow all doctors to access all patient records? Weighing quick accessibility in emergencies against patient record security and privacy will be a difficult hurdle to take. How is privacy aligned to the installment of medical databanks? This is certainly an issue to liven up legal debate in coming years.

Conclusions

The explosive growth in e-health applications puts significant strain on IT departments, supporting facilities and allocated budgets. A diverse approach to managing medical data and other related services has proven a valid model.

The healthcare facility data centre is no longer a mere supporting element but has become the very core of the operations of the healthcare sector. An effort needs to be made to get the IT shed out of the basement and give it the status and reliability it needs. However, integrating many sources and types of medical data requires significant thought to protect patient privacy.

> *"Weighing quick accessibility in emergencies against patient record security and privacy will be a difficult hurdle"*

An integrated solution calls for an integrated approach, where the central management office play a crucial role: requirements need to be detected at an centralised level, budgets need to be allocated at centralised level, and the very IT infrastructure and facility needs to managed and operated at centralised level. ■

LOOKING BACK ON 2011

For this edition of ICU Management, we asked four influential leaders in critical care medicine, "What was the most important or interesting development in intensive care in 2011?" with the aim of pinpointing the hot topics in critical care and emergency medicine during the year just past, and identifying trends for the future. Each contributor provided a different and important viewpoint that identifies key strengths and weaknesses in the provision of care today, from the availability of ICU beds to driving greater awareness with regards to the need for greater attention to quality control.

PERSISTENT ORGAN FAILURE BEFORE DEATH IN PATIENTS WITH SEVERE SEPSIS

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Intensivists are used to describing the patient's condition at the time of handover or when speaking to family members as stable, suggesting that nothing new has happened during the last period of clinical treatment or evaluation, usually one day. Families generally receive this information as positive news, thinking that as there has been no further deterioration, that this will give space for future improvement. In actuality, things may be quite different, because even staying in an ICU itself, receiving care over a long time may expose the patient to serious complications, such as sepsis, which can ultimately be responsible for death. A positive evaluation of a patient receiving ICU care should contain at least some minor improvement, such as in terms of reduced support (for instance, lower FiO2) or better vital parameters (e.g. increased oxygenation, as in our example).

> *"A paper by J-L Vincent published in Critical Care Medicine in 2011 demonstrates that persistent, rather than worsening, organ failure is the more common pattern before death in patients with severe sepsis"*

A paper of some significance shed some light on this: Authored by Prof. J-L Vincent and published in Critical Care Medicine in 2011, by identifying a common pattern in sepsis patients prior to their death, it provided a new way in which to evaluate the likelihood of patient mortality. This paper demonstrates that persistent, rather than worsening, organ failure is the more common pattern before death in patients with severe sepsis. The authors performed a retrospective analysis of the 1,201 patients with severe sepsis who died within 28 days, collected in five trials in 28 countries, and found that non-survivors had only small increases in individual organ SOFA scores in the 4-day period before death. The finding that SOFA scores were relatively stable in the days preceding death reflects persistent rather than dramatically worsening organ failure. The authors claim that they could not exclude a potential impact of specific actions or non-actions of the clinical team during the dying process on trends in SOFA scores. However, we would expect that any withdrawal be associated with a consistent increase in SOFA score, which was not found. This study helps physicians to understand the evolution of septic non-survivor ICU-admitted patients. We now wait to know whether non-septic patients show the same finding.

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TECHNOLOGY AS A MEANS OF SUPPORTING THE CLINICAL ENVIRONMENT

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I predict that when we look back on 2011 from the perspective of 2014 and beyond, we will see that one of the most influential published articles in the field of critical care medicine will be that authored by Lilly CM et al and entitled, **"Hospital mortality, length of stay, and preventable complications among critically ill patients before and after Tele-ICU reengineering of critical care processes"** which was published in JAMA 2011; 305(21):2175-2183.

