ICU MANAGEMENT

Volume 6 - Issue 1 - Spring 2006

The Official Management and Practice Journal

SAFETY in Care

CARDIAC OUTPUT MONITORS

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Safety in Care

Safety must be a key priority for any service driven industry where errors have the potential to cause harm to people (Dorman 2005). All humans make errors, and doctors are no exception. Each year the media highlight cases where the wrong limb has been amputated or the wrong organ removed, where chemotherapy has been given intrathecally instead of intravenously, where excess doses of radiotherapy have been given, … the list goes on. Medical errors are very much a fact of life; doctors, even intensivists (!), are not infallible. One recent study (Rothschild et al. 2005) reported that 223 serious medical errors occurred in one ICU over a 6-month period, equating to 149.7 errors per 1000 patient days, or 1.5 errors per day for a 10-bed ICU; 11% of these errors were potentially life-threatening (Rothschild et al. 2005). Another study focusing on medication errors found one preventable error for every five doses of medication administered (Kopp et al. 2006). These statistics will be of no great surprise to any of us, but what can and should be done to reduce the incidence of such errors, to improve safety in our ICUs?

Over the years, healthcare services have developed a 'cover-up' culture where mistakes have been hidden, or even denied, and reporting discouraged. However, this traditional attitude is beginning to change as we learn from other industries where great harm is possible, e.g. aviation and nuclear power, which approach the concept of safety with a no-fault or limited fault approach (Pronovost et al. 2005). Systems are being designed to make it harder for people to make errors and easier for them to report errors when they do occur without fear of unwarranted personal reprisal. Medical errors are rarely the fault of one individual, but more likely the result of multiple failings in the system behind the individual. Changing the system is more likely to prevent a similar error occurring in the future than chastising one person. Those involved need to look beyond the immediate event to the assumptions and conditions that gave rise to it, and then introduce global, as well as local, reforms to prevent it happening again (Reason et al. 2001).

In this issue, Drs Gaba, Manser, Pronovost, Flin, Al-Ansari and colleagues present some of the potential organizational and management mechanisms that can be used to improve patient safety on our ICUs. Improving safety is a key step in improving quality of care (Institute of Medicine 2000), surely a primary aim for us all.

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

26th International Symposium on Intensive Care and Emergency Medicine

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Posters: Deadline for abstract submission: December 15, 2005

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EDITORIAL@ICU-MANAGEMENT.ORG

ICU Management is the Official Management and Practice Journal of the International Symposium on Intensive Care and Emergency Medicine and was previously published as Hospital Critical Care. Business Publication Audit (BPA) applied for.

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Dear Editor,

With reference to Dr Cochard's article on evaluation of pressure sensors in the autumn issue of **ICU Management**, *quality of a pressure measurement is more dependent on the quality of the fluid-filled tubing, the catheter and the monitor filter than on the transducer. We recommend the frequency response test to obtain the Bode diagram of the system: amplitude and phase shift vs. frequency (Billiet and Colardyn 1998). The result needs to be interpreted taking into account the frequency bandwidth in which the pressure signal needs to be measured, which is 12 Hz for the right heart and the radial artery.*

Our investigation has shown that all commercial disposable transducers have a 1/1 amplitude ratio far beyond the bandwidth of 12 Hz and are therefore of good quality.

To obtain a usable technique when evaluating commercial products, we developed the Gabarith test to select different configurations with a preset "maximum distortion" of 2%, 5% or 10% (i.e. with accuracy of 98%, 95% and 90%).

Yours sincerely,
Lic. Ing. E. Billiet, UZ Gent Biomedisch Technische Dienst,

LETTERS TO THE EDITOR: EDITORIAL@ICU-MANAGEMENT.ORG

News Worldwide

UN Pandemic Planning and Preparedness
www.undg.org

To counter the direct impact that an influenza pandemic may have at a global level, the United Nations System Influenza Coordination (UNSIC) has developed "UN System Pandemic Planning and Preparedness Guidelines". These include checklists, templates and toolkits showing best practice. According to the guidelines, each country has to formulate not only a preparedness strategy but also a contingency or response plan for in the event of a pandemic. Plans for nations worldwide are accessible on line at www.undg.org. UNSIC is responsible for the monitoring and coordination of their implementation in cooperation with the World Bank, United Nations Development Group and United Nations Development Programme.

WHO: Emergency Preparedness & Capacity Building
www.who.int

The World Health Organization (WHO) held an Expert Consultation, "Emergency Preparedness for the Health Sector Communities: Challenges and Way Forward" from 15th to 17th February in Geneva, Switzerland. The main topics of discussion were preparedness for crisis situations, and analysis of recent events and future policies. WHO's work in this field has intensified recently and the Health Action in Crisis (HAC) department has been reorganized into three main programmes: Emergency Response Operations, Recovery and Transition, and Emergency Preparedness & Capacity Building. The consultation in Geneva acted as a kick-off meeting for a renewed Emergency Preparedness & Capacity Building Programme. The main objective of the programme is to increase WHO's support to help countries set up their management capabilities for cases of emergency and disaster. The meeting concluded a set of recommendations for global strategy to scale up emergency national preparedness and mitigation activities. Further information about HAC and the recommendations can be found online at www.who.int.

News National

Haïti: Medicin Sans Frontières
www.msf.be

On August 2005 Medicine Sans Frontières (MSF) started an intervention in Cité Soleil, one of the most neglected and dangerous slums in Port au Prince, Haiti's capital city, where 250,000 people live in poverty, violence and social instability. MSF re-opened Choscal Hospital (St. Catherine's Hospital) and the Chapi Health Centre in the heart of Cité Soleil, where volunteer staff performed nearly 12,000 medical consultations and 800 emergency interventions during the first three months. At both sites, MSF collaborates with the staff of the Ministry of Health. During the last months of 2005, MSF has faced a huge increase in casualties of violence due to the intense fighting between local armed groups and UN troops of MINUSTAH (United Nations Stabilizations Mission in Haiti). In Choscal Hospital, MSF volunteers treated 34 victims of gunshot in November 2005, 80 in December and 103 in January 2006. Half of the wounded were women, children or elderly.

Médecins Sans Frontières is a Non Governmental Organization and is looking for anaesthetists with knowledge of French to work at least one month on its project in Cité Soleil. Visit our website for more information: www.msf.be

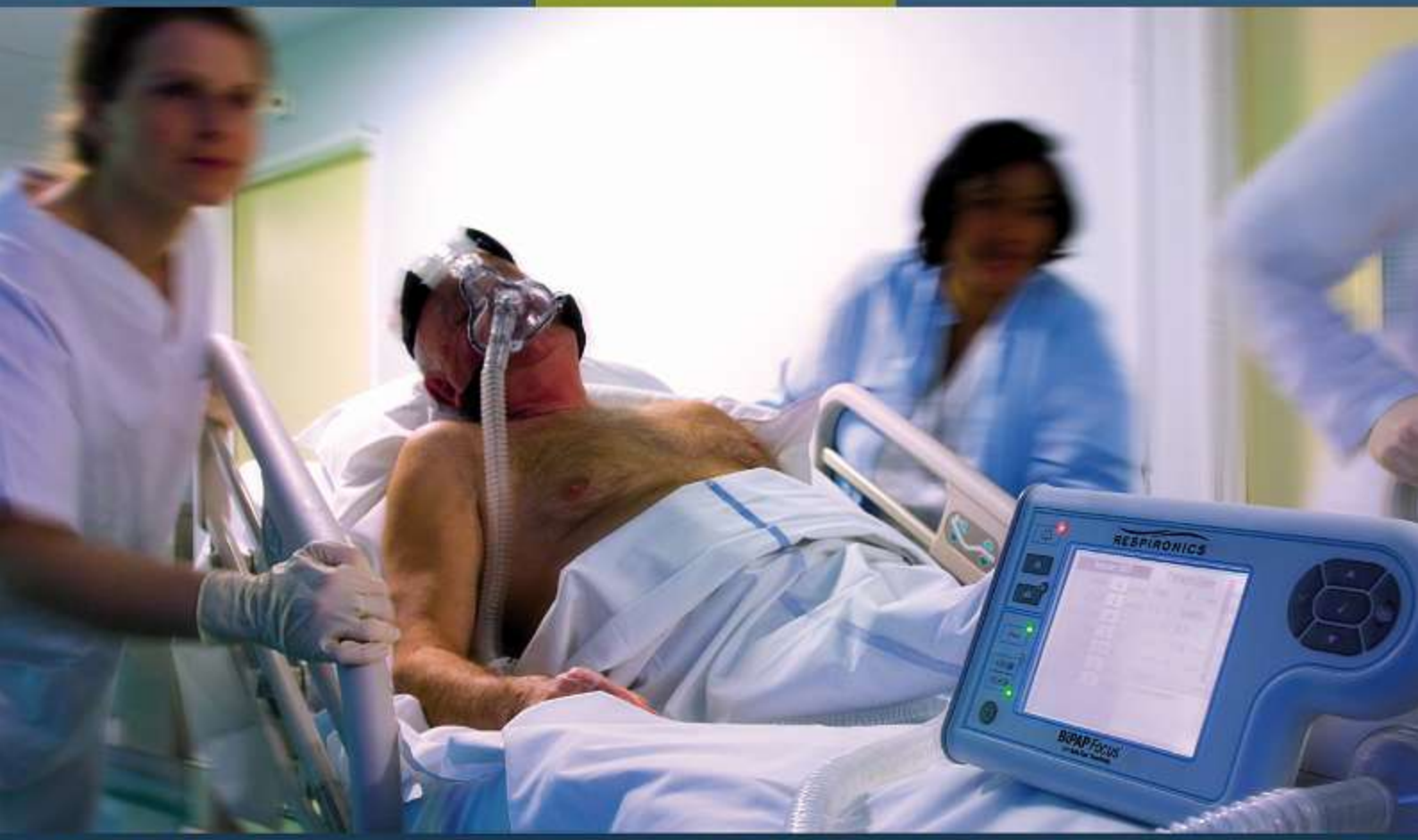
UK: Critical Care Contingency Planning
Bruce Taylor, Chair CCCP Group

The UK Intensive Care Society (ICS) and the Department of Health has established a working group to plan for expansion of ICU capacity in the event of an infectious pandemic. The multidisciplinary Critical Care Contingency Planning (CCCP) group has received valuable advice from colleagues in Hong Kong and Canada, who have learned from experience with the SARS outbreaks. Potential options for expanding capacity by using other clinical areas such as theatre recovery and high-dependency areas as surrogate ICUs have been outlined, and an information gathering questionnaire will assess existing potential for ICU expansion. A draft document on phased responses / triaging has been produced. Outline plans have been developed for expanding critical care nursing assistance, identifying operating theatre staff as being the most appropriately skilled for this purpose, and guidelines on core competencies for support staff training are being developed. The ICS is also working to produce a UK-specific core training programme in critical care for medical staff.

US: Family Support® in NICUs
www.marchofdimes.com

The March of Dimes NICU Family Support® project provides information and comfort to families of premature and other critically ill newborns in hospital-based neonatal intensive care units (NICUs) throughout hospitalization, for the transition home, and in the event of a newborn death. Currently, NICU Family Support® is being implemented in 23 hospitals in the US, and is planned for 38 hospitals by the end of

RESPIRONICS



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2006. The service will be offered in at least 50 NICUs by 2007. The project includes education and activities for siblings, parent-to-parent support, photography, professional development opportunities for NICU staff, and bereavement programs. The March of Dimes is a national not-for-profit health agency whose mission is to improve the health of babies by preventing birth defects, premature birth and infant mortality. NICU Family Support® is part of the March of Dimes Prematurity Campaign, which addresses the growing problem of premature births, the leading cause of newborn death in the US. According to the latest government figures, more than 500,000 US babies -- or 1 in 8 -- are born prematurely each year. The most recent collaborating site is Memorial Health University Medical Centre in Georgia. In 2003 alone, 17,762 babies were born prematurely in Georgia.

News *Industry*

HAMILTON MEDICAL: RAPHAEL XTC

www.hamilton-medical.com

In March 2006 at ISICEM in Brussels, Hamilton Medical will launch the Raphael XTC, a single ventilation solution for both noninvasive positive pressure ventilation (NPPV) and invasive ventilation. Combining the RAPHAEL platform with a single-limb breathing circuit and a large monitor, the RAPHAEL XTC is suitable for step-down or -subacute care units, long-term care centres, ICUs, recovery rooms or transit. To adapt to frequently changing leakage conditions, HAMILTON MEDICAL has developed trigger technology that automatically and continuously adjusts the trigger threshold to the leakage.

The RAPHAEL XTC is an Intelligent Ventilation solution that features Adaptive Support Ventilation (ASV), a closed-loop mode of ventilation for the respiratory management of patients from intubation to weaning. ASV requires no mode changes during ventilation. It employs lung-protective rules and adjusts the respiratory pattern based on the patient's pulmonary mechanics and spontaneous respiratory activity. Studies show that ASV facilitates shorter times on the ventilator, while at the same time less user interaction is required and fewer alarms occur (Sulzer et al. 2001; Cassina et al. 2003).

MAQUET: MRI-compatible SERVO-i

www.maquet.com

MAQUET has launched its MRI compatible SERVO-i, which enables the same ventilator system to be used in the intensive care unit and in the magnetic resonance imaging (MRI) facilities, for the treatment of all categories of patients. This makes it possible for continuous care, with the patient connected to the same ventilator from the ICU bed to the MRI examination and back. SERVO-i can now be used everywhere in the hospital and also in airborne or road transport. These new capabilities of the product will be officially introduced at the International Symposium on Intensive Care and Emergency Medicine (ISICEM) in Brussels, March 21-24, 2006, where Maquet will also present a non-magnetic cart and other non-magnetic mounting solutions, which can be used in MRI rooms.

Respironics® Launches BiPAP® Focus™ Noninvasive Ventilator

manuela.leurent@respironics.com
www.respironics.com

Respironics have released the BiPAP® Focus™ Noninvasive Ventilator, a basic BiPAP delivery system designed specifically for the institutional setting. Ventilatory assistance is provided to stable, less acute patients with respiratory insufficiency or failure. Features of the BiPAP Focus System include:

- Digital Auto-Trak Sensitivity
- Large easy-to-use user interface
- Display of patient parameters
- Pressure bar graph
- Easy to use alarms
- Backup battery

The BiPAP Focus includes Respironics' proprietary Digital Auto-Trak™ Sensitivity that assures optimum triggering and cycling sensitivity throughout changing breathing patterns and leaks. This eliminates the need for a perfect seal of the patient interface and constant adjustment while promoting patient-ventilator synchrony. The pressure bar graph indicates patient breaths and pressure ranges. Pressure alarms are automatically set to 5 cm/H2O above IPAP and below EPAP settings, minimizing nuisance alarms. An integral backup battery system maintains patient ventilation in the event of an interruption in power, also allowing intra-hospital patient transport from one care area to another with uninterrupted ventilatory care.

ZOLL: ResQPOD® Circulatory Enhancer

www.zoll.nl

Impedance threshold devices (ITD) have been given a Class IIa recommendation by the American Heart Association (AHA) in its new guidelines for CPR and emergency cardiac care. The AHA report that the use of the ITD has been shown to improve circulation during CPR and increase the return of spontaneous circulation (ROSC) in cardiac arrest patients (AHA Guidelines for CPR and emergency cardiac care 2005).

Advanced Circulatory System's ResQPOD® Circulatory Enhancer – sold in Europe by Zoll Medical Corporation – helps increase blood flow to the heart and brain during assisted ventilation. It works in conjunction with all standard resuscitation techniques and equipment. The ResQPOD uses proprietary technology that increases circulation by regulating airflow into the lungs during the chest wall recoil (or decompression) phase of CPR. In multiple preclinical investigations and seven different published clinical studies with patients in cardiac arrest, the ResQPOD has been shown to increase blood return to the heart and blood flow to the vital organs during CPR (Aufderheide et al. 2005; Pirrallo et al. 2005; Thayne et al. 2005 (in press); Wolcke et al. 2003; Plaisance et al. 2000 2004 & 2005).

News *Societies*

ESICM Research Awards

Jean Daniel Chiche
Head of Research Committee
www.esicm.org

The European Society of Intensive Care Medicine (ESICM) has launched a programme to fund European research initiatives led by young investigators. Thanks to a genuine partnership with industrial leaders, 6 Industry Research Awards ranging from 5,000 to 80,000 € are available:

The "Alain Harf Award on Applied Respiratory Physiology", supported by Hamilton Medical, aims to fund research related to respiratory physiology and its applications to the field of mechanical ventilation.

The "Eli Lilly – ESICM Sepsis Elite Award" is a 2-year award to fund a PhD thesis or a post doctoral fellowship on sepsis.

The "Spacelabs Intelligent Monitoring Award" aims to fund research focused on patient monitoring in intensive care and emergency medicine.

The "iMDSoft Patient Safety Award" is a 10,000 € award to fund a research project focused on patient safety.

The "Edwards Minimally Invasive Haemodynamic Monitoring Award" and the "Edwards Nursing Science Award" are supported by Edwards Lifesciences to advance knowledge respectively related to minimally invasive haemodynamics and nursing skills and procedures.

In addition, investigators can also apply to one of the prestigious 20,000 € ECCRN awards funded by the ESICM. Details (including eligibility criteria such as ESICM membership) and application materials for the ESICM Young Investigator Award, the ECCRN Clinical Research Award, the ECCRN Basic Science Award or each of the 6 Industry Research Awards are available on the ESICM website www.esicm.org.

SCCM release iCriticalCare Podcasts

www.sccm.org/podcast

The Society of Critical Care Medicine (SCCM) became the first medical and only critical care society to provide podcasts, with the release of its iCriticalCare Podcasts in July 2005. Since then, the breadth and depth of the podcasts continues to grow, as was evident at the Society's Critical Care Congress in January 2006. A podcast delivers information in audio format, which can be downloaded from the Internet to a computer, an iPod, or another MP3 player. SCCM podcasts are available at http://podcasts.yahoo.com and www.sccm.org/ podcast, free of charge. The iCritical Care Podcasts include news releases, interviews, and article summaries from the SCCM publications *Critical Care Medicine, Paediatric Critical Care Medicine* and *Critical Connections*. SCCM have also released a vodcast (video podcast), with content on SCCM's Right Care, Right Now™ philosophy. According to SCCM's President, Charles G. Durbin, "this launch was a major achievement for SCCM, as it was timely, strategic and ahead of the curve." See also Professor Durbin's article on page 54 of this issue of **ICU Management**.

News
Research

Research: SCCM Awards

The 35th Critical Care Congress of the Society of Critical Care Medicine was held in San Francisco 7th to 11th January 2006. A selection of the SCCM awards is reported here and a full list is available on the SCCM website: www.sccm.org/membership/awards/recipients/index.asp

The winner of the 2006 SCCM Vision Grant, sponsored through contributions to the SCCM's Critical Care Education and Research Foundation, was Nasia Safdar (Clinical Instructor at the University of Wisconsin-Madison Medical School) for her research, "Enhancing patient safety by preventing nosocomial infections: a randomized controlled trial of preemptive precautions for prevention of infection by multi resistant pathogens". The 2006 Norma J. Shoemaker Critical Care Nursing Research Grant, sponsored by KCI USA Inc., was awarded to Sandra K. Hanneman. Dr Hanneman is Professor of nursing research, Associate Dean for research and Director, Centre for Nursing Research, University of Texas Houston. She won the award for her research "Multi-site randomized clinical trial of horizontal positioning to prevent and treat pulmonary complications in mechanically ventilated critically ill patients; a pilot study."

Sandra Swoboda (John Hopkins, Baltimore) won an educational scholarship for her research "Does isolation status impact the frequency of adverse events in a surgical intermediate care unit". From this prospective observational study of all patients admitted to a surgical intermediate care unit with a length of stay over 2 days, Dr Swoboda and her colleagues concluded that adverse events reported underestimated actual events for the isolated and non-isolated patient groups, and that isolated patients were more likely to experience an adverse event compared with the non-isolated patient group.

In addition to the ten educational scholarships, 10 specialty awards were also presented. These included the Clinical Pharmacy and Pharmacology Award, which was won by Lorianne Wright, (Vanderbilt Children's Hospital Nashville), for her research "Impact of patient-specific decision support on medication errors in critically ill children". The Healthcare Industry Award was won by James Shaffer (Health First, Inc.) for "Remote ICU Management improves outcomes in patients with cardiopulmonary arrest." Co-researchers on this project included Mike Breslow from VISICU Baltimore (see Dr Breslow's article on page 58 in this issue of ICU Management). The Paediatrics Award was presented to Kshitij Mistry (Paediatric Critical Care Medicine, University of North Carolina), for "Communication error during post-operative patient hand off in the paediatric intensive care unit." This research study defined miscommunication as absence or inaccuracy in 18 categories of information necessary to provide adequate post-operative care. Recordings of the verbal sign-out process and medical records were used to evaluate 134 admissions. The researchers concluded from their results that miscommunications commonly occurred during post operative patient hand over and that most involved multiple events. See also the article, "Teamwork for Safety" on page 12 in this issue of **ICU Management**.

