ICU MANAGEMENT

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Mobility in Care

Critical care has traditionally been administered through intensive care units and emergency departments attached to a hospital. In this setting, intensivists, nurses and other medical specialists work together, side by side, to treat the critically ill. But medical emergencies may happen anywhere, at any time.

In today's fast-paced world, patients and doctors alike find themselves travelling more and more. Indeed, even as I write this editorial, I am abroad, travelling on business. Work, family, holiday, war – any number of forces drive us far from home and far from the medical facilities that respond to emergency medical situations. Thus, a critical care specialist may leave his hospital short one pair of hands when disaster strikes during his holiday abroad. Likewise, a patient may suffer a life-threatening emergency miles from the nearest medical facility.

Nevertheless, our duty remains to ensure that patients who may benefit from critical care receive the best medical attention possible. For this reason, as technology allows society to travel faster, further and to more exotic locations, we as critical care specialists must explore new technologies and procedures that allow us to provide critical care in a variety of settings, on the move and across great distances.

In recognition of these modern challenges, this issue of **ICU Management** explores mobility in care. Drs. Halpern, Fuerstenberg, Bridges, Dulchavsky and colleagues offer unique perspectives on some of the mobility challenges that critical care is experiencing today. In his article, Dr. Halpern examines the application of wireless technology in the intensive care unit, increasing patient and device mobility within the hospital and creating opportunities for remote care. Drs. Fuerstenberg and Beilman discuss recent developments in the United States military's ability to provide front-line critical care during the wars in Iraq and Afghanistan. Then, Dr. Bridges and colleagues describe the effects of flight on the provision of critical care services. Finally, Dr. Dulchavsky and colleagues describe the training programs, remote diagnostic capabilities and medical technologies that are helping improve critical care in a most exotic travel destination indeed – aboard the International Space Station. Each article offers a unique perspective on our ability to bring care to critically ill patients, wherever they may be in today's on-the-go world.

The world is now faster and more dynamic than ever, and we must learn to adapt critical care services to today's mobile society. The technologies and procedures discussed in this issue may help inspire us to provide fast, effective medical attention to critical care patients within our own hospitals, in danger zones and even thousands of miles away. Advances in technology will undoubtedly continue to present new mobility challenges and new solutions to critical care, and we must stay alert to new technological developments that help us respond to emergencies wherever they may arise.

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

Letters to the Editor & Requests for References cited in ICU Management editorial@icu-management.org

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Posters: Deadline for abstract submission: December 15, 2006

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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.

News Worldwide

WHO: Workforce Crisis Endangers Healthcare

www.who.int

The World Health Organization (WHO) announced in its World Health Report 2006 that a serious shortage of trained healthcare professionals is severely limiting the life-saving services available in 57 countries around the world, 36 of which are in sub-Saharan Africa. According to the report, this shortage, in conjunction with inadequate medical training, poses a significant obstacle for health systems trying to respond effectively to chronic diseases, avian influenza and other health challenges. The declining number of healthcare workers is even more problematic in light of the growing global population.

The WHO reports that over four million additional doctors, nurses, midwives, managers and public health workers are urgently needed to fill the healthcare gap in the 57 most-affected countries. In addition, the WHO concludes, every country must improve its healthcare planning, education and employment policies, as well as working conditions. The World Health Report 2006 includes a 10-year plan for addressing the workforce crisis.

News National

ASPE Releases First-Ever Treatment Guidelines for Diabetic Peripheral Neuropathic Pain

www.paineducators.org

The American Society of Pain Educators (ASPE) published consensus guidelines for the treatment of diabetic peripheral neuropathic pain in the April issue of Mayo Clinic Proceedings. This is the first set of guidelines ever released on this medical condition. The guidelines are intended to give medical practitioners a definitive, consistent treatment strategy for managing diabetics' pain, both improving treatment and minimizing medical errors. According to ASPE, approximately one million people are known to suffer from chronic and debilitating diabetic peripheral neuropathic pain.

JCAHO Issues Alert on Dangerous Tubing Misconnections

www.jointcommission.org

The Joint Commission on Accreditation of Healthcare Organizations (JCAHO) in the United States has issued a Sentinel Event Alert regarding dangerous misconnections of catheters and tubes used in medical procedures. The alert was triggered by reports to JCAHO, ECRI, the United States Food and Drug Administration (FDA), the Institute for Safe Medication Practices and United States Pharmacopeia, which revealed that tubing and catheter misconnection errors occur frequently and often have deadly consequences. According to JCAHO, tubes that require the use of force or adaptors to be connected or tubes that are used for anything other than their intended purpose may signal a possible misconnection. The JCAHO's Sentinel Event Alert urges healthcare workers to pay special attention to the way in which they attach catheters and tubes to patients and challenges manufacturers to redesign devices that use these connections, so that misconnections are less likely to occur.