> *"… considering the economic crisis we are in, there will be an increasing demand for more explicit demonstration of competence and integrity"*

This manuscript eloquently demonstrates how technology, when appropriately designed and coupled with cultural change can not only support a clinical environment but can be associated with an improvement in both process and outcome measures. In this particular case, the technological solution is not simply a monitor or device or a system that presents relevant data in a spreadsheet or graphic context at the bedside. It is an integrated system that combines those sorts of technological advancements with a human clinician. This integrated system is thus more than just a technological solution.

I believe that such an integrated system will ultimately help change perceptions on what models of care are most effective in both environments with intensivists and those in need of intensivists. Such an approach might support regionalisation of care and will open the door for a more global care solution. This manuscript will likely push those that control payment systems to reevaluate and ultimately cover care provided by such an integrated system. This manuscript also reminds us that significant change is not easy and requires a change in the culture of an environment. Facilitation tools like telemedicine and checklists should thus not be judged as isolated variables, but as just what they were designed to be, tools that facilitate change, though not the agent of change themselves.

UNEVEN DISTRIBUTION OF RESOURCES IN THE ICU

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Two studies, different but still similar, come to my mind when looking back on the year 2011. The first is a large study that aimed to compare medical ICU admissions in the U.S. and UK from 2002. The study again confirms the very different ways intensive care is delivered in these two countries (Wunsch et al: AJRCCM 2011; 183: 1666-73). The U.S. has seven times the number of ICU beds, which obviously changes their patient case-mix compared to the UK, and with less sick patients as a general finding. Still, it remains difficult to find the evidence for large differences in quality of care.

Taking a more general view, certain differences in healthcare spending are not reflected in global measures like infant mortality rates or overall life expectancy. This obviously raises questions as to whether adding more ICU beds is always the solution.

Another study, although local, demonstrates the regional differences in the number of ICU beds within a given country (Flaatten et al: Regional differences in ICU resources and use in Norway. Abstract 21, SSAI congress Bergen 2011). This study from 2009, shows that the number of ICU beds differs from 2.9 to 6.9 /100,000 inhabitants

within the four health regions, and that the number of ICU admissions hence varied from 1,090 to 2,306 per /100,000. Again, the quality of care seems to be similar within the regions.

These differences are not only of interest in a larger political context, but also in the case of multi-centre studies, and even when performed within a given country. Since the availability of beds obviously has impact on case-mix , this makes a lot of ICU derived data difficult to compare from unit to unit without correcting for the differences. This is a problem seldom discussed or mentioned as a limitation in the design of such studies.

QUALITY MEASUREMENT & EVALUATION OF ICU

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For years, some have tried to deny their value, but today we can no longer ignore the increasing importance of applying measures to monitor and evaluate the quality of ICU care delivered. However, considering the economic crisis we are in, it is strongly apparent that there will be an increasing demand for more explicit demonstration of competence and integrity, including providing accountability for the resources received and this based on accurate checking, using measurement and surveillance.

All involved in ICU care are striving to provide high-quality care to their patients. But what is 'quality', and how can it be defined? For many, it still remains a term so vague, general and ambiguous as to be almost completely meaningless. Quality care should be as safe and cost-effective as possible, and patients should be treated with compassion, dignity and respect. Besides clinical quality, the term refers to care that is personal and well adapted to the specific needs of each individual. And yes, there is no way back, the quality debate has definitely been opened whether we want to or not. Quality and safety is now high on the agenda. Maybe, it is easy to agree with its broad aims; however, defining the specific aspects of our care that deliver this is more difficult.

Hence, in 2011 an increasing amount of literature has shown that researchers over the world are searching for a comprehensible set of reliable and evidence-based ICU quality indicators, which if upheld, will likely contribute in improving patient outcomes, safety and thus the quality of ICU care. Nevertheless, achieving this goal will highly depend upon the successful implementation of these indicators in daily ICU practice. As such, and besides the fact that additional research for measures to inform quality improvement initiatives is warranted, a next step will be to better explore potential barriers for quality indicator implementation and to identify facilitators of behavioural change. I really look forward reading the 2012 contributions on this topic! ■

Continues from page 20

2008). When patients with optimal PEEP (regardless of the level) ventilate with acceptable PtpPlateau pressures (< 20 cm H_2O), they most likely have recruitable lungs and are being ventilated within safe limits. Airway plateau pressures in these patients are not a concern. Therefore, by measuring Ptp the clinician is able to individually target the needs of the patient with ARDS.