Two nursing section research awards were also presented, and there were five research citation winners, including one for "Blood Volume measurements: Impact on fluid management". Elisabeth Biuk-Aghai and colleagues from the Surgical Critical Care Unit at the University of Hawaii, Honolulu, hypothesised that blood volume measurement may alter treatment decisions regarding fluid and blood product management. Following a prospective observational study of blood volume measurements followed by a retrospective chart review of 42 surgical intensive care unit patients, the researchers concluded that traditional means to evaluate the fluid status of critically ill patients may not be accurate. Blood volume measurements resulted in treatment changes in 40% of the cases in this study.

Full abstracts from the Congress are published in the "Society of Critical Care Medicine's 35th Critical Care Congress Abstracts" Supplement to Critical Care Medicine Volume 33 Number 12 December 2005.

What can critical care learn from **High Reliability Organizations**

Drs Manser, Gaba and Lighthall review how high reliability organization theory can be applied to improve patient safety and quality of care.

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http://anesthesia.stanford.edu/VASimulator/simulator.htm

Introduction

The public expects that healthcare should be a high reliability undertaking with little risk of preventable harm. Other industries, such as commercial and military aviation or nuclear power production have come to grips with the routine conduct of activities that bear intrinsic hazard. At their best, organizations in these domains have been described as High Reliability Organizations (HRO).

Of course, healthcare is not the same as generating electricity, flying airliners, or building a space station. For one thing we do not design or manufacture human beings, nor do we receive an official instruction manual. Also, unlike some other industries in which the activities are relatively "elective" (the airliner doesn't have to fly from New York to Chicago tonight) in healthcare there are situations in which procedures must be performed even if the hazards are particularly high. Nonetheless, healthcare still has much to accomplish to qualify as a high reliability undertaking, and we have much to learn from HRO theory (Gaba 2001).

What lessons can we learn from HRO theory?

HRO theory (HROT) is now a complex amalgam of approaches and viewpoints (Roberts 1990; Weick and Sutcliffe 2001). In general terms, HROT states that appropriate organizational control can yield nearly failure free results despite high hazard and high tempo, if the organization (and overall industry) embodies characteristics listed in Table 1.

The emphasis on systems does not mean that people and their skills are unimportant. Systems are made up of people working in organizations. The dynamism, complexity, and risk in industries of high intrinsic hazard requires special attention to decision making processes of individual personnel and the teams they work in. In fact, it appears that well-functioning clinical "microsystems" within healthcare institutions may be the best current examples of HROs in healthcare (Mohr and Batalden 2002; Nelson et al. 2002). Such HRO-like microsystems are still found only sporadically.

Creating high reliability characteristics in IC

OVERVIEW

Using the framework above and what we know about care delivery in intensive care units, it is possible to map out a few categories of activity that would be seen if critical care were a high reliability organization. These areas of activity could be termed overall quality improvement, practice improvement, and performance analysis. It is immediately obvious that these categories are intertwined, but will be separated here for purposes of clearer discussion.

QUALITY IMPROVEMENT ACTIVITIES

In medicine there is often a huge gulf between credible evidence of measures that can improve patient safety and survival, and actual practice change. Examples pertinent to critical care include programmes for reducing catheter related bloodstream infections, tight glycaemic control, protective lung ventilation, perioperative beta blockade, and specific early haemodynamic management of severe sepsis. Evaluation of clinical evidence and generation of relevant local data to analyze for applicability should be an ongoing effort of patient safety and quality improvement. Having the personnel and data collection procedures in place to make these assessments in a timely manner is the type of proactive self awareness that characterizes an HRO.

PRACTICE IMPROVEMENT

Medical training is based on the intensive learning of basic science concepts and is followed by a variably structured apprenticeship. In the ICU and in other environments, the practice of medicine is based on teamwork and cooperation between multiple disciplines. Across the board, medicine offers incredibly little exposure to team management, communication, and group processes. HROT highlights that team skills are not acquired unless specifically taught. HROs recognize that intensive training and performance assessment in both routine work and in simulations and drills pays off. HROs ensure that teams and work units hone their skills during routine operations. They debrief themselves routinely and keep track of individual and team performance. For example, every Naval aviator – regardless of experience level or seniority - is graded on every carrier landing. HROs also use simulation and drills extensively to ensure maximum readiness for critical but uncommon situations and to optimize team performance. Training is built into the work environment – it is not an add-on for the individual. The emphasis is on training the system, not just individuals. Moreover, training continues for the entirety of one's career and is not limited to those learning the job. In healthcare the nursing profession adheres to these principles more avidly than does medicine. Physicians rely on a fairly weak and haphazard system of "continuing medical education" to maintain individual abilities.

This system is largely at the discretion of the individual, their time and expense. There is little systematic training of teams.

Table 1. Key Elements of a High Reliability Organization

A culture of safety permeates the organization
Systems, structures, and procedures conducive to safety and reliability are in place
Intensive training of personnel and teams takes place during routine operations, drills and simulations
Safety and reliability are examined prospectively for all the organization's activities; organizational learning by retrospective analysis of accidents and incidents is aggressively pursued

From the earliest training on, doctors, nurses and other healthcare workers should not only be taught basic knowledge and skills that traditionally define medical competence but also the concepts that are essential to teamwork: effective communication and coordination, establishing and maintaining shared situation awareness, joint decision making and problem solving, and conflict resolution. To be most effective, the training of team skills should – like all training – be recurrent rather than a one-time event. Team training needs to be integrated at different levels of training and should continue throughout one's career. Based on the concept of crew resource management from aviation, Howard et al. (1992) introduced a similar training paradigm to medicine with anaesthesia crisis resource management (ACRM). The latter is a comprehensive curriculum that examines the sources of errors as well as training in communication, leadership, dynamic planning and decision making, workload management, and teamwork as tools for effective crisis management (Gaba et al. 1994). The teaching points are practiced during simulations and discussed during video-assisted debriefing sessions.

The ACRM concept has since been adopted by many different medical disciplines including critical care. Courses have to be tailored to the specific challenges to teamwork in critical care by involving different medical and allied health professions in training activities.

In bridging the gaps between the current system of medical practice and that of an HRO, teamwork in high frequency (septic shock, myocardial infarction), high risk (massive haemorrhage), and even rare but catastrophic conditions (cardiac tamponade, anaphylaxis), would provide an unmistakably high yield to all involved. The use of human patient simulation with videotaped debriefing has become the state of the art method for immersive and simulation learning for crisis management in the ICU (Lighthall 2004).

PERFORMANCE ASSESSMENT

Although assessment of team performance in healthcare is considered important, tested and validated methodologies for evaluating not only clinical or technical performance, but also skills that are needed for effective crisis resource management and good teamwork, are scarce. Review of critical events immediately after the fact is considered a valuable experience from many points of view including error reduction, performance modification and improvement, and processing of a stressful event. Review of near misses, even if anonymously submitted, opens a constructive dialog that encourages error reporting and ensures that future patients derive the maximum benefit from known errors. Cultural changes that encourage such reporting rather than generating shame are of obvious value.

The experience in simulation training has led many to believe that the educational value is bidirectional. Simulations often reveal shortcomings in how trainees are prepared to manage certain situations, and shortcomings of the system at large (Hammond 2004; Helmreich 2000; Lighthall 2004). Our experience suggests that to be maximally effective, it is important that simulation activities bring together the multiple professions present in the critical care unit.

SUMMARY

HROs have employed a number of common sense practices as part of their everyday operation without asking for evidence to justify their use. While there is great evidence that medical errors are common, we don't incorporate findings from well designed studies into clinical practice as efficiently as possible, and we don't train practitioners to act as teams despite the fact that this is how many conditions are managed. Because many ICUs function as a closed shop and are attended to by subcultures of larger departments and professions, and because the patients are at a higher overall risk for adverse events, there may be greater interest and potential to apply HRO concepts to this domain of healthcare. In this article we emphasized the role of self-examination and multidisciplinary, multiprofessional team training as the centrepieces of quality improvement, practice improvement, and performance assessment. Improved cooperation amongst all stakeholders in a critical care unit will create a greater sense of shared purpose and move towards achieving higher reliability in the realm of patient safety.

Figure 1.
Training with simulation
© 2005 Patient Simulation Centre of Innovation

A novel **collaborative model** to improve ICU care in Michigan

A novel collaborative model to improve ICU care was implemented in 127 ICUs in the state of Michigan. Interventions were used to improve culture of the working environment, and eliminate blood stream infections in >80% of ICUs.

The need for dramatic improvements in healthcare quality and patient safety is widely recognized. Global healthcare stakeholders including academic researchers, regulators, purchasers, payers, hospitals, health systems and consumers have taken the message posed by the Institute of Medicine reports *To Err is Human* (1999) and *Crossing the Quality Chasm* (Institute of Medicine 2001) seriously. This message made the 98,000 lives lost annually in US hospitals from preventable errors a public issue. A new challenge has risen in the wake of these reports: how can we assess whether, using valid measures, our efforts are actually improving quality and safety? (Pronovost et al. 2006)

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Acknowledgement
Funding provided by the Agency for Healthcare Research and Quality (AHRQ), grant no. 1UC1HS14246

Quality and safety researchers at the Johns Hopkins University, the MHA-Keystone Centre for Patient Safety and Quality and 127 Michigan intensive care units have taken on this challenge and made wide-scale improvements using a novel collaborative model (Pronovost, Goeschel 2005). In this project, participants were given interventions to improve safety and a safety scorecard to track their progress. Participating ICUs can now state that they are safer than they were when the project started two years ago. To state with confidence that they are safer now, teams worked to answer the following questions:

- How often do we harm patients?
- How often do we do what we should?
- How often do we learn from our defects?
- How well do we improve culture?

Answering these questions created a safety scorecard that addresses two related components: (1) generic measures that are not rates (qualitative), apply throughout a health system, and focus on learning from mistakes and improving culture (Pronovost et al. 2005a); and (2) discipline specific measures that are rate based (quantitative) and focus on ensuring we do what we should do and eliminate harm (Pronovost et al. 2006).

Process outcomes

To support teams we provided evidence-based measures, standardized data collection tools and performance reports, dedicated project web space, weekly recorded conference calls, consistent encouragement and individual coaching upon request.

Beyond long distance sharing, biannual workshops allowed teams and Hopkins faculty to work side-by-side as colleagues. As project leaders, we periodically sent letters to hospital CEOs providing them with progress reports and asking for specific executive assistance. Ninety percent of teams routinely participated in conference calls. Nearly 100% of the 127 teams attended the biannual workshops and participant evaluations averaged 4.5 on a 5.0 scale. Teams are increasingly cognizant of their power to change the way care is delivered, to improve patient outcomes, and to enhance unit culture. Administrative leaders have started speaking firsthand about infection rates, safety issues, and the renewed sense of satisfaction that is permeating their ICUs. Variation in achievement spans the demographic mix of participants, and sharing what works and does not work is universally valued.

Clinical outcomes

During the first nine months of data collection, the entire state moved from the 50th percentile in the country in catheter related blood stream infections (CR-BSI) and ventilator associated pneumonia (VAP) to the 10th. Indeed, over 80% of participating teams eliminated CR-BSI; VAP data is still being analyzed. In addition, culture improved throughout Michigan ICUs.

Lessons learnt and next steps

The clinical and cultural improvements achieved by Michigan teams are important and we believe replicable. Importantly, this study provides significant new insights regarding how to measure and improve patient safety and how to run a large scale improvement collaborative. However, the resources needed, and clinical, measurement and management expertise required for this collaborative exceed the capacity of any single organization.

We learned several lessons; first, package educational materials as specific interventions or behaviours. For example, we converted the 100-page guideline for preventing CR-BSI into 5 interventions; wash hands, use barrier precautions, clean skin with chlorhexidine, remove unnecessary lines and avoid femoral site (Berenholtz et al. 2004). Second, efforts to improve culture should accompany efforts to improve specific outcomes (Pronovost et al. 2005b). Third, valid measures and data management, like any clinical research project, are imperative. Such measures are uncommon in quality improvement projects. Beyond the immediate results, this project has been important in creating a virtual learning community across participating ICUs, the hospital association and the research team. The partnership in Michigan continues and lessons learnt have been applied to implement an improved program in New Jersey and Rhode Island.

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Team skills for safety

Effective teamwork is crucial for ensuring patient safety within the ICU. In other high-risk industries (see also Manser, Gaba and Lighthall in this issue of **ICU Management**) where teamwork has also been found crucial for safety, special courses have been developed to train the team skills required for maintaining safety. To develop similar training programmes within intensive care, an analysis of the skills required for effective teamwork in the ICU is necessary.

Introduction

The intensive care unit (ICU) is a high-risk environment that requires multidisciplinary teams to cope with rapidly evolving challenges, heavy workloads and intense time pressure. The complexity of the ICU environment renders it particularly prone to errors resulting from failures in teamwork and communication.

This is exemplified in a root-cause analysis of an adverse event where a patient being treated for heart and renal failures suffered an air embolism (resulting in considerable neurological damage) after a large central venous catheter was removed whilst the patient was sitting up (Pronovost et al. 2004). The analysis of the causal factors underlying the incident revealed that the attending doctor, a first-year renal fellow, did not know the proper technique for removing central lines, yet was allowed to perform the procedure unsupervised and without training, with the institution having no system to ensure competency for the procedure, and with the fellow feeling unable to admit his lack of knowledge. Furthermore, a nurse observed the fellow conduct the procedure incorrectly, and could have expressed concern, yet was reluctant to speak up or correct the physician.

In high-risk industries that share similar characteristics to the ICU (e.g. aviation and nuclear power), team working skills are considered especially important for protecting against errors and in enhancing performance, with considerable investment being made in understanding teams and their training requirements (Burke et al. 2004). This has resulted in training programmes being developed to meet the challenge of reducing error through making better use of human resources (Helmreich et al. 1999). Team researchers have demonstrated the importance of team cognition (e.g. shared mental models), as well as interpersonal behaviours and task coordination (Salas et al. 1997). If properly designed, the programmes are based on a training needs analysis that defines the team skills required for a particular environment, as well as the present levels of accomplishment.

In light of evidence demonstrating that a high proportion of medical errors result from failures in team skills such as communication, an Institute of Medicine report encouraged healthcare providers to emulate high-risk industries in the application of human factors research to enhance safety (Kohn et al. 2000). In particular, as the ICU is an environment that requires a high level of cooperation between multidisciplinary team members, it would appear likely that good team working skills are important for reducing error, and thus enhancing patient safety.

Teamwork and safety in the ICU

A number of studies have published data demonstrating the association between good teamwork and patient safety in the ICU. An examination of ICU critical incident studies, where the causal factors underlying incidents that either harmed or could have harmed patients are identified, reveals that poor team working is frequently associated with occurrences of critical incidents. Team working factors such as poor or inadequate communication, poor supervision, a lack of openness between team members, and not ensuring other team members follow protocol are all associated with occurrences of errors and critical incidents (Beckmann et al. 1996; Beckmann et al. 2003; Buckley et al. 1997; Wright et al. 1991).

However critical incident studies can lack a fine-grained analysis of the precise contributory teamwork factors behind incidents, as often the actual role of a particular causal factor in the incident is not described (Fletcher et al. 2002). Observational simulator studies, where the performance of ICU teams is video recorded and later reanalysed, can overcome this. Simulator research based in the ICU has shown that failures in team working, such as a lack of leadership, failures to communicate priorities, not sharing patient status information, and overloading nurses with requests, have a negative impact upon performance and result in the occurrence of errors (Lighthall et al. 2003). Additionally, real-life ICU observational studies have shown communication between nurses and doctors to be associated with a high proportion of errors. Verbal communications between nurses and doctors were observed during relatively few activities and were associated with a high proportion of errors, leading the researchers to conclude that nurses and doctors were not combining their knowledge and skills efficiently.

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Table 1. Teamwork skills outlined in the Anaesthetists Non-technical skills (ANTS) taxonomy

For more details please see the ANTS website (www.abdn.ac.uk/iprc/ants), and Reader et al. (BJA, in press) for relevance to the ICU.

Team Working	Skills for working in a group context, in any role, to ensure effective joint task completion and team member satisfaction
Skill elements	**Definitions**
Co-ordinating activities with team members	Working together with others to carry out tasks, for both physical and cognitive activities; understanding the roles and responsibilities of different team members, and ensuring that a collaborative approach is employed
Exchanging information	Giving and receiving the knowledge and data necessary for team coordination and task completion
Using authority and assertiveness	Leading the team and/or task (as required), accepting a non-leading role when appropriate; adopting a suitably forceful manner to make a point, and adapting this for the team and/or situation
Assessing capabilities	Judging different team members' skills, and their ability to deal with a situation; being alert to factors that may limit these and their capacity to perform effectively (e.g. level of expertise, fatigue)
Supporting others	Providing physical, cognitive or emotional help to other members of the team

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Finally, research using performance measures and self-reported ratings of teamwork has revealed that higher ratings by ICU staff of interdisciplinary collaboration skills (e.g. communication) are associated with lower risk-adjusted lengths of stay for patients, lower rates of staff turnover and lower rates of patient mortalities (Baggs et al. 1999).

Training team working skills

In other high-risk industries where failures in teamwork have also been shown to be a major source of human error, Crew Resource Management (CRM) training programmes have been developed to meet the challenge of reducing error. These programmes were initially designed by psychologists and pilots to increase the effectiveness of teams through enhancing skills such as communication, leadership and cooperation. CRM courses generally consist of lectures, role plays, discussions, accident analyses, case studies, and video re-enactments of accident scenarios. The team working skills taught on CRM courses can include: assertiveness and speaking up; asking questions; listening; providing appropriate feedback; attending to and observing non-verbal signals; maintaining team focus; supporting other team members; team decision making; resolving conflicts; considering others; and sharing mental models (Flin et al. 2002). In Europe, CRM training is mandated for airline pilots and in the UK their CRM skills are re-evaluated during licence checks.

The skills taught on any CRM programme should be based on a framework developed from an empirical analysis of the skill requirements for a specific domain. It is not sufficient to simply take the training materials used in aviation, replace the word 'pilot' with 'doctor', and then apply the materials in intensive care. A CRM course developed for any setting should reflect the specific challenges and needs of that setting (Helmreich & Merritt, 1998). An analysis of skill requirements involves investigating the root-causes of accidents and near misses, analysing performances during normal or emergency operations (e.g. from voice recorders), and researching organizational climate factors that may affect performance. This provides diagnostic data that enables the identification of the key cognitive and interpersonal skills that are relevant for the particular job, thus providing an empirical basis for the training content. To evaluate the subsequent use of the skills, and therefore the effectiveness of a CRM training programme, behavioural marker systems are developed (Flin et al. 2002). These are empirically derived taxonomies of observable requisite non-technical skills for a particular domain. Behavioural marker systems allow trained raters to assess team skills through rating of behaviours known to be indicative of good cognition and team working. Through the use of behavioural marker systems, CRM training in aviation has been shown to result in significant increases in the target skills by flight crews alongside improved attitudes towards the importance of teamwork skills. Behavioural marker systems based on empirically derived taxonomies of non-technical skills have been developed for several high-risk industries, as well as medical domains such as anaesthesia (see table 1) and surgery (Patey et al. In press; Yule et al. 2005). They have also been used to demonstrate that simulator training can enhance anaesthetists' non-technical skills (Yee et al. 2005).

Training team skills for the ICU

As the ICU is an environment in which good team working skills are essential for safety and performance, the potential benefits of team training are apparent. However, the ICU is a unique and complex domain that makes specific demands from those who work within it, and thus the precise team skills required for effective team working within the ICU need to be identified. A number of techniques can be employed to identify these skills, including attitudinal surveys, structured interviews, observations of behaviours in real-time and in simulation, and studies of cognition. This process facilitates the development of a skills taxonomy for guiding and structuring the training of those skills. Furthermore, it allows the development of a behavioural marker system which enables the evaluation of team working skills through an observable set of exemplar skills.

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Training residents for **safety**

Medical errors related to residents are well-documented. Focusing the attention of physicians-in-training towards patient safety represents an opportunity for improving safety in the ICU. In this article, Dr Mariam Al-Ansari summarises the key educational issues for promoting the contribution of residents to patient safety drawn from the work of John Heffner and colleagues.

Residents and patient safety

Patient safety has emerged as a compelling issue in healthcare. Intensive care is one of the largest, most expensive, and complex components of healthcare, accounting for approximately 30% of acute care costs (Pronovost 2002). Complex systems – of which ICUs are an example – are breeding grounds for errors, because interdependent components interact in unexpected ways. Errors resulting in adverse events are common in ICUs (Pronovost et al. 2004) and adverse events related to resident errors are well-documented (Wu et al. 1991). Focusing the attention of physicians-in-training towards patient safety represents a major opportunity for improving the safety of care in the ICU.

Little discussion has emerged, however, regarding how physicians-in-training can integrate their work and learning into these new patient safety initiatives. This observation has stimulated educators to call for dramatic changes in undergraduate medical education to incorporate elements of patient safety (Rosebraugh et al. 2002). James Reason (1995) defined seven broad categories of conditions that promote medical errors: high workload, inadequate knowledge, ability or experience, poor interface design, inadequate supervision or instruction, stressful environment, mental state (e.g. fatigue, boredom) and change. Residents who enter an ICU rotation face most of these error-promoting conditions. ICU is an inherently hazardous environment in which human error is inescapable.