Resuscitation Council (UK) Releases Updated Statement on the Use of Automated External Defibrillators

www.resus.org.uk

In April 2006, the Resuscitation Council (UK) released an updated statement on the use of Automated External Defibrillators (AEDs) until they have been re-programmed to be compliant with Guidelines 2005, an international consensus on treatment standards during resuscitation. The updated treatment recommendations in Guidelines 2005 do not define the only way that successful resuscitation may be achieved; they merely represent a widely held view of how resuscitation can be undertaken both safely and effectively. The priority for patients in ventricular fibrillation is to deliver an effective shock with minimum delay, regardless of the specific procedures used.

The Resuscitation Council (UK) recognises that the AED algorithms published in 2000 and in 2005 are both capable of providing acceptable standards of treatment. According to the updated statement from the Resuscitation Council (UK), until AEDs (and training AEDs) have been reprogrammed to comply with Guidelines 2005, AEDs complaint with earlier guidelines should continue to be used. Similarly, AEDs incapable of modification may be used until the end of their useful life. In both cases it is imperative that their users are adequately trained and that users follow the voice prompts given by the machine.

News Research

IARS Research Awards

www.iars.org

Deadlines for 2007 International Anaesthesia Research Society (IARS) research award applications are rapidly approaching. Applications for the 2007 IARS Clinical Scholar Research Awards are due June 5, 2006. This annual award, of up to $80,000 is intended to fund clinical investigations that enhance the understanding of clinical practice in anesthesiology and related fields. Applications for the 2007 IARS Frontiers in Anesthesia Award are due September 11, 2006. This award, of up to $500,000, is given biannually to one scientist who demonstrates innovation and creativity in support of anesthesiology. These IARS awards are limited to IARS members.

Winners of the 2006 Clinical Scholar Research Awards include: Dr. Giora Landesberg's "Cardiac Morbidity and Mortality in High-Risk General ICU Patients: Pathophysiology and Prospective Randomized Trial," Kyle T. S. Pattinson's "Investigation of Pharmacological Modulation of Respiratory Control Using fRMI," Dr. Esther M. Pogatzki-Zahn's "The Role of the Menstrual Cycle, Sex Hormones and Gender for Modulation of Pain Perception and Cortical Activation After an Experimental Incision in Human Volunteers, " Dr. Sam R. Sharar's "Subjective and Neuroimaging Assessment of Combined Opioid and Virtual Reality Analgesia" and Dr. Ruth Zaslansky's "Topical Morphine for Analgesia and Promotion of Wound Healing in Patients with Skin-Graft Donor Sites." The 2005 winner of the Frontiers in Anesthesia Award was Dr. Michael Zaugg's "Functional Genomics of Anesthetic Protection in Human Myocardium." More information about past and future IARS research awards can be found at www.iars.org.

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Wireless technology in the ICU:

Enhancing mobility and improving patient care

Wireless technology offers a viable opportunity to make ICUs more mobile and introduces new possibilities for enhanced ICU management and medical care.

Introduction

The intensive care unit (ICU) relies on a variety of bedside devices to deliver care to critically ill patients. These devices include physiological monitors, ventilators, infusion pumps and bedside computer terminals, among others. Each device offers a critical medical service to the patient or reports the patient's condition to the medical staff. Traditionally, these devices are attached to the patient, the bedside head walls and to the hospital networks through a maze of wires and cables, which provide medical service to the patient and electricity and/or data network connectivity to the device. As a result, contemporary ICUs are often choked with cables and wires, limiting the mobility of the patient, the bedside devices attached to them, and the nursing and physician staffs who must navigate the jungle of wires to provide care. Wireless technology offers a viable solution to these problems and opens opportunities for enhanced medical care and device and personnel mobility.

Increased mobility and other advantages

Introducing wireless connectivity into the ICU offers many advantages. First and foremost, wireless technology allows the ICU to eliminate the tangle of wires at each bedside. This allows the medical staff to relocate devices and even the patients as needed. It also creates a tidier, safer ICU room. Because wireless technology offers new opportunities for mobility, a wireless ICU can better manage its space and equipment, optimizing the number of patients served and the number of medical services available to patients throughout the ICU.

Wireless technology may also be used to integrate, through a consolidated wireless network, a variety