ICU MANAGEMENT

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Safety

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Safety

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Safety is defined as the condition of being safe – freedom from danger, risk, or injury. Of course, safety itself is a relative term. It relies on the elimination of all risk. As we in the field of intensive care, are aware – eliminating risk is an impossible feat, and all that we can do as ICU managers is attempt to ensure that the risks are as low and manageable as possible.

With the publication of "To Err is Human" by the Institute of Medicine (US) in 2000, came the confirmation of what most of us, as intensive care professionals increasingly knew – that the number of adverse events attributable to medical error were staggering, and increasing at an alarming rate.

Whether we look to technology to provide tools (such as computerised prescription and administration systems) to assist us in our goal of improving patient safety or we employ additional staff and utilise accreditation programs which focus on prevention and monitoring, we all acknowledge that the gravity of the problem requires careful evaluation and assured action. In many cases, the lives of our patients depend on it.

In their contributions to this important topic, Dr. Michalsen and Dr. Flaatten each focus on medical errors and their inevitability, and offer insightful ideas on how we as clinicians and managers can work to not only improve-but rectify issues which go to the heart of making our ICUs safer places.

As making our ICU environments safer inevitably brings about concerns involving added costs, Akos Csomos highlights recent studies and offers clarity on the containment of costs while striving to improve patient safety.

Finally, Karen Timmons of US-based Joint Commission International outlines how an updated accreditation program can benefit hospitals, and specifically critical care by standardising methods and processes and thereby ensuring safe delivery of services.

We have compiled an exciting series of articles for our Matrix in this issue. Drs. Jean, Cinel and Dellinger describe new lung imaging technology and its potential benefits in the ICU, while Dr. Girbes takes on the controversial and timely issue of glycemic control.

Dr. Wolfe makes a strong argument that early detection and management of intra-abdominal hypertension not only improves outcomes of patients but saves resources in the long-term – something we in ICU Management aspire to achieve.

Our county focus heads this time to Canada, where we are enlightened by a number of our overseas colleagues on emerging issues in critical care-specifically those of communication and patient-focus approaches which are being increasingly adopted.

Dr. Polderman has been kind enough to provide us with a summary of the Therapeutic Temperature Management (TTM) Congress held in Cancun, Mexico last December. In the congress preview, we outline highlights of the upcoming 28th ISICEM in Brussels in March, an event which never fails to invigorate and challenge us in **ICU Management** to embrace new techniques and network with other professionals…. I hope to see you all there!

Letters to the Editor & Requests for References Cited in ICU Management
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News

News World

Efforts on Child-Appropriate Medicines Intensify

www.who.int

Efforts to ensure children have better access to medicines appropriate for them have intensified with the unveiling of a new research and development agenda by the World Health Organization (WHO). The agenda targets a range of medicines – including antibiotics, asthma and pain medication – that need to be better tailored to children's needs. It calls for further research and development of combination pills for HIV/AIDS, TB and malaria, as well as appropriate child therapy for a number of neglected tropical diseases.

In industrialized societies more than half of the children are prescribed medicines dosed for adults and not authorized for use in children. In developing countries, the problem is compounded by lower access to medicines.

WHO has already begun work to promote increased attention to research into children's medicines. The agency is building an Internet portal to clinical trials carried out in children and will publish the web site containing that information early next year. WHO has also released the first international List of Essential Medicines for Children. The list contains 206 medicines that are deemed safe for children and address priority conditions.

News Europe

A New Manifesto For Medical Research In Europe

www.esf.org

Public spending on medical research in Europe should be doubled over the next ten years to ensure the health and welfare of Europe's citizens and to nurture a thriving medical research industry, according to an influential panel of distinguished scientists. In addition there should be greater collaboration between European institutions in medical research and improved career paths for medical scientists.

The European Medical Research Councils (EMRC) White Paper, 'Present Status and Future Strategy for Medical Research in Europe', makes several key recommendations aimed at strengthening and improving medical research in Europe. These include:

- Implementation of best practice for funding and performing medical research – with distribution of funding in competition based on excellence and evaluated by peer review
- Strengthened collaboration and coordination of medical research in Europe through the EMRC and its membership organisations, via the European Commission, the European Research Council and the learned medical societies
- Revision of EC directives related to medical research
- Implementation of equal opportunities for all researchers
- A doubling of public funding of medical research in Europe within the next ten years – to a minimum of 0.25% of gross domestic product (GDP)

The EMRC White Paper recognises that the newer countries of the European Union require extra investment in research infrastructure to bring their facilities to the level of the older countries within the union.

News Research

Beating Hospital Yeast Infection

http://ccforum.com/

Increasing numbers of critically ill patients develop fungal or yeast infections, which are associated with high mortality. Now a review published in the online open access journal, Critical Care, compares treatments involving single-drug antifungal prophylaxis (SAP) or a multi-drug regimen of selective digestive tract decontamination (SDD) and suggests that both methods reduce yeast-related morbidity and mortality, but to different extents.

A team from Academic Medical Center Amsterdam, the Netherlands set out to compare the effectiveness of preventative antifungal therapies by trawling the medical databases. This yielded data from more than 5,500 patients enrolled in over thirty studies. The team compared data on SAP and SDD treatments in critically ill patients, detailing the incidence of yeast colonisation, infection, candidemia, and hospital mortality.

Both SDD and SAP reduced yeast-associated disease among the critically ill. The author's findings suggest that SDD is more effective than SAP for reducing yeast colonisation and infection, with the exception of candidemia. The latter responded best to SAP. Although both strategies decreased mortality attributable to yeast, SDD led to a significant reduction in all-cause in-hospital mortality.

"Systemic drugs may be advised as prophylaxis in patients with a high risk of developing Candida bloodstream infections, whereas SDD may be given to critically ill patients to prevent Candida colonisation and infection," the authors suggest.

Effective management of yeast infections is tricky, because diagnostic blood tests are only around 70 percent accurate, and it is hard to differentiate between normal yeast colonies and infection. Previous studies have investigated both SAP and SDD, but to date there has been no direct comparison between the two treatments. In 1995, yeast was reported to be the fourth most common intensive care unit-acquired infection in Europe. It could now be even more common, in lack of more recent data. Candida is also the fourth leading cause of all nosocomial blood stream infections in the USA, accounting for up to 11% of all infections.

News Industry

New Web Resource For Intensive Care Clinicians

www.maquet.com

MAQUET Critical Care has launched a peer-to-peer ventilation information source for intensive care clinicians interested in clinical applications in ventilation therapies.

The site hosts an extensive amount of peer-to-peer material in different ventilation therapies, where physicians share their experiences by means of interview articles and patient case reports. Besides literature reference lists and abstracts in topical subjects in ventilation therapy, such as ALI/ARDS and NAVA (Neurally Adjusted Ventilatory Assist), it is possible to view lectures on these topics from internationally known researchers in intensive care. Critical care staff can also find tutorials on the latest topics in ventilation therapy. Visitors interested in these breakthrough ventilation therapies, can easily find all peer-to-peer materials including interviews, lectures, references, patient cases and tutorials simply by selecting the clinical application topic. An updated schedule for upcoming seminars and workshops is listed as well.

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Adverse Events in the ICU: Are We Aiming at the Wrong Target?

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Several studies the last decade have revealed that errors and adverse events are common in the ICU. Errors have become the norm rather than the exception in most ICUs—for physicians as well as nurses. Efforts have been made to prevent errors and adverse events from occurring, but evidence showing that preventive measures are effective is scarce.

Experiences from our own ICU have also affirmed that adverse events are common occurrences. Approximately 400 events are reported annually in our 10-bed ICU, with no reduction in incidences during the 10 years we have run our anonymous reporting system for adverse events (Hevroy 1999). The accumulated rate of adverse events is nearly linear in its increase over the years. In spite of targeted efforts from all ICU personnel to reduce errors, this has not occurred. At monthly intervals, we have met to analyse the events, categorise them and made data available for ward personnel as well as for the administration. Recurrent and severe events are regularly discussed in staff meetings, and suggestions for improvement have been implemented. Still the rate of adverse events is nearly unchanged!

"To err is human", a book published by the Institute of Medicine in 2000, triggered a renewed interest in medical error. The title is very accurate; humans are prone to error, not only in medical care, but also in every aspect of life. One needs to look no further than at the statistics for traffic accidents in most countries to exemplify this. It stands to reason that as long as humans care for other humans, errors or unwanted events will occur with regularity and the more complex the environment, the more often errors will occur. We must learn to concede these sad, but nevertheless inevitable facts.

Since human nature is difficult to change (at least within the time available for us) we have to accept the existence of medical errors and adverse events. This does not imply that we should acquire a fatalistic attitude to this problem. In order to achieve improvements we just have to re-focus and approach other goals. We must change the conditions, and the environment where we work, in order to produce an atmosphere of safety. This is not an easy task, since to date, there has been little hard evidence to point to specific actions that really make a difference.

If we cannot beat human nature, what can we do? There are two options: one is to design systems that make us less prone to error, and another important aim is to reduce the consequence of errors. If we cannot prevent an error from occurring in the first place, we may be able to reduce its impact on patients. Before an error reaches a patient and causes harm, there is a chain of events where several defence mechanisms are overwhelmed; often called the "Swiss cheese" model (Ranson 1990). It could also be best illustrated as a chain of domino bricks falling, one causing the next brick to fall if it is unstable or within reach. If we can design more effective defence mechanisms, this might be one important strategy in our struggle against adverse events (or preventing the next domino brick from falling).

Many errors and adverse events are related to drugs and infusion therapy (Valentin 2006). In the age of computerised ICU environments (clinical information systems), it should be possible to design very robust defence mechanisms with the aim of reducing the consequences of drug errors. Drugs prescribed in an incorrect dose could be automatically flagged (if, for example, an inappropriate dose is given according to age or body weight). Nurses could be given warnings by the system about the correct timing of doses and interactions between drugs could be automatically checked. Errors of omissions could also be detected using such a system. For example, if thromboembolic prophylaxis is routine in the ICU, physicians could be warned about an omission after a predefined time (ex. 24 hours). Algorithms for predefined treatment protocols could be incorporated into clinical information systems, and guidance could be offered in order to follow best clinical practice, like use of the sepsis guidelines in the treatment of severe sepsis. In addition, double control (by two independent nurses) of all medications (at least those to be administered intravenously) will decrease the likelihood that the wrong medication or dose is accidentally given to a patient.

By simply focussing more efforts on designing safer systems, we can hope to detect more errors at a stage where they do little harm, or can be counteracted in an efficient way.

ICUs by definition are the ideal environments to develop this concept. Close monitoring of all patients put us in an optimal position where we are able to detect deviations in vital functions at an early stage. Increased use of clinical information systems will further enhance our abilities to improve safety. ■

Cost Containment and Patient Safety

There is an ongoing demand for quality patient care and reduction of human errors. We know it is possible to prevent errors, but how much does it cost?

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Over a decade ago, the much-quoted To Err is Human report (Kohn et al. 1999) was published and we acknowledged that unsafe medical practices cost lives. Since then, a number of changes have been implemented, however, the magnitude of clinical errors in costs still continue to grow, estimated to be £6 billion in UK alone (Vincent et al. 2001). It is by all means no surprise that the National Conference of State Legislatures (USA), has prepared a document titled "State Health Care Cost Containment Ideas", of which one full chapter focuses on medical errors and medical malpractice.

Being safer does not always mean higher costs; sometimes change of practice means lower cost without worsening patient safety. One example of this is to abolish routine chest X-ray in ICUs: There are numerous studies showing this practice is unnecessary (Hendrikse et al. 2007). Another example, when a small capital investment is needed, is the use of real-time ultrasound for central venous catheter (CVC) insertion. It is cost-effective in that it prevents complications (Shojana et al. 2001). Eventually, ultrasound guidance will probably be used in the airway management of critically ill patients as well (Sustic 2007).

In a critical analysis of patient safety practices, Leape and colleagues (2002) summarised what practices would most improve safety. According to the results, available evidence points heavily towards injuries from care, that are not caused by errors. For example, use of sterile barriers during catheter insertion, use of pressure relieving bedding materials or continuous aspiration of subglottic secretion all demonstrate strong evidence of preventing injuries from care. These technical advances, which have been shown to prevent complications, are cost-effective as well, in terms of their reduction of length of stay. Of the 73 practices listed in Leape's analysis, only 30% (22 out of 73) were intended to prevent errors. Why is the evidence weighted towards technical advances? The answer is simply because they have been studied extensively by industry-driven funds. Error prevention is a relatively young field having only limited resources for research.

These are some examples of error prevention initiatives that are related to medical mistakes and/or medication errors:

- Ask patients to recall and restate what they have been told during informed consent
- Localise specific surgical procedures to high-volume centres
- Initiate changes in ICU structure – i.e. more active management by intensivists
- Evaluate/initiate changes in nursing staff levels
- Improve information transfer between inpatient and outpatient pharmacy
- Use computer monitoring for potential adverse drug events
- Employ specialised teams for inter-hospital transport
- Follow protocols for high risk drugs (e.g. nomo grams for heparin)
- Utilise clinical pharmacist consultation services

Some of the untoward inpatient events could be prevented as well, for example, in the case of inpatient falls, or early recognition of cardiopulmonary arrest on ward using bed alarms. In a recent study, Marchetti and colleagues modelled the cost-effectiveness of an early-alert surveillance system for these two conditions and they found it to be efficacious with a daily economic benefit of 14.6 US$ per patient assuming a 40% reduction in the fall rate and a 25% reduction in the cardiopulmonary arrest rate (Marchetti et al. 2007).

Have we done everything possible to curb errors in the past decade? Certainly not, as it was clearly shown in the SEE Study, where the total prevalence of unintended events was 38.8 per 100 patient days (Valentin et al. 2006). The majority of unintended events were medication prescription and administration errors. However, these could be prevented by computer-based prescription systems, which may not be as expensive as they appear. In a study from Boston in the US (Teich et al. 2000), a time series analysis was performed at an urban academic centre, in which all adult inpatient orders were entered through a computerized system. Although it cost around 700 000 US$ per year to implement and maintain such a computer system, the use of dose selection menus and guidelines resulted in a decrease in drug doses by 11% and consequent cost savings. Reduction in recommended frequency of ondansetron administration itself generated 250 000 US$ savings in the first year.

What is the way forward? In the US, the state of Nevada passed legislation in 2003 requiring that all hospitals report "sentinel events" to an institutional

continued on p. 17

Medical Errors: Much Ado About Nothing?

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Risk-prone industries, such as aviation and nuclear power plant operations, have been addressing the issue of erroneous design and behaviour in systematic ways over the last decades. In general terms, an error is the failure of planned actions to achieve their desired goals. Failures of the execution of an adequate plan are often called slips and lapses, whereas designing an inadequate plan is often called a mistake (irrespective of the execution) (Reason 1990; 1995).