Goals in training should therefore focus on how to improve systems of care and how to manage the consequences of errors if they occur. John Heffner and colleagues have written extensively on the issue of residents in training in the ICU (2005), and I summarize here the key educational issues they raise for promoting the contribution of residents to patient safety.

New teaching methodologies

Traditional didactic courses and methods of teaching are limited in their effectiveness compared with newer approaches, such as problem-based learning, interactive forms of education, small group discussion and simulation with videotape feedback during residency training. The best predictor of performance is practice. This underpins the new vision of medical education with the adoption of simulation. Simulation allows trainees to learn all the skills required in a risk-free environment. A broad array of simulation models should be incorporated into the resident patient safety curriculum to ensure competency in a variety of cognitive and procedural subjects. These new techniques promote greater understanding of patient safety and successful change in clinical performance (see also Gaba et al. in this issue of **ICU Management**).

Resident orientation to the ICU

It is no longer acceptable to have an increase in adverse events with the induction of new residents into an ICU. More errors occur in new work environment, which implies that ICU orientation is an essential element of patient safety. Detailed orientations must include training in the processes and procedures of the ICU, an introduction to key staff, a copy of relevant protocols and guidelines, and a discussion of the duties of the rotation and degree of responsibility. Clear instructions are essential on who to call if in doubt, especially for support outside normal working hours.

Resident supervision

During the training, a call for assistance is often interpreted as a sign of weakness. This promotes reluctance of residents to involve senior staff in care decisions after hours. An appropriate safeguard to overcome this problem is to encourage nurses and other caregivers to activate their chain of command when they note resident deviation from standard practices. Additionally, the Accreditation Council of Graduate Medical Education (ACGME) now recommends that the responsibilities of the faculty be extended to monitor residents for signs of fatigue or stress. Supervision is an essential requirement for promoting patient safety in the ICU and resident well-being. Levels of supervision can be graduated appropriately with trainees' progress.

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Team building

Teamwork is especially important in the ICU. The hierarchical model of patient care wherein the physician prefers to be preeminent on the healthcare team, does not promote optimal patient care and safety. Team building is assisted by interdisciplinary training, which rarely occurs in resident level education, despite having been shown to improve patient care. An ICU safety curriculum should provide knowledge on how to work effectively as part of a team in the dynamic environment of the ICU, where the common goal in the team is patient safety and optimal outcome.

Information technology

Residents face multiple distractions that interfere with their provision of quality ICU care. In noncomputerized ICUs, for example, they often divert time from patient care to find charts and information. Information technology in the ICU has a proven effect on the physician performance, with reduction in the frequency of errors and associated adverse events, and a decrease in patient mortality (Dimick 2005). Physicians in training should have a thorough knowledge of applications and the value of new information technologies towards improving patient safety.

Error and adverse event reporting

Recognizing and reporting medical errors and adverse events represents a critical opportunity for residents' learning. This positive response to medical errors is likely to promote residents' willingness to report errors when they occur. Confidential interviews can facilitate the reporting of errors by residents who are rotating on clinical services.

Medico-legal education and disclosure

Residents demonstrate little understanding of how to disclose adverse events and errors (Lester and Tritter 2001; Pilpel et al. 1998). 76% of residents reported that they had never disclosed a serious error to a patient (Wu et al. 1991). A patient safety curriculum should teach the resident the importance of full acceptance of responsibility for errors. Open disclosure by communicating adverse events in an honest, open, and empathetic manner is likely to decrease medico legal risk (Mazor et al. 2004).

adverse events related to resident errors are well-documented

Residents should be taught to provide patients and families with statements explaining that an error or adverse event has occurred, a description of the nature of the event, why it occurred, how recurrences will be prevented and an apology.

Resident support after errors

Physicians are often the second victim of medical errors. Contributing to adverse patient events triggers anger and self blame and sometimes the temptation for intellectual dishonesty by not disclosing errors. Blame has been the traditional response to errors in recent years and this philosophy needs to be eliminated, a point to be emphasized in the patient safety curriculum. As a core component, curricula need to support the emotional needs of the resident, and educate on the real sources of errors, which are usually to be found in faulty systems.

Clinical auditing

Analysis of adverse events is an essential component of care improvement. In these analyses, the role of the individual and underlying system defects should be correctly emphasized to improve care, and opportunities used for teaching residents. Such analyses provide valuable opportunities for residents' education, for gaining clinical skills and promoting individual and organizational performance improvement. Trainees in the ICU should therefore participate in clinical audits and mishap analyses.

Quality improvement methodology

Curricula should increase the awareness of physicians in training about quality improvement methodologies. Participation in at least one ICU quality improvement project should be a requisite of training for critical care fellows. A patient safety curriculum teaches the residents and fellows in the critical training program the nature of healthcare systems and grounds them in quality improvement and total quality management methodologies.

ICU MANAGEMENT

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Thank you

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Dialysis Dosing in **Acute Renal Failure**

In the winter issue of **ICU Management** 2005, Drs Kellum and Venkataraman reviewed evidence on timing of initiation of renal replacement therapy in Acute Renal Failure (ARF). In this article, they review the limitations of research to date on the appropriate dose of renal replacement therapy of patients with ARF.

ICU Stakeholder

- Anaesthesiology
- Cardiology
- Pharmacy
- Internal medicine
- Microbiology
- ➤ Nephrology
- Respiratory
- ...

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The appropriate dose of renal replacement therapy (RRT) of patients with acute renal failure (ARF) is a matter of considerable debate. The dose of intermittent dialysis is quantified using the unitless index, Kt/V, where K represents urea clearance, t is the time of dialysis and V is the volume of distribution of urea. Existing literature supports a single-pool Kt/V urea of at least 1.2 per treatment, at least 3 times weekly, as the minimum dose in patients with end-stage renal disease (ESRD) (National Kidney Foundation 1997). Arguably, most patients with ARF are more ill, malnourished and catabolic than ESRD patients and hence warrant "more" RRT. While supported by small, retrospective and non-randomized studies (Paganini 1996; Schiffle 1997), until recently this hypothesis had not been tested by randomized trials.

Although an optimal dialysis dose has not been established in patients with ARF, it is generally accepted that the delivered dose of dialysis should be at least as great as that recommended for ESRD. Despite this, a recent prospective study of 40 patients (136 dialysis treatments) with ARF treated with intermittent haemodialysis (IHD), reported that prescribed Kt/V was less than 1.2 in 49% of treatments, and more importantly delivered Kt/V was less than 1.2 in nearly 70% of treatments (Evanson et al. 1998). In a recent study, Schiffl et al. assigned 160 critically ill, but haemodynamically stable, patients with ARF to daily or every other day haemodialysis, in alternating order (Schiffl et al. 2002). The two study groups were similar at baseline. Mortality was 28% in patients assigned to daily IHD as compared to 46% with alternate-day dialysis (P=0.01). Daily haemodialysis also resulted in faster resolution of ARF (mean [± SD], 9 ± 2 days vs. 16 ± 6 days; P=0.001), better control of uraemia and fewer hypotensive episodes during haemodialysis than conventional haemodialysis. Although this study is supportive of a more intensive dialysis prescription in ARF, it has several important limitations. First, the exclusion of haemodynamically unstable patients eliminated the sickest patients (these patients were treated with continuous RRT instead) and diminished generalizability. Second, the non-random assignment of patients to groups may have introduced bias, although the reported baseline characteristics of the two groups appear similar. Finally, the delivered dose of therapy in the alternate-day group was substantially lower than accepted as "adequate" haemodialysis as described above.

In continuous haemofiltration, dose of therapy correlates with effluent flow rate (Clark et al. 1992; Clark et al. 2003). Using effluent flow as an index of dose of therapy, a recent single centre RCT demonstrated that higher haemofiltration doses improved patient survival in ARF compared to conventional doses, while further increases in dose were not helpful (see table 1: Ronco et al. 2000). Of note, more than 90% of patients in this study received the prescribed dialysis dose. However, a second recent smaller RCT did not show similar results. In this study, 106 patients with oliguric ARF (defined as refractory to furosemide) were randomized to three (almost equal) groups for early high- and low-volume and late low-volume haemofiltration (see table 1: Bouman et al. 2002). No differences in 28-day survival or duration of ARF were found between these groups. This study was however limited in that it was underpowered and probably enrolled less sick patients as suggested by very high survival rates.

Similar to IHD in ARF, CRRT delivery may not reach the levels prescribed. In a single centre retrospective review of CRRT dosing patterns, we found that the mean CRRT dose prescribed for patients with ARF was only 24.46 ± 6.73 ml/Kg/h, and that the mean dose delivered was merely 16.55 ± 5.41 ml/Kg/h (68% of the prescribed dose, p<0.000001) (Venkataraman et al. 2002). While there was high concordance between prescribed and delivered effluent flow rates in this study, treatment time was reduced (16.1 ± 3.53 hours/day) due to interruptions in therapy.

Although these clinical studies suggest that more intensive renal support may improve survival, they have significant limitations and hence are not widely accepted into clinical practice. An ongoing multicentre trial (Palevsky et al. 2005) is now comparing intensive renal support to conventional management of renal replacement therapy in critically ill patients with acute renal failure to provide a more definitive answer to this question.

Table 1. Results of two effluent flow studies

Study	Dose	Survival
Ronco et al. 2000	20ml/kg/hr	41 %
	35ml/kg/hr	57 %
	45ml/kg/hr	58 %
Bouman et al. 2002	Early 72-96 L per 24 hrs	75 %
	Early 24-36 L per 24 hrs	68.8 %
	Late 24-36 L per 24 hrs	74.3 %

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*Omato J et al. *American Heart Association Annual Meeting, 2005.*

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Thrombolytic therapy during cardio-pulmonary resuscitation: the **TROICA** trial

Risk of life-threatening bleeding complications has prevented the use of thrombolytic drugs during CPR, although recent cases suggest improved short and long-term outcomes in certain patient groups. The Thrombolysis in Cardiac Arrest (TROICA) trial is assessing the efficacy and safety of a generalized use of thrombolytic drugs during CPR in patients suffering cardiac arrest.

ICU Stakeholder

- ➤ Anaesthesiology
- ➤ Cardiology
- Pharmacy
- Internal medicine
- Microbiology
- Nephrology
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- ...

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Out-of-hospital cardiac arrest is associated with a very poor prognosis. Only 5-14% of all patients suffering cardiac arrest are expected to be discharged from hospital (Böttiger et al. 1999; Newman et al. 2000). Although several drug therapies during cardiopulmonary resuscitation (CPR) have been proposed, none has proved to improve long-term outcome in these patients (Brain resuscitation clinical trial I study group 1986 & trial II study group 1991; Kudenchuk et al. 1999). The two major underlying diseases leading to sudden cardiac arrest in more than 70% of cases are acute myocardial infarction (MI) or ischemia-related arrhythmia and massive pulmonary embolism (PE) (Silfvast 1991; Spaulding et al. 1997; Zipes and Wellens 1998). Systemic thrombolysis is an effective therapy for acute MI or PE with haemodynamic instability (Arcasoy and Kreit 1999). Thrombolytic therapy during CPR causes direct thrombolysis at the site of coronary or pulmonary artery occlusion. In addition, experimental and clinical studies have shown a marked activation of coagulation during CPR which is not counterbalanced by an adequate activation of fibrinolysis (Böttiger et al. 1995; Gando et al. 1997). This generalized hypercoagulable state leads to formation of microcirculatory thrombi which may severely impair organ function even after restoration of spontaneous circulation, especially in the brain (Fischer et al. 1996).

The fear of causing life-threatening bleeding complications which may be increased by mechanical CPR, however, has been a major drawback for using thrombolytic drugs during CPR. Consequently, thrombolytic agents have historically been withheld in the setting of cardiac arrest. However, in patients failing to achieve restoration of spontaneous circulation despite immediate advanced cardiac life support after in-hospital cardiac arrest, thrombolysis during CPR has been used as a last resort therapy. As a result, case reports and small case series of thrombolysis published over the last 30 years have suggested an improved long-term outcome of neurologically intact survivors without causing critical bleeding complications (Padosch et al. 2002).

In addition, several clinical studies on thrombolysis during out-of-hospital cardiac arrest have shown an improved short-term outcome. The Heidelberg thrombolysis trial (Böttiger et al. 2001) was the first prospective, controlled study that compared thrombolytic treatment during CPR with standard treatment in patients who had failed to achieve spontaneous circulation after more than 15 minutes of conventional resuscitation. Patients treated with the thrombolytic drug alteplase were admitted to hospital significantly more frequently as compared to the control group (58% vs. 30%). In addition, there was a trend towards improved survival at hospital discharge in the thrombolysis group (15% vs. 8%). These results were confirmed by a retrospective study with 108 out of hospital patients who received alteplase during CPR (Lederer et al. 2001). Compared to 216 conventionally resuscitated patients both short and long term survival were improved in the thrombolysis group. Significantly more patients who were treated with alteplase survived to discharge (25.0%, as compared to 15.3% in the control group). The recent guidelines for cardiopulmonary resuscitation recommend considering thrombolytic therapy in patients suffering cardiac arrest in whom an acute thrombotic etiology for the arrest is suspected (Nolan et al. 2005).

In order to assess the efficacy and safety of a generalized use of thrombolytic drugs during CPR in patients suffering cardiac arrest of presumed cardiac origin (i.e. acute MI or PE), a large randomised study is currently under way in Europe. The Thrombolysis in Cardiac Arrest (TROICA) trial is a double-blind, placebo-controlled multicentre trial on thrombolysis during CPR after out-of-hospital cardiac arrest, designed to enrol more than 1000 patients in ten European countries. Adult patients who suffer witnessed out-of-hospital cardiac arrest of presumed cardiac origin can be randomised, if basic or advanced life support is started within 10 minutes of onset. Patients presenting with asystole, however, are not included. Patients are randomised to receive a weight-adjusted dose of tenecteplase or placebo. Primary endpoint will be survival at 30 days and at hospital admission; secondary endpoints include neurological performance of surviving patients and survival after 24 hours. Safety endpoints will assess the incidence of symptomatic intracranial haemorrhages and major bleeding complications. Enrolment is expected to be completed by summer of 2006.

Development of critical care clinical **pharmacy** services in the UK

New legislation and national standards in the UK promote the role of the critical care clinical pharmacist towards integration in the critical care team and improving patient care.

Traditionally, critical care clinical pharmacy services have often been developed in response to requirements to improve cost effective use of medicines and/or reduce medicine risk. While these aspects of medicine management remain paramount, there is increasing recognition of the skills clinical pharmacists contribute to the care of the critically ill patient (Intensive Care Society 1997).

Critical care pharmacists reduce adverse drug reactions, optimise medicine utilisation, improve fluid management, and reduce patient morbidity and mortality as well as having a positive pharmacoeconomic impact (Kane 2003; Papadopoulos et al. 2002). These results are achieved by integration within the critical care multidisciplinary team. Pharmacists attend medical ward rounds, review individual patient's medication, develop drug guidelines, educate staff, and manage therapeutic drug monitoring (TDM), medication risk, and medicine audit and research.

Appropriate use of pharmacy technicians for roles such as medicines management, drug audit and drug expenditure reporting enable clinical pharmacists to spend more time on clinical care as recommended in A Spoonful of Sugar (Audit Commission 2001).

A major difficulty for clinical pharmacy services for critical care in the UK has been the lack of national standards, demonstrated in the variation in practice and service provision (Timmins 2000). Some critical care areas had no pharmacist input; others had newly qualified, inexperienced pharmacists clearly attempting to practice beyond their current capability, while others had teams of experienced critical care pharmacists (Department of Health 2004). Predictably the perceived value of critical care clinical pharmacy services fluctuates widely from hospital to hospital accordingly. The recent development of national recommendations for both critical care pharmacist staffing levels and experience required, has gone some way to correcting this variation (Department of Health 2003).

Developments in Clinical Pharmacy Services

As the role of the critical care pharmacist gains further national recognition, it underlines the need to make further improvements in the standardisation of services which units receive. In the UK, we have made some significant developments in this area and now have national recommendations for core knowledge standards for specialist critical care pharmacists. A career framework for clinical pharmacists within critical care has been established including the competencies required for these positions (Department of Health 2005a). Consultant pharmacist posts have been established and will be expected to provide significant leadership, research and educational roles, in addition to expert clinical practice.

Importantly, these standards have been produced in conjunction with a new pay scheme affecting pharmacists, in which they must demonstrate the necessary competencies and experience (i) to take up a post and (ii) to progress along the pay scale within that post.

In spring 2006, accredited pharmacists will be able to prescribe medication independently for the first time. This legislation provides a huge opportunity for clinical pharmacists to take even greater responsibility for individual patient care within the multidisciplinary team. It will allow pharmacists, for example to undertake TDM, dose alterations in multiorgan failure, parenteral nutrition and optimise antimicrobial therapy.

ICU Stakeholder

- Anaesthesiology
- Cardiology
- ➤ Pharmacy
- Internal medicine
- Microbiology
- Nephrology
- Respiratory
- ...

Further work

Nationally, the current pharmacy workforce is lacking the numbers of pharmacists with appropriate critical care experience, as demonstrated by particular difficulties in recruitment to these positions. It is therefore paramount that larger critical care units and pharmacy departments have recognised rotations for clinical pharmacists, thereby increasing their skills and fostering an interest in a critical care career. It is only in this way that we can hope to meet the needs of the 24/7 activity of critical care (Department of Health 2005b). While some centres have achieved positive steps to address these needs, this is not the norm. Clearly, the future workforce development plan needs a national accreditation system that incorporates these requirements.

Clinical pharmacy services are not alone in experiencing the challenges of funding their activity. It is hoped that national acceptance of staffing levels in addition to agreed staff skills and experience will ease the incorporation of clinical pharmacy costs in any critical care expansions.

Conclusion

Clinical pharmacy services are accepted as integral to national recommendations for critical care. The challenges ahead include reducing national variations and developing a skilled pharmacy workforce not only capable of meeting the service needs of this specialty, but also to contribute to the clinical, audit and research agendas to improve the future care of the critically ill patient.

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Cardiac output monitoring with **intravascular catheters**

In this paper we present the main characteristics of devices that can provide cardiac output measurement and which require the placement of an intravascular catheter.

Introduction

Haemodynamic monitoring is part of routine clinical practice in the intensive care scenario and its application is now spreading further to other critical care areas such as the emergency department. The first device able to give some estimate of the cardiac output at the bedside was the pulmonary artery catheter (PAC). It has been used now for nearly 30 years and even if the PAC is still considered the gold standard for measurement of cardiac output, several concerns have been raised regarding its invasiveness, usefulness and associated complications (Boyd et al. 1983). Indeed despite the growing evidence that monitoring cardiac output can guide fluid and drug management in the haemodynamically unstable patient, there is still a lack of evidence on which form, if any, is best for monitoring cardiac output. The use of the PAC opened the way to the use of dilutional techniques for the determination of cardiac output. In this paper we will briefly describe devices using intravascular catheters for the determination of cardiac output in the intensive care unit.

Thermal dilution was the first dilution technique used in clinical practice. Nowadays two kinds of thermal dilution are possible with PAC: intermittent thermal dilution and semi-continuous inverted thermal dilution (Boldt et al. 1994). Another device developed more recently is the PiCCOplus by Pulsion. It uses thermal dilution to measure the cardiac output and to derive volumetric indices. This is then used to calibrate a continuous measure of stroke volume (SV), taken from the arterial waveform (Goedje et al. 1999). As well as thermal dilution, dye dilution techniques have been used in clinical practice. Currently the only device available on the market that uses a dye dilution technique to measure cardiac output is LiDCO, by LiDCO, UK. These measurements can be used to calibrate an algorithm for the continuous determination of cardiac output (Jonas and Tanser 2002).

Is a dilution technique fundamental to the determination of cardiac output? Recently two new devices have been developed that analyse the arterial pressure waveform. PRAM, FIAB, Italy and Vigileo Monitor with Flotrac Sensor, Edwards Lifescience, CA, USA, can track stroke volume and cardiac output from the analysis of any arterial pressure waveform (Manecke et al. 2004; Romano and Pistolesi 2002). Nowadays some devices can give an estimate of the cardiac output without the need for calibration, for instance through thoracic bioimpedance and oesophageal doppler monitoring; neither of these two techniques require the placement of an intravascular catheter.