There has been some hesitation to use Ptp measurements due to the potential inaccuracy of the measurement (Pes is only an estimate of pleural pressure in one area of the lungs). However, pleural pressures are so variable among patients it seems that the potential risk of an inaccurate Ptp measurement for a patient is much less than the risk of using a generalised approach for setting PEEP and limiting plateau pressure with multiple patients presenting with a variety of illnesses. The measurement of Ptp is much more representative of individual respiratory mechanics than airway pressure alone. ■

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ANAESTHESIOLOGY AND INTENSIVE CARE IN BULGARIA

Current Goals & Future Challenges

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This article was submitted on behalf of the Society of Anaesthesiolgists in Bulgaria.

Statistics:

Total Population (2011 Census)*
7,364,570

Life expectancy at birth (2010)*
73.58 years
70.00 years (male)
77.24 years (female)

Infant mortality rate (2009)*
9 per 1,000 live births

Hospitals (2010)*
312

Hospital beds (2010)*
45,832

Physicians (2010)*
27,997

Population per physician (2010)*
268

Percentage of GDP spent on medical services per capita†
4.2%

***Source:**
NSI (National Statistical Institute, Bulgaria), www.nsi.bg
† Source:
http://www.physorg.com/news201776479.html

The accession of Bulgaria as a member of the European Union in 2007, has meant that in recent years, there is an increasing drive to reset Bulgaria's healthcare system along the lines of the other EU member states. However, such modernisation is not easily arrived at. The recent and ongoing instability in the political environment engendered by the severe economic crisis and frequent changes in the political climate present healthcare centres in Bulgaria with the challenge of providing their patients European quality healthcare services with limited and often insufficient resources. This challenge applies particularly to hospital departments that provide high-cost medical services such as the departments of intensive care and anaesthesiology, and which we focus on in this article.

Organisation of Anaesthesiology and Intensive Care

The Bulgarian Ministry of Health defines how the clinics of anaesthesiology and intensive care are organised. Departments of anaesthesiology exist either as independent clinics within general hospitals for active treatment, located in every major city in the country, or as separate units appended to other clinics such as neurology and cardiology depending on the needs of intensive care in each particular hospital. There are currently five medical universities in Bulgaria with academic departments in anaesthesiology and intensive care in Sofia, Plovdiv, Varna, Pleven and Stara Zagora.

Statistics from recent years show that the average annual number of incoming patients in intensive treatment in Bulgaria is around 77,000. Of those 46,000 will be discharged, 9,000 pass away, and the remaining transferred for further treatment to other departments. Specialists in anaesthesiology and intensive care are responsible also for the transport of critically ill patients in and outside Bulgaria. Specialised anaesthesiology and resuscitation teams participate in peacekeeping missions in Iraq and Afghanistan.

Staff Shortages & Economic Migration

Currently, the number of anaesthesiologists/intensivists in Bulgaria is around 700, which amounts to roughly two percent of the total number of doctors in the country. There is one anaesthesiologist per 10,000 patients, which is highly insufficient for the needs of the territory. Understaffing is one of the most serious issues anaesthesiology and intensive care in Bulgaria faces. The primary reasons noted for the deficit in staff are low pay and heavy workloads on medical staff in these units. Understandably, a significant percentage of trained anaesthesiology professionals choose to continue their careers abroad.