Healthcare practice is a risk- and error-prone field as well. Until a few years ago, however, the impact of medical errors most likely had been underestimated. "To Err is Human", a sentinel publication from the Institute of Medicine (IOM), has helped to bring this issue to the attention of clinicians and administrators certainly in the United States, if not worldwide. In the IOM report, a medical error is defined as the failure of a planned action to be completed as intended, or the use of the wrong plan to achieve an aim. An adverse event is defined as an injury caused by management rather than the underlying condition of the patient. According to the report, more than 44,000 deaths annually may be attributable to medical errors in the US, rocketing them to one of the 10 leading causes of death there (Kohn et al. 1999). Rates of adverse events in hospitalised patients have been estimated as approximately 4 to 11%, and about 30 to 70% of those cases were most likely preventable. The excess length of hospital stay, mortality, and charges due to medical errors have been estimated to reach 11 days, 22%, and $ 57,000/case, respectively (Venkatesh et al. 2006; Zhan and Miller 2003).

Patients in intensive care units (ICUs) are frequently exposed to medical errors. In an early study, Donchin and colleagues had identified approximately 1.5 medical errors per patient each day in an Israeli university hospital ICU over a four-month period. About one third of those errors were graded as potentially very harmful, and communication problems were thought to be the largest contributor to the rate of medical errors (Zhan and Miller 2003; Donchin et al. 1995). In a 24-hour prevalence study in 205 ICUs worldwide, Valentin and coworkers recently found approximately 40 unintended events compromising patient safety per 100 patient days (Valentin et al. 2007). The most frequent events were related to lines, catheters and drains; events related to the prescription or administration of drugs were the second most frequent observation; and equipment failures were the third most frequent observation (approximately 15, 11, and 9 events per 100 patient days, respectively).

In common with other complex technologies, medical errors usually result from a frequently unpredictable combination of active human failures, and latent organisational flaws (e.g. organisational structure, device design, decision pathways complexity). Whereas it is usually quite easy to find and blame the malefactor explicitly, it is often not so easy to detect the systems' flaws – if they are investigated at all. However, organisational contextual factors are amenable for improvement, whereas individuals remain prone to erroneous behaviour under certain circumstances no matter how well they have been trained and scrutinised (Reason 1990,1995; Kohn et al. 1990). Similarly, if medical errors are compared to injuries in general, humans will continue to take risks. Therefore, safety features of potentially dangerous materials, objects, consumer goods, or procedures need to be improved to allow for less harm once risks have materialised (Haddon 1970; Michalsen 2003). Like injuries, medical errors are not extinguishable, but most of them are preventable.

Conclusion

The impact of medical errors and adverse events is substantial both by frequency and severity. Therefore, preventing medical errors or at least decreasing their toll remains an important goal within the healthcare sector. Much still can be done! Beyond the realisation of the problem, we can all strive to increase our knowledge about the determinants of both actual medical errors and so-called near miss events (Reason 1995; Kohn et al. 1999; Donchin et al. 2007). We might then attempt to reduce a few specific hazards (Provonost et al. 2006). However, "the biggest challenge in moving toward a safer health system is changing the culture from one of blaming individuals for errors to one in which errors are treated not as personal failures, but as opportunities to improve the system and prevent harm" (IOM 2001).

Acknowledgement: The help of J. Vincenten, MA, BPE, Amsterdam, in reviewing the manuscript is gratefully acknowledged. ■

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The process of external quality evaluation against consensus healthcare standards, commonly referred to as "Accreditation", is one of the most effective means for standardising care processes in healthcare organisations. The accreditation process focusses on the functions and processes that support quality, safe care, and thus facilitates the use of the best science and professional knowledge and skills. There are few settings in the contemporary acute care hospital that can benefit more by this process standardisation than in fast paced critical care and intensive care medicine units. Standardisation through accreditation is a powerful risk reduction strategy proven effective around the world.

Joint Commission International (JCI), one of the oldest and largest accreditation bodies in the world has recently updated its' accreditation standards to focus even more on patient safety. These updated international standards incorporate lessons learned since 2003 from the 140 hospitals in 26 countries accredited by JCI. There are currently 323 standards that hospitals must meet to receive accreditation. These standards allow for cultural differences while still requiring hospitals to standardise and provide patient care that promotes safety and quality. The accreditation is for a period of three years and therefore the implementation of standards must result in sustainable good practices.

Unlike some high reliability industries, such as air traffic control, healthcare has lacked standardisation across the globe. It is important to change that by helping hospitals around the world learn a common healthcare language, which promotes safety and consistency in the delivery of care.

Examples of changes to current standards that will reduce risk and improve quality in all units of a hospital include:

- More stringent requirements for how hospitals verify credentials of healthcare providers. It is no longer sufficient for a hospital to simply gather diplomas and certificates, they must be validated with the granting institution, including the validation of credentials from critical care medicine programs;

- New medication use standards for reporting and learning from errors and near misses to address the significant rise in medication errors in all units of hospitals, in particular emergency departments, where 70% or more of patients are given a medication;

- Enhanced protection of patient's rights to ensure that every patient and their family are educated about their care in a language which they understand and thus can appropriately participate in their care decisions including the granting of informed consent through a process effective in emergency and critical situations; and

- Emphasis on ensuring healthcare organisations provide uniform care 7 days a week, 24 hours a day. Care provided on weekends and in the middle of the night must meet the standards as well.

In addition, there are standards changes that even more directly impact the standardisation of care, and thus the safety of care, in critical care units and in emergency services. For example, the clear and timely "hand-off" of critical information is one of the most important factors in safe care. This hand-off can be from the emergency department to the operating theatre, from the operating theatre to the critical care unit, and also from physician to physician, from nurse to nurse and many more combinations.

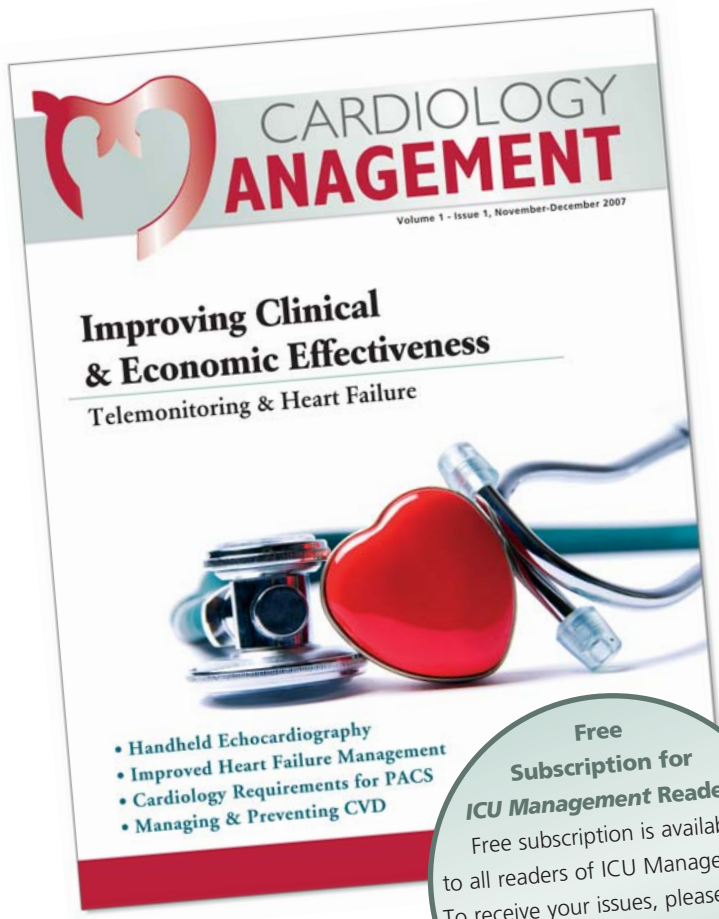
A 2006 survey by the Joint Commission showed that the most important information to hand-off correctly is the current condition of the patient (Joint Commission 2007). However, in most organisations, transfers use unclear language, are not standardised, are frequently done in noisy, busy environments and may be a mix of verbal, electronic and written information. Similarly, poor communication is cited 65% of the time as the root cause of treatment delays (Joint Commission 2007), as many of those treatment delays begin in overcrowded emergency departments.

As communication is complex, standards address effective communication through a variety of means, such as by focussing on the elimination or reduction of risk in processes known to

continued on p. 31

CARDIOLOGY MANAGEMENT

The Management Journal for Cardiologists



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Lung Assessment & Monitoring in the ICU Using Vibration Response Imaging

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Lung imaging and monitoring in critically ill patients is challenging. In the intensive care unit (ICU), the most common bedside methods for assessing the lungs are portable chest radiography and auscultation. Chest radiography is associated with some radiation exposure and is not practical for frequent serial assessment of lung pathophysiology in an ICU setting. Auscultation is simple and useful but suffers from its subjective nature. Other imaging modalities such as computerised tomography (CT) or ventilation perfusion scanning typically require patient transport and associated risks with critically ill patients. A new technology, vibration response imaging (VRI), provides a visual display of distribution of lung vibrations created by air movement in and out of the lungs and may offer utility in diagnosis and monitoring in ICU patients.

Vibration Response Imaging Technology

Vibration response imaging (VRI) is a computer assisted acoustic-based technology that measures the vibration energy generated in the lungs and transmitted to the surface of the chest during respiration or mechanical ventilation. Vibration response imaging creates a functional, two-dimensional video depicting distribution of vibration within the lung. Turbulent air and vibrations within the airways generate lung sounds. The vibrations are affected by the structural and functional properties of the lungs and can exhibit responses that vary in frequency, intensity, space and time. Pathologic processes affecting the lungs such as pneumonia, heart failure, and acute respiratory distress syndrome are expected to alter these transmitted sounds.

The VRI device is a portable, stand-alone device with thirty-six piezoelectric contact sensors spatially assembled on two planar arrays placed posterior under each lung of the patient (Figure 1). Recordings may be performed in both supine and sitting positions. In the sitting position, the arrays are attached to the back using low computer-controlled suction. Dorsal attachment is used as the area of sound transmission between the lung and the sensors is more uniform between patients (particularly females) and interferes less with routine patient or nursing care. The sensors' signals undergo several stages of filtering that reduces interference generated by chest-wall movement and heart sounds.

Data collected by the sensors during a 20 second recording is processed and a greyscale video depicting the relative geographical distribution of respiratory sound is created. The process and algorithm used in creating the image has been described in detail (Dellinger et al. 2007). A sequential dynamic display of images (each from 0.17 seconds of data) is displayed 60 seconds after the start of the recording, generating a movie that shows changes occurring in the distribution of vibration energy across lung regions over time. The maximal energy frame (MEF) is the frame in the video sequence that usually provides the most information on the distribution of lung vibration and usually approximates peak inspiratory vibration. A larger MEF image indicates a more homogeneous distribution of vibration intensity throughout the lung and a smaller MEF image indicates regional inequity of vibration intensity.

When imaging a mechanically ventilated patient, a flow sensor is placed in the tubing between the patient and the ventilator, allowing flow and pressure waveforms to be synchronised with the VRI image and displayed (Figure 1C). The VRI faceplate also displays the percentage contribution of lung regions (left, right and upper, middle, lower) to the total vibration signal (Figure 1C).

Potential Advantages of VRI

- Non-invasive and radiation free: The VRI passively detects vibration reaching the skin surface without introducing radiation to the patient. Although this technology will not replace conventional imaging techniques such as portable chest radiographs or CT since these technologies show anatomy, it may reduce their number and frequency.
- Bedside assessment with immediate results: Compared to chest radiograph, which requires processing time and CT and ventilation/perfusion (V/Q) scan requiring transportation with its inherent risk. Unlike CT and V/Q scanning, VRI provides near-real time lung imaging results at the bedside.
- Objective: Unlike auscultation, VRI does not depend on the auditory acuity of the clinician. The recording and accompanying data are stored for later viewing and for comparison with subsequent recordings.
- Monitoring and serial imaging possible (practical):

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The non-invasive and radiation-free nature of the VRI allow for its use as a lung-monitoring tool where recordings can be obtained in rapid succession or hourly/daily. Recruitment manoeuvres and adjusting PEEP settings are good examples where rapid serial studies might be beneficial in matching optimal settings with distribution of lung vibrations.

Potential Role of VRI in the Management of ICU Patients

• Assessment of endotracheal tube placement and detection of inadvertent oesophageal or endobronchial intubation. VRI may assist in differentiation of endotracheal vs. oesophageal vs. endobronchial position of the endotracheal tube as each of these different placements would be expected to produce a different distribution of sounds created during air movement.

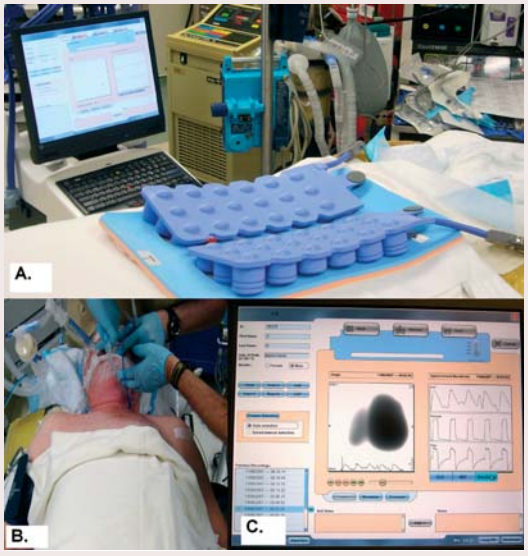
• Lung assessment in ICU patients: The lungs of ICU patients are not homogeneous. The VRI technique makes it possible to detect changes in function of different regions and it might impact treatment possibilities. Diagnosis of lung pathologies may be facilitated or may be identified sooner with use of this technology (Dellinger et al. (2007) have shown that the distribution of vibration energy differs with the mode of ventilation. With more studies, VRI may offer the potential as a real time non-invasive method of adjusting ventilatory therapy in intensive care units.

• Assessment of the effectiveness of therapy: Differences in the VRI image have been demonstrated in ICU patients before and following therapy for pulmonary diseases. These diseases include pleural effusion before and after thoracentesis as well as acute congestive heart failure with pulmonary oedema before and after clinical improvement. These characteristic changes after therapy could be used to titrate therapy and to assess changes in airflow induced vibraton.

Conclusion

In ICU patients who frequently have acute pulmonary pathology, determining differences in regional vibration for diagnostic and management purposes could be advantageous. This novel imaging technique may offer the potential to use vibration intensity as a surrogate of regional lung function. There is currently no direct lung monitoring technique at the bedside. Further studies will help determine how this technique might be integrated into ICU care. ■

Figure 1. A. Vibration response imaging supine matrix placed on the bed. There are two matrices placed under each lung, each with three columns of sensors referred to as medial, midclavicular and axillary. B) Intubated and mechanically ventilated patient lying on supine matrix. C) VRI screen showing VRI image. Note that the VRI waveform display is synchronized to pressure and flow with in-line flow sensor.