PAC

The PAC provides measurement of cardiac output, (through intermittent thermodilution), of pulmonary artery pressures and of pulmonary artery occlusion pressure (PAOP). It has been modified in recent years by adding a thermal coil which semi continuously produces thermal waves. This allows a semi-continuous measurement of the cardiac output. The most recent development in PAC technology is the volumetric PAC. This is equipped with a rapid response sensor and integrates the signal from the electrocardiogram. In this way it calculates the right ventricular ejection fraction and then, combining this data with the SV, calculates the right ventricular end diastolic volume (RVEDV: Cheatham and Right 2000). Intermittent measurement of cardiac output using the PAC is still considered by many to be the gold standard of clinical cardiac output measurement. Semi-continuous cardiac output has been validated against intermittent thermodilution and offers the great advantage of not requiring any operator to direct its measurement. The accurate placement of the catheter is the most important requirement for reliable measurement. Although cardiac output can now be measured by other less-invasive devices, the PAC is the only device that allows continuous measurement of pulmonary artery pressure and determination of the pulmonary artery occlusion pressure (PAOP). Many PAC's also continuously monitor the mixed venous oxygen saturation (SvO2). Despite concerns regarding the usefulness of both PAOP and RVEDV to predict preload status, there are some patient groups, for instance acute right ventricular dysfunction, where the continuous monitoring of pulmonary artery pressures remain both important and useful.

Despite much criticism of the PAC in recent years, especially regarding the lack of evidence for improved outcome in critically ill patients, there are several studies of haemodynamic optimisation using PAC to monitor cardiac function and to direct therapy which have shown some improvement in outcome (Boyd et al. 1993).

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PiCCOplus by Pulsion

This monitor is less invasive than PAC, requiring only a central line and a specialised arterial catheter (femoral or radial) for set-up. Like PAC it uses thermodilution as the technique for measurement of cardiac output. A bolus of cold saline is injected through the central line and transpulmonary thermodilution is registered and computed via the specialised arterial catheter. The value of the cardiac output is then used to calibrate the algorithm of the pulse contour analysis available on PiCCOplus. In this way the monitor tracks the SV beat to beat giving a continuous estimate of cardiac output. Both transpulmonary thermodilution and continuous cardiac output monitoring have been validated in clinical practice in several situations (Della Rocca et al. 2003; Rodig et al. 1999).

In addition to the cardiac output, the PiCCOplus, through the analysis of the thermodilution curve, gives "volumetric parameters" such as global end diastolic volume (GEDV), intrathoracic blood volume (ITBV) and extravascular lung water (EVLW). These parameters have proven to be better indices of preload than PAOP and CVP. EVLW is an interesting parameter that represents the amount of water in the extravascular thoracic space. High values of EVLV correlate well with pulmonary oedema and have been associated with poor outcome in the intensive care population (Marting et al. 2005). In addition, PiCCO is able to monitor the functional haemodynamic parameters of stroke volume variation (SVV) and pulse pressure variation (PPV). These have been shown to reliably reflect fluid responsiveness in patients who are intubated and sedated (Michard et al. 2000).

LiDCO

LiDCO™plus is a new cardiac output monitor. It measures cardiac output using transpulmonary dilution of lithium. This technique requires the injection of 0.3 mmols of lithium through a central or peripheral line and the dilution curve is detected via a sensor that can be attached to an arterial line already in-situ. Technically LiDCO™plus requires only a peripheral line and an arterial line. Through the transpulmonary dilution of lithium the system calibrates an algorithm for continuous cardiac output monitoring derived from the arterial pressure wave analysis. Both the lithium dilution and continuous cardiac output of LIDCO have been validated in several conditions (Hamilton et al. 2002; Tsutsui et al. 2004). A recent study utilising the LiDCO™plus to target-directed therapy versus standard management in high-risk surgical patients showed an improved outcome in the treatment group (Pearse et al. 2005). This system, like the PiCCO can also provide the functional parameters that can predict fluid responsiveness.

Vigileo monitor and PRAM

The Vigileo system and PRAM are the most recent haemodynamic monitors that can track changes in stroke volume from the analysis of the arterial wave trace. The most interesting characteristic of these monitors is that they require no calibration and only an arterial line for their use. Flotrac is the sensor used by Vigileo to transduce the arterial line trace to the monitor. The algorithm, based on the standard deviation of arterial pressure waveforms, uses age, weight and sex of the patient and incorporates the information obtained from the analysis of the arterial trace to calculate stroke volume and cardiac output. Vigileo has been validated so far in only two studies, showing reasonable accuracy and precision in comparison with the PAC (Manecke et al. 2004; McGee et al. 2005). PRAM uses an analysis of the arterial pressure waveform which is based on the physics of perturbation. It analyses the points of "perturbance on the wave trace" and from this analysis it calculates the impedance of the system, bypassing the problem of calibration. PRAM has already been validated against the PAC in cardiac surgery patients, showing good accuracy and precision (Giomarelli et al. 2004). Whilst preliminary studies performed with these technologies appear promising, further investigations are required to establish if they can replace more invasive monitors.

Conclusions

The intensivist can now choose from several devices for monitoring cardiac output in critically ill patients. Degree of invasiveness is very different depending on which device is chosen while some monitors provide parameters that others cannot. It will be important in coming years not only to see if the new devices that are replacing the PAC prove to be as accurate, but also to determine what clinical impact treatments guided by their use can provide. We will hopefully have an answer soon. So far it is difficult to proclaim which, if any, is best.

ICU MANAGEMENT

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Cardiac output monitors

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Amongst its many products and services ECRI is pleased to provide readers of **ICU Management** with sample information on products for cardiac output measurements using thermal dilution, 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 and reported problems.

This extract from our database contains model by model specifications for easy assessment and review and also includes ECRI's 'Recommended specifications' (generic templates) which can be used for comparison and tendering purposes.

The data are extracted from ECRI's 2003 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 ECRI or editorial@icu-management.org.

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Footnotes used in pages 29 and 30

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

EDWARDS LIFESCIENCES
E1 (9.5 x 11.5 x 8.2)

PHILIPS
Ph 1 The M1012 is just the CO measurement module. The M3012A measurement extension provides invasive pressures and temperature with CO as an option. They can be used with a large number of different patient monitors from Philips, from small transport monitors that can run on batteries for several hours to large high end systems with multiple high resolution touch displays. Obviously, weight and dimensions of the complete monitoring devices are larger. http://www.medical.philips.com/main/products/patient_monitoring/products/intellivue_mp70_mp60/

PULSION
Pu 1 Continuous
Pu 2 Not currently available in the USA, FDA clearance pending

Healthcare Product Comparison System

	ECRI RECOMMENDED SPECIFICATIONS[1]	Dräger medical	Edwards LIFESCIENCES	PHILIPS
MODEL	**BASIC**	**HEMO 2:4: HEMONED PODS**	**VIGILANCE II**	**M1012A**
WHERE MARKETED		Worldwide	Worldwide	Worldwide
FDA CLEARANCE		Yes	Yes	Yes
CE MARK (MDD)		Yes	Yes	Yes
CONFIGURATION	Stand-alone or modular	Pods for SC7000, SC8000, SC9000XI, Delta, Delta XL, Kappa and Kappa XLT. Vista XL and Gamma X XL (without CO) support the HemoMed Pod	Stand-alone	Module for the V24, CMS, and Intellivue patient monitoring systems. The M3012A measurement extension provides invasive pressures & temperature with CO as an option
CO RANGE, L/min	0-12	0.5 to 20	1-20	0.1 to 20
THERMAL INJECTATE				
Injection vol, mL	3, 5, 10	3, 5, 10	3, 5, 10	As specified with computation constant
Temp range, °C	0 to 25	-5 to +30	0 to 30	0 to 27
Thermistor for injectate temp	Any	T-piece	Edwards Immersion or flow through probe	Bath or in-line 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 and type	Catheter size, injectate volume, computation constant automatically set when most Edwards Lifesciences catheters are selected; manually set for others	Computation constant based on injectate temperature, injectate volume, and catheter characteristics
Method	User selected	Start key on pods, menu on the monitor	Navigation knob	Softkeys
REMOTE START SWITCH	Optional	Remote Keypad	No	Optional handswitch
OUTPUT COMPUTATION	CO, blood and injectate temperature	Integration cuts off at 50% of peak; exponential extrapolation	Integration cuts off at 30% of peak; exponential extrapolation	CO, CI, blood and injectate temperature
DATA DISPLAYED	Thermal dilution curve, blood and injectate temps, CO consumption, trace size, position controls, haemodynamic calculations	CO, blood temperature, injectate temperature; optional with calculations package: BSA, CI, CCI, SV, SVI, SVR, SVRI, TVR, PVR, PVRI, TPR, LVSW, LVSWI, RVSW, RVSWI, LHCPP, RPP	CCO, CCI, CO, CI, SvO2,ScvO2, EDV, EDVI, SVR, SVRI, RVEF, SV, SVI (additional measured or calculated data available in the small parameter frame windows)	PA, injectate temperatures; blood temperature; computation constant; CO; CI; BSA; average CO, curve
NO. STORED CURVES/ CALCULATIONS	6	50	6	6
NO. CURVES AVERAGED	5	5	6	Selectable up to 6
SELF-TEST CURVE	Optional	No	Optional	Yes
CIRCUITS SELF-TEST	Yes	Yes	Automatic	Yes
EXTERNAL DISPLAY DEVICES	Optional	Scope, recorder, printer at Multiview Workstation	2 serial ports, 1 analog output port	Printer, optional recorder
CATHETERS				
Compatible brands		Arrow, Baxter, Ohmeda, Edwards, Abbott/Medex	Edwards Swan Ganz catheters, Pre Sep oximetry catheters	Any with standard connector
THERMISTOR CIRCUIT FAULT INDICATOR	Visual	Message on monitor, Multiview Workstation	Visual message, audible alarm	Message on display
H x W x D, cm (in)		14 x 20.5 x 6 (5.5 x 8.1 x 2.3)	24.1 x 29.2 x 20.8 [E1]	9.9 x 3.6 x 9.7 (3.9 x 1.4 x 3.8)
WEIGHT, kg (lb)		Hemo4 0.9 (1.9) Hemo 2 and HemoMed 0.7 (1.6)	3.43 (7.5)	0.23 (0.5)
POWER SOURCE, VAC (Hz)		110/220 (50/60) from monitor	100-240 (50/60) power consumption: 40 watts maximum	NA (internal)
Battery type		None	None	None
Rechargeable		NA	NA	NA
Open time, hr		NA	NA	NA
Charger		NA	NA	NA
Low-battery indic		NA	NA	NA
PURCHASE INFORMATION				
Price, unit 7 Fr, balloon tip		Not specified	Not specified	Not Specified
Warranty		1 year	1 year	1 year (module)
Delivery time, ARO		Not specified	Not specified	Not Specified
Year first sold		Not specified	Not specified	1989
Fiscal year		Not specified	January to December	January to December
OTHER SPECIFICATIONS	When a correct calculation cannot be provided, a message should describe the problem and give an explanation.	All data stored in monitor/ multiview workstation.	Trending; CEDV and SvO measurement capabilities optional. UL certified.	Up to 6 curves displayed for review & selection for use in determination of avg CO value; directly links to CMS/ Intellivue haemodynamic calculations; measurement reliability by multiplecurve alert message; when abnormal thermodilution curve is detected, alerts include noisy baseline, thermal drift, slope, multiple peaks, delayed injection, and injectate temp.[Ph1]

Healthcare Product Comparison System

	GE Healthcare	GE Healthcare	PULSION Medical Systems	Spacelabs
MODEL	**DASH 3000 - 4000 - 5000**	**SOLAR/TRAM**	**PICCO PLUS**	**91496/90496**
WHERE MARKETED	Worldwide	Worldwide	EU, USA, Canada, Russia, Asia/Pacific (incl. Japan, China, India), South America, Middle East.	Worldwide
FDA CLEARANCE	Yes	Yes	Yes	Yes
CE MARK (MDD)	Yes	Yes	Yes	Yes
CONFIGURATION	Configured	Modular	Stand-alone, integrated in CO module for Philips and Dräger Infinity SmartPod	Modular; compatible with any Spacelabs Ultraview or PCMS monitors2. With appropriate software levels.
CO RANGE, L/min	0.2 to 15	0.2 to 15	0.25 to 25	0.1 to 18 ±10%
THERMAL INJECTATE				
Injection vol, mL	3, 5, 10	3, 5,10	2-20	5, 10
Temp range, °C	0 to 30	0 to 30	0 to 24	0-27.5°C injectate and 17.2-43°C blood.
Thermistor for injectate temp	Depending on catheter brand	Depending on catheter brand	PULSION injectate temperature sensor	In-line or bath probe
DYE DILUTION	No	No	No	No
DATA ENTERED	Patient height and weight, catheter brand, injectate temp sensing type (in-line or bath), catheter size, injectate volume; optional: computation constant	Patient height and weight, catheter brand, injectate temp sensing type (in-line or bath), catheter size, injectate volume; optional: computation constant	Patient height and weight, injectate type, injectate volume, CVP, automatic catheter detection	Patient height and weight, HR, BSA, MPAP, MAP, CVP, PCWP, computational constant
Method	Trim knob	Touchscreen or trim knob	Membrane keypad	User selected
REMOTE START SWITCH	Auto mode or Remote control	Auto mode or Remote control	No; acoustic signal "ready"	No
OUTPUT COMPUTATION	BSA, HR, MAP, CVP, PAM, PAW, CO, CI, SC, SV, SVR, SVRI, PVR, PVRI, LVSWI, RVSWI	BSA, HR, MAP, CVP, PAM, PAW, CO, CI, SC, SV, SVR, SVRI, PVR, PVRI, LVSWI, RVSWI	Stewart Hamilton formula	Stewart Hamilton formula
DATA DISPLAYED	Thermal dilution curve, CO, blood & injectate temps, computation constant, time stamp	Thermal dilution curve, CO, blood & injectate temps, computation constant, time stamp	Cardiac output: COtherm, PCCO[Pu1], SV[Pu1], Preload: GEDV, ITBV; Afterload: SVR[Pu1] Contractility: GEF, CFI, dPmax[Pu1,2] Lung water: EVLW[Pu2], PVPI[Pu2] Volume responsiveness: PPV[Pu1,2], SVV[Pu1] Others: MAP[Pu1], APsys[Pu1], APdia[Pu1], HR[Pu1], R-L-shunt [Pu2]	CO, CI, PVR, SVR, SVRI, PVRI, LVSW, SV, SVI, RVSW, LVSWI, RVSWI, blood temperature, injectate temperature
NO. STORED CURVES/ CALCULATIONS	No curves, all calculations within the last 24 hours	No curves, all calculations within the last 24 hours	5 curves, 50 thermo dilution results, 7 day trend	5/30 measurements
NO. CURVES AVERAGED	4	4	Up to 5	Up to 5
SELF-TEST CURVE	No	No	No	No
CIRCUITS SELF-TEST	Yes	Yes	Yes	Yes
EXTERNAL DISPLAY DEVICES	Printer, central station (CIC)	Printer, central station (CIC)	Blood pressure data transfer to any bedside monitor; Interface solution for bedside monitors and patient data management systems via data port	Monitors, bedside and central recorders/printers
CATHETERS				
Compatible brands	Edwards (Baxter), Abbott, B&D (Ohmeda, Spectramed), Arrow, Other	Edwards (Baxter), Abbott, B&D (Ohmeda, Spectramed), Arrow, Other	PULSIOCATH	All major
THERMISTOR CIRCUIT FAULT INDICATOR	Visual message on display	Visual message on display	Message on display	Visual
H x W x D, cm (in)	Dash 3000: 26 x 28 x 20 Dash 4000: 27 x 29 x 24 Dash 5000: 29 x 31 x 24	Not applicable (modular system)	15.8 x 26 x 25 (6.2 x 10.2 x 9.8)	11.3 x 5.7 x 18 (4.5 x 2.2 x 7.1)
WEIGHT, kg (lb)	5.1 to 6.4 kg	Not applicable (modular system)	4.8 (10.6)	0.8 (1.8)
POWER SOURCE, VAC (Hz)	Depending on region	Depending on region	115/230 (50/60)	From monitor; <5 W
Battery type	Lithium ion; 2x hot-swappable	No battery	Sealed lead D-cells	None
Rechargeable	Yes	Not applicable	Yes	NA
Open time, hr	4 to 5 hr	Not applicable	0.5 minimum	NA
Charger	Yes: integrated and optional external	Not applicable	Internal	NA
Low-battery indic	Yes	Not applicable	Symbol on screen	NA
PURCHASE INFORMATION				
Price, unit 7 Fr, balloon tip	Not specified	Not specified	Not specified	Not specified
Warranty	1 year parts & labor	1 year parts & labor	2 years	1 year
Delivery time, ARO	4 weeks	4 weeks	devices on stock	Not specified
Year first sold	1999	1990	1997	2004 (91496); 1998 (90496)
Fiscal year	Not specified	Not specified	calendar year	July to June
OTHER SPECIFICATIONS	Comprehensive messages related to technical/ physiological problems, like "Instable Blood Temperature"	Comprehensive messages related to technical/ physiological problems, like "Instable Blood Temperature"	Minimally invasive; 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 R-L-shunt detection and quantification; Verbal error messaging on screen.	Edit; auto average; user prompts; self-tests; haemodynamic calculations; 24 hr trends.

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Communication with the **Administration**

In previous articles in this series, Drs Pauldine and Dorman have discussed communication skills in conflict resolution, and strategies for effective communication in intensive care practice. In this article, the authors focus on how to communicate effectively with administrators.

Communications series

Conflict and communication - autumn 2005
Effective communication - winter 2005
➤ Communicating with administration - spring 2006

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Clear and effective dialogue is needed between the intensive care team (physicians, nurses and support staff) and the administrative managers of the hospital and healthcare system. Such dialogue is necessary to ensure the efficient function of the healthcare organization. From the perspective of the intensivist, administrative understanding and support is paramount in maintaining the financial and physical resources necessary to provide excellent and safe patient care. From the perspective of the administration, intensive care units represent a significant financial outlay, comprising as much as 30% of the total hospital budget (Bekes et al. 2004). In order to appreciate potential barriers to effective communication between these entities, it is important to understand the culture and general priorities of each and to design strategies and systems to overcome these obstacles when they are present.

Barriers to Communication with Administrators

A number of potential barriers to effective communication exist between clinical providers and administrators. In many situations, the clinicians have no formal business training and may look upon administrative tasks as an unwelcome intrusion into their busy practices. Even when enthusiastic about administrative responsibility, lack of management training and true differences in the language of clinical medicine and business administration may impair meaningful discourse (Atun 2003). A clear understanding of business terms is required for the intensivist team to communicate their needs in a means that allows administration to understand the need, and demonstrates to administration that the intensivist and their team are dedicated to institutional goals. Thus a thorough understanding of fixed and variable costs is required. Furthermore, an appreciation for the context in which these costs exist is also required. For example, the intensivist must understand whether payment is based upon a per-diem basis or bundled into diagnosis-related groups (DRG). Reducing length-of stay under a per diem payment system may be beneficial in the long term but acutely may lessen cash flow and thus hurt the institution, whereas reductions in length-of-stay under a DRG-like system will immediately contribute positive margin.

The goals of clinicians and administrators are not often aligned. Intensive care clinicians frequently value autonomy of practice, commitment to their patients and specialty while gaining a source of identity from their profession. Administrators are more likely to value a team and committee approach with loyalty to the organization, and tend to identify with their position in the organizational hierarchy (Nowicki and Summers 2002). External pressures including the cost of information technology, new patient technology, and expensive therapies that may not necessarily demonstrate a proven cost savings benefit may further polarize physicians and administrators. Increasing consumerism and access to information on the worldwide web has led to greater expectations from patients and their families. Additionally, escalating malpractice costs, decreasing reimbursement for services, government budget cuts, an aging population, pressure to increase clinical workload and an ever more restrictive policy environment all serve to widen the schism between the perceived goals of practitioners and administrators (Rundall et al. 2004). Tension over resource allocation can lead to an environment where administrators are viewed as only being concerned about the bottom line, and clinicians are seen as wasteful of valuable resources. Distrust, alienation and power struggles may result. It is clear that intensive care unit directors are facing an increasing demand for services in an environment of rapidly increasing costs and diminishing resources. In order to create and sustain a positive environment of care and practice for patients and the clinical staff, while contributing to the financial health of the organization as a whole, intensivists and administrators need to remove the barriers to effective communication, seek common ground and work together interdependently.

Improving Communication with Administrators

Strategies to improve communication between clinicians and administrators begin with appreciating the differences in focus and values outlined above. Formal or informal training in principles of business administration is beneficial for intensivists in bridging the cultural and language gap with managers. Learning to speak in the language of the administration cannot be stressed enough. Understanding the

overall goals or mission of the healthcare organization is useful in ensuring that the short-term and long-term plans for intensive care resources are aligned with the vision of senior leadership (Burmahl 2003). The ability to demonstrate and clearly articulate the benefits and return on investment of a well-run and well-supported intensive care unit can make a strong argument for the provision of responsible leadership and active support of this expensive resource.

Plans to be presented to administration should be researched and prioritized in advance. Recall that communication can be accomplished through a variety of media and formats. Communication can take the form of face-to-face meetings, group encounters, telephone conversations, written correspondence, email, or other printed media such as newsletters. An appreciation and in-depth understanding of your administrator's leadership style and preferred learning style can be extremely helpful. Is live presentation preferred over written communication? If so, does the administration prefer informal presentations or formal briefings with audiovisual aids? Should there be a written follow-up? Is email effectively utilized or is a formal document preferred? Do scheduled meetings at regular intervals meet the need or should meetings be scheduled on an "as needed" basis? Who should request the meeting? Are your communication needs met by existing standing committees? Obviously, the answers may vary with the issues at hand and the culture of the institution. However, the point of tuning in to the right method for the people involved and the question presented is an important one. Finally, these alternate means can be extremely useful, but the value of face-to-face meetings must not be underestimated.