Another problem stems from the inadequate funding of the anaesthesiology and intensive care units by the State. As there is a lack of follow-up centres (i.e. rehabilitation centres, homecare, etc.) for further treatment

Continues on page 44

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CHALLENGES FOR HEALTHCARE & ICU MANAGEMENT IN BULGARIA

New System for Health Financing May Improve ICU Services

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At the present moment, intensive care medicine is not yet identified as an independent specialty in Bulgaria, but considered as an integral part of anaesthesiology. Thus, traditionally every anaesthesiologist in Bulgaria is classed as "a specialist in anaesthesiology and intensive care medicine". In the majority of clinics, anaesthesiologists alternate their work in the operating room with ICU shifts. Their duties in the ICU last 12 hours (day shift and night shift) and in the operating theatre, their working day lasts seven hours. In some ICUs, internal medicine physicians participate more than cardiologists, working eight hours every day of the week except weekends. Over time they are considered to have specialised in intensive care medicine via clinical practice, without ever passing an obligatory educational course. This is but one of the many challenges facing intensivists in Bulgaria, which I will outline in this article.

Our Two Largest ICU Centres

The organisation of modern day ICU centres is as follows. The most highly specialised and best-equipped ICUs are in the MMA Sofia and in the Pirogoff hospital. The biggest centre of emergency medicine in Bulgaria (the Pirogoff hospital) is also known for its role as an educational base for the medical academy. It features a specialised burns treatment centre, where patients suffering from extensive burns are treated, and which includes two surgical departments and an ICU department, which employs an anaesthesiologist specialised in treating burns victims.

Over the last 10 years, the ICU department in the Military Medical Academy (MMA) in Sofia has become the leading centre in the field of intensive care medicine. Its patients mainly suffer from severe polytrauma, severe craniocerebral trauma, severe gunshot and explosion trauma and come from across the country. In this department, anaesthesiologists as well as internal medicine physicians specialised in intensive care are employed to treat patients. This ICU has modern equipment as well as the possibility to provide rapid consultations with leading specialists from other specialties, if necessary.

In the regional cities in Bulgaria there are, of course, regional hospitals. Each has an ICU, whose patients come mainly after emergency or elective surgery. Most of these hospitals are not sufficiently funded. When they get patients needing very expensive treatment, they call for help to the most proximate university hospital. There are five university hospitals in Bulgaria – in Sofia, Plovdiv, Varna, Stara Zagora and Pleven. The MMA Sofia and the ICU in the Pirogoff hospital receive the most severely ill patients from across the country. The transport of patients is carried out by a so-called "reanimobile" or less frequently, by helicopter. As a general rule, paediatric, neonatal patients and patients with extensive burns are stabilised in the closest regional or university hospital, before being transported to the capital where they are treated in a specialised clinic in either the Pirigoff hospital or the MMA Sofia.

Challenges for Funding of ICU Care

During a period of socialism in Bulgaria, between 1950 and 1998, and a little after that, medical assistance was free for all citizens, and its value was covered by the state budget. In 1999, a national health insurance fund (NHIF) was set up. NHIF is an independent institution, which is not a division of the Ministry of Health. It is funded by the employee health insurance and

is at the moment mandatory for all workers. Students and retirees, on the other hand, have their health insurances paid for by the Ministry of Health. If the patient has no health insurance, they must pay for their entire treatment. The NHIF is set up so that reimbursements are made according to clinical pathways, which refers to the sum of all clinical and laboratory investigations and all therapeutic measures. Most of the clinical pathways are not sufficiently funded and the patient must therefore pay for certain extra elements, for example, prosthetic devices such as heart valves, hip/knee joints, etc, kits for laparoscopic surgery and stents for angioplasty. In the last few years, private health insurance funds are gaining in popularity as a means to address this insufficiency. Usually they have a contract with some big public or private hospital. If their client chooses this hospital, they refund expenses not covered by the clinical pathway.

Most elderly and critical patients suffer different conditions at the same time. Unfortunately, according the rules of NHIF, the patient can be reimbursed for treatment of only one individual illness. This creates an obstacle for financing in the ICU, because all patients need complex medical care and different investigations. This problem has been solved partially by the Ministry of Health for co-funding of ICUs by allocating financial aid depending on the number of healed patients per individual ICU department. However, even this is usually insufficient. Hospital managers and ICU chiefs have to seek ways for internal redistribution of the hospital's budget to cover the extra expenses. Therefore, the majority of hospitals maintain only a minimum number of beds in the ICU, otherwise they accumulate a large debt. If the patient recovers in a private hospital, they must cover the extra cost on their own.