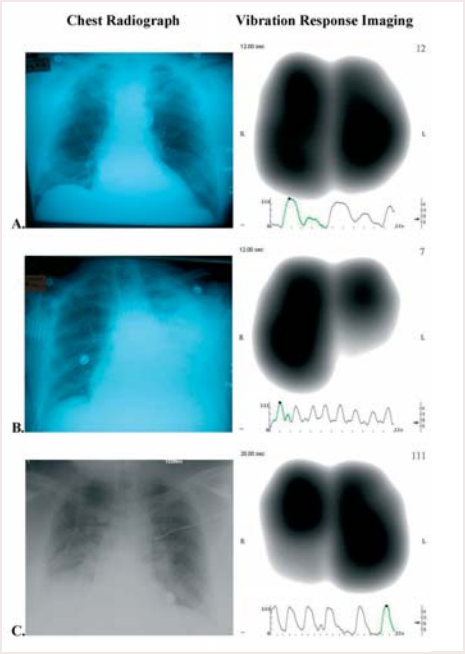


Figure 2. Sample ICU patient chest radiographs with corresponding VRI images. A) 74-year-old male with normal appearing chest radiograph. B) 51-year-old male with left pleural effusion and consolidation. C) 39-year-old male, mechanically ventilated with right basilar atelectasis.

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Introduction of Tight Glucose Control in the ICU: Hype or Evidence Based Medicine?

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Introduction

In 2001, Van den Berghe et al. published the results of a study, demonstrating a clinically and statistically significant fall in mortality in intensive care (IC) patients treated by intensive insulin therapy, aiming at glucose levels between 4.4 and 6.1 mmol/l. To achieve this goal, a maximum amount of 50 units/hour of insulin was given. The intervention group was compared to a control group where a glucose level up to 12 mmol/l was accepted. Above this level insulin was given aiming at a glucose level of 10,0-11,1 mmol/l. The reduction in mortality was spectacular with an absolute reduction of 3.7% (10.9% in the control group and 7.2% in the intervention group). In a subgroup of patients who remained longer than 5 days in the ICU, the reduction was even more obvious: a mortality rate of 26.3% in the control group compared to 16.8% in the intervention group. An absolute reduction of almost 10% was therefore achieved.

Beside the fact that a particular feeding protocol may have played a role in the results of this single-centre study, the most important criticism was on the case-mix of the studied population, of which 63% were cardiac surgery patients and only 5% were non-surgical patients. This study was nevertheless the reason for a huge enthusiasm in the IC community and many ICU's introduced a protocol for tight glucose control. However, most ICU's were not that successful in terms of achieving glucose control (Fraser et al. 2006; Vriesendorp et al. 2006; Polderman and Girbes 2006).

In the international directives for the treatment of severe sepsis, the Surviving Sepsis Campaign (SSC), recommendations were given for glucose control with levels < 8.3 mmol/l, despite the fact that the beneficial effects of tight glucose regulation on mortality have not been shown in septic patients (Dellinger et al. 2004). The target glucose levels advocated by the SSC were expert-opinion based and were higher than in the original study by Van den Berghe, in order to reduce risk of hypoglycaemia.

In 2006, the same group from Leuven published a similar intervention trial in non-surgical patients. In the total population no effect of intensive insulin therapy on mortality could be detected (Van den Berghe et al. 2006). Moreover, an excess mortality trend was present in patients from the intervention group, staying less than 3 days in the ICU. Additionally, in the intensive insulin intervention group, the risk of hypoglycaemia (glucose < 2.2 mmol/l) increased by a factor of 6 and was recognised as an independent risk factor for mortality. In a predefined subgroup with an ICU stay > 3 days, however, mortality was significantly reduced compared with the intervention group: 38.1% versus 31.3%. The latter study is therefore a negative study in terms of mortality reduction, demonstrating no beneficial effects of intensive insulin therapy versus accepting blood glucose values to 12 mmol/l.

Other Studies

In a recent German multi-centre study (The German Competence Network Sepsis), which to date, was exclusively published as an abstract, no effect of intensive insulin therapy in 488 patients with severe sepsis could be detected (Brunkhorst et al. 2005). However, serious hypoglycaemia (glucose < 2.2 mmol/l) was found in 12.1% of patients in the intervention group and in only 1.2% of patients in the control group. Despite these results, this study was underpowered for mortality and terminated prematurely. A European multicentre study, the Glucontrol trial, was also stopped early because of a high prevalence of hypoglycaemia. An Australian/New Zealand/Canadian study is underway, called NICE-SUGAR, and results are expected soon.

Euphoria and Contemplation

With all these data in mind, a contemplation on the introduction of tight glucose control as standard care in the ICU seems appropriate. Many ICU's have over-enthusiastically introduced the target glucose control as defined by Van den Berghe et al. It has even been suggested that the percentage of glucose levels within this target be included as an indicator of quality of care in the Netherlands (de Vos et al. 2006). Taking glucose regulation as an indicator for quality of care should not be coupled in any case to the target levels as indicated in the studies from Leuven. Several publications point at the danger of hypoglycaemia, although not unequivocally associated with mortality and short-term complications (Vriesendorp et al. 2006). On the other hand, it is surprising how easily the data from the 2001 study from Leuven has been extrap-

olated. A closer analysis of that study shows, for example, a high mortality in the control group, particularly in cardiac surgery patients. In this group of patients mortality was as high as 5.1%. In a similar case mix of 16,349 cardiac surgical patients, coronary surgery and valve surgery, from the National Intensive Care Evaluation (NICE) database in the Netherlands, mortality was 2.3% (de Jonge, NICE Foundation). This is entirely similar to the mortality in the intervention group from Leuven. It might therefore be suggested that conclusions on the effect of intensive insulin therapy, are more a consequence of the relatively high mortality in the control group, and not due to a low mortality in the intervention group.

Relatively little attention had been given to the role of possible bias. It can be argued that more attention was paid to patients in the intervention group in this obviously unblinded study. But, combining all available data and pathophysiological understanding, it is more than reasonable to control high levels of glucose. It is also appropriate to acknowledge that Van den Berghe et al. compared only a strategy of accepting glucose levels up to 12 mmol/l to a target of 4.4-6.1 mmol/l. It is apparent that aiming at lower glucose values induces a higher risk of hypoglycaemia with its' associated complications, just as accepting high levels of glucose levels has its' own danger of complications. The favourable effect of glucose control can therefore be considered as a J-curve for the optimal glucose level (Figure 1). The question remains whether hypoglycaemia is an independent risk factor, or rather a risk marker. Hypoglycaemia as risk marker could be the result of being a reflection of serious illness of the patient, and that the secretion of counter regulating hormones is insufficient. But hypoglycaemia does not contribute causally to mortality per se. Another possibility is that hypoglycaemia is a secondary symptom of administering insulin that in itself contributes to mortality. Finally, it is conceivable that hypoglycaemia is causally related to mortality, although existing data has failed to clarify this thus far.

Figure 1. Hypothetical J-curve, demonstrating mortality risk in relation to target glucose levels. Aiming for low glucose levels and accepting high levels are both associated with higher mortality.

Conclusion

Given the results of the recent studies, intensive insulin therapy aiming at glucose levels between 4.4 and 6.1 mmol/l cannot be considered as standard care in ICU patients. The risk of hypoglycaemia is increased and repeated multi-centre studies have not confirmed the results of single centre studies. It is possible that the NICE-SUGAR study will bring new insights to the debate. In my opinion, intensive insulin therapy has been embraced with too much eagerness and some contemplation and reluctance is more appropriate.

Acknowledgement: The author wishes to thank the Dutch NICE foundation (Chairman Dr. E. de Jonge) for making available the data on mortality of cardiac surgery patients in the Netherlands. ■

continued from p. 7

safety officer within 24 hours of an occurrence. There are other key areas for improvement, both in regards to internal and external education and training, as well as manual development and maintenance of medical equipment. However, these activities require extra staff to be employed. How much does it cost? A very recent study from Japan quoted 1 full-time equivalent (FTE) for 250 beds (Hayashida et al. 2007) and this is in accordance with earlier studies. As the cost of one FTE nursing staff is between 35 000 and 50 000 euros per year in Europe; this can be seen as a good investment in improving patient safety.

Mortality of anaesthesia has declined ten-fold in the last decade as a result of a concerted effort to improve patient safety. If careful guidelines for prevention and reporting of errors are followed, the hope is that intensive care will follow this pattern in the coming decade. ■

Intra-abdominal Hypertension:

Evidence that Early Detection and Management Improves Outcomes and Reduces Resource Utilisation

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Introduction

There are several important issues concerning intra-abdominal hypertension (IAH) and abdominal compartment syndrome (ACS). The first is that IAH/ACS are often seen outside the trauma population. In fact this syndrome is just as common in the medical ICU as the surgical ICU, with prevalence rates over 30% in both populations (Malbrain et al. 2004). The second point is that clinically important increases of intra-abdominal pressure (IAP) are possible in just a few hours. For this reason, measurements conducted every 6-12 hours in the unstable patient are likely inadequate due to the risk of delayed diagnosis and prolonged tissue ischaemia (Balogh et al. 2003). Most importantly, however, it must be noted that intra-abdominal pressure can greatly assist the clinician in decision-making in the complex critically ill patient. A quickly increasing IAP in a patient could point straight to the diagnosis of abdominal compartment syndrome, rapidly identifying the underlying cause of multi-organ dysfunction. This data could allow the timely reversal of the underlying cause, reversal of organ ischaemia, prevention of permanent end organ damage and early transfer out of the ICU – freeing up an ICU bed for another patient and reducing resource consumption. The following discussion will focus on this concept – **outcome impact and resource consumption in patients with IAH/ACS.**

Intra-abdominal Hypertension: Definitions and Risk Factors

International consensus definitions, risk factors, monitoring and interventional recommendations for intra-abdominal hypertension were published in early 2007 (Cheatham et al. 2007). Table 1 lists important definitions. Risk factors for developing elevated intra-abdominal pressure are listed in Table 2. All newly admitted ICU patients or those with new organ dysfunction who have two or more risk factors should have serial intra-abdominal pressure measurements taken to ensure IAH is not developing.

Impact of IAH on Patient Outcome

Although multi-centre, randomised, controlled outcome trials have not been conducted for IAH management, there is an increasing body of data demonstrating that IAH worsens patients outcomes and increases resource consumption, whereas aggressive protocol driven interventions designed to treat IAH improve outcomes without increases in resource utilisation. Numerous epidemiologic studies demonstrate that patients suffering IAH/ACS have increased morbidity, mortality and ICU/hospital length of stay (LOS). Raeburn noted IAP >20 mm Hg in 36% of his damage control surgical patient population (Raeburn et al. 2001).

Compared to those that did not develop elevated IAP, this group suffered
- longer ICU lengths of stay,
- longer ventilator times,
- more multiple organ failure and
- higher mortality.

Pupelis found similar results in severe pancreatitis:
- IAP elevation predicted higher mortality (36% vs. 0%),
- more multiple organ dysfunction (64% vs. 19%) and
- longer ICU LOS (21 days vs. 9 days) (Pupelis et al. 2002).

Data on liver transplants shows association between elevated IAP and renal failure, delayed ventilator weaning and death (Biancofiore et al.

Table 1: Definitions

Intra-abdominal Hypertension (IAH)	Sustained or repeated pathologic elevation in IAP ≥12 mm Hg.
Abdominal Compartment Syndrome (ACS)	Sustained IAP >20 mmHg that is associated with new organ dysfunction or failure.
Primary ACS	A condition associated with injury or disease in the abdomino-pelvic region that frequently requires early surgical or interventional radiologic intervention.
Secondary ACS	ACS due to conditions that do not originate in the abdomino-pelvic region.

- Have you ever had an ICU patient become progressively more swollen and edematous after fluid resuscitation?
- Have you ever had an ICU patient develop progressive renal failure and need dialysis?
- Have you ever had an ICU patient develop multiple organ failure and die?

What was their Intra-Abdominal Pressure?

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Monitoring IAP + Intervention = Reduced Organ Failure[2-3]

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2004). Malbrain showed that an IAP≥12 mm Hg predicted higher mortality (39% vs. 22%) in adult populations while Ejike found a similar but more pronounced mortality link in children (33% vs. 2.4%) with an associated increase in ICU LOS (13d vs. 6 d) (Malbrain et al. 2005; Ejike et al. 2007). Finally, Sugrue found IAP (along with age, blood pressure and sepsis) to be an independent predictor of renal insufficiency or failure in a large surgical population (Sugrue et al. 1999).

Impact of IAH Interventional Management on Outcome and Resource Utilisation: Primary IAH/ACS

While epidemiologic data demonstrates a clear association between IAH/ACS and morbidity, a common question is whether IAH/ACS is simply a prognostic indicator or if it is a modifiable parameter that can be addressed to improve patient outcomes. Increasing data suggests the latter. Ten years ago, Ivatury and colleagues noted that interventions directed specifically at preventing ACS in trauma patients undergoing damage control laparotomy (i.e. using temporary abdominal closure following the initial laparotomy) resulted in marked improvement in survival (89% vs. 61%) (Ivatury et al.1998).

Table 2: Risk factors for IAH/ACS

1. Diminished abdominal wall compliance
   - Acute respiratory failure, especially with elevated intrathoracic pressure
   - Abdominal surgery with primary fascial or tight closure
   - Major trauma / burns
   - Prone positioning, head of bed > 30 degrees
   - High body mass index (BMI), central obesity
2. Increased intra-luminal contents
   - Gastroparesis
   - Ileus
   - Colonic pseudo-obstruction
3. Increased abdominal contents
   - Hemoperitoneum / pneumoperitoneum
   - Ascites / liver dysfunction
4. Capillary leak / fluid resuscitation
   - Acidosis (pH < 7.2)
   - Hypotension
   - Hypothermia (core temperature < 33°C)
   - Polytransfusion (>10 units blood/24 hours)
   - Coagulopathy
   - Massive fluid resuscitation (>5 L / 24 hours)
   - Pancreatitis
   - Oliguria
   - Sepsis
   - Major trauma / burns
   - Damage control laparotomy

"All newly admitted ICU patients or those with new organ dysfunction who have two or more risk factors should have serial intra-abdominal pressure measurements taken to ensure IAH is not developing"

Since that publication other institutions have implemented temporary abdominal closure protocols with clear outcome improvements (Cipolla et al. 2005; Cheatham and Safcsak 2007). This advancement is now commonly applied in field hospitals in the ongoing Iraq war and may explain some of the dramatic improvements in survival from severe trauma in this war compared to the gulf war 15 years prior. Other surgical subspecialties caring for abdominal aortic rupture, neuro-trauma and severe pancreatitis also report outcome improvements using selected TAC as an interventional therapy for IAH (Oelschlager et al. 1997; Joseph et al. 2004; Leppaniemi et al. 2007). Most recently, Cheatham et al presented data outlining outcomes and resource utilisation in patients with ACS who were treated with temporary abdominal closure plus a standardised medical interventional protocol (Cheatham and Safcsak 2007). Utilising this protocol, the investigators noted

- a reduction in mortality (49% down to 29%),
- more rapid and more successful closure of the abdominal wall (34% vs. 61%),
- reduced total hospital LOS (29 days down to 18 days) and
- decreased resource utilisation.