If lines of communication are closed or difficult to access, methods such as structured dialogue can be considered to direct the formulation and presentation of specific plans, by soliciting meaningful input from the clinical staff and administration. Structured dialogue has been recommended as a method for administrators to partner with physicians in a systematic scheduled exchange of information that allows clinicians to be part of the decision-making process, thereby increasing their influence and stake in their professional and economic affairs (Cohn et al. 2005). A series of scheduled meetings with the input of a committee of clinician leaders has been suggested as a format. In order to be successful, the environment must foster cooperation between all of the stakeholders with a commitment to implement the recommendations of the panel. Milestones to measure progress should be implemented. In building trust and strengthening relationships between the intensivist staff and administration, communication techniques such as appreciative inquiry utilize principles that recognize achievement and success, as opposed to dwelling on shortcomings and problems. Such techniques are based on the concepts that people respond to positive reinforcement that strengthens self esteem, shared vision is the engine that drives lasting change, and affirmation and envisioning of goals increases the likelihood that the goals will transform into reality. While it is important for the intensivist to understand administrative styles, goals, and values, communication is clearly a two way street. Administrators send very potent messages through the way they listen, seek to build partnerships with clinical staff, and exhibit willingness to share risk and reward.

Another important area for communication with administrators is in creating an institutional climate of safety. The use of executive walk rounds has been demonstrated to be beneficial in improving nursing attitudes regarding the climate of safety on inpatient units where leadership participated in regular discussions with the providers on the unit (Pronovost et al. 2004; Thomas et al. 2005).

The goal of communication up the administrative chain is for problem solving or resource allocation as it relates to the delivery of services in a particular healthcare organization. However, the importance of communication systems is magnified in times of crisis. Effective and efficient communication between the critical care group and hospital administrators was demonstrated to be of extreme importance during the SARS outbreak in Toronto in 2003. In an assessment of lessons learned from the situation, a recommendation was made for critical care communities to consider existing systems for communication in advance of crisis (Booth and Stewart 2003). This interplay stresses the importance of the relationship between clinicians, their hospital administration and the regional critical care community as a whole.

Intensive care professionals can improve communication with administrators by becoming familiar with their culture, language, values and specific management styles, while using techniques to align goals and build teams. The long-term result of establishing improved communication between clinicians and administrators is in the development of shared perspectives that result in an increase in mutual respect and trust, leading to the most effective and efficient use of intensive care resources.

A new **risk-adjustment** system for IC

Problems with existing risk assessment models for assessing the likelihood of a patient dying following admission to intensive care have recently been addressed by the SAPS 3 study and development of a new model, the SAPS 3 Admission Score.

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On behalf of the SAPS 3 Investigators

Risk-adjustment, i.e. the "normalization" of raw mortality rates according to the severity of illness for each patient is a method that has been used for a long time in epidemiology. In intensive care medicine, risk adjustment became popular in the early nineties, shortly after publication of the first systems by Knaus et al. 1981 & 1985, Le Gall et al. 1983 & 1993 and Lemeshow et al. 1993.

Today, severity-of-illness scores have a fixed place in intensive care research: the adjustment for the risk to die within the hospital that a certain patient carries at the time of ICU admission or within the first hours in the ICU. At the end of the nineties, however, some studies unveiled a lack of prognostic performance of the current systems: in most cases an underestimation of mortality in low-risk patients and an overestimation in high-risk patients. This pattern was observed for all the published models (Apolone et al. 1996; Moreno and Morais 1997; Moreno et al. 1983; Metnitz et al. 1999). For this reason, several researchers tried to improve the prognostic performance of various systems through recalibration (also called "customization"), which generally did not solve the various problems inherent to the models.

These problems can be classified as either user-, patient, or model-dependent. User-dependent problems include differences between, or ambiguous definitions, and their non-uniform application. Patient-dependent problems are mainly related to shifts in the baseline characteristics of the populations and the therapeutic options over time: besides differences in the age distribution, several new techniques have been developed (such as advances in minimal invasive surgery or liver replacement therapy etc.). Model-dependent problems often also include the lack of important prognostic variables, such as diagnostic information or the presence of infection. For this reason a group of intensivists (SAPS 3 Outcome Research Group, SORG) have developed a new risk-adjustment system for intensive care. After several years of preparation, the SAPS 3 study was completed at the end of 2002. More than 340 ICUs worldwide documented all admitted patients over a period of two months. The subsequent data analysis then took more than one and a half years.

The main model – the SAPS 3 Admission Score - which has been published recently in Intensive Care Medicine (Metnitz et al. 2005; Moreno et al. 2005) uses data from within one hour prior and after ICU admission. The score consists of 20 variables, which can be ordered in three logical boxes (see table 1). The score can thus be used on a variety of levels. First, patients can be compared selectively on one or more levels, such as status before ICU admission (Box I) or the physiological derangement (Box III). Moreover, the sum score (Box I + Box II + Box III) can be used as a measure of the overall severity of illness. In addition, the sum score can be entered into a logistic regression equation and a predicted hospital mortality can be calculated. This "expected" mortality can then be compared with the observed mortality, which gives the so called O/E ratio. The O/E ratio can then be used to statistically compare mortality rates from different groups of patients (or ICUs).

Intensive care medicine is, however, a very heterogeneously plasticized medicine. For this reason, seven different regions were defined and separate mortality prediction equations developed to allow comparisons at both general and regional levels. Additionally, a tool for comparisons by major patient typologies is under development. Comprehensive supporting information for calculations has been published with the study reports (www.springer.com) and additional information is available at www.saps3.org.

SAPS 3 has successfully addressed some of the problems of currently used prognostic models, providing the most modern and accurate risk-adjustment system available. Whether the SAPS 3 is adopted in ICUs depends on the willingness and motivation of intensivists to integrate a new system into their environment.

Table 1. SAPS 3 Admission Score Variable Categories

Category	Type of variables
Box 1	Information on patients before ICU admission: age, previous health status, co-morbidities, location before ICU admission, length of stay in the hospital before ICU admission, and use of major therapeutic options before ICU admission
Box 2	Information on circumstances of ICU admission: reason(s) for ICU admission, surgical status and anatomic site of surgery (if applicable), planned or unplanned ICU admission, and infection at ICU admission
Box 3	Information on the presence and degree of physiologic derangement at ICU admission, within 1 hour before or after admission

Objective triage for the elderly: **ELDICUS** update

ELDICUS investigators move another step towards identifying the elements for an objective triage decision making tool in a consensus meeting of 34 experts. ELDICUS is the project acronym for "Triage decision making for the ELDerly in European Intensive Care UnitS.

On 29th and 30th January 2006, 34 experts came together in Lisbon for a consensus meeting following preliminary research results of the ELDICUS project. This project aims to make triage decisions for the elderly in Europe more transparent, fair and cost-effective, and to deliver recommendations for public policy towards harmonising European standards. Literature research, data on more than 8000 triages across Europe (the largest trial of its kind) and the expertise of the investigators have contributed to this second stage of a consensus on 60 statements, designed to promote an objective triage decision making process. In addition to directors and professors of intensive care, the consensus group comprised Jane Barratt, Secretary General, and Yitzhcak Brick, President, of the International Federation for Aging, Avi Israeli, Director General of the Israeli Ministry of Health, and specialists from external healthcare consultancies, anaesthesiology, gerontology, statistics, economics and biophilosophy.

The ELDICUS project has comprised a number of challenging aims, including the design of a standardized triage score for ICU, the comparison of ICU costs across France, Spain, Italy, Denmark, the UK, the Netherlands and Israel, and social linkage analysis to help identify effective triage decision making solutions. Patient data before and after triage were collected, including demographic and physiologic data, and mortalities. Participating ICUs completed activity and cost forms based on the cost block methodology previously used in the UK (Edbrooke et al. 2004). Additionally, a social linkage analysis was completed by Professor of Applied Ethics, Guido Van Steendam, from K.U. Leuven. Based on the results of the study, and in part on earlier guidelines published by the Society of Critical Care Medicine (Society of Critical Care Medicine Ethics Committee 1994), 60 statements and guidelines for decision making in triage were drawn up and circulated in December 2005 for consideration by all the investigators and experts attending the consensus meeting in January 2006.

On the first day of the consensus meeting, the preliminary results of the ELDICUS project were presented. In addition, investigators and experts discussed results from the first evaluation stage for each of the 60 statements in depth, including recommendations for amendment, rejection or deletion of statements, and voted on each point. With consensus defined as agreement of over 80%, 42 of the 60 statements were accepted or amended as appropriate and agreed on during this second stage. All statements were reconsidered in a third stage on the second day of the meeting, with emphasis on discussing those without consensus. A further eight statements were agreed on and detailed comments on the remaining statements recorded to guide a subgroup of experts in a final round of consideration and amendment.

In the ELDICUS multi-centred trial, 50% of the triaged patients were over 65 years, with significant variation in refusal rates for the elderly between the different countries. Further in depth qualitative analysis was proposed at the consensus meeting to research what elements of the decision making process may lead to lower refusal rates of the elderly. Particularly focusing on the role of age in triage decision making, statement 31, which acquired 100% consensus in the third round, was concluded as "Age should never be the sole determining factor in triage decisions." Social linkage analysis, however, identifies that one selection criterion can be used to hide another more controversial criterion. To further protect the elderly so that no decisions based on age can be hidden, and those who *can* benefit *will* benefit, the group agreed unanimously on a further statement related to physiological status and age: "Physiological status is more important than chronological age in triage decisions".

Perhaps the most significant statement agreed on in this third round of consideration, was "An objective triage score should be used by physicians to help make triage decisions for individual patients". Social linkage analysis suggests that selection criteria cannot be truly objective, because many criteria such as "quality" and "benefit" require subjective interpretation. The group debated, however, that objectivity and subjectivity are not a dichotomy, but a continuum, so that aiming for the objective end of the continuum remains a realistic goal. Additional solutions to not achieving the ideal of an entirely objective tool are recognition of the fact, and keeping the door open for continuous improvement.

Final consensus on all the statements is yet to be concluded following further statistical analysis and interpretation of the data collected in the ELDICUS study, further consideration of all the statements by the subcommittee, and final voting by all the experts and investigators.

ELDICUS is an EU funded project and closes at the end of April 2006, although analyses, meetings and publications are expected to continue long after.

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Acknowledgement
The ELDICUS project is funded as part of the European RTD project ELDICUS – "Triage decision making for the Elderly in European Intensive Care Units" funded by the European Commission (Contract No. QLK2-CT-2002-00251) and in part by the European Society of Intensive Care Medicine.

Measuring **patient satisfaction**

Outcomes as an indicator of quality of care have become increasingly important in the past decade. Assessment of patient satisfaction reflects care from the patient's viewpoint. The development of valid and reliable instruments to measure patient satisfaction is the first step in continuously improving patient care.

Research to practice series

- Perception and practice, autumn 2005
- Research from nursing practice, winter 2005
- Appraising the evidence, winter 2005
- ➤ Outcome measures
- Evidence to practice

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Satisfaction is a part of outcome quality, in addition to clinically orientated 'traditional' outcomes (e.g. mortality), economic measurements (costs) and health-related quality of life, and has become an important endpoint in outcomes research (Cleary et al. 1988; Orkin 1999). The concept of satisfaction is complicated, and influenced by cultural, socio-demographic, cognitive and affective components (Aharony et al. 1993). Many theories include patients' expectations as the basic concept of satisfaction (Calman 1988; Thompson et al. 1995; Wu et al. 2001). A traditional definition of satisfaction is therefore the degree of congruence between expectation and accomplishment (Pascoe 1983). Consequently, the involvement of patients in the development of an instrument to measure satisfaction is very important and must be an integral part of development. Unfortunately, most instruments have not considered this aspect and are therefore of questionable value (Le May et al. 2001). This has contributed to the poor reputation of patient satisfaction as an indicator of the quality of healthcare services (Westbrook 1993).

From surveys of the US and Europe that consciously adopted the patient's perspective, we know that patient satisfaction is primarily determined by aspects such as 'respect for patients' values', 'information', 'coordination and continuity of care', 'physical comfort', 'emotional support', and 'involvement of family' (Allshouse 1993; Delbanco 1992). This has also been shown when measuring patient satisfaction with anaesthesia care in European countries (Auquier et al. 2005; Heidegger et al. 2002).

Measuring patient satisfaction requires the application of a valid and reliable method of measurement. Only a high quality psychometric instrument will be able to generate high quality data (Avis 1997; Roberts et al. 1987). Most instruments used are questionnaires that are completed by the patients themselves. This technique allows surveys with (relatively) higher numbers and a lower budget than face-to-face or other personal interview methods. For this quantitative research, usually highly standardised instruments are applied. Qualitative interviews are of great importance in the phase of generating instruments in order to evaluate all relevant aspects. This approach is, however, (usually) too expensive for broad-based data collection.

The most important points during the construction of questionnaires are content validity, criterion validity, construct validity, reliability, and practicability (DeVellis 1991; Hall et al. 1988; Streiner et al. 1998).

Content validity: All relevant aspects of satisfaction need to be included in the questionnaire, integrating patient and expert views, and evaluation of the state of the art for similar constructs. Focus groups with patients who have already gained experience with healthcare, help to collect items, assure content validity and avoid relevant parts of patient perception of care from being omitted. An evaluation of the 'state of the art' considers and incorporates aspects from other studies measuring similar constructs, if appropriate.

Criterion-related validity: Aspects, which are related statistically to central outcome parameters such as overall satisfaction show criterion-related validity - in a causal interpretation also called predictive validity. Thus, items and scales believed to assess an important aspect of patient satisfaction must demonstrate such a relationship in terms of a correlation to a central outcome parameter.

Construct validity: Construct validity is the extent to which a measure 'behaves' in the same way as the construct it represents (DeVellis 1991). An important point is whether the relevant aspects are translated in a comprehensive way into questions which truly measure them. Questions simply relating to overall satisfaction are inadequate; patient satisfaction should be measured multi dimensionally using a multi-item technique for each aspect.

Reliability: Besides test-retest reliability, scale reliability (internal consistency) is of great importance. This is based on correlation and determines to what extent the incorporated items (or questions) are measuring the same underlying construct (latent variable), for example "information".

Practicability: The instrument should be as economical as possible, and include everything that is necessary for the measurement of patient satisfaction (content validity), but no more. To achieve high response rates (> 60%), questionnaires should be concise and sent within five weeks after discharge (Saal et al. 2005), with one reminder, if possible.

Patient satisfaction as part of outcome quality has gained great importance in the past decade. The development of highly standardised, valid and reliable instruments is a prerequisite to gain plausible data. The patient's involvement should be an integral part of this process. Results of single item ratings of overall satisfaction are over-optimistic and do not represent the true indication of care. Conclusions should only be drawn from results of well-designed, psychometrically developed instruments.

ICU MANAGEMENT

What do we know about ICU and how can we improve?

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IC beds cf. other healthcare provision in four European countries

This paper describes differences in ICU provision (reported as beds per 100,000 population) in France, Germany, Hungary and the UK. These data are then compared to wider healthcare indices including markers of expenditure and healthcare provision. The large differences highlight the necessity to collect new international data to explain these differences.

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This small study investigated Intensive Care provision in four countries, the United Kingdom (UK), France, Hungary and Germany, from data collected in 2000. There has been no published data on the provision of Intensive Care beds for about 7 years and thus this research provides a much needed update for this decade. Whilst there is little information to compare the differences internationally, the few available studies have reported the number of beds per 100,000 population (Burchardi et al. 1994; Rapoport et al. 1995; Miranda 1986).

It's difficult to assess the number of Intensive Care Unit (ICU) beds per 100,000 population due mainly to difficulties regarding ICU definition. In France, ICUs and intermediate care units are merged in the same unit, whilst in the UK, high dependency units (HDUs) are often organisationally separate from ICUs (consequently in table 1, HDU provision is included within the ICU totals in the UK figures). In addition most European ICUs admit a larger number of elective post-operative patients than the UK.

For France and Germany the number of ICUs available from national data was utilised and the median number of beds for each country was applied to this from the sample available. Population estimates were derived from a standard source (www.populationwold. com) (see table 1). This data shows that the UK provides fewer ICU beds than the other three countries.

Table 2 shows other data on healthcare within the same four countries for comparison. GDP per capita is defined as a measure of the total goods and services produced within a specific territory and within a defined time period per person. When converted using cross country comparators, such as purchasing power parities or exchange rates, it can be used to compare simplistically the wealth of a country. The GDPs in France, Germany and the UK are similar, but the UK seems to expend approximately 30% less per capita on healthcare. As a percentage of GDP, Hungary and the UK spend considerably less than France and Germany.

Is this spending of the four countries reflected in markers of healthcare provision? Available markers include the number of hospital beds and physicians available per 100,000 population and if France and Germany were used as a standard, one would expect the number of hospital beds per 100,000 population in the UK to be 604. In fact, it is much lower at 421. The predicted number of physicians in the UK using the same model would be 259 whereas the actual provision is 212. Surprisingly, Hungary provides as

Table 1. Provision and Costs of ICUs per 100,000 population

Country	Population	Total No. ICU beds	ICU beds per 100,000 population	Source & Date of ICU bed data
UK	59,040,300	3213	5.44	Department of Health 2005: this figure includes high dependency beds
France	59,303,800	5310	9.8	Garrouste-Orgeas et al. 2005: Predictors of intensive care unit refusal
Germany	81,904,100	22,887	27.94	www.gbe-bund.de 2003: this figure includes intermediate care.
Hungary	10,164,100	1153	11.41	National Registry, Hungarian Society of Anaesthesiology and Intensive Care (www.anesz.info) 2004

Table 2. WHO healthcare data (World Health Report 2004 reporting for 2002)

	France	Germany	Hungary	UK
GDP per capita	26,809	26,205	13,473	26,273
Healthcare Expenditure per person (US $)	2,567	2,820	914	1,989
Health Expenditure as % of GDP	9.7	10.9	7.8	7.7
Hospital Beds per 100,000 population	780.11	892.69	783.53	421.82
Physicians per 100,000 population	334.86	336.93	324.57	212.61

many hospital beds and physicians as France and Germany, despite the GDP per capita of Hungary being lower. Hungary provides nearly twice as many hospital beds and 50% more physicians per 100,000 population than the UK.

Returning to ICU beds, if the number of ICU beds per 100,000 patients was also utilised as an indicator of healthcare provision, it is clear that the UK's healthcare expenditure per person is not reflected in the number of ICU beds provided. There is no gold standard as to how many beds should be provided per 100,000 population, but the frequent transfers that occur between ICUs and the cancellation of elective surgery in the UK, may well indicate an under provision of intensive care.

In conclusion, whilst the authors accept that the figures calculated for each country are estimates and may not be representative of the whole country and that it is difficult to calculate the number of ICU beds with the lack of an internationally accepted definition, we contend that the reporting of these figures represent a starting point for expanding and refining data collection for ICU at an international level, which is an essential step to explain the large differences observed.

The Medical Economics and Research Centre (MERCS) in Sheffield has launched an initiative with **ICU Management** to collect data on how many adult general ICU beds are available in different countries. If you can help, please contact editorial@icu-management.org

Australian and New Zealand IC databases

This article describes the three intensive care resource and quality assurance projects managed by the Australian and New Zealand Intensive Care Society (ANZICS).

Figure 1. Distribution of ICUs in Australia and New Zealand.

Database series

- NICE, NL
- ICNARC, UK
- ANZICS

Adult Patient Database (APD)

The APD was established in 1992 (Stow et al. 2006) and currently holds over 560,000 records. Local data collection software is provided free by the Society to all Australian and New Zealand sites. Units submit electronic de-identified data quarterly and receive periodic reports comparing their performance against similar units. Annual reports are also periodically generated and published in the public domain (Bristow 2003; Bristow & George 2002; Victorian Data Review Committee 2005). The minimum dataset (ANZICS Adult Patient Database 2003) contains the required variables needed to use the APACHE II, SAPS II and APACHE III-J prognostic models. Recalibration of the APACHE II algorithm has been undertaken on the 2000 – 2003 central repository data (Bishop et al. 2004). Whilst better performance was achieved for APACHE II, APACHE III-J was found to be better calibrated with good discrimination and is now the main prognostic model used to benchmark performance (Bristow et al. 2004).

Paediatric Intensive Care Registry (ANZPIC)

ANZPIC was established by the ANZICS Paediatric Study Group (PSG) in 1997 with three aims:

- To describe paediatric intensive care practices and outcomes in Australia and New Zealand;
- To provide contributing units with efficacy and efficiency reports comparing performance against national and international standards;
- To facilitate research in paediatric intensive care.