The health ministry is working on the implementation of diagnostic related groups (DRGs) as a much needed financial strategy for the country. The main principle is that each clinic or department will receive a payment per performed activity (pay for performance), rather than per treatment pathway. The Ministry hopes that this system will solve the problems regarding reimbursement of expensive treatments.

"Hospital managers and ICU chiefs have to seek ways for internal redistribution of the hospital's budget to cover the extra expenses. Therefore, the majority of hospitals maintain only a minimum number of beds in the ICU, otherwise they accumulate a large debt"

Emergency Care

Emergency care is, naturally, free for all citizens, financed by the Ministry of Health. Each hospital is obliged to provide emergency care for patients or victims, and emergency departments located in the regional and university hospitals are charged with this duty. National emergency centres are set up in the Pirigoff hospital and MMA Sofia. Citizens may request an ambulance via a local emergency phone number but also on the European emergency number, 112. This is a free service across the country. In the emergency department physicians specialised in emergency medicine or anaesthesiology and intensive care are employed to treat patients.

Challenges for Education

In Bulgaria, to achieve qualification in anaesthesiology and intensive care one must complete a four-year course. The candidates then take part in a competition and those who succeed attain residency in a university clinic. The government finances part of these residencies, another small part is paid by the residents themselves. All residents have individual educational programmes. In terms of their education, they must pass different courses, including those held in leading intensive care departments across the country. Educational courses organised by different European and world associations are not mandatory. If someone wants to pass them, they must cover the expenses themselves. Every six months, a commission of lecturers from the same department examines the residents, who must pass an exam that cov-

Continues on page 44

Origins of Intensive Care in Bulgaria

The first large Bulgarian ICU centre was created in the 1970s as part of the medical academy in the capital, Sofia. Its purpose was to treat seriously ill polytraumatic patients, those suffering considerable blood loss, severely septic patients, and patients experiencing major surgical interventions. It was called a respiratory centre, because at that time, intensive care medicine was associated closely with the provision of ventilatory support. The physicians were anaesthesiologists, and when needed they invited consultants of other specialties such as cardiologists, neurologists, gastroenterologists or surgeons to pinpoint the therapeutic plan and the medical treatment.

In the same centre, in the 80s, a service for the intensive care of newborns was formed, which established the foundation for neonatology. A paediatric intensive care centre was created, together with the only specialised paediatric surgery centre in Bulgaria. Paediatric intensive care is a service provided by anaesthesiologists. During the same period in Bulgaria, cardiosurgery began to develop alongside a specialised ICU. At this time, eight cardiosurgical centres (five in the capital, three in the provinces) were in operation, each with its own cardiac ICU service. During the second half of the 1980s, paediatric cardiosurgery ICU was incorporated as a special part of the national hospital for treatment of cardiovascular diseases.

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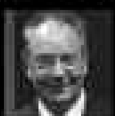

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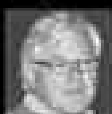

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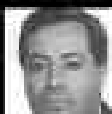

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HOW IT WORKS

IT @ 2012 is a fast-paced, interactive event with two presentation rounds:

Day 1 – MindByte Presentation - each presenter is given 5 minutes to highlight the key advantages of his project and persuade the audience to vote for them. This is followed by a 5 minute Q&A by with the audience who vote based on the presentation/ voting criteria. Only the top 8 rated projects will succeed and move into the next presentation round.

Day 2 – WorkBench Presentation – each presenter is given 25 minutes to provide an

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in-depth insight into their project. The aim is that the audience will support the project. Corporate supported projects are allowed to highlight the industry angle in the Work-Bench session.

In a 15 minute Q&A session all questions can be answered, followed by the final vote to cast the winner.