The authors conclude that evidence based IAH/ACS management strategies significantly improve patient survival without an increase in resource utilisation and should be adopted by other institutions.

continued on p. 22

Pet Visitation Programmes in Critical Care:

Positive Impact on Patient Outcomes

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Although empirical research is still limited and insufficient, there is increasingly more evidence that pets can have a positive emotional and physical impact on people, and in particular patients, through the human-animal bond. In this article, we will explore two particular experiences at different institutions where pet visitation programmes are encouraged, and talk about the sorts of guidelines necessary to ensure hygiene and patient safety. The most recent study in the acutely ill patient population was done using seventy-six hospitalised heart failure patients randomised to three groups:

1) Those left alone (at rest);
2) Those who received a human visitor; and,
3) Those visited by a therapeutic companion dog visit with dog lying on the bed.

The findings of the study clearly showed that only the third group of acutely ill patients, who each received a therapeutic visit from their family pet, experienced measurable physiological benefits, which included improved haemodynamics, decreased plasma epinephrine and decreased anxiety.

Pet Visitation Programmes Make a Difference

Baystate Medical Center in Springfield, Massachusetts (USA) has had a pet visitation programme in place in the medical-surgical ICU since 1995. In order to minimise infection control and safety, the infection control department was included in the development of the program. Proof of immunization, recent bathing with flea treatment and 24-hour notice are all required. While it can sometimes be a labour-intensive endeavour, staff feel that it is well worth the effort.

Just two weeks after the completion of the organisation of the infrastructure for the programme, there was a request from a patient's family to have the patient's own pet visit. The family was surprised and quite pleased to hear that not only were pets permitted to visit in the ICU, but that there was a supportive programme in place. This was especially important since the patient, Mr. S., was very withdrawn and appeared to respond only to the pictures of his dog that were kept at the bedside.

Assessing the patient's mental status was difficult because the patient had both a previous psychiatric condition as well a current neurological insult that was the reason for his ICU admission. "Ellie", his greyhound, began to visit daily and was received with a smile and a notable increase in Mr. S's cognitive awareness.

In addition, we found that we were able to talk to the patient through Ellie, even though he did not respond to our direct communication, which allowed us to more thoroughly assess his mental status. Both the nursing and medical staff embraced the intervention of pet visitation and enthusiastically incorporated the new therapy into their practice as evidenced by their support and acceptance of Ellie with each visit. After he was discharged from the ICU, Ellie continued to visit him regularly on the long-term respiratory unit. He completed the process of weaning from his ventilator support and was discharged home. Considering that Mr. S. was completely unresponsive to all nursing staff and significant others everyone except for Ellie, this reaction was quite powerful.

Pets Help Long-term Critically Ill Patients

At Catholic Medical Center in Manchester, New Hampshire, it was recognised that long term critically ill patients often became depressed and lacked the motivation to participate in their care and journey back to wellness, despite improvement in their condition and active family involvement. There is evidence that depression can adversely affect the outcome of patient recovery, even to the point of increasing mortality risk.

A patient's stay in the ICU can sometimes be long, arduous, and monotonous and at times, a member of his or her family and that family, including a pet, best meets patient needs. Knowing that we needed to find creative ways to encourage these patients, animal assisted therapy was introduced into our ICU by Donna Proulx, a staff nurse, using the patient's own pets. During pet visits we have observed withdrawn patients become interactive and anxious patients become calmer. For others, seeing their beloved pets became a motivating factor to participate in their own care in order to get home again and care for their pet. Patients look forward to these visits and exhibit great joy when they see their pet walk into the room and lie in bed with them. This happiness permeates the unit and positively impacts the staff as well.

Conclusion

This doesn't mean that every ICU patient will get a pet visit. It means that if a pet is important to a patient we will try to bring them together. Certain guidelines are followed, such as consent, proof of immunisation, and recent bathing with flea treatment. Nevertheless, it is our belief that pet therapy is a minimal cost intervention that can make a noticeable contribution to the well being of the critically ill patient. ■

continued from p. 20

Impact of IAH Interventional Management on Outcome and Resource Utilisation: Secondary IAH/ACS

Non-surgical patients with secondary IAH/ACS also demonstrate outcome improvements with early interventional therapy. Oda established a protocol whereby all patients with severe acute pancreatitis who developed IAP >15 mm Hg underwent continuous renal replacement therapy before onset of organ dysfunction (Oda et al. 2005). The result was a rapid reduction in IAP levels to less than 10 mm Hg, along with a drop in serum cytokine levels. Compared to their traditional 30% ICU mortalities for this patient population, this interventional group had a mortality of 6%. Sun also studied severe pancreatitis patients, randomising them into a study arm that received IAP monitoring plus peritoneal drainage with a continuous indwelling catheter versus no IAP monitoring and no catheter (Sun et al. 2006). All patients were otherwise managed in the same fashion. Groups were compared for changes in APACHE II scores, hospital LOS and survival to discharge. The interventional arm fared much better – APACHE II scores dropped while hospital LOS and mortality were cut in half (15 d vs. 28 d, 10% mortality vs. 20% mortality).

Conclusion

Similar to compartment syndromes of the extremity or skull, prolonged elevation of pressure in the abdominal compartment leads to severe tissue ischaemia and irreversible cellular death. Without treatment, long ICU admissions, progressive organ failure and death may ensue. Current evidence suggests that early compartment pressure monitoring combined with interventional therapies can reduce morbidity and mortality while simultaneously reducing total resource consumption by the patient. Intensivists should consider intra-abdominal pressure as one piece of the physiologic picture and begin implementing an approach to managing this syndrome in the appropriate patient populations. ■

Assessment and management protocols are available online at www.wsacs.org, while teaching materials and nursing management protocols can be found at www.abdominal-compartment-syndrome.org.

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Cardiac Output Monitors: An Overview

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Although there is no evidence for an improved outcome of critically ill patients by measurement of cardiac output (CO) per se, this haemodynamic variable is still considered clinically important, as it is a major determinant of systemic oxygen delivery. Since the early 1970's, the pulmonary artery thermodilution technique, which enabled measurement of cardiac output at the bedside, has become the clinical reference technique par excellence. However, due to lack of benefit in outcome pulmonary artery catheterization, currently it is less frequently used in the critical care scenario. As a consequence, alternative and less invasive techniques have been developed and introduced into the clinical setting over the last years.

For instance, the transpulmonary thermodilution technique is currently increasingly applied in intensive care units and it has been shown in various studies that CO measurement works well with pulmonary artery thermodilution in numerous clinical and experimental situations. In addition, this technique enables assessment of cardiac preload by volumetric and dynamic parameters, which are superior to cardiac filling pressures in critically ill patients. It also allows assessment of lung oedema and vascular permeability that may be helpful in guiding treatment in critically ill patients. The latter has been emphasized recently, as goal-directed fluid management reduces vasopressor and catecholamine use in cardiac surgery patients.

Usage of another indicator, transpulmonary lithium dilution, has been introduced with comparable reliability for measurement of CO in critically ill patients. However, this technique does provide information on fluid responsiveness but not lung water and is less convenient, as an extracorporeal system is required for quantification of lithium, a substance whose use may be limited by the frequency of application. Nevertheless, transpulmonary thermodilution and lithium dilution techniques are clinically attractive, as they also offer continuous cardiac output monitoring from arterial pulse contour analysis that may be recalibrated at any time by the integrated reference technique.

While algorithms for continuous CO monitoring by pulse contour analysis are still modified, these systems are also increasingly reliable during various changes in treatment. Despite a long history, determination of CO by arterial pressure curve alone has received considerable attention, particularly since systems based on pressures recording analytical method (PRAM) have become commercially available. Since it is less invasive and obtainable from a single peripheral arterial line, continuous cardiac output measurement by arterial waveform analysis alone-without any internal reference is also clinically attractive. Although extremely desirable for the clinical scenario, validity of absolute CO and changes in CO with the currently available technology is an issue. These systems are still in a clinical validation process and further data are required for broad use in critically ill patients with manifold clinical conditions. In general, all systems based on arterial pressure recording have the potential to assess dynamic parameters on fluid responsiveness such as systolic pressure variation (SPV), pulse pressure variation (PPV) and stroke volume variation (SVV), which are considered to be superior to cardiac filling pressures in critically ill patients with positive pressure ventilation.

Ultrasound techniques (oesophageal Doppler) or transcutaneous Doppler for detection of aortic flow profiles are also increasingly used. These systems are minimally to non-invasive and promising in their results. However, absolute CO values obtained by these techniques may be questionable, while changes may be more correctly reflected and helpful in guiding treatment. Additionally and clinically relevant, indices of cardiac preload can also be derived by these systems. Notably, goal-directed intra-operative fluid administrations, based on algorithms using this technique have had positive effects on length of hospital stay and complications after major surgery. Independently, data on critically ill patients is still limited and further studies are required for validation of these techniques.

Finally, non-invasive techniques using airway access for CO_2 re-breathing (Fick's principle) have been suggested. However, this technique may be limited in patients with lung pathology and not be applicable in all critically ill patients. Unfortunately, assessment of cardiac preload is not possible with such systems. The CO_2 re-breathing technique cannot be regarded as validated in severely ill patients with different underlying diseases. A further completely non-invasive and safe technique, bioimpedance, which is based on the electric properties of flowing blood, has been developed for many years and has been the subject of further study more recently. So far, reported studies have had mixed results and further evaluation is required before these systems can be regarded as sufficiently accurate for use with critically ill patients.

In conclusion, a number of manifold techniques for CO measurement in critically ill patients have been developed and introduced into the clinical setting in recent years. However, some of these techniques are still in a validation process and indicator dilution techniques are currently regarded as the clinical reference. ■

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

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

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Footnotes used in pages 25 to 28

1. These recommendations are the opinions of ECRI Institute's technology experts. ECRI Institute assumes no liability for decisions made based on this data.
2. transpulmonary thermodilution measurement for determination of cardiac output, preload volume, and extravascular lung water; continuous cardiac output and stroke volume by pulse contour analysis; continuous volume responsiveness.
3. self-tests; hemodynamic calculations; 24 hr trends.
4. overlapping color CO curves; hemodynamic summaries strored in monitor; full printout capabilities.
5. ACCS stands for Abbott Critical Care System.
6. and charger; hemodynamic and drug-infusion computation; optional footswitch and printer. Meets requirements of BSI, CSA, and UL.
7. SvO_2 capability when used with OPTICATH thermodilution catheters; CO-average editing screen; hemodynamic and O_2-transport computations; drug-infusion computation. Meets requirements of BSI, CSA and UL.
8. SvO_2 capability when used with OPTICATH thermodilution catheters; CO-average editing screen; hemodynamic and O_2-transport computations; drug-infusion computation. Meets requirements of CSA.
9. SvO_2 capability when used with OPTI-Que or OPTICATH thermodilution catheters; CO-average editing screen; hemodynamic and O_2-transport computations; drug-infusion computation. Meets requirement of CSA.
10. stored in Dash.
11. stored in PDM.
12. COavg, Clavg, EDV, EDVI, SVR, SVRI, RV EF, SV and SVI; UL certified.

Healthcare Product Comparison System

	ECRI INSTITUTE'S RECOMMENDED SPECIFICATIONS[1]	PULSION Medical Systems
MODEL	**BASIC THERMAL DILUTION CO UNIT**	**PiCCO plus**
WHERE MARKETED		Worldwide
FDA CLEARANCE		Yes
CE MARK (MDD)		Yes
CONFIGURATION	Stand-alone or modular	Stand-alone, integrated in CO module for Philips, CMS, and Dräger/Siemens Infinity SmartPod
CO RANGE, L/min	0 to 12	0.25 to 25
Accuracy	5% or 0.25 L/min	Not specified
THERMAL INJECTATE		
Injection voll, mL	3, 5, 10	2-20
Temp range, °C	0 to 25	0 to 24
Thermistor for injectate temp	Any	Injectate temperature sensor
DYE DILUTION	Optional	No
Data Entered	Catheter resistance and sensitivity, injectate volume and temperature	Patient height and weight, injectate type, injectate volume, CVP, automatic catheter detection
Method	User selected	Membrane keypad
REMOTE START SWITCH	Optional	No
OUTPUT COMPUTATION	CO, blood, and injectate temperature	Stuart Hamilton formula
DATA DISPLAYED	Thermal dilution curve, blood and injectate temps, CO consumption, trace size, position controls, hemodynamic calculations	Discontinuous: CO, GEDV, ITBV, EVLW (not available in USA), CFI, GEF, PVPI; continuous: PCCO, SV, SVR (all indexed), APsys, APdia, MAP, HR, SVV, PPV dp/dt max
Alarms	Visual message or audible alarm	Acoustic warning signal
No. Stored curves/calculations	6	5 curves, 50 results, 7 day trend
No. Curves Averaged	5	Up to 5
SELF-TEST CURVE	Optional	No
CIRCUITS SELF-TEST	Yes	Yes
EXTERNAL DISPLAY DEVICES	Optional	BP transferred to any bedside monitor, interface solution for bedside monitors and patient data management systems via data port
CATHETERS, Compatible brands		Pulsiocath
THERMISTOR CIRCUIT FAULT INDICATOR	Visual	Message on display
H x W x D, cm (in)		15.8 x 26 x 25 (6.2 x 10.2 x 9.8)
WEIGHT, kg (lb)		4.8 (10.6)
POWER SOURCE, VAC (Hz)		115/230 (50/60)
Battery type		Sealed lead D-cells
Rechargeable		Yes
Operating time, hr		≤0.5
Charger		Internal
Low-battery indicator		Symbol on screen
PURCHASE INFORMATION		
Price, unit		Not specified
7 Fr, balloon tip		N/A
Warranty		1 year
Delivery time, ARO		Not specified
Year first sold		1997
Fiscal Year		Not specified
OTHER SPECIFICATIONS		Minimally invasive; [2]
LAST UPDATED		January 2007