Participating hospitals (All 8 PICUs and 8 adult ICUs) maintain unit specific databases and submit electronic copies of de-identified data to the ANZPIC registry each quarter. Annual reports are generated for each participating unit and compare performance to that of other participating units. An aggregate annual report is published by ANZICS each year and is available at: http://sas.anzics.com.au/Portal. This report publishes data on the demographics of critically ill paediatric patients in Australia and New Zealand, and includes admission characteristics, length of stay and mortality.

Research Centre for Critical Care Resources (ARCCCR)

Established in 1993, ARCCCR catalogues the critical care resources and infrastructure in Australian and New Zealand. It aims to provide reliable information upon which healthcare providers, policy makers and government can base decisions to improve healthcare services. The research focus is quality-oriented and directed toward intensive care infrastructure, processes of care, critical care workforce (medical and nursing), demographics and international comparators. Over 95% of the 197 units in Australia and New Zealand submit data each year, and the annual surveys completed by ICU staff assist in monitoring trends in intensive care service delivery. Reports are available at http://sas.anzics. com.au/Portal.

Challenges

The geographical spread of the Australian and New Zealand populations has provided unique challenges to the development of ANZICS intensive care registries. Australia, with a population of approximately 20 million, covers an area of some 7.7 million square km, thirty two times greater than the UK (Australian Bureau of Statistics 2005). Lying over 2000 km to the east, New Zealand, with a population estimate of 4 million, occupies 270,500 sq km, similar in size to the UK (Statistics New Zealand 2000). See figure 1. The vast distances in Australia and across to New Zealand has challenged the provision of data collection training to ICUs, and the submission and reporting processes. Participation in educational workshops in regional centres and information sessions held at scientific meetings continues to be difficult for geographically isolated units. However, rigorous verification and validation are centrally undertaken at the time of data submission, and extensive data validation and training are conducted annually by independent auditors for the paediatric registry. In 2006, a pilot study will evaluate the feasibility of extending this to the 189 adult ICUs in Australia and New Zealand.

Web-based reporting software has recently been implemented for direct query and reporting access to previously submitted data to the ANZICS projects. Improved web access to the central data repository for authorised researchers and regional audit committees will facilitate epidemiological research and clinical audits. A key area of focus for the future is to integrate the information held by the adult and paediatric registries, together with that of the research centre.

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Acknowledgement

The ANZICS database projects are funded at a regional level by grants from the Ministry of Health (New Zealand) and State and Territory Health Departments through the Australian Health Ministers Advisory Council.

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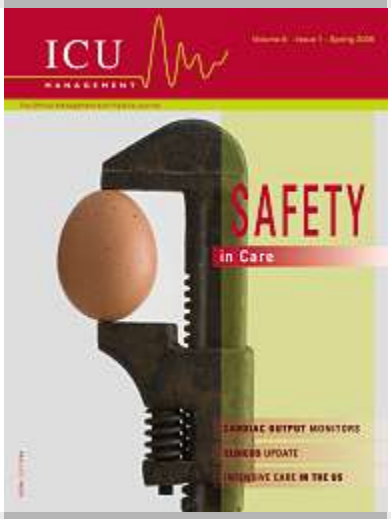

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Therapeutic **hypothermia** for all cardiac arrest patients

Dr Michael Holzer presents the rationale for cooling all comatose patients after cardiac arrest.

About 17 million people worldwide die from cardiovascular diseases each year (World Health Organization 2002), and many of these deaths are due to sudden cardiac arrest. The incidence of out-of-hospital sudden cardiac arrest in industrial countries lies between 36 and 128 per 100,000 inhabitants per year. Unfortunately, full cerebral recovery after cardiac arrest is still a rare event and good neurological recovery of patients admitted to a hospital can only be achieved in 11% to 48% of the cases. The rest of the patients die during the hospital stay or remain in vegetative state (Vreede-Swagemakers et al. 1997).

Therapeutic hypothermia is a new therapy that acts in a multifactorial way on the mitigation of post-resuscitation disease. This includes the slowing of destructive enzymatic processes, the protection of lipid membranes fluidity and the reduction of oxygen needs without impairing microvasculatory blood flow in low-flow regions during reperfusion after ischemia. Additionally, therapeutic hypothermia also acts on lipid peroxidation, brain oedema, intracellular acidosis and apoptotic neuronal cell death (Chopp et al. 1989; Lei et al. 1994; Sterz et al. 1992; Zhu et al. 2004). Therapeutic hypothermia not only protects neurons, but also has beneficial effects on white matter injury and astroglial cell proliferation (Hachimi-Idrissi et al. 2004; Roelfsema et al. 2004).

Recently two randomized trials documented that reducing the body temperature to 32-34°C after successful restoration of spontaneous circulation could substantially improve neurological recovery (Bernard et al. 2002; The Hypothermia After Cardiac Arrest (HACA) study group 2002). Based on these trials, recent published guidelines of resuscitation recommend cooling comatose patients after cardiac arrest due to ventricular fibrillation. The guidelines state that this might also be beneficial in patients with a cardiac arrest due to a non shockable rhythm or in-hospital arrest (European Resuscitation Council 2005).

Experimental evidence shows that therapeutic hypothermia is also beneficial in other cerebral ischemic states (e.g. stroke). Studies analysing the protective mechanisms have shown that the effect of therapeutic hypothermia is largely independent of the underlying cause of ischemia. Further, a small randomized trial including only patients resuscitated after asystole or pulseless electrical activity found a non significant increase in survival and improvement of neurological recovery (Hachimi-Idrissi et al. 2001). A recent meta-analysis of all three randomized hypothermia trials showed a significant improvement of survival and short-term neurologic recovery (Holzer et al. 2004). It could therefore be concluded that as long as the patient has restoration of spontaneous circulation, there is some brain tissue left which could be rescued by therapeutic hypothermia, independent of the underlying cause, location or rhythm of cardiac arrest.

There are also side effects of using therapeutic hypothermia and in each case whether the risk outweighs the benefit needs to be assessed. Negative experiences with lower temperatures (26-32°C, moderate hypothermia) at the beginning of the therapeutic hypothermia era raised concerns that the developing complications outweighed any favourable effects of hypothermia.

More recent experiences with mild therapeutic hypothermia (32-34 °C), however, show that the beneficial effect exceeds the complications by far. The following complications can occur and should be considered when treating patients with therapeutic hypothermia. A significantly higher rate of pneumonia has been reported, although only in one study (Yanagawa et al. 1998), in which it was also reported that none of the cases of pneumonia was a direct cause of death. A higher incidence of complications has been found in other studies with arrhythmias, haemodynamic instability, bleedings, thrombocytopenia, pneumonias, sepsis and convulsions (Bernard et al. 1997; Bernard et al. 2002; The Hypothermia After Cardiac Arrest (HACA) study group 2002). The total complication rate was not significantly higher in the cooled group in any of the reported studies. However, the number of patients studied was small. Treatment with therapeutic hypothermia requires defined protocols, to identify possible arising complications promptly.

Induced mild hypothermia after resuscitation from cardiac arrest improves neurological outcome. Extending further the existing resuscitation guidelines, all unconscious adult patients with spontaneous circulation after out-of-hospital cardiac arrest should be cooled to 32 to 34 °C for 24 hours as long as there is no contraindication (ongoing haemorrhage, pregnancy, terminal disease). Although the optimal target temperature, duration and mode of re-warming are still the subject of investigation, it is clear that therapeutic hypothermia should be started as soon as possible to yield the maximum benefit. A very effective method of inducing therapeutic hypothermia is the rapid infusion of 30 ml/kg cold (4°C) lactated Ringer's solution.

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An interview with Professor **Antonio Artigas**

Professor Antonio Artigas describes the design and operation of the Critical Care Centre at Sabadell Hospital, his management experiences and strategic aims for improving intensive care.

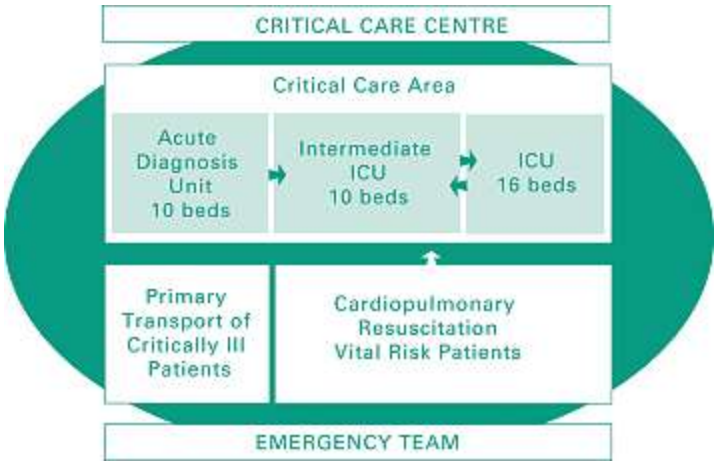

Figure 1. Organization of the Critical Care Centre

Professor A. Artigas has organized 20 scientific meetings, published 15 books, more than 120 papers in internationals scientific journals, and is a board member and peer reviewer for numerous critical care journals. Research activities have included Eurosepsis, RCT new pharmacological treatments, APC, TFPI, AT III, the development of the new severity scores SAPS II, SAPS III and MPM II, ALI ARDS consensus conferences for North America and Europe, and epidemiologic studies on incidence, outcome and risk factors.

Since 1988, Professor Artigas has been managing the Critical Care Centre at Sabadell hospital in Sabadell, Barcelona. The hospital has 660 acute care beds. The ICU part of the Critical Care Centre has 16 beds and the intermediate ICU 10 beds, with 12 medical staff, 6 residents and 40 nurses. Managing 2500 patients per year, the nurse to patient ratio is around 1:3 (1:2.3 in the ICU and 1:1.5 in the intermediate ICU). ICU beds cost three times the cost of other hospital beds and the critical care centre accounts for 15% of the hospital budget. Mortality rates are 16.5% for the ICU and 1.1% for the intermediate ICU.

Describe the organization of your unit

All rooms are fully equipped with mechanical ventilators and monitoring equipment, and the unit is a closed ICU with open visiting hours. Single visiting family members can stay for as long as they wish between 13:00 and 22:00 hours. A second visitor or friend may stay for half an hour at scheduled times. This requires flexibility on the part of the staff, although often they find families keen to participate in care of the patients. The centre is currently researching the feelings of families in ICU as a special quality control analysis. The atmosphere in the unit is pleasant, with relaxing, grey and pink colour schemes. Televisions are available for entertainment or informative programs on the patient's illness or the ICU. The ICU design, built 14 years ago, lends itself to the maintenance of a clean ICU, with cleaning stations and the laboratory conveniently located on the same floor (see figure 1), and stratified levels of care managed in separate ICUs.

Highly invasive treatments for the more severely ill patients are managed in the ICU and non invasive treatments and monitoring in the intermediate ICU (see figure 1). We are also responsible for pre-hospital care of critically ill patients for a population of 600,000. We're called out by phone and the ambulance which goes to the patient has a physician, nurse and driver/technician. Patients are given early treatment in the ambulance and come straight to the ICU. There's a flow of 7% patients who worsen and move to the ICU from the intermediate ICU, and 40% of patients from the ICU move to the intermediate ICU for non invasive treatment and monitoring. It's probably due to this stratified system that the readmission rate is only 1.29% and the occult mortality in the ward is only 2.25%.

The Critical Care Centre handles medical and surgical patients. The same staff serves pre-hospital care and in both intensive care units. Staff comprise intensivists, one anaesthesiologist for 24 hour cover, who links with the operating room, and consultants from various specialties such as cardiology, neurology etc. who dedicate 25% of their time to critical care. The critical care team can also be consulted for any patient with vital risk criteria in the hospital. Physicians and nurses from the critical care centre go to the ward to check the patient. A senior is responsible for triage and optimising bed use in the critical care centre, taking the surgery schedule into account. For severely ill patients who stay for longer than 2 weeks, e.g. sepsis patients, ARDS patients etc. the physician also follows up for the first three or four days after the patient has been transferred to the ward, to monitor for complications and prevent respiratory or cardiac arrest.

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What are the main directives of your role?

I would estimate that my time is divided between 30% teaching, 40% research and 30% clinical care. We are also heavily involved in designing quality control strategies and promoting discussion for improvement. We monitor and analyse internal data annually. Every 5 years, we present the results and propose improvement plans to the hospital management. We are also responsible for the critical care department donor organs, and pacemaker and cardiac arrest programmes.

The centre has different working groups for infections, severity scores, management of acute respiratory failure, renal failure, trauma and sedation etc. Each group has a member of staff as leader and two nurses from the critical care centre, and consultants or physicians from other departments e.g. for infections we have a microbiologist and someone from infectious diseases. We meet daily to learn about new cultures, for example The idea is to bring people from the critical care centre together with experts from all these specialty areas. The working groups are responsible to develop guidelines, treatment and diagnostics, to provide annual reports on quality control, and to design the teaching activities and research programmes in their specialty areas. The working groups meet monthly and provide a multidisciplinary platform for critical care, presenting their work annually to the centre for discussion.

What skills are essential in ICU Management?

I believe experience is an essential component to training in management. In addition to this, I attended an MSc programme with the University of Jerusalem. I had to study week-ends for two years to achieve this. The course was designed to train people in how to promote improvements in hospitals and act as facilitators. Our Professor flew from Israel every week-end and we worked together for one and half days. We also had to complete homework in groups. These were projects to improve care in the hospital or healthcare system, using the same methodologies as commercial companies. For example, one problem to be addressed was the relationship between primary care and hospitals. We presented our solution as a contract to the hospital management for approval, thus treating the hospital as a company. I apply many of the things I learnt on this course in my practice. An example in intensive care is the admission of stroke patients, for which there is a competence mismatch between the neurologist and intensivist. Working together with the objective to detect and start treatment within 3 hours, we defined the needs and a protocol, according to the available resources. The result is that neurosurgeons and radiologists are now happy to work with us. In this way, we detect problems, consider the opinions of everyone and encourage people to find solutions.

Describe your best and toughest experiences

It's been especially wonderful to have the opportunity of working with our new organizational design. A very special experience, though, was the treatment of a young lady who arrived in the ICU with severe ARDS many years back. She was treated with mechanical ventilation for a month, and survived. I followed her progress for a year afterwards and was eventually invited to her wedding. I have a fantastic relationship with this family and I'm now Godfather of her 16 year old child. This family have shown enormous appreciation. Human relationships have no price.

I've also had two very sad experiences. My sister suffered a car accident on holiday a few years ago and died within two days. The resources were simply not in place to support her care in the ICU she was taken to; I couldn't help her. Also in our own critical care centre, a young male nurse died of cancer and this was a very difficult year for all of us.

On a day to day basis in intensive care, it's sometimes very difficult to explain to administration the special difficulties of our work; it takes a long time to gain the support we need.

How would you improve intensive care?

We're addressing several areas to improve intensive care more generally:

- we're using new technologies to explore the potential of monitoring and advising in smaller hospitals using telemedicine. We can also manage patients in ambulances in this way. This may avoid unnecessary transfers in the next few years;
- e-consultation, improved numbers of ICU beds, and good coordination of existing facilities are all potential solutions to improving intensive care in regions such as Catalonia, for example;
- we're also working towards earlier care, pre-hospital and in the emergency area, and towards supporting the crucial follow-up after discharge;
- we believe in the value of stratifying care according to severity e.g. with the intensive care unit and intermediate intensive care unit in our centre;
- another important area is prevention of adverse events to improve short and long term outcomes.

What are your personnel management strategies?

We practice a human management style, considering the expectations of colleagues, talking with them and prioritising what they want to do, to keep them motivated. We've had the same staff for 14 years, except for one colleague, who recently moved to a more senior position in another hospital. The head of nursing staff has changed more regularly (four times in six years), but on the whole, we're more like a family.

Thank you, Professor Antonio Artigas.

Council of the European Union: the main decision making body of the EU

European Institutions Series

This is the third part in a series which covers the structure and operations of the EU institutions. In the first of the series (autumn 2005) Helicia Herman introduced the European Commission (EC).The second part (winter 2005) described the composition, functioning and main role of the European Parliament.

In this third instalment, the structure, role and operation of the Council of the European Union are explained by our EU Editor for European Affairs, Sonja Planitzer. Representations on the Council, and the decision making processes are presented. The European Council, and the Councils of Europe, and the European Union are carefully distinguished. Evolutions in the EU decision making processes are presented, and finally our EU Correspondent, Rory Watson describes some of the current decision making activities related to healthcare.

The final instalment in the series will be published in the summer issue 2006, and will cover the Court of Justice.

Sonja Planitzer
Editor European Affairs

The key-role of the Council of the EU

The Council of the European Union was set up by the founding Treaties in the 1950s, similar to the European Parliament. The Council of the EU is the main decision-making body. It represents the member states, and its meetings are attended by one minister from each of the EU´s national governments.

The Council of the EU has the main role of agreeing legislation, although in recent years this has been shared more and more with the Parliament under the codecision procedure. The European Commission makes proposals, for which in principle, the Council acts as legislator. The Council may modify the proposals before adopting them.

The Council consists of one government minister from each member state. Although there is just one Council, different groups of ministers meet depending on what topic is being discussed at the weekly meeting. Each minister is empowered to commit his or her government and is accountable to their own national parliaments for the decisions in the Council.

Council configurations

Depending on the matters under discussion, the Council meets in nine different configurations within which each country is represented by the minister responsible for that subject. If the Council is to discuss environmental issues, for example, the meeting will be attended by the Environment Minister from each country and is called the "Environment Council". The nine Council configurations are:

- General Affairs and External Relations
- Economic and Financial Affairs (ECOFIN)
- Justice and Home Affairs (JHA)
- Employment, Social Policy, Health and Consumer Affairs
- Competitiveness (Internal Market, Industry and Research)
- Transport, Telecommunications and Energy
- Agriculture and Fisheries
- Environment
- Education, Youth and Culture

Each minister in the Council is empowered to commit his or her government. This means that the minister's signature represents the signature of the whole government. Moreover, each minister in the Council is answerable to his or her national parliament and to the citizens who the parliament represents, which ensures the democratic legitimacy of the Council's decisions.

Responsibilities of the Council of the EU

The Council has the following six key responsibilities

- To pass European laws. As mentioned above, the Council shares legislation jointly with the European Parliament in many fields.
- To co-ordinate the broad economic policies of the member states. This co-ordination is carried out by the economics and finance ministers, who collectively form the ECOFIN Council.
- To conclude international agreements between the EU and one or more states or international organizations.
- To approve the EU`s budget, jointly with the European Parliament.
- To develop the EU`s Common Foreign and Security Policy (CFSP).
- To co-ordinate cooperation between the national courts and police forces in criminal matters.

Most of these responsibilities relate to the "Community" domain, for example, areas of action for which the member states have decided to pool their sovereignty and delegate decision-making powers to the EU institutions. This domain is the "first pillar" of the European Union. However, the last two responsibilities

relate largely to areas in which the member states have not delegated their powers, but are simply working together. This is called "intergovernmental cooperation" and covers the second and third "pillars" of the European Union.

European Council

Article 4 of the Treaty on European Union says: "The European Council shall provide the Union with necessary impetus for its development and shall define the general political guidelines thereof."

The European Council brings together the heads of state or government of the European Union and the president of the Commission. It defines the general political guidelines of the European Union. The European Council meets at least twice yearly (in practice, four times yearly, and sometimes, if necessary more often), usually in Brussels.

The European Council provides the impetus for the major political issues relating to European integration: amendments to the Treaties and changes to the institutions, declarations on external relations in the context of the common foreign and security etc; its guidelines and declarations, however, are not legally binding. To be put into effect, such political guidelines must undergo the routine procedures by the European Parliament and the Council of the European Union, followed where necessary by implementation at national level.

Procedures of the Council of the EU

COREPER

In Brussels, each EU member state has a permanent representation to the European Community, representing and defending its national interest at EU level. The head of each representation is, in effect, his or her country's ambassador to the EU.

These ambassadors (also known as "permanent representatives") meet weekly within the Permanent Representatives Committees – the "COREPER". The role of this committee is to prepare the work of the Council, with the exception of most agricultural issues, which are handled by the Special Committee on Agriculture. "COREPER" is assisted by a number of working groups, made up of officials from the national administrations.

PRESIDENCY OF THE COUNCIL

The "Presidency of the Council" rotates every six months. In other words, each EU country in turn takes charge of the Council agenda and chairs all the meetings for a six month period, promoting legislative and political decisions and brokering compromises between the member states. Currently, Austria chairs the EU (for more information see page 51); in July Finland will take over the EU Presidency until December 2006.

GENERAL SECRETARIAT

The Presidency is assisted by the General Secretariat, which prepares and ensures the smooth functioning of the Council's work at all levels.

In 2004, Minister Javier Solana was re-appointed Secretary General of the Council. He is also High Representative for the Common Foreign and Security Policy (CFSP), and in this capacity he helps coordinate the EU's action on the world stage. Under the new constitutional treaty, the High Representative would be replaced by an EU Foreign Affairs Minister. The Secretary General is assisted by a Deputy Secretary-General, in charge of managing the General Secretariat.

Minister Javier Solana
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Not to be mixed up!

We have now the "European Council", the "Council of the European Union" and last but not least, the "Council of Europe". These three different institutions should not be confused:

The European Council comprises, as described above left, the heads of state or government of the European Union, and the president of the Commission. The role of the European Council is crucial, but differs to that of the Council of the European Union.

Members of the Council of the European Union are Ministers from the Member States. The Council of the European Union exercises the power conferred on it by the Treaty subject to review by the European Court of Justice, and adopts Community legal instruments.

The Council of Europe, currently with 46 members, is another institution distinct from the European Council and the Council of the European Union. This is an international organisation outside the European Union, which deals with education, culture and above all the protection of human rights.

The power of legislation

The power to legislate is shared between the Council and the European Parliament. In most situations, European laws are made by a co-decision procedure. This means that the Council and the Parliament jointly adopt proposals for legislation originating from the European Commission. The Council and the Parliament may make amendments to the legislation under this procedure. However, there are certain important areas, for example, tax legislation, where the Parliament may only give an opinion on whether a proposed piece of legislation can become law.

The Council only acts, as a rule, on a proposal from the Commission, and the Commission normally has responsibility for ensuring that EU legislation, once adopted, is correctly applied.

EU decision making procedures

In general it is the European Commission that proposes new legislation, but it is the Council and Parliament that pass the laws. Other institutions and bodies also have roles to play.

The rules and procedures for EU decision making are laid down in the Treaties. Every proposal for a new European law is based on a specific treaty article, referred to as the "legal basis" of the proposal. This determines which legislative procedure must be followed. The three main procedures are "consultations", "assent" and "co-decision".

CONSULTATION

Under this procedure, the Council consults Parliament as well as the European Economic and Social Committee (EESC) and the Committee of the Regions (CoR). The Parliament has three options: 1) to approve the Commission proposal 2) to reject it or 3) to ask for amendments. If the Parliament asks for amendments, the Commission will consider all the changes Parliament suggests. If it accepts any of these suggestions it sends the Council an amended proposal. The Council examines the amended proposal and either adopts it or amends it further. In this procedure, as in all others, if the Council amends a Commission proposal, it must do so unanimously.

ASSENT

This procedure means that the Council has to obtain the European Parliament`s assent before certain very important decisions are taken. In this case the Parliament cannot amend a proposal – it must either accept or reject it. Acceptance ("assent") requires an absolute majority of the vote cast.

CO-DECISION

This is a procedure now used for most EU law making. In the codecision procedure, Parliament does not merely give its opinion: it shares legislative power equally with the Council. If Council and Parliament cannot agree on a piece of proposed legislation, it is put before a conciliation committee, composed of equal numbers of Council and Parliament representatives. Once this committee has reached an agreement, the text is sent once again to Parliament and the Council, so that they can finally adopt it as law.

Table 1. Number of Council votes per country

Germany, France, Italy and the UK:	29
Spain and Poland	27
Netherlands	13
Belgium, Czech Republic, Greece, Hungary and Portugal	12
Austria and Sweden	10
Denmark, Ireland, Lithuania, Slovakia and Finland	7
Cyprus, Estonia, Latvia, Luxembourg and Slovenia	4
Malta	3

Council decision making procedures

There are different ways that the Council makes its decisions. A unanimous decision is required in important areas, such as common foreign and security policies, and taxation. Each member state has a vote in these areas.

In other fields, the Council makes its decisions by Qualified Majority Voting. Each member state has a specific number of votes (see below), which is related to the size of its population. A qualified majority will be reached, if a majority of member states approve, and if a minimum of 72.3 % of the votes are cast in favour.

Since 1st November 2004 the total number of votes has been 321. The numbers of votes each country can cast are shown in table 1.

Modernising the system with the Constitution

The EU is growing bigger and bigger. Although the decision making system has evolved over half a century, it was originally designed for a community of just six nations. The EU now has 25 member states and its membership will increase further in the years ahead. The decision making system, therefore, needs simplifying and streamlining. To avoid paralysis, most decisions will have to be taken by "qualified majority voting" rather than requiring every single country to agree.

The proposed Constitution agreed by the European Council in 2004 tackles these questions head on. It spells out much more clearly than in previous treaties what the European Union is and where it is going. It lays down the new rules for more streamlined decision making. It is due to come into force in 2006, but first it has to be approved by all 25 member countries – in some cases by referendum. Meanwhile the situation is at a "standstill", with some member states having approved the Constitution – with referendums in some countries, such as in France and the Netherlands – and some member states returning a "negative" response. There is now what some politicians are describing as a period of reflection.

The priorities of the Austrian and Finnish **presidencies**

ICU Management EU Correspondent, Rory Watson, describes current EU decision making activities concerning the working time directive, services directive, the European Commission's health priorities programme 2006, and a new organ transplants legislative proposal.

The Austrian and Finnish governments have already established the priorities for their two presidencies as they steer European Union business throughout the year. Whether they manage to achieve their objectives will depend not just on their diplomatic skills, but also on the willingness of the European Parliament and EU governments to strike compromises, particularly on legislative proposals.

Vienna will have its work cut out if it is to reach agreement on the provisions of an updated working time directive. As negotiations between employment ministers in Brussels shortly before Christmas demonstrated, there is a huge gulf between those countries which want to retain the opt out from the 48-hour week and those that wish to phase it out eventually.

Surprisingly, a large part of the complex negotiations were filmed and broadcast live to media and the public, sitting elsewhere in the building, and provided a fascinating insight into the way deals are normally put together behind closed doors. But, even with the evident good will that existed on all sides, the gap proved too wide to bridge. If that remains the case, then behaviour in this area, particularly on on-call time, will be determined more by rulings from the European Court of Justice, as in the past, than by legislation agreed by Europe's politicians.

The two governments may have greater success on the services directive – an ambitious piece of legislation that aims to liberalise the cross-border market in this area. The probable outcome should become clearer in mid-February when the European Parliament will vote on the draft text. At stake, from the medical point of view, is whether health services should be excluded from the scope of the legislation. The Parliament is split over the issue. The Left basically supports exclusion. The Right accepts such a solution for public health services, but believes that private services should be covered.

The result, either way, will have implications for the health sector. The European Commission, which has drawn up its own public health priorities programme for 2006, will have to take this into account as it finalises a wide-ranging strategy paper. Due to be completed by the end of the year, this aims to set the framework and provide a more coherent approach to EU public health activities.

While fully accepting that the provision and management of healthcare remains a national responsibility, this will emphasise where Union activity can bring added value. This is notably the case in developing the EU's capacity to respond to health emergencies. Here, the recently established European Centre for Disease Prevention and Control based in Stockholm, which is helping to put in place a structure for handling pandemics, will have a key role to play.

The strategy paper will also examine how to tackle inequalities in health treatment and how to strengthen the Union's role in international health organisations and its relations with national health systems.

Further measures to highlight the dangers of tobacco loom large on the Commission's agenda. It will launch a new awareness programme aimed at the young, deglamourising the practice of smoking and is considering setting up a European Youth Parliament to discuss tobacco control.

Member States which have failed to fully implement the EU legislation banning tobacco advertising that came into effect last August face legal action. The main culprit is Germany. Berlin tried unsuccessfully to persuade the European Court of Justice to declare the legislation illegal and has still not transposed the EU directive into national law. But some countries – Italy, Spain and Hungary – are believed to be flouting the new rules by allowing advertising at Formula One racing events. Others, such as the Czech Republic and Portugal, have still not notified the Commission of the measures they have taken to implement the legislation.

Organ transplants is another area where the Commission is exploring the possibility of further EU action. Union rules already cover blood, human tissue and cells. The Commission is now examining issues such as the donation and trafficking of organs and intends to table a legislative proposal later this year to guarantee their quality and safety.

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Healthcare in the United States

This article describes the healthcare system in the US, current issues, cost and management.

Healthcare

The US has a mixed system of public and private insurance. Most working-age Americans receive private health insurance through their employers. Private health insurance covers about 70% of the population, but it accounts for only 35% of the healthcare spending (Levit et al. 2004). Over 40 million Americans do not have health insurance and about half of bankruptcies in the US involve a medical reason or large medical debt. Private and government programmes for healthcare exist and are explained below.

Private programmes

1. Health Maintenance Organizations (HMOs): An HMO is a prepaid "managed" health plan delivering comprehensive care to members through designated providers, having a fixed periodic payment for health services.

2. Preferred Provider Organizations (PPO): A PPO has arrangements with doctors, hospitals and other providers who have agreed to accept the plan's allowable charges for covered medical services that are similar to a fee-for-service plan. This gives patients a choice of using doctors and hospitals in a network with a co-payment and outside network with an annual deductible and a percent of the bill. More Americans with job-provided insurance are enrolled in PPOs (41%) than in HMOs (29%) (Oberlander 2002).

Government programmes

1. Medicare: A federal program provides health insurance to all Americans over 65 years of age, persons with disabilities and end-stage renal disease.

2. Medicaid: This health insurance program provides for certain low-income families with children; aged, blind, or disabled people on supplemental security income, certain low-income pregnant women and children, and people who have very high medical bills. Medicaid is funded and administered through a state-federal partnership. Although there are broad federal requirements for Medicaid, states have a wide degree of flexibility to design their program. However all states must cover basic services: inpatient and out patient hospital services, skilled nursing and home health services, family planning, and periodic health check ups. Medicaid reaches about 40% of Americans at the 100% poverty level (defined as an annual income of $9,570 for a family size of one person; Dept of Health and Human Services 2005; US Census Bureau 2006).

3. State Children's Health Insurance Program (SCHIP): This provides health benefits coverage to children living in families whose income exceeds the eligibility limits for Medicaid with incomes at or below 200% of the federal poverty level (annual income of $32,180 for a family size of 3).

4. There is also a military plan for active and retired servicemen and women.

Healthcare statistics and costs

US life expectancy was 77.6 years in 2003 (74.8 for men and 80.1 for women). Deaths from heart disease, cancer and stroke continue to drop (National Centre for Health Statistics 2005). Heart diseases are the number one cause of death followed by malignant neoplasm and cerebrovascular diseases (ibid). Infant mortality has dropped to 6.9 deaths per 1,000 live births.

As a percentage of GDP, healthcare spending reached 15.4% in 2004 (Centres for Medicare and Medicaid Services 2005). In 2005 it is estimated that the total National Health expenditure was $1,921 billion. National healthcare expenditures are projected to reach $3.6 trillion (18.7% of GDP) in 2014, growing at an average annual rate of 7.1% per year from 2003 to 2014 (Centres for Medicare and Medicaid Services 2004 & 2005). Intensive care units spend 10-30% of a hospital budget which accounts for to 0.5-1% of the GDP (Polderman and Metnitz 2005).

The US has the highest per capita health expenditure of any nation (Anderson et al. 2003). It spent $5267 per person for healthcare in 2002, compared to the second most expensive system in Switzerland ($3445 per capita; Bodenhemier 2005). Ten percent of the population accounts for 70% of the cost (Bodenhemier and Fernandez 2005). Figure 1 presents relative healthcare expenditures (Bodenhemier 2005; Levit et al. 2004). Prescription drugs have been the fastest growing expenditure, increasing at a rate of 11% over the last 3 years.

The US had fewer physicians and hospital admissions per 1,000 population, physician visits per capita, acute care beds and acute care days per capita than the median of industrialized countries (Anderson et al. 2003). The medical school enrolment has been con-

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stant since 1980 in the US, and the increase in number of physicians has mostly come from physicians who immigrated to the US following medical education in other countries (Anderson et al. 2003). In 2000, per 1000 population there were 8.3 nurses, 2.8 physicians, 3 acute care beds, and 118 admissions. There were 5.8 physician visits per capita (ibid).

US healthcare system: an analysis

A rapidly emerging trend in every American metropolitan area is the formation of health networks made up of hospitals, physicians and insurance underwriters. Managed care, an organized way to manage the cost, use and quality of the healthcare system has had a profound impact on the delivery of medical services, transforming traditional insurance arrangements (Oberlander 2002). Most studies have found little difference in quality of care between traditional insurers and managed care plans, though there is evidence of worse outcomes for chronically ill seniors in HMOs (Miller and Luft 1997). The functional status of the elderly has improved recently and there is a decreased death rate. Recent advances are cost effective at generally accepted values of an added year of life (Cutler and McClellan 2001).

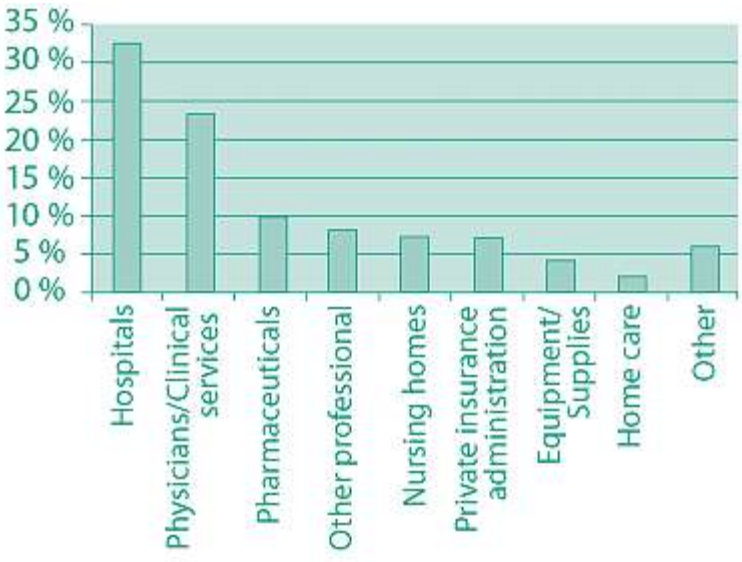
While rising costs may not create major problems for the economy as a whole, they negatively affect employers, employees, government and patients. The aging population is not an adequate explanation for the increased cost since it is too gradual a process to rank as a major cost driver in healthcare (Reinhardt 2003). The lack of well developed competitive markets in healthcare may be partially responsible for the higher expenditure. Technologies such as magnetic resonance imaging, computed tomography, coronary artery bypass graft, angioplasty, intensive care units, positron emission tomography and radiation oncology facilities are associated with higher costs and are used extensively in the US (Bodenheimer 2005). However, Japan's healthcare system has the highest usage of CT and MRI scanners (84.4 and 23.2 compared to the USA's 13.6 and 8.1 per million population in 2000) and a relatively high use of dialysis, with the least expensive health system among developed countries (Anderson et al. 2003).

The US also has the highest cost per unit of care, physician fees, payment per hospital day and pharmaceutical prices. Even though physician visits and hospital days per capita have been lower in the US than many other developed nations, use of expensive technologies, market power of hospitals and physicians, who are able to garner high prices for services, more rapid diffusion of innovative technologies, and a higher cost for administering the healthcare system has driven the overall healthcare cost to be high (Bodenheimer 2005). One proposed driver of healthcare spending growth is the medical malpractice system, which encourages physicians to practice "defensive medicine" by ordering unnecessary diagnostic tests or treatments to avoid malpractice litigation (Anderson 1999). Defensive medicine may account for 5-9% of health expenditure (Hessler and McClellan 1996).

Approximately 63% of growth in healthcare spending is the result of an increased prevalence of obesity, stress, ozone, changing treatment threshold for hypertension, diabetes, hyperlipidaemia and osteoporosis and new innovations like statins, antidepressants, and other medications (Thorpe et al. 2005). Treatment of low-birth weight babies and heart attacks has also accounted for 37% of growth in healthcare spending (ibid).

One strategy for reducing the growth in healthcare costs is to focus on slowing or reversing prevalence of obesity including school based interventions to reduce childhood obesity (15% of school-age children were obese in 2000), changing certain behaviours like smoking and driving while intoxicated, work place health promotion programmes, and cost effective use of high cost, low benefit medical technologies.

Figure 1. Relative healthcare expenditures. Adapted with permission from Bodenheimer, T. (2005) High and rising healthcare costs. Part 1: seeking an explanation. Annals of Internal Medicine, 142 (10), pp. 847-854



Progress in **Safety** and Quality in ICU Care in the US?

Scientific studies support delivery of ICU care by a multi-professional team of experts stationed at the patient's bedside. A looming shortage of healthcare providers in the United States will threaten ICU safety and quality.

Introduction

Evaluation of and increasing the quality of healthcare is an international issue. Patients, physicians, insurance entities and governments share a concern for improving quality and reducing cost of care. Each interested community has their own agenda but the common understanding is that the current system of care in the United States is neither consistently safe nor universally effective. The intensive care unit is of particular interest as the cost of intensive care is very high and the risk to life and limb from errors is great in the vulnerable patients cared for in ICUs.

Multi-professional teams improve care

The Society of Critical Care Medicine was founded over thirty years ago with the belief that having a multi-professional team of experts overseeing care at the critically ill patient's bedside is the optimal way to deliver safe and effective care. Scientific studies have overwhelmingly supported this hypothesis. Most strongly supported is the improvement in patient survival of having a board-certified intensivist involved with patient care and as leader of the multi professional ICU team.

In a systematic metaanalysis, Pronovost defined a "high-intensity unit model" as one in which there was a mandatory consultation with an intensivist on all ICU patients or all patients were managed by the critical care team, and a "low-intensity unit model" in which there was no required or only elective consultation by an intensivist (Pronovost et al. 2002). 16 of 17 published studies demonstrated lower hospital mortality with a high-intensity model compared to a low-intensity model. This difference was highly significant. The high-intensity model was also associated with shorter length of stays. No study demonstrated increases in mortality with a high-intensity model of staffing in place. This metaanalysis included all papers between 1979 and 2000, and the selected 27 studies comprised over 27,000 critically ill adults and children.

Critical care nurses' team contribution

Other studies have documented the value of having other expert members of the ICU team at the bedside. These individuals include critical care pharmacists, specially trained ICU nurses, and respiratory therapists. Each profession can bring state-of-the-art practice to care.

Nursing qualifications and workload have been associated with patient outcome. Nursing-to-patient ratios directly influence the incidence of preventable adverse events in ICU patients. In a paediatric ICU, factors that predicted unplanned extubations included patient agitation and a nurse-to-patient ratio of less than 1:1. Having a nurse-to-patient ratio of less than 1:2 in caring for patients following repair of an abdominal aortic aneurysm increased patient complications and length of stay in a study of Maryland hospitals (Pronovost et al. 2001). Using non-ICU trained nurses to care for patients with central venous lines inserted for hyperalimentation was associated with a higher line infection rate than when patients were cared for by ICU specialist nurses (Alonso-Echanove et al. 2003). Providing additional nursing hours reduced errors even when the extra staff members were not ICU trained (Binnekade et al. 2003). This was due to allowing ICU trained nurses to concentrate on the higher level, more risk-prone activities. Nursing inexperience contributed to at least half of the more than 1400 adverse events reported in the Australian survey of ICU outcomes study (Morrison et al. 2001).

Respiratory therapists for quality care

Critical care respiratory therapists have contributed in important ways to ICU care. The use of patient-driven protocols for increasing and withdrawal of respiratory support has shortened duration of mechanical ventilation and reduced the incidence of ventilator associated pneumonia (VAP) in critically ill patients, by promoting consistency in ventilation (Ely et al. 1999; Restepo et al. 2004). These protocols are developed locally, are collaborative and supported by the team. They include state-of-the-art ventilatory care recommendations, which are continually updated as knowledge increases. Identification and reduction of risk factors for the development of VAP is an area of respiratory care in which large gains have been made. Use of inline suction devices and reducing the frequency of ventilator circuit changes has saved money and reduced VAP (MacIntyre 2005; Stamm 1998). Instituting therapist-initiated daily spontaneous breathing trials has the potential for further shortening the duration of mechanical ventilation and reducing morbidity (Ely et al. 1996).

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Pharmacists' contributions

Many of the errors occurring in the ICU are from drugs. Preventable adverse drug events (ADEs) are more frequent in the ICU than on acute patient wards. ADEs occur as high as 19 per 1000 patient-days in the ICU (Cullen et al. 1997). Adding a senior pharmacist to the ICU rounding team reduces this problem. In one unit, the ADE rate fell 66% following addition of a pharmacist to ICU rounds (Leape et al. 1999). See also Dr Bourne's article on the developing role of critical care pharmacists in the UK in this issue of **ICU Management**.

Team interaction impacts quality

While most benefits of care by a multiple professional team have been shown with individual members, the question remains whether the team actually makes a difference. In reporting the actual to predicted mortality in the 13 units used for the original APACHE data set, one unit was found to perform significantly better (only 41 deaths when 69 were predicted) and one unit was significantly worse than average (58% more deaths than predicted; Knaus et al. 1986). Comparison of the organization of care in these units demonstrated increased coordination of care at the better performing unit. Physicians and nurses worked better together in the best unit. When caregivers work as a team, patient outcome improves.

Zimmerman and colleagues studied structural and organizational characteristics of nine ICUs selected for their different performance in patient mortality and efficiency (Zimmerman et al. 1993). Superior units demonstrated patient-centred culture, strong medical and nursing leadership, effective communication, coordination of care, and an open, collaborative approach to problem solving and conflict resolution. The best units experienced more than the average amount of conflict, but they had effective and open means for achieving resolution. No particular structure in this observational study was predictive of superior performance, but the factors in table 1 were associated with unit performance.

Caregiver shortages threaten quality

Despite the accumulation of supportive data, little progress has been made towards increasing the number of ICUs with an intensivist led team of dedicated experts. A recent survey by the American College of Critical Care Medicine noted that only 25% of general medical/surgical ICUs had a full-time, board-certified intensivist as a medical director. This is little changed from a survey in 1991 (Groeger et al. 1992). Less than 50% of physicians staffing the 5,800 US ICUs had any specialized training in critical care medicine and less than 25% of ICU nurses were ICU certified.

Increased demand for critical care beds has resulted in caring for a larger percentage of these patients outside traditional ICUs with resultant prolonged stays in post operative care units (PACU) and the emergency department. The number of ICU beds has expanded significantly since the survey of 1991; there are about 30% more ICU beds in the US now. This expansion may account in part for the failure of a larger percentage of beds to be staffed by certified practitioners.

The major threat to sustaining ICU quality is the diminishing workforce in the United States (Buerhaus et al. 2000). The average age of bedside caregivers continues to rise and exceeds 45 years for nurses. Retirement and burn-out are further affecting the quantity of ICU nurses (Chen and McMurray 2001; Odem 2000). There is a projected short fall in trained and certified intensivists and fewer individuals in the US are entering the medical workforce (Ewart et al. 2004). This is an ongoing and increasing issue for all concerned parties that will affect quality and safety of critical care treatment in the future.

Table 1. Factors associated with ICU performance (Zimmerman et al. 1993)

Operational and Organizational Characteristics of the Best Performing Units
Strongly shared beliefs and objectives about excellence in patient care
Team-satisfaction oriented culture
Nurse and therapist empowerment to take initiative
Strong educational programmes including mentorship and skills exercises
Nurse and therapist empowerment to challenge others decisions
Liberal use of rewards
Community celebration of successes
Highly developed sense of collegiality
Visible nursing leadership
Commitment of hospital administration to quality care
Characteristics Observed in the Worst Performing Units
Concern about personal job security
Focus on procedural issues
Concern with "rules"
Highly developed bureaucracy
Overly concerned with work hours, pay, and hiring
Little concern with patient care issues

Current State of critical care medicine in the United States

Dr Maccioli discusses some of the issues which threaten to aggravate the predicted shortage of intensivists in the US, and some potential solutions.

The practice of critical care medicine (CCM) in the United States can be divided into the adult and paediatric patient populations. Paediatric CCM practice is a fully consolidated line of patient care. No general, non-specialist, paediatrician in community or academic practice would attempt to manage a critically ill child or adolescent. In contradistinction, practitioners of adult CCM include physicians in the medical specialties of anaesthesiology, surgery, and internal medicine. All offer post-residency fellowship training in CCM. The fragmentation of CCM may increase, as emergency medicine programmes may begin to offer CCM fellowship training. Currently, the majority of practicing American intensivists are internal medicine based physicians (dominated by pulmonary-CCM practitioners; Angus et al. 2000).

Despite a large body of literature demonstrating that a "closed" (specialist practitioner only) unit improves patient outcomes (Brown and Sullivan 1989; Carson et al. 1996; Ghorra et al. 1999; Li et al. 1984; Manthous et al. 1997; Multz et al. 1998; Pollack et al. 1988; Pronovost et al. 1999; Pronovost et al. 2002; Reynolds et al. 1988; Rosenfeld et al. 2000) and optimizes resource utilization (Hanson et al. 1999), the vast majority of community (private hospital) intensive care units (ICUs) have "open" (any practitioner) admission and management policies. The traditional "open" model reduces friction between the medical staff and the intensivist in most instances, but does little to improve the quality of care. The "closed" model has not yet taken hold due to issues of resource allocation, control of patients, concerns by non-intensivists over lost revenue, and fears of restricting non-specialist practice.

The majority of critical care consultants combine CCM practice with work in their parent specialty. This mixed workload may be attributed to many factors including but not limited to: economics, preserving skills and interest in their base specialty, and a more flexible work pattern. The emotional and physical challenges, unpredictable work pattern, lower remuneration and political factors may have limited many physicians from full time careers in CCM. Federal reimbursement for critical care services pays less than private insurance, and as Medicare (a federal health insurance program for people aged 65 and older and for individuals with disabilities) covers a large percentage of ICU patients, time spent in one's base specialty remains more economically attractive. This may be addressed by the recent increase in the relative value unit for critical care services negotiated by the Critical Care Work Group, comprising six national societies related to intensive care.

In November 2000, the Leapfrog Group published a standard regarding Intensive Care Unit Physician Staffing (IPS; Birkmeyer et al. 2000). The Leapfrog Group is a consortium of the largest US companies, and other large healthcare purchasers committed to a common set of purchasing standards with full implementation in 2003. As a result, the physician workforce projects an increased demand for intensivists. It has been estimated that 35,000 critical care physicians will be required to staff all adult American ICUs (Ewart et al. 2004). This demand outstrips supply which continues to hover around 9,500.

In an effort to provide the necessary patient coverage, many institutions and group practices have added nonphysician providers to the clinical picture. Collaboration between advanced practice nurses and medically directing physicians may be a clinically efficient response. The Acute Care Nurse Practitioner (ACNP) is a registered nurse with a graduate degree in nursing who is prepared for advanced practice in acute clinical care. Early studies suggest that this model can be clinically efficient and effective in some patient populations (Jatremski 2001; Hoffman et al. 2005). The addition of nurse practitioners to the critical care team results in maintenance of the decreased length of stay, and improved clinical outcomes seen in 'closed' units, with documented evidence of improved family satisfaction and communication (Schukman et al. 1995).

Over the coming years as the population ages and an increased number of individuals survive with chronic diseases, tertiary-care centred hospitals are likely to increase the percentage of critical care and monitored beds to upwards of 50% of the total. The combination of a sicker patient population, coupled with the payer driven demand for quality care and the planned reimbursement adjustments, may result in significant demands for future critical care practitioners.

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Remote ICU care in the US

Remote ICU care programmes have become more prevalent in the US over the past 3 years as hospitals try to leverage clinician expertise and improve quality.

Introduction

There are insufficient numbers of intensivists, critical care nurses and other healthcare professionals to achieve consistent, high quality care for all high acuity patients. Despite data demonstrating improved outcomes with the dedicated intensivist care model, < 15% of US ICUs have this model in place during daytime hours. Moreover, the simple presence of intensivists does not translate into standardized care processes and routine use of best practices. Recognizing that significant restructuring of clinical care represents the only viable approach to achieving quality goals, many health systems across the US have implemented remote ICU care programmes. This care model centralizes select elements of ICU care to increase provider efficiency and effectiveness.

Structure

Thirty-two health systems, representing more than 4000 ICU beds, 300 ICUs and 150 hospitals, have elected to establish remote ICU care programmes. The remote care model links ICU beds in multiple hospitals to a centralized care centre. The remote care centre is staffed with intensivists and critical care nurses from the health system implementing the program. The size of the remote team varies with the number of beds in the network. Most sites have a single intensivist and a variable number of critical care nurses (~ 1 for every 30-35 patients). Hours of operation range from 12 per day (nights) to 19-24 per day (ICUs without dedicated intensivists). Most programs include a flagship centre (academic medical centre or major tertiary care facility) and several smaller facilities. Some service a single metropolitan area; others cover large geographic catchment areas.

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Technology

The technology infrastructure includes high-resolution, in-room cameras, speakers and microphones, remote bedside monitor viewers, an ICU clinical information system, an automated alerting system and local and wide area networks. This configuration allows the remote team to access all relevant clinical data and interact with on-site providers. It also provides them with tools to manage the population of patients in the ICU network.

Services

ICU clinicians at the remote site work in concert with on-site providers to provide consistent, round-the-clock, quality care. The on-site clinicians are responsible for establishing a comprehensive daily care plan for each patient. The remote team is responsible for ensuring that all goals of the care plan are achieved. This entails frequent review of clinical data (e.g. virtual rounding) and titration of therapies, as needed. The remote team, through regular rounding and automated alerts, is also charged with identifying new problems promptly and initiating timely countermeasures. Many sites have centralized quality improvement activities as well (e.g. ventilator and sepsis bundles).

Operations

Implementation of a remote care program requires significant changes in how ICU care is organized and delivered. In addition to individual practitioners mastering new skills and new technologies, there is often a need for major cultural change. Collaboration and standardization are central to the care model; unfortunately, these concepts are not universally embraced. Even in academic medical centres there are often practice variations among the different sub-specialty ICUs, and cross-departmental collaboration is uncommon. Sites that have successfully implemented remote care programmes have recognized the scope of the clinical transformation and allocated the resources to manage the change process. This includes strong executive support, enlistment of key thought leaders, extensive advance education and effective program management.

Outcomes data

The first remote care program, implemented 5 years ago, reported decreases in mortality, ICU LOS and hospital LOS of 27%, 17% and 13%, respectively (Breslow et al. 2004). The other programmes are < 3 years old, and thus there is a paucity of published data. A recent abstract reported a significant decrease in cardiopulmonary arrests and deaths from cardiopulmonary arrest after program implementation (Shaffer et al. 2005). Another observed a decrease in ventilator days, with the magnitude of the decrease correlated with the degree of autonomy granted to the remote team (Cowboy et al. 2005). Sites that have centralized best practice oversight have reported significant increases in compliance rates.

Conclusion

Remote ICU care programmes are becoming more common in the US, driven by both the shortage of intensivists and other healthcare professionals and the desire of health systems to improve the quality of ICU care across all their facilities. The health systems implementing these programmes are changing how healthcare is delivered and through their efforts are discovering how best to implement these programmes and maximize their effectiveness.

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Billing and documentation: a primer

Billing and documentation requirements are extremely complex for critical ill patients and no relief is in sight. Drs Dorman and Pauldine review the present documentation requirements for critically ill or injured adults.

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Billing for critical care services in the United States can be quite confusing and time consuming. Every patient represents a different billing scenario related to potentially a different payer or multiple payers. Each payer is permitted to utilize their own system of coding and to establish their own payment rules. Furthermore, each payer is permitted to change these rules as they see fit and thus the combinations of rules are endless and constantly changing. In addition, few payers pay what is billed, with most negotiating a discounted rate such that the gross collection ratio is commonly in the 30-40% range.

Many payers base at least a component of their system on Medicare payment policy, which is established by the Centres of Medicaid and Medicare Services (CMS). Thus most physicians establish documentation practices in line with Medicare rules and typically bill according to Medicare principles. In this manuscript we will briefly review the documentation criteria for billing for critical care services for adults.

The guidelines for documentation are initially established as a component of the definition of critical care services, which is established by the AMA Common Procedural Terminology (CPT) Committee (AMA 2005). There are two CPT codes for critical care services. One for the first hour of critical care (99291) and one for each subsequent half hour of critical care (99292). It should be noted that CPT defines the first hour of critical care as ranging from 30 minutes to 74 minutes, thus establishing the principle that critical care services can never take less than 30 minutes. The time can accrue over multiple iterative sessions and can include the time to document the care. Furthermore, the time can include time in family conferences if, and only if, the patient is unable to communicate or is deemed incompetent and the discussion is absolutely necessary for care provided or withheld for that day.

In addition to time criteria, two additional criteria must be met and documented; the patient must meet the CPT definition of critical illness and the physician must provide direct critical care services. Critical illness is described as, "the critical illness or injury [that] acutely impairs one or more vital organ systems such that the patient's survival is jeopardized" (AMA 2005). Additionally, there is "a high probability of sudden clinically significant or life threatening deterioration in the patient that requires the highest level of physician preparedness to intervene urgently" (AMA 2005).

Once the physician believes that the patient meets the definition of critical illness and that their time has exceeded 30 minutes, the physician must document that they have provided critical care services to the patient while on the unit or floor. There are three treatment criteria which must be met and documented. The "critical care services require direct personal management by the physician," the "services are life and organ supporting interventions that require personal assessment and manipulation by the physician," and "withdrawal of, or failure to initiate these interventions on an urgent basis, would likely result in sudden clinically significant or life-threatening deterioration of the patient's condition" (AMA 2005). One should note that merely activating protocols does not constitute critical care services. Furthermore, it should be stressed that all components (critical illness, critical care service and time) must be met and clearly documented or payment can be withheld or claims of fraudulent billing practice can be made against the physician.

Procedures done in addition to providing critical care services can also be billed under certain conditions. First, the procedure must not be bundled into the definition of critical care. Procedures that are considered bundled include: ventilator management, cardiac outputs, temporary pacing, arterial puncture, interpreting chest radiographs. If the procedure is not bundled then separate documentation is required and a bill can be submitted. Of course, the physician must ensure that the time to do the procedure is not counted in the time accrued for billing the critical care services, as this would be considered double dipping.

As one can see there are many nuances to documenting critical care services and subsequently to billing and receiving payment for said services. Given the variability in the model of critical care physician services in the United States, it is unlikely that a more streamlined approach that principally serves the full-time intensivist model will be established any time soon.

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The European Society of Anaesthesiology, amalgamated since 2005 with the European Academy of Anaesthesiology (EAA), and the Confederation of European National Societies of Anaesthesiologists, holds the largest scientific anaesthetic meeting in Europe, *Euroanaesthesia*. Jennifer Hunter, Chairman Elect of the Scientific Programme Committee, previews this year's meeting to be held in Madrid.

From June 3-6 2006, the European Society of Anaesthesiology (ESA) will hold its annual meeting in Madrid, the beautiful capital of Spain. Our venue is the purpose-built Juan Carlos Exhibition Centre in the North Convention Centre Building, conveniently accessible from the airport and city centre by public transport. A local organizing committee led by Professor Hector Litvan has contributed significantly to the preparation of this meeting on behalf of the Spanish Society of Anaesthesia, Reanimation and Pain Therapy.

The ESA Scientific Programme Committee (SPC) led by Dr Gordon B Drummond (Edinburgh, UK) has put together an exciting four day scientific programme, covering many aspects of intensive care medicine. Its 17 subcommittees have planned the programme with such diverse topics as Monitoring, Patient Safety, Local and Regional Anaesthesia, the Neurosciences, Respiration, and Clinical and Experimental Circulation. Each subcommittee of seven members from throughout Europe has a Chairman, nominated to the SPC chair by the subcommittee members, and approved for the appointment through the Nominations Committee by the ESA Board. Each subcommittee recommends to the SPC (16 months in advance of each scientific meeting) two Refresher Courses, each given by recognised experts as didactic lectures; two or three 90 minute symposia consisting of three 30 minute lectures, including discussion; and two 45 minute practical workshops.

The Chairman of the SPC subcommittee on Intensive Care Medicine, Professor Gernot Marx (Jena) has been aided by intensivists from throughout Europe to put this part of the ESA programme together. Didactic Refresher Courses will cover the diagnosis and treatment of sepsis (F Stüber, Bonn), nutritional support in the critically ill (RJ Beale, London), and global and regional oxygen transport in the critically ill (S Jakob, Bern). Symposia will cover blood transfusion and IV fluids in the critical care environment, antibiotic therapy, metabolism and acid-base, and an update on mechanical ventilation, and weaning from it. Management of critically ill children will be discussed, including the use of high frequency ventilation in this population. This symposium will be chaired by W Habre (Geneva) and includes HFO in the child with ARDS, HFO in the neonate, and HFJV for laser airway surgery in children. A workshop on paediatric airway management will be led by Isabelle Murat (Paris), ably supported by D Patel (Manchester) and M Weiss (Zurich).

Perhaps the most interesting lecture for all delegates will be the one opening the meeting on Saturday June 3rd at 13.00 hr: Juan Navia Roque of Madrid will discuss the management of the casualties from the Madrid bombings in "Mass Casualties: The Madrid Experience". Emergency medicine in Europe will be discussed in a symposium chaired by J Andres (Cracow) and CD Deakin (Southampton), and German and Norwegian views will be given in a workshop asking "Do we need doctors to go out in Emergencies?"

A symposium on Incident Reporting will specifically discuss this approach in intensive therapy, and workshops managing a range of critical incidents will recruit audience participation. A workshop on the influence of human factors, such as stress and fatigue, on patient safety will be of value to all practising clinicians. Other workshops include two on TEE, where the theory, anatomy and pathology as well as the applied physiology will be discussed. Tips on how to pass the ECHO examination will be given Italian style by Fabio Guarracino (Pisa), and assessment of mitral valve function using transoesphageal echocardiography (TOE) will be formally discussed by the international expert Jan Poelaert (Gent). Monitoring of organ and cell function including for the liver and gut, will be addressed in a symposium organised by Andreas Hoeft.

There is much for intensivists to enjoy at the ESA meeting in June 2006. The increasing number of delegates – 5033 in Vienna in June 2005 – must indicate that the programme for these events continues to be relevant and stimulating. Supported so ably by the Secretariat, and especially by Raf Kinnaer as the Programme Administrator, the ESA is fully committed to the continued enhancement of this, the largest scientific anaesthetic meeting in Europe. The fusion of the EAA, CENSA and the "old" ESA at the beginning of 2005 represented the beginning of a truly united approach to the continued development of anaesthesiology, critical care and pain relief on this continent. Join us, as we move forward in our continued attempts to understand the scientific basis of our ever-widening clinical practice, and at the same time enjoy the delights of Madrid and its environs.

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Acknowledgement

We thank Dr Gordon Drummond, who completes his term of office as Chairman of the Scientific Programme Committee in March 2006, for his flair, energy and commitment to the ESA and its annual scientific meetings.

European Society of Anaesthesiology

ESA

Euroanaesthesia 2006

Annual Meeting of the European Society of Anaesthesiology

Madrid Spain

3-6 June

Symposia

Refresher Courses

Workshops

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Agenda

MARCH 2006

21-24 26th International Symposium on Intensive Care and Emergency Medicine
Brussels Belgium
www.intensive.org

24-28 International Anaesthesia Research Society 80th Congress
San Francisco USA
www.iars.org

MAY 2006

10-13 8th Scientific Congress of European Resuscitation Council
Stavanger Norway
http://congress.erc.edu/

13-17 Australian and New Zealand College of Anaesthetists (ANZCA) Annual Scientific Meeting
Adelaide, South Australia
www.sapmea.asn.au/conventions/anzca/index.htm

23-24 UK Intensive Care Society Annual Spring Meeting
Harrogate UK
www.ics.ac.uk

JUNE 2006

3-6 Euroanaesthesia
Madrid Spain
www.euroanesthesia.org

SEPTEMBER 2006

2-6 European Respiratory Society 2006 Annual Congress
Munich Germany
www.ersnet.org/ers/default.aspx?id=2078

24-27 19th Annual Congress of the European Society of Intensive Care Medicine
Barcelona Spain
www.esicm.org

OCTOBER 2006

12-15 31st Australian & New Zealand Annual Scientific Meeting on Intensive Care
Tasmania Australia
www.anzics.com.au

FEBRUARY 2007

18-21 36th Critical Care Congress of the SCCM
Orlando, USA
www.sccm.org

LETTERS TO THE EDITOR & REQUESTS FOR REFERENCES CITED IN ICU MANAGEMENT EDITORIAL@ICU-MANAGEMENT.ORG

ICU MANAGEMENT is the Official Management and Practice Journal of the International Symposium on Intensive Care and Emergency Medicine and was previously published as Hospital Critical Care. Business Publication Audit (BPA) applied for.

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Christian Marolt

MEDIA CONTACT, MARKETING, ADVERTISING
Luk Haesebeyt marketing@icu-management.org

SUBSCRIPTION RATES

One year	Europe 50 Euros	Overseas 65 Euros
Two years	Europe 85 Euros	Overseas 100 Euros

Note: Participants of the International Symposium on Intensive Care and Emergency Medicine receive a one year subscription as part of their symposium fee.

ART DIRECTOR
Sarah Daeleman layout.g5@emceurope.com

PRODUCTION AND PRINTING
Imprimerie Centrale s.a., Luxembourg
Print run: 9,000 - ISSN = 1377-7564

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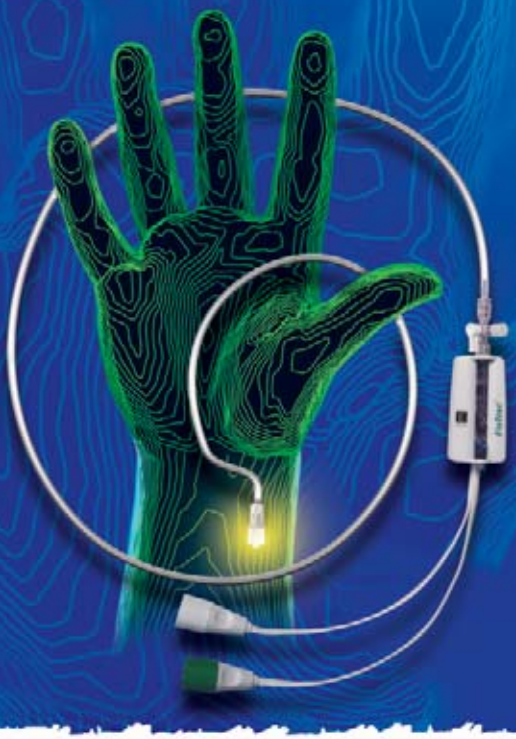

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