THE PRESENTATION / VOTING CRITERIA

IT @ 2012 will highlight installations from all areas in healthcare to support cross-departmental understanding. All presenters are required to follow a strict structure allowing the audience to compare on common grounds:

1. THE IMPORTANCE OF TECHNOLOGY
   - What technology was used and how was it integrated into the workplace?
2. BENEFITS
   - Has the project helped those it was designed to help?
   - Has the project changed how tasks are performed?
   - What new advantages or opportunities does the project provide?
3. ORIGINALITY
   - What makes the solution special?
   - Are there any original features?
   - Is it the first, the only, the best or the most effective application of its kind?
   - Is it an improvement on existing implementations?
4. DIFFICULTY
   - What important obstacles had to be overcome?
   - Were there any technical or organisational problems?
5. SUCCESS
   - Has the project achieved or exceeded its goals?
   - How do you see the project's success affecting other applications, your facility or other organisations?
   - How quickly would the users accept the implications of this innovation?
6. IMPACT
   - What is your overall impression of the project?

THE VOTING SYSTEM

IT @ 2012 uses a highly sophisticated voting system with two separated groups of voters: the expert panel and the audience/presenters, each with 50 % impact.

Based on the Bayesian Model the expert panel is setting a trend. To avoid bias, every vote from the audience out of a credible margin will be automatically disqualified.

WHY IS IT @ 2012 SO DIFFERENT?

The main difference lies in the element of competition. Presenters from across the world must present their idea to the highest standard, master all questions and persuade the audience and judges that their solution deserves to win. By allowing presenters to cross-examine their competitors, the Q&A sessions take on a new dimension.

IT @ 2012 requires the open disclosure of difficulties during planning and implementation of the solutions and how these issues where solved. This allows the audience to learn from others' mistakes and bring new methods and solutions back to their own institutions.

WHY ATTEND?

IT and medical technology is of key importance to healthcare. Intelligent IT solutions increase cost-effectiveness, productivity and safety.

IT @ 2012 will expand your knowledge on different medical technology and IT solutions from all areas in healthcare and supports a cross-departmental understanding like no other event.

HOW TO REGISTER

To register, please visit:
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LOCATION

IT @ 2012 will take in Brussels, the capital of Europe.

Hotel reservations can be obtained through www.booking.com.

For more information please visit our website **www.itandnetworking.org** or contact us on +32/2/2866601 or send an email to **office@hitm.eu**

We look forward to seeing you in January!

Continues from page 38

following patient discharge, patients' length of stay in ICU is prolonged, despite the fact that their condition is no longer life-threatening. Thus an additional burden is being placed on ICUs' already inadequate budgets.

Goals and Future Challenges

There are several goals that the Society of Anaesthesiolgists in Bulgaria have set out to deal with existing and anticipated challenges in the field in the years to follow, that fall into three categories.

1. Scientific and Human Resource Development

- Enhance and develop qualifications and continuous training of existing staff;
- Retain current medical professionals and encourage addition of new specialists.

2. Optimisation of Funding

- Improve existing facilities and purchase modern equipment;
- Attract funding on project basis under EU programmes, and
- Ensure adequate valuation of medical services performed by anaesthesiology and intensive care units.

3. Reorganisation

- Redirect personnel to regional medical facilities depending on the demographic profile of the particular region.

Conclusions

Anaesthesiology and intensive care have a long tradition in Bulgaria and it is a highly respected profession. In their practice, Bulgarian anaesthesiologists and intensivists are confronted with many problems. Nevertheless, our specialists manage to develop and drive growth in accordance with the leading trends in Europe and worldwide.

Evidence of the enthusiasm with which Bulgarian anaesthesiologists and intensivists work and develop, are the regular congresses which enjoy international participation, organised by the Society of Anaesthesiologists in Bulgaria. The 17th edition of this congress took place in late October 2011 in Plovdiv. More than 600 doctors from Bulgaria and around the world participated. ■

History of Anaesthesiology & Intensive Care in Bulgaria

In 1957, anaesthesiology and intensive care were officially declared a separate clinical specialty in Bulgaria. The academic departments of surgery at ISUL and the Military Medical Institute gradually assembled a specialised academic body to supervise the process of teaching anaesthesiology to students and medical professionals. In the decades that followed, the medical specialty of anaesthesiology and intensive care in Bulgaria were developed in accordance with global trends in the field. Also in 1957, the Society of Anaesthesiologists in Bulgaria was established, after which it joined the World Federation of Societies of Anaesthesiologists in 1962. In August 2011, a double membership agreement was signed between the Society of Anaesthesiologists in Bulgaria, and is currently presided over by doc. Dr. Nicolay Petrov and ESICM.