Healthcare Product Comparison System

	ECRI INSTITUTE'S RECOMMENDED SPECIFICATIONS[1]	SPACELABS Healthcare	Mennen Medical	Mennen Medical
MODEL	**BASIC THERMAL DILUTION CO UNIT**	**91496**	**960-SYS (101 : 102 : 201 : 202) Horizon Series Cath Lab**	**ENVOY Patient Monitor CO Module**
WHERE MARKETED		Worldwide	Worldwide	Worldwide
FDA CLEARANCE		Yes	Yes	Yes
CE MARK (MDD)		Yes	Yes	Yes
CONFIGURATION	Stand-alone or modular	Compatible with any Spacelabs Ultraview or PCMS monitors with appropriate software levels	Module	Module for ENVOY patient monitor
CO RANGE, L/min	0 to 12	0.1 to 18	0.5 to 20	0 to 20
Accuracy	5% or 0.25 L/min	+/-10%		
THERMAL INJECTATE				
Injection voll, mL	3, 5, 10	5, 10	3, 5, 10	3, 5, 10
Temp range, °C	0 to 25	0-.27 to 5°C injectate and 17.2 to 43°C blood	0 to 25	0 to 25
Thermistor for injectate temp	Any	In-line or bath probe	Injectate supply, in catheter	Injectate supply, thermistor
DYE DILUTION	Optional	No	No	No
Data Entered	Catheter resistance and sensitivity, injectate volume and temperature	Patient height and weight, HR, BSA, MPAP, MAP, CVP, PCWP, computational constant	Computation constant, patient height and weight; other data automatically entered	Computation constant, patient height and weight
Method	User selected	Touchscreen	Cursor keypad and softkeys	Quicknob and softkeys
REMOTE START SWITCH	Optional	No	Optional IR control	Optional remote control; also hardkey on module
OUTPUT COMPUTATION	CO, blood, and injectate temperature	Stuart Hamilton formula	Values measured at peak and 30% of peak to determine extrapolation	Values measured at peak and 30% of peak
DATA DISPLAYED	Thermal dilution curve, blood and injectate temps, CO consumption, trace size, position controls, hemodynamic calculations	CO, CI, SVR, SVRI, PVRI, LVSW, SV, SVI, RVSW, LVSWI, RVSWI, blood temperature, injectate temperature	Supplier name, cathether type, injectate volume, catheter size, injectate temp, blood temp, BSA, K, Factor, HR, CO, CI, SV, SI, and 6 thermodilution curves	Injectate temperature, blood temperature, BSA, CO, SV, TSR, SVR, PVR, RCW, LCW, LVSW, RVSW, TB, CI, SVI, SVRI, PVRI, RCWI, LCWI, LVSWI, TI, and 6 thermodilution curves
Alarms	Visual message or audible alarm	Not specfied	Not specified	Not specified
No. Stored curves/calculations	6	5/30 measurements	4 standard	Curves stored until results are accepted, unlimited number of results stored, up to 90 days of patient data
No. Curves Averaged	5	Up to 5	User-defined	6
SELF-TEST CURVE	Optional	No	With simulator	No
CIRCUITS SELF-TEST	Yes	Yes	No	Yes
EXTERNAL DISPLAY DEVICES	Optional	Monitors, bedside and central recoders/printers	Remote video displays	Remote video display, central station, bedside
CATHETERS, Compatible brands		All major	All major	All major
THERMISTOR CIRCUIT FAULT INDICATOR	Visual	Visual prompt messages	Message on monitor, CRT	Message on monitor, CRT
H x W x D, cm (in)		11.3 x 5.7 x 18 (4.5 x 2.2 x 7.1)	22.9 x 6.4 x 38.1 (9 x 2.5 x 15)	10 x 4 x 14 (3.9 x 1.6 x 5.5)
WEIGHT, kg (lb)		0.8 (1.75)	1.8 (4)	Not specified
POWER SOURCE, VAC (Hz)		From monitor, <5 W	From monitor 90-130/180-264 (47-63)	From monitor 90-130/180-264 (47-63)
Battery type		N/A	None	N/A
Rechargeable		N/A	N/A	N/A
Operating time, hr		N/A	N/A	N/A
Charger		N/A	N/A	N/A
Low-battery indicator		N/A	N/A	N/A
PURCHASE INFORMATION				
Price, unit		Not specified	Not specified	Not specified
7 Fr, balloon tip		Catheter not supplied	Not specified	Not specified
Warranty		1 year	1 year	1 year
Delivery time, ARO		Not specified	90 days	90 days
Year first sold		1998 : 2004	1991	1998
Fiscal Year		July to June	January to December	January to December
OTHER SPECIFICATIONS		Edit; auto averge; user prompts; [3]	Auto averaging ≤6 trials with [4]	None specified.
LAST UPDATED			January 2007	January 2007

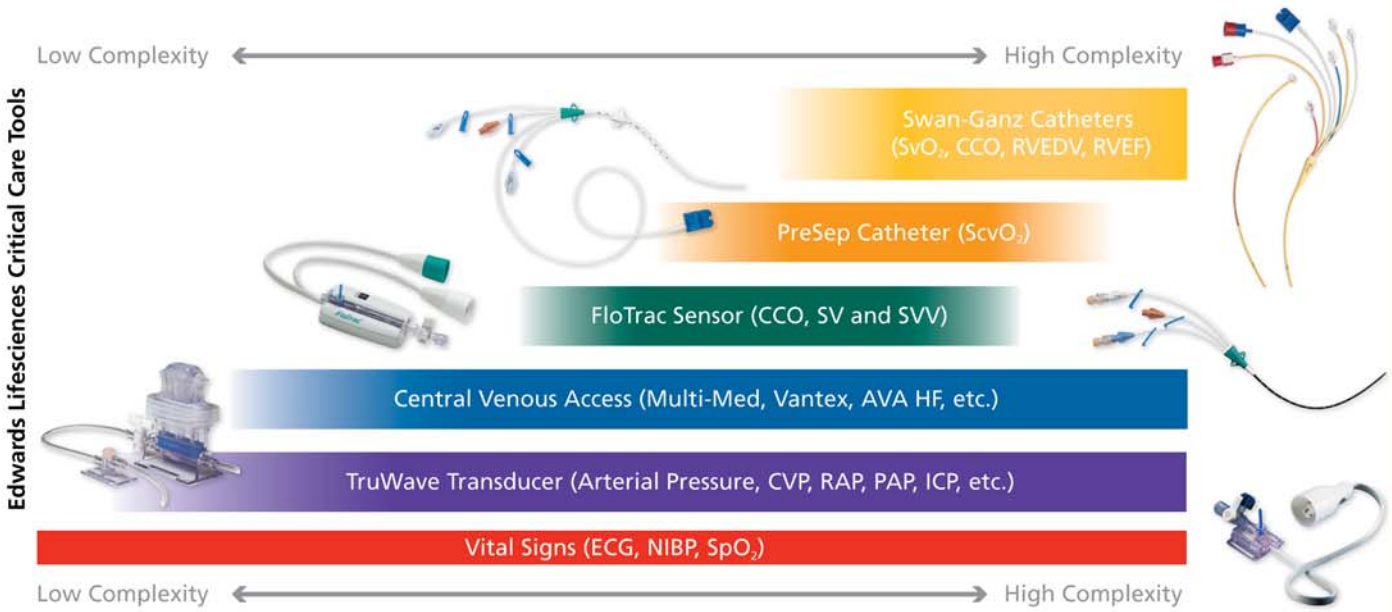
ECRI INSTITUTE'S RECOMMENDED SPECIFICATIONS[1]	Hospira	Hospira	Hospira	Hospira
BASIC THERMAL DILUTION CO UNIT	**Model 3300 Cardiac Output Computer**	**Oximetrix 3 SO2/CO Computer**	**Q2 Plus SO2/CCO Computer**	**Q2 SO2/CCO Computer**
	Worldwide	Worldwide	Worldwide	Worldwide
	Yes	Yes	Yes	Yes
	No	No	No	Yes
Stand-alone or modular	Stand-alone	Stand-alone	Stand-alone	Stand-alone
0 to 12 5% or 0.25 L/min	0.5 to 20	0.5 to 20	0.5 to 20	0.5 to 20
3, 5, 10 0 to 25 Any	3, 5, 10 0 to 25 Immersion or flow-through probe	3, 5, 10 0 to 25 Immersion or flow-through probe	3, 5, 10 0 to 25 Immersion or flow-through probe	3, 5, 10 0 to 25 Immersion or flow-through probe
Optional Catheter resistance and sensitivity, injectate volume and temperature User selected	No Computation constant automatically set when most ACCS [5] catheters are selected; manually set for other catheters Keypad	No Computation constant automatically set when most Opticath catheters are selected; manually set for other catheters Keypad	No Computation constant automatically set when most Abbott catheters are selected; manually set for other catheters Keypad	No Computation constant, automatically set when most Abbott catheters are selected; manually set for other catheters Keypad
Optional	Yes	No	No	No
CO, blood, and injectate temperature	Integration cuts off at 30% of peak; exponential extrapolation	Integration cuts off at 30% of peak; exponential extrapolation	Integration cuts off at 30% of peak; exponential extrapolation	Integration cuts off at 30% of peak; exponential extrapolation
Thermal dilution curve, blood and injectate temps, CO consumption, trace size, position controls, hemodynamic calculations Visual message or audible alarm 6 5	CO, pulmonary artery and injectate temperatures, CO curve, CO-average editing screen, calculated hemodynamic parameters, drug administration screens Not specified Not specified Up to 6	CO, pulmonary artery and injectate temperatures, CO curve, CO-average editing screen, calculated hemodynamic parameters, drug administration screens, SO_2 Not specified Not specified Up to 6	CCO and CO, pulmonary artery and injectate temperatures, CO curve, CO-average editing screen, calculated hemodynamic parameters, drug administration screens, SO_2 Not specified Not specified Up to 6	CCO and CO, plumonary artery and injectate temperatures, CO curve, CO-average editing screen, calculated hemodynamic parameters, drug administration screens, SO_2 Not specified Not specified Up to 6
Optional	No	No	No	No
Yes	Automatic	Automatic	Automatic	Automatic
Optional	Optional printer	Optional printer	Optional printer, data I/O ports	Optional printer, data I/O ports
	Most major 14 KΩ	Most major 14 KΩ	Most major 14 KΩ	Most major 14 KΩ
Visual	Visual message	Visual message	Visual message	Visual message
	12.7 x 30.5 x 27.9 (5 x 12 x 11)	16.5 x 30.5 x 40.6 (6.5 x 12 x 16)	18 x 33 x 38 (7 x 13 x 15)	18 x 33 x 38 (7 x 13 x 15)
	6.4 (14)	12.2 (27)	11 (24.3)	11 (24.3)
	100, 120, 220/240 (50/60) Sealed lead Yes ≥6 Internal LCD screen	100, 120, 220/240 (50/60) None N/A N/A N/A N/A	~100-120, 200-240 (50/60) None N/A N/A N/A N/A	~100-130, 210-260 (47/63) None N/A N/A N/A N/A
	$10,500 $107 1 year Not specified Not specified January to December	$10,500 $253 1 year Not specified Not specified January to December	$30,000 Not specified 1 year Not specified 2003 January to December	$25,000 Not specified 1 year Not specified Not specified January to December
	Backlit LCD; self-contained battery [6]	High-visibility CRT screen; [7]	High-visibility LCD screen; [8]	High-visibility CRT screen; [9]
	January 2007	January 2007	January 2007	January 2007

Healthcare Product Comparison System

	ECRI INSTITUTE'S RECOMMENDED SPECIFICATIONS[1]	GE Healthcare	GE Healthcare	Edwards
MODEL	**BASIC THERMAL DILUTION CO UNIT**	**Dash 3000 : Dash 4000 : Dash 5000**	**CARESCAPE PDM (Patient Data Module)**	**Vigilance II**
WHERE MARKETED		Worldwide	Worldwide	Worldwide
FDA CLEARANCE		Yes	Yes	Yes
CE MARK (MDD)		Yes	Yes	Yes
CONFIGURATION	Stand-alone or modular	Configured or semi-modular	Modular	Stand-alone
CO RANGE, L/min	0 to 12	0.2 to 15	0.2 to 15	1 to 20
Accuracy	5% or 0.25 L/min	C.O. +/- 5%, Blood Temperature +/- 0.2°C, Injectate Temperature +/- 0.3°C	Blood Temperature accuracy +/- 0.5°C 17°c - 30°C, Injectate Temperature accuracy +/- 0.3°C	
THERMAL INJECTATE				
Injection voll, mL	3, 5, 10	3, 5, 10	3, 5, 10	3, 5, 10
Temp range, °C	0 to 25	0 to 30	0 to 30	0 to 30
Thermistor for injectate temp	Any	Bath probe or in-line	Bath probe or in-line	Immersion of flow-through probe
DYE DILUTION	Optional	No	No	No
Data Entered	Catheter resistance and sensitivity, injectate volume and temperature	Patient height and weight, injectate volume, catheter size	Patient height and weight, injectate volume, catheter size	Operator choice of entering a specific computation constant or configuring the monitor to automatically select a computation contant based on injectate volume and catheter size
Method	User selected	Trim knob	Touchscreen or trim knob	Navigation knob and pushbutton
REMOTE START SWITCH	Optional	Remote control, Auto Mode	Remote keypad, auto mode	No
OUTPUT COMPUTATION	CO, blood, and injectate temperature	Manual entry of computation constant for nonspecified catheters	Manual entry of computation constant for no specified catheters	Not specified
DATA DISPLAYED	Thermal dilution curve, blood and injectate temps, CO consumption, trace size, position controls, hemodynamic calculations	CO, blood temp, injecate temp, CO waveform, last avg CO, BSA, CI, SV, SVR, SVRI, PVR, LVSW, RVSWI	CO, blood temp, injectate temp, CO waveform, last avg CO, BSA, CI, SV, SVR, SVRI, PVR, LVSWI, RVSWI	CCo, ICO, EDV, SvO_2, $ScvO_2$, derived hemodynamic and oxygenation parameters
Alarms	Visual message or audible alarm	Error Messages	Error Messages	Audible and visual alarms
No. Stored curves/calculations	6	20	20	Not specified
No. Curves Averaged	5	4	4	Not specified
SELF-TEST CURVE	Optional	No	No	Not specified
CIRCUITS SELF-TEST	Yes	No	No	Automatic
EXTERNAL DISPLAY DEVICES	Optional	Printer, central station (CIC)	Printer, central station (CIC)	Standard printer option and USB compatible printer option
CATHETERS, Compatible brands		Baxter, Abbott, Ohmeda, Arrow	Baxter, Abbott, Ohmeda, Arrow	Edwards CCO, volumetric and oximetry catheters
THERMISTOR CIRCUIT FAULT INDICATOR	Visual	Built into every monitor	Sensor fail message	Visual message
H x W x D, cm (in)		Dash 3000: 26 cm (10.25 in) x 28 cm (11.0 in) x 20 cm (8 in); Dash 4000: 27.4 cm (10.8 in) x 29.3 cm (11.5 in) x 24.3 cm (9.6 in); Dash 5000: 28.7 cm (11.3 in) x 30.7 cm (12.2 in) x 23.9 cm (9.4 in)	Integral part of PDM multiparameter module	24.0 x 29.2 x 20.8 (9.5 x 11.5 x 8.17)
WEIGHT, kg (lb)		Dash 3000: 5.2 kg (11.2 lbs); Dash 4000: 5.5 kg (12.2 lbs); Dash 5000: 6.4 kg (14 lbs)	Part of PDM module	3.43 (7.5)
POWER SOURCE, VAC (Hz)		Built into Dash monitors	Part of PDM module	100, 120, 220/240 (50/60)
Battery type		Lithium ion	Part of PDM module - Removable lithiumion	None
Rechargeable		Yes	Part of PDM module - charging time ~2 hrs	N/A
Operating time, hr		4 each (up to 2 per monitor)	Part of PDM module - ~ 3.5 hrs (new, fully charged)	N/A
Charger		Yes	Part of PDM module or external battery charger, reconditioner	N/A
Low-battery indicator		Yes	Part of PDM module	N/A
PURCHASE INFORMATION				
Price, unit		Not specified	Not specified	Not specified
7 Fr, balloon tip		Not specified	Not specified	Not specified
Warranty		1 year parts and labor	1 year parts and labor	1 year
Delivery time, ARO		4 weeks	4 weeks	Not specified
Year first sold		Dash 3000: 1999; Dash 4000: 2000; Dash 5000: 2005	2007	Not specified
Fiscal Year		Not specified	Not specified	January to December
OTHER SPECIFICATIONS		Up to 20 cardiac output calculations [10]	Up to 20 cardiac output calculations [11]	Trending; SVO_2, $ScvO_2$, CCO, CCI,[12]
LAST UPDATED		January 2007	January 2007	January 2007

The Continuum of Critical Care

The Critical Care Patient



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Applied Leadership Skills for Intensive Care Professionals

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Physicians complete years of medical training to learn how to care for patients. However, especially in intensive care medicine, medical knowledge provides only limited help when these physicians enter their first management position. Suddenly they find themselves faced with the difficulties of leading an interdisciplinary team, coping with highly emotional situations with patients and relatives and challenged by sometimes stressful collaborations with other specialties. While an increasing number of physicians attend management courses, the emphasis of these is usually more on business theories and the presentation of management tools, than on the training of practical skills.

What are Practical Leadership Skills?

The basis of practical leadership skills is a combination of personal resources, social competencies and management tools. Main issues connected to personal resources are awareness of one's role as a leader and self-management aptitude. Social competencies include communication skills, ability to solve problems in interpersonal contacts and the capability to manage conflict. Management tools important for daily work are human resource development, organisational development, time management, process skills and results-oriented work structuring.

Objectives

To meet this need, the Karl Landsteiner Institute for Anaesthesiology and Intensive Care developed an applied course, focussing on practical leadership skills and management tools relevant for intensive care unit (ICU) professionals. The main goal of the course was to make top executives´ factors of success accessible to ICU professionals. To accomplish this goal, training focused on defining personal strengths and potential for development as a leader, acquiring tools for effective and efficient structuring of daily leadership work (process competence) and increasing competence to intervene in case of tension or conflicts, in addition to learning how to develop guidelines for successful teamwork.

Focus was set on the importance of self-development, interpersonal skills and the ability to get along with others. To supply a spectrum of solutions to problems that are beyond the range of the intensivist, top economic and healthcare executives were invited to informal evening discussions called fire-side rounds. These meetings provided an insight into the daily work of other managers and supplied incentives for enhancing one's own work. A variety of teaching methods provided an interactive learning environment and dispensed suitable teamwork tools.

Course

The course was structured in five parts—with two-day training sessions held over a period of six months. Between sessions, peer group meet-

Applied Leadership Skills – 5 courses

Course 1: Leadership and Personality Traits Authenticity in actions and appearance are essential for a leader. Intensivists learn how to use their own potential – identify, develop and apply personal and social skills.	Course 3: Teamwork Building Shaping teamwork in a goal-oriented way to reach commonly set goals is the main topic of this course. Adequate, active intervention in case of tension within teams is also addressed.
Course 2: Leadership Tools Attendants learn factors for success and managerial tools for daily work. Main topics include: motivation, delegation and leadership in times of change.	Course 4: Leadership and Support This course concentrates on awareness of your staffs´ potential, while supporting and utilising their strengths.
Course 5: Leadership, Communication, Information The meaning of communication within a team, handling complaints and other related issues are dealt with in this course. Summary of the key skills/techniques of all 5 courses.	

Table 1: Content of training courses

ings and individual coaching sessions were organised to guarantee long term results. In each course, emphasis was placed on a differing approach to leadership: personality, active creation of leadership, teambuilding, staff support and communication. The layout of the course was designed to allow for a small group of participants to concentrate on personal development and training issues.

Evaluation

The Society of Medical Doctors of Lower Austria supports this course, accrediting it with the highest possible number of points achievable in the educational program. 88% of the participants filled out the standardised evaluation questionnaire from the Section of Continuous Education of the Society of Medical Doctors of Lower Austria. The evaluation showed that training not only met expectations of participants, but a high percentage (96%) commented on its high practical relevance for their daily work. All participants attested that the main goals of the course were reached. Participants also valued the level of the courses' trainers – awarding them high marks in terms of didactics, rhetoric and medical knowledge.

Conclusion

With increasing management responsibilities, intensivists have a deficit of practical management skills, often neglected in management training. A specialised management training course for ICU professionals was well accepted and highly evaluated as helpful for fulfilling the tasks required from intensivists in management positions. Development of such management-centred courses, specifically designed to meet the needs of ICU professionals, may be an important step for other medical institutions to begin to overcome this deficiency in leadership and interpersonal skills and key to the successful management of ICUs in the coming decades. ■

continued from p. 10

frequently fail. For example, standards propose the following actions:

- Eliminating confusing abbreviations and stan dardisation of the format for indicating drug dosages,
- Writing down and reading back of verbally given drug orders,
- Reporting of critical test results, and
- Standardising information that is transferred with the patient from unit to unit in the hospital.

JCI standards describe the important "functions" and "processes" in an organisation that support safe, quality care. These include patient rights, patient assessment and care, patient education, infection control, quality management, and others. Thus, there is no chapter devoted to an emergency services department or critical care unit as all these functions apply. To evaluate the standards, we conduct an on-site survey with a team of three professionals, typically a doctor, nurse, and administrator. Although visits are currently announced, unannounced surveys are foreseen in the near future.

To begin the on-site evaluation process, surveyors (evaluators) use a "tracer" methodology where they select eight or more patients and examine their healthcare services from the time they enter the hospital until they are discharged. It is vitally important to examine how hospital departments work together to create positive outcomes for patients rather than survey each department separately as discrete units within the organisation. This process takes between three and five days. Before leaving the hospital, the survey team has a conference with hospital administrators and provides a preliminary report on how the organisation fared in the survey. As many of the patients "traced" are complex cases, they frequently enter the hospital through the emergency services department and involve a stay in a critical care unit. Thus, these units are integral to the evaluation process.

The mission of JCI is to improve the safety and quality of patient care in the international community. As not all organisations in a country will seek JCI accreditation, it is also important for JCI to be actively involved in helping countries around the world develop their own quality and safety evaluation programs. Through partnerships with ministries of health, many countries are adapting or adopting the standards while others have used our accreditation format and evaluation methodology as template for their own accreditation programs.

Although our reports are all confidential, we list hospitals receiving accreditation on our website. For more information on JCI, its new standards and other publications, and our accredited hospitals, please visit our website at www.jointcommissioninternational.com. ■

ICU MANAGEMENT

Author guidelines

ICU Management

Content

Articles may focus on any management or practice issue in intensive care related to economics, quality of care or patient outcome. We only accept scientific papers with a clear connection to management and practice issues. We also invite viewpoints for publication in our Forum section, which can be personal opinions of the author and/or reactions to articles published in prior issues. These are published at the discretion of the Editors.
Submissions may not have been published previously or be currently submitted for publication elsewhere.
Articles must be written by independent authorities and any sponsors for research must be named. If manufacturers are named in an article, the text must present an unbiased view, not in support of any particular company.

Submission Guidelines

Authors are responsible for all statements made in their work, including changes made by the editor and authorised by the submitting author.
The text should be provided as a word document via e-mail to editorial@icu-management.org.
Please provide a contact e-mail address for correspondence.
Following review, a revised version, which includes the editors' comments and recommendations, is returned to the author (at the contact e-mail address) for authorisation.

Length

- Articles: maximum 700 words (less if figures or tables are included)
- Viewpoints: maximum 700 words
- News/research/product updates: maximum 175 words

Please note that contributions longer than the specified number of words may not be accepted.

Structure

Article texts must contain:

- Title
- Names of authors with abbreviations for the highest academic degree
- Affiliation: Department and institution, city and country
- Main authors are requested to supply a portrait photo (see specifications below)
- Summary of one or two sentences (no more than 30 words) describing the content
- Contact name for correspondence and an e-mail address which may be published with the article
- Website, if appropriate
- Acknowledgements of any connections with a company or financial sponsor
- Introduction, main text and summary/conclusion, with subheadings as appropriate
- Authors are encouraged to include checklists and/or guidelines, which summarise findings or recommendations
- References or sources, if appropriate, as specified below

Writing Style

Articles must be written in UK/British English (e.g. organisation, not organization), with short sentences, a clear structure (see above) and no bias. Full stops in numbers may only be used to indicate a decimal place; otherwise use commas as separators.

Images

Main authors are invited to supply a portrait photo for publication with their article. This and any other relevant images for publication with an article should be sent by e-mail as separate files (only high resolution images with 300dpi) and their order of placement in the article must be clearly indicated. Only the electronic formats ".tif" or ".jpg" can be used for images, i.e. not Microsoft Word or PowerPoint. Images must be no smaller than 9cm x 9cm at 100% scale. Only images meeting these specifications can be published.
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Format for References

Any references that are deemed important to understanding of the article should be cited in concise form within the article. Please use the Harvard reference system.
Citations within the text for a single author reference should include the author surname and year of publication; for a citation with two authors include both author surnames and year of publication; for more than two authors, include the first author surname followed by "et al." and the year of publication. Multiple citations should be separated by a semicolon, and listed in alphabetical order.
Example of within text citation: (Edwards 2004; Edwards and Miller 2002; Miller et al. 2003).
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Thank you,
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An interview with

Dr. Marco Ranieri

Dr. Ranieri is the Chair of the Department of Anaesthesia and Intensive Care at Molinette Hospital in Turin, Italy; Professor at the University of Turin and the current President of the European Society of Intensive Care Medicine (ESICM). In this interview with Sherry Scharff, Dr. Ranieri reflects on the difficulties of applying business principles to critical care management and outlines his vision for ICU and emergency rooms of the future.

Can you briefly describe your professional history?

I graduated from University of Bari, Italy with a specialisation in Anaesthesia and Intensive Care medicine. I completed a two to three year fellowship at McGill University in Montreal, Canada before returning to Italy in 1992. Subsequently, I was an Assistant Professor in the Anaesthesia and Intensive Care Department at the University of Bari until 1998. I spent the two years following as a visiting Professor at Mount Sinai Hospital, in the University of Toronto's Critical Care Department. Upon returning to Italy I worked as an Associate Professor in Anaesthesia and Intensive Care at the University of Pisa. In 2001, I became a full Professor at the University of Turin in the Anaesthesia and Intensive Care department. I took on the Presidency of ESICM in 2006 and my term ends in 2008.

What does a typical day consist of?

I would say an average day is divided between the administration and maintenance of a busy ICU and research. The first order of business when I reach the department in the morning is to meet with attending doctors. I do rounds of the ward as well as the lab, and attend meetings with hospital officials and others, depending on the day. The rest of the day consists of administration of the department until the afternoon when the doctors arrive and I am able to focus on writing and reviewing research papers and preparing presentations for upcoming conferences.

Which management and personnel issues take up most of your time?

In my roles in both ICU and anaesthesia departments, the central management issue is always allocation of resources. I deal with this continuously, in direct cooperation with the hospital CEO. It often becomes a factor with personnel. Resources are not infinite, and an important part of my role as a manager is to make sure that limited resources are being used in the most efficient manner. Flexibility is the absolute key to success. Presently in Italian hospitals, I see this as our primary issue. There is a lack of flexibility in terms of personnel, structure and organisation, which prevents the most efficient use of resources. Anaesthetists, for example, are assigned to one operating room as opposed to transferring from varying theatres based on need. As some personnel are under-utilised and others over-utilised, there is a danger not only of wasting resources, but also burnout syndrome.

What are your goals for your ICU/Emergency Department?

We must reach a gold standard of treatment means that we are providing the best possible medicine with the knowledge that resources are limited. This is the challenge of the new millennium, and we must learn to evolve rapidly and remain flexible. In many ways we need to think of ourselves as an efficient service, like that of an airline. We must adopt the same criteria in our system. The best way to organise our services more

efficiently and fairly, in my view, would be by utilising a system of classification such as an updated Diagnosis Related Group (DRG). Patients can be assigned a group based on ICD diagnoses, procedures, age, sex, and the presence of complications or co-morbidities. This can help managers and intensivists, among others, to determine how much time, personnel, and resources to devote to each case, since patients within each category are similar clinically and are expected to use the same level of hospital resources.

Are there particular areas in which you feel your department excels?

Management of acute respiratory failure, specifically mechanical ventilation and extra-corporeal lung assistance is our speciality.

What has been your most satisfying experience in your professional life?

There are several pinnacle moments thus far in my career in general, and specific high points in both my physician and managerial roles.

As a doctor, absolutely the most rewarding experience to date occurred just over a year ago, and involved a patient who was a 15 year-old girl. She desperately needed a new lung and while awaiting a transplant, we used extra capillary support as a bridge and mechanical support to buy her time. The fact that we were able to save her life through our efforts was incredibly gratifying.

As a manager, running all institutional activities – within budget, while making some relevant savings last year was a success, easily measurable in business terms, and also satisfying in a goal-meeting sense. Of course, having my article published in JAMA was also deeply fulfilling on a professional level and was perhaps most beneficial in regards to my ego.

What is the hardest decision you have had to make as an ICU/Emergency Department Manager?

The choice to close an ICU (6 beds) because it ceased to be cost effective, and the medical personnel issues that resulted was clearly a difficult, albeit, necessary decision I was forced to make. As a manager, there is a fragile balance between maintaining personnel levels and overall satisfaction amongst ICU staff, and creating a good, efficient general system of care. Ultimately, in the case of this ICU closure, the personnel were reallocated, and, after a necessary transitional period, satisfaction returned and efficiency improved.

What sorts of issues do you feel the ICU community needs to address to prepare for the future?

At the root of ICU organisation and management, there lies an inherent contradiction. On one hand, there is a drive for research and all that connects to it, in terms of new medications, updated tools and equipment to improve response and diagnosis time; while on the other hand, there are limited resources, and a push to tighten budgets and rein in spiralling expenditures. The challenge remains how to cope with this continual debate – on a daily basis, within our own ICU's, as well as how to face these issues on a grander scale; in terms of whether we should be spending a million dollars in technological advances to save 10 lives in our own developed world, or the same amount for a continental vaccination program for Africa – where it could save thousands. These are the kinds of questions we need to ask ourselves within the intensive and emergency care communities and the broader issues we must deal with in the coming decade.

What are your feelings as you near the end of your term as President of ESICM?

Well, I hold enormous pride in the fact that I was able to oversee ESICM during such a momentous period. We celebrated our 25th Anniversary and held a successful 20th Annual Conference over the past year. I think as a relatively young society, and in so few years, ESICM has managed to reach the same level of accreditation, professional and clinical status that other societies have attained in a much longer period of time. I think it is a sign of how prevalent critical care has become and a clear signal of its' importance in the future. ■

An Overview of Healthcare in Canada

"Through the years, I came to believe that health services ought not to have a price tag on them, and that people should be able to get whatever health services they require irrespective of their individual capacity to pay."
–T. C. Douglas, Founder of Medicare (1984)

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Organisation of the Healthcare System

Canada's publicly funded healthcare system provides universal coverage for medically necessary healthcare services to all legal residents and citizens. The annual healthcare budget in Canada continues to increase, reaching $148 billion (CAN) in 2006, approximately 10.3% of the total Gross Domestic Product (GDP). Canada continues to rank among the world's top five health spenders when compared to other Organization for Economic Co-operation and Development (OECD) countries, yet remains behind the United States in terms of healthcare spending per person.

Canada has ten provinces, three territories and a population of over 33 million, with 24 million (~80%) living in urban areas. The population reflects an ethnic, cultural and linguistic makeup unique to any other country, with continuous influxes of immigrants. Each province/territory is responsible for administering healthcare services free of charge based on a similar health insurance plan known as Medicare. The federal government shares the roles and responsibilities with the provincial/territorial governments, providing financial assistance as long as they meet the criteria set out under the federal health insurance legislation (Canada Health Act). The five basic principles of the Canada Health Act ensure that healthcare is universal, accessible to all residents, portable within the country and during travel, comprehensive and publicly administered. The federal government also provides direct funding for specific groups including Aboriginal groups, members of the Armed Forces and eligible veterans.

The provincial/territorial governments provide hospitals with an annual global budget, and certain health programs are funded under special funding agreements. While universal coverage of all medically necessary health services is provided, deci-

Canada: Facts & Figures	
Population	33,084,891 (2006)
Capital	Ottawa
Administrative divisions	10 provinces and 3 territories
Area	9,984,670 square kilometres
Age structure	0-14 years: 17.3% 15-64 years: 69.2% 65 years and over: 13.5% (2007)
Life expectancy at birth	Males: 76.98 years Females: 83.86 years (2007)
Ethnic groups	British Isles origin 28%, French origin 23%, other European 15%, Amerindian 2%, other (mostly Asian, African, Arab 6%, mixed) 26%
Religions	Roman Catholic 42.6%, Protestant 23.3% (including United Church 9.5%, Anglican 6.8%, Baptist 2.4%, Lutheran 2%), other Christian 4.4%, Muslim 1.9%, other/unspecified 11.8%, none 16% (2001)
Languages	Official: English 59.3%, French 23.2%, other 17.5%
Total GDP	$1.178 trillion (2006)
GDP per capita	$35,700 (2006)
GDP - real growth rate	2.7% (2007)
Healthcare spending	$148 billion in total - $104 billion public; $44 billion private (2006) $4,548 per capita (2006) 10.3% of total GDP (2006) Largest category of spending: hospitals, drugs, physicians
Total number of physicians	62,307 (2006), 2 physicians / 1,000 people
Total number of nurses	321,590 (2005), 10 nurses / 1,000 people

Note: All financial figures quoted are in CANADIAN DOLLARS.
Data sources: Canadian Institute for Health Information, 2007; Health Canada, 2003; Health Canada, 2005; Statistics Canada, 2001.

sion-makers in the health system are constantly struggling to determine which services are deemed 'medically necessary' and therefore eligible for public coverage.

Each province/territory manages their healthcare delivery differently, while remaining true to the values set by the Federal legislation. Some provinces (Alberta, British Columbia, Ontario) charge a healthcare tax, which does not limit access to required services. Many jurisdictions have decentralised their funding structures by creating regional health authorities, or health integration networks within each province/territory, which have become responsible for managing their funds and setting priorities within their region.

Access to healthcare services has become a key concern for many Canadians and government agencies. Funding poses the greatest challenge to effective delivery and quality of care. Under the Canada Health Act, prescription drugs and supplies provided in the hospital are mostly free of charge for patients. However, on discharge from the hospital, coverage is not provided for all services (e.g. physiotherapy, optometry, massage therapy, chiropractic and dental treatments). Comprehensive Health Insurance packages are available through most employers and private providers. While the Canada Health Act does not cover all homecare and community services, provinces/territories generally cover most of these costs. Given varied demographics and competing regional demands, regulation and delivery of these programs differs significantly across jurisdictions, as does the range of services provided.

Current Challenges

Canada faces political challenges of meeting public demands for quality improvements in healthcare services. Regional variations in care across jurisdictions and among rural communities are evident, resulting in concerns about access to quality care. The current focus is on addressing concerns regarding patient wait times for access to specialists, elective surgeries and diagnostic tests, improving medical technologies, and the inclusion of pharmaceutical, home and long-term care. Crowded emergency rooms, lack of access to family health practitioners and availability of specialty services are among some of the concerns being addressed by today's health authorities in Canada.

Recruitment and retention of trained healthcare providers in the country presents unique human resource challenges. Nurses and physicians are drawn towards "greener pastures", mostly in the United States, by promises of better wages. Incentive packages and other retention strategies beyond financial incentives are important in addressing these issues.

In an effort to improve the current system, the federal government provided $34 billion (USD) in 2004 with a detailed ten-year agreement to improve Canada's healthcare system. The focus was on reducing wait times prompting all provinces and territories to establish new criteria and priority schemes to address these issues by hiring more staff, increasing capacity, clearing backlogs and increasing ambulatory and community care programs.

Common Trends

With an aging population, fiscal constraints, advancements in technologies and rising costs, Canada's healthcare system has come under stress over the years. With the current funding structure, delivery of care has evolved from a reliance on hospitals and physicians to alternative care in clinics, primary healthcare centres, community health, homecare, and public health interventions. Advances in medical technology have led to an increased number of procedures conducted as outpatients, reducing length of stay in hospital for patients and increasing post acute care in the home and community. Reform initiatives have focused on primary healthcare service delivery, creating healthcare teams, initiatives on preventing illness and injury and chronic disease management.

In response to some of the challenges cited, some provinces (Alberta, British Columbia and Quebec) have introduced private care for core services to reduce wait times to improve access for Canadians. This has triggered a widespread debate on the future of healthcare. Concerns with privatisation include preferential treatment and a disproportionate distribution of resources. This debate often ignores the fact that private healthcare has long existed in Canada's public system. The current system has been structured in a way that has avoided the development of a distinct two-tier system where care and services are purchased to bypass existing structures. Universal healthcare is not only one of the pillars of Canadian identity and national pride – it is constitutionally protected. Given the legal obligations, political demands and financial constraints that must be navigated, continued discussion is anticipated among a population that holds strongly to the current values of a publicly funded healthcare system. ■

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Critical Care in Canada

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The Canadian national health insurance program for many Canadians represents a fundamental and defining value of our society. The "Medicare" Program has as its key values those of public administration, comprehensiveness, universality, portability and accessibility for all insured services across the country including critical care. As in other countries, Canadian critical care units struggle to meet ever- increasing patient needs and requests for care. This struggle is felt even more intensely than in other countries though, in view of the deep-seated founding values of our healthcare system, its nearly entirely public nature and the multicultural diversity of our society. Critical care services thus need to balance respect for individual autonomy, multicultural and religious diversity – concepts central to the Canadian notion of a just society – with the equally vital need to ensure appropriate and fair access to a limited resource.

To meet these challenges, recent efforts have focused on the development of a system approach to critical care delivery. Regionalisation networks have done much to break down traditional hospital based silos and have helped to address the problem of placing "the right patient in the right bed at the right time". The creation of Critical Care Response Teams (also known as Outreach or Medical Emergency Teams) have also helped facilitate patient transfers in and out of intensive care units (ICUs), better inform decision-making regarding the use of life-sustaining treatments, and decrease overall hospital mortality (University Health Network 2007). The Canadian Critical Care Trials Group continues to provide new knowledge that serves to improve the quality of patient care worldwide.

However referring healthcare and intensive care teams still struggle with decision-making regarding the appropriate use of life-sustaining treatments (Sibbald et al. 2007), a struggle that is also shared worldwide. Patients diagnosed with a life-threatening illness may engage the healthcare system in a number of different ways and must be informed of life-sustaining and palliative treatment options at various times, in different places and stages of illness. The recent emphasis on autonomy, patients' rights and the societal emphasis on respecting various cultural and religious beliefs has led to a reluctance to make recommendations against patients' or their substitute decision-makers' (usually family members) request for ICU admission or continued ICU treatments even when potential benefits are marginal at best or when death is inevitable. Two provinces, Manitoba and, more recently, Ontario, are attempting to standardise best practices to improve decision-making in these challenging situations and hence trying to improve the quality of care received by critically ill patients.

In Manitoba, the College of Physicians and Surgeons proposed a "Statement on Withholding and Withdrawing Life-Sustaining Treatment" in June 2006. The purpose of the proposed statement is to "assist physicians, their patients and others involved with decisions to withhold or withdraw life-sustaining treatment by establishing a process for physicians to follow". The statement specifies that life-sustaining treatment must "recover or maintain a level of function that enables the patient to achieve awareness of self and environment and to experience his/her own existence". A physician may withhold or withdraw treatments if it is not medically indicated (has no chance of achieving the minimum goal) or is not medically appropriate (defined as treatment that may achieve the minimum goal however chances of doing so are poor or there are significant negative effects – such as pain and suffering or expected short duration of effective treatment). The statement details the roles and responsibilities of physicians in communicating information, facilitating decision-making, seeking a second opinion when the benefits are unclear or when conflict arises, and in transferring care and/or even withholding/withdrawing treatments against patient or substitute decision-maker's wishes. It is not clear yet if and how this statement is being used in clinical practice.

In Ontario, The College of Physicians and Surgeons' policy, titled "Decision-Making for the End of Life", also provides some guidance in dealing with the withholding or withdrawal of treatment, and in resolving conflicts. The policy states that "physicians are not obliged to provide treatments that will almost certainly not be of benefit to the patient" where "recovery or improvement is virtually unprecedented", or any permanent benefit would not be experienced. What constitutes a benefit, and decision-making processes surrounding such issues (e.g. who decides and how, the likelihood of success, its duration) should be factored into decision-making are not clearly addressed, particularly in cases of intractable conflict failing to clearly answer the ethical dilemmas that arise in daily practice.

continued on p. 41

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Communication and Decision-Making in the Intensive Care Unit in Canada

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Communication is an important issue in the Canadian healthcare system. Recent studies have shown that communication problems are the most common reason for patient complaints to Canadian regulatory agencies (Tamblyn et al. 2007), and seriously ill Canadians consider honest communication to be as important as having trust and confidence in their doctors (Heyland et al. 2006).

Communication is particularly important in the ICU. Although most Canadians are satisfied with the care that they or their loved ones receive in the ICU, many are not satisfied with the communication they have with doctors or their role in decision-making (Heyland et al. 2003). While the Canadian legal system mandates an informative model of decision-making (Emanuel and Emanuel 1992), the overwhelming majority of Canadians prefer a degree of shared decision-making (Heyland et al. 2003), and many come from cultural backgrounds in which patients are typically shielded from the burden of bad news and difficult decisions. Meanwhile, those who accept their role as decision-maker are equally disappointed by the fact that few patients and substitute decision-makers (SDMs) are properly informed about their diagnosis, prognosis, and alternative treatments prior to arrival in the ICU (Heyland 2006; Sibbald et al. 2007; Rady and Johnson 2004). Thus, Canadian physicians must be sensitive to the needs of a broad spectrum of cultures and beliefs.

> When facing a situation in which cultural differences may be a factor, physicians should start by asking a few questions that will help them understand how their patient/SDM views issues such as decision-making, communication, candor or truthfulness, and life support. Try to normalise the conversation as much as possible:
>
> "This is a conversation I have with all of my patients..."
> "How are decisions made in your family? If decisions need to be made, who should be involved?"
> "If I receive any new information, whom would you like me to speak with?"
>
> Communication is never easy, but a few simple questions at the start of a conversation can help avoid misunderstandings, build a strong therapeutic alliance, and facilitate good medical care for the patient.

Critical Care Response Teams – The Right Communication at the Right Time

ICU physicians typically meet their patients at a time of acute illness; often after life support (including ventilation) has been initiated. Thus, initial communication with the patient is often extremely limited, and many patients are admitted to the ICU without the benefit of informed consent or discussion. The advent of Critical Care Response Teams (CCRTs, also known as Medical Emergency Teams) has allowed ICU physicians to meet patients earlier in their illness, perhaps at a time when they can participate in discussions. This reduces their reliance on subsequent family meetings for decision-making if the patient deteriorates and ultimately requires life support. It may also result in a change in philosophy of care, whereby the patient would decide that they did not want admission to the ICU.

So far, the published literature on CCRTs has not described their role in facilitating dialogue and decision-making, but at least one Canadian study has reported that CCRTs are sometimes consulted solely for this purpose (Sibbald et al. 2007). More studies are needed in order to establish whether this is a common use for CCRTs.

Simulation Training to Improve Communication Skills

The SUPPORT trial showed that physicians communicate poorly with patients, even when given resources and a legal obligation to improve communication (SUPPORT 1995). This may be due to the fact that very few physicians have ever received formal training in communication (Nelson 2006). Simulation training may be useful in this regard. Canadian ICU trainees often use simulation to learn acute resuscitation or procedural techniques, but recent studies suggest that simulation can also be used to teach communication skills (Fallowfield et al. 2002; Lorin et al. 2006; Alexander et al. 2006).

In our institution, we have developed an educational seminar featuring simulated family meetings with standardised family members portrayed by actors. In these meetings, trainees are given chal-

lenging scenarios (e.g. two estranged siblings who disagree about a treatment decision for their aunt) that they must resolve according to the legal and ethical standards of our province. Trainees are also taught communication and conflict-management skills, which they can practice during the scenarios. These simulation sessions allow trainees to practice their skills in a safe environment, and to receive constructive feedback and evaluation from the actors and senior ICU physicians observing their performance. The cost of developing such a session is significant, but feedback from participants at our institution has been very positive, and trainee performance scores suggest that this session is effective for improving both communication skills and legal/ethical knowledge.

In summary, communication is a core skill for all physicians, and an important part of patient care in the ICU. Communication skills are particularly important in a country like Canada, where almost one quarter of the population is foreign born, and patients have a broad spectrum of values and beliefs. In order to improve patient satisfaction with communication, we need to make better use of novel approaches such as critical care response teams and simulation training. ■

continued from p. 38

For these reasons, the Critical Care Secretariat, Ministry of Health and Long Term Care has initiated the Ethical Issues of Access component of its transformation strategy with a goal of engaging a broad platform of key professional and public stakeholders in developing province wide access and utilisation guidelines for critical care services. These guidelines will

1) Define and respect patients' rights and ability to consent to treatment;
2) Define healthcare providers' obligations to facilitate development of reasonable goals and treatment plans regarding the use of life-sustaining treatments;
3) Inform patients about the risks and benefits of treatment and provide reasonable alternatives; and
4) Ensure fair access of all people in Ontario to reasonable and competent healthcare; all in a manner that will enable the healthcare system to deliver sustainable ICU services over the long-term.