It is our pleasure to welcome all colleagues with an interest in the field of anaesthesiology and intensive medicine to join us at our next congress, to be held in Autumn 2012.

For more information, please visit: **www.anesthesiology.bg** or **www.anaesthesiologists.org.**

Continues from page 41

ers a defined part of the anaesthesiology and intensive care curriculum. The specialty qualification in anaesthesiology and intensive care is obtained after passing state exams before a committee chosen by the Ministry of Health, consisting of the headmasters of leading ICU departments in Bulgaria.

One of the current and more serious challenges for education is that each physician who acquires a general qualification in anaesthesiology and intensive care has the right to practice many subspecialised anaesthesia techniques without being obliged to follow courses to attain accreditation in a subspecialty, for example paediatric anaesthesia, obstetric anaesthesia, cardioanaesthesia, etc. This obviously, has worrying consequences for the provision of high quality care in the country. Instead of obligatory education, our system relies on continuing practice amongst physicians over time as a means of passing down the skills of the older professionals in the department. This is one cause for the large difference in the skill level of physicians in different parts of the country. Therefore, the regular congresses held by the Society of Anaesthesiologists in Bulgaria provide an important way to compare specialist knowledge in anaesthesiology and intensive care, whose aim is to affirm the high standards of the leading clinics in the country.

Challenges for Future Development

Problems with the provision of intensive care in Bulgaria stem, in part, from poor funding. The more severe patients one clinic treats with higher technology and expensive medications, the greater this eats into the allocated budget. The larger services receive dual funding. For example, MMA Sofia cures patients from across the country. Part of its financing is provided by the Ministry of Defense. Another leading intensive care department, the Pirigoff hospital, receives an extra grant from the Ministry of Health. Very often these two centres have a large influx of patients who cannot be matched with available hospital beds and medical personnel in other areas. In all, it is to be hoped that with changes and modernisation to the government and regulation of health services in Bulgaria, this will filter down to the provision of excellent ICU and emergency services to critically ill patients. ■

EUROPEAN SOCIETY OF INTENSIVE CARE MEDICINE

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Example of within text citation: (Edwards 2004; Edwards and Miller 2002; Miller et al. 2003).

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Example of standard journal reference: Sydow Campbell, K. (1999) "Collecting information; qualitative research methods for solving workplace problems", Technical communication, 46 (4) 532-544.

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http://itandnetworking.org

19-20 40th International Congress of Intensive Care Medicine SRLF-Paris
Paris, France
www.srlf.org

FEBRUARY

3-4 17th International Symposium on Infections in the Critically Ill Patient
Barcelona, Spain
http://infections-online.es

4-8 Society of Critical Care Medicine (SCCM) 41st Annual Congress
Houston, Texas, USA
www.sccm.org

15-19 18th Annual Congress of the Indian Society of Critical Care Medicine & International Critical Care Congress 2012
Pune, India
www.criticare2012.org

MARCH

20-23 32nd International Symposium in Intensive Care and Emergency Medicine (ISICEM)
Brussels, Belgium
www.intensive.org

25-30 15th World Congress of Anaesthesiologists®
Buenos Aires, Argentina
www.wca2012.com

MAY

18-23 American Thoracic Society (ATS) International Conference
San Fransisco, California
www.thoracic.org

24-25 ESICM Summer Conference – Trauma Update 2012
London, United Kingdom
www.esicm.org

JUNE

9-12 Euroanaesthesia 2012
Paris, France
www.euroanesthesia.org

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