Ontario is the first province to use the ethical model of accountability for reasonableness (Daniels and Sabin 2002) to attempt to facilitate a widespread informed discussion detailing when life-sustaining treatments may be of benefit, when they will not, and what standards and processes must be met in decision-making with patients and families—both before and during ICU admission, and at the time of ICU discharge. Furthermore, it is the first province to attempt to devise an evaluation schemata to assess the impact of its guidelines on quality of care. Ontario is thus the first to initiate a comprehensive practical process to support patients, families and ICU teams as they navigate these challenging dilemmas that arise on the front lines.

Critical care in Canada is starting to address on a systems' level how to improve the quality of patient care at the end of life, and how to improve access and utilisation of an expensive resource whose benefits are not always certain. Without these efforts, ICU services will not be sustainable over the long-term and patients, who would most likely benefit, will not receive them. Hopefully our current Canadian experiences and transformation efforts to will serve to help others in the field in achieving our common goal: to provide the best care to critically ill people. ■

The Future of Critical Care in Canada: A Patient-Centred Approach

The Canadian Healthcare system has reorganised its resources through regionalisation to respond to increasing demands on critical care. The next step should realign critical care services along the patient's trajectory.

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Background

The purpose of critical care is to provide a large spectrum of care for patients with critical conditions due to an acute medical illness, exacerbation of a chronic disease, surgical intervention or injury. In Canada, critical care is an ever-evolving medical specialty, provided by physicians with backgrounds in Anaesthesia, Internal Medicine and Surgery. Canada is experiencing the global trends in limited resources and increasing demands for critical care services as a direct result of increasing needs of patients (Shumaker and Hill 2006; Carson et al. 2006; Needham et al. 2004; Needham et al. 2005). Today's patients have more complex diseases requiring highly trained caregivers—an expensive and scarce resource (Roy and Brunet 2005; Jastremski 2006). In addition, there are a greater number of total patients in need of these services because of technological advancements in managing care, leading to prolonged life duration. To improve access, quality and system efficiency, most Canadian provinces have organised services according to a regionalised approach in order to maximize resource utilisation, cost effectiveness and to improve healthcare providers' response to population needs (Bell and Robinson 2005).

A Regionalised Approach of the Healthcare System

To one degree or another, all Canadian provinces have begun to re-engineer their critical care resources to better respond to growing patient needs and demands. Efforts to provide early outreach to improve patient outcomes have been established via critical care outreach teams. These teams deliver critical care expertise within the hospital outside the walls of the intensive care units (Bellomo et al. 2003; Hillman et al. 2005; Scales et al. 2003). To address the shortages in supply, system-level training initiatives and targeted health human resources investments have been made. Quality improvements have been guided through the development of integrated provincial computer tracking systems and establishment of targeted metrics to measure and monitor improvements. Strategically cataloguing resources and concentrating new funding on limited areas, while at the same time, investing in the dialogue around ethical issues of access to critical care services, have approached the limits on capacity. These initiatives are continuing to evolve and the evaluations of the results are still pending. It is certain that these strategies will improve access, quality and system efficiency to a degree (Scales et al. 2004; Bekes et al. 2004; Manns et al. 2003). But can this model alone respond to the vast spectrum of patients and families needs?

The Future: A Patient-Centred Approach with a Realignment of Services

The next steps for critical care services in Canada should incorporate two major principles: A patient-centred approach to better respond to increasing patient expectations, and a realignment of critical care services to harmonize the level of care provided (intensive, intermediate, acute and chronic) with patient needs.

The realignment of critical care resources should create a continuum of care that matches the spectrum of patients needs from prevention to rehabilitation (Vincent et al. 2006). Services must come together around the patient, treating the patient as integral to the care team, instead of viewing the patient as a sum of medical problems requiring the patient to travel through silos of care. The answer will be to combine inter-professional and multidisciplinary expertise into a network of services that can integrate the social, moral and psychological aspects of patient need, in concert with the treatment of their organic medical conditions. This approach requires reconsidering ICU organisation, using appropriate medical technology and developing team spirit through teamwork training (Stone et al. 2006; Craft 2001; Risser et al.1999). Research and education should be integrated to generate, translate and evaluate knowledge at the bedside to continuously improve quality of care.

The patient must also be considered an actor in their own care, using their priorities for outcomes as the main concern. As such, critical care services have to start at home with early education of patients, families and upstream care resources, such as emergency medical services and primary care providers, to create integrated systems of care like the trauma system (MacKenzie et al. 2006; Nathens et al. 2000). Then services can extend to provide early goal therapy through inter-

action with pre-ICU and post-ICU care across specialties, including emergency departments, acute, chronic, long-term and managed care facilities (Rivers et al. 2001; Spaulding et al. 1997). These services could be provided in unique ways with telemedicine, via videoconference, and medical call centres. Similarly, critical care must grow beyond the focus on "saving life" to allow for complete rehabilitation and social reinsertion into the home and community post-ICU (Herridge 2007; Tansey et al. 2007), in addition to enabling a dignified death for end-of-life care when required (Cook et al. 2006; Heyland et al. 2006).

Conclusion

The regionalisation of critical care in Canada was an essential step in improving access, quality and system efficiency. The next step should be the proactive integration of critical care services into a network and seamless patient navigated system to truly realign the level of care provided with patient needs and expectations. ■

Induced Hypothermia & Neurological Outcome:
The 1ST Therapeutic Temperature Management Congress

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There is an increasing awareness in the critical care community of the importance of body temperature in determining outcome in patients with neurological injuries. Numerous studies have shown that development of fever is closely linked to increased neurological injury, even when no infection is present; this difference persists after multivariate analysis, suggesting that the link is a causal one. In addition, there is increasing evidence that inducing controlled hypothermia in the immediate aftermath of ischaemic injury decreases the extent of this injury; in some cases permanent injury can be completely avoided.

The meeting on therapeutic temperature management (TTM) that took place in Cancun, Mexico, from December 4-7, 2007 was the first to deal specifically with all aspects of controlled temperature management, as well as general issues pertaining to the care of patients with neurocritical illness. The "TTM Congress" drew more than one hundred experts from around the globe to discuss their experiences and research findings. The faculty included researchers as well as clinicians from the field of emergency medicine, intensive care, traumatology, neurology, cardiology, paediatric intensive care and neonatology.

General issues included thrombolysis in severe stroke (Patrick Lyden, San Diego, United States), reperfusion in patients with myocardial infarctions (Simon Dixon, Royal Oak, United States), management of patients with severe traumatic brain injury (Kees Polderman, Utrecht, The Netherlands), sex differences in resuscitation and the possible role of oestrogens and progestagens in preventing brain injury (Paul Pepe and Jane Wiggington, Dallas, United States and Dalton Dietrich, Miami, United States), management of brain-injured patients in the field (Paul Pepe) and treating brain injuries from the battlefield (Rocco Armonda, Bethesda, United States), as well as many other topics.

Temperature management issues included fever control (Stephan Mayer, New York, United States), cooling for TBI and stroke (Kees Polderman and Patrick Lyden), spinal cord injury (Dalton Dietrich), myocardial injury (Simon Dixon), trauma (Samuel Tisherman, Pittsburgh, United States), hypothermia in children with TBI or anoxic injury (Reese Clark, Pittsburgh, United States) and neonates with asphyxia (Michael Cotton, Durham, United States).

Neonatal asphyxia probably represents the area with the strongest evidence for use of hypothermia; benefits have been demonstrated in 3 multi-centre RCTs, all published in 2005. However, most neonatological societies currently advocate a cautious approach, stating that routine usage of hypothermia should await longer-term follow up from the three multi-centred studies as well as the results of three additional multi-centred trials: ICE (infant cooling evaluation), TOBY (whole body hypothermia for the treatment of perinatal asphyxial encephalopathy) and nnn-Hypothermia (neo-neuro-network trial) that together have enrolled 829 patients. The results of these trials are expected in late 2008.

According to the present guidelines, hypothermia for neonatal asphyxia should still be regarded as an experimental treatment, and should only be used in the context of clinical trials. The pros and cons of this approach were extensively discussed at the TTM meeting. Some of the centres that have participated in one of the three abovementioned (already published) trials are now offering hypothermia as part of their routine patient care, and are helping other hospitals that want to start hypothermia programs. Most experts expect the new trials to show positive results. Thus, overall, it seems likely that usage of hypothermia in neonatal therapies will increase in the next few years.

Much TMM Congress attention also was devoted to implementation issues and to the practical aspects of temperature control, both in the hospital and pre-hospital setting. Doctors, nurses and ER staff shared their experiences and participated in discussions. Experiences with pre-hospital cooling (Mike Clumpner and Jim Mobley, Spartanburg, United States and Stephen Bernard, Melbourne, Australia) indicate that early cooling can be feasible with a low-tech approach. A doctor (Mauro Oddo, New York, United States) discussed the pros and cons of patient selection as well as the pitfalls and results of implementing a cooling protocol for cardiac arrest patients in everyday clinical practice. The nursing perspective (May Kay Bader, Mission Viejo, United States) included discussion of both the nursing implementation of cooling and usage of various monitoring devices in patients with neurocritical illness.

Additional discussion (Stephen Bernard) was devoted to pros and cons of different cooling methods and devices. Preliminary results were released from the RICH study on very early cooling (pre-hospital, in the ambulance) to cooling in the ER (which is still early by most standards). Most attendants shared the view that although induction of hypothermia can be accomplished and/or facilitated by methods such as cold fluid infusion, ice packs, etc., a cooling device will probably be required for effective maintenance and controlled re-warming.

Finally, discussion (Kees Polderman) concerning the efficacy of cooling in traumatic brain injury concluded that the available evidence supports usage of cooling in TBI patients with high ICP in the early stages of injury. However, although it is widely accepted that hypothermia can help control intracranial hypertension, its usage to improve neurological outcome in TBI remains controversial.

The 2ND TTM Congress will take place in Barcelona, Spain, from October 1-4 2008. ■

2nd Annual Therapeutic Temperature Management Congress

SAVE - THE - DATE

October 1-4, 2008

Barcelona, Spain

"After the invigorating experience of our meeting in Cancun I am really looking forward to next years' TTM Congress in Barcelona, one of the most spectacular cities in Europe where we will build on last years' experience to organize an even better meeting. An expanded and first-rate faculty will provide the best and most complete scientific program on neurological injuries in general and therapeutic temperature management in particular, in a city famous for its art and architecture, its sun and beaches, its wonderful restaurants and its boisterous nightlife."

~ Kees Polderman, MD, PHD

For more information please contact Cincinnati Sub-Zero
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28th International Symposium of Intensive Care and Emergency Medicine

Jean-Louis Vincent
Department of Intensive Care
Erasmus Hospital
Free University Brussels
Brussels, Belgium

As we look out on the wet and windy winter weather, we may find ourselves looking forward to spring, and springtime in Brussels is, of course, synonymous with the International Symposium of Intensive Care and Emergency Medicine, held every year in March! The 28th ISICEM will be held at the Brussels Exhibition Centre from March 18 to 21, 2008, and we are anticipating another exciting week of stimulating lectures, debates, and discussion. The ISICEM welcomes about 5000 participants from around the world and has a faculty of some 200 international experts and present and future leaders in intensive care medicine.

The main aim of the meeting is to provide a place where busy physicians can "catch-up" with all the latest pathophysiologic, diagnostic, technologic, and therapeutic advances in their field, so that they can continue to provide optimal care to their patients. But of course the meeting is much more than a schoolroom, and participants are encouraged to take the chance to meet informally with other doctors from other units, hospitals, and countries to exchange experiences over a cup of coffee or during lunch. Such conversations provide an invaluable insight into how other doctors practice intensive care medicine, and can often be the start of major collaborations and exchanges between units. In addition to the main scientific program, technical exhibitions, poster presentations, satellite symposia, and pre-symposium courses, all help to make this a not-to-be-missed event in the annual intensive care agenda.

As always, the scientific committee has tried to develop a program with something to interest everyone. This year will see the presentation and discussion of early results from several important studies that have been conducted during 2007. The first data from the epidemiological EPIC II, a study designed as a worldwide follow-up to the European Prevalence of Infection in Intensive Care study that was conducted in 1992, and introduced at last year's ISICEM, will be available, providing important information on the impact of hospital-acquired infections worldwide. Nosocomial infections remain a common and important source of morbidity and mortality, and are associated with increased costs and resource use. Epidemiological surveys such as this provide important information about the numbers of cases, the sources of infection, the organisms involved, the risk factors, and the associated morbidity and mortality; such data can facilitate the development of effective local and global approaches to combat this problem.

In many areas of intensive care medicine there is ongoing debate as to the best treatment regimen or monitoring technique. There has been considerable discussion as to the relative merits of dopamine and norepinephrine as first-line vasoactive agents in patients with shock, particularly in patients with septic shock. Currently there is no evidence to support one treatment over the other, but will data from a large randomised controlled study conducted by the SOAP investigators change this equipoise? Some early results will be presented during the 28th ISICEM.

Sedation and analgesia are important components of ICU patient care. Over- and under-sedation are both associated with negative effects, but finding the right balance in all ICU patients can be difficult. The importance of adequate analgesia and sedation and new techniques for optimising analgosedation will be discussed in several sessions. Pro-con debates are always a popular part of the symposium program and this year topics range from therapeutic hypothermia, hydroxyethyl starch solutions, to the need or not for antibiotic restriction in the ICU. Other developments in intensive care that will be covered include advances in antimicrobial therapy, new modes of mechanical ventilation, potential new agents for the treatment of sepsis, changing guidelines for cardiopulmonary resuscitation, and techniques to monitor microcirculation.

It is not possible to summarise this 4-day meeting in only 700 words, but I have tried to give you a brief sample of the many and varied topics that will be covered in the 2008 ISICEM – I can guarantee that there will be something of interest for everyone, and that you will return refreshed and armed with new knowledge and skills, both to share with your colleagues and to apply in daily practice to improve patient care.

I look forward to seeing you in Brussels in March! ■

EUROPEAN SOCIETY OF INTENSIVE CARE MEDICINE

21st annual congress

European Society of Intensive Care Medicine

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Agenda

MARCH 2008

18-21 28th International Symposium on Intensive Care and Emergency Medicine (ISICEM)
Brussels, Belgium
www.intensive.org

MAY/JUNE 2008

31-3 Euroanaesthesia 2008
Copenhagen, Denmark
www.euroanesthesia.org

22-25 15th International Symposium on Infections in the Immunocomprosed Host
Thessaloniki, Greece
www.ichs.org

SEPTEMBER 2008

21-24 21st Annual Congress European Society of Intensive Care Medicine (ESICM)
Lisbon, Portugal
www.esicm.org

OCTOBER 2008

1-4 2nd Therapeutic Temperature Management (TTM) Congress
Barcelona, Spain
www.ttmcongress.com

4-8 European Respiratory Society Annual Congress
Berlin, Germany
www.ersnet.org

24-28 2nd Congress of the European Academy of Paediatrics (EPA)
Nice, France
www.kenes.com/paediatrics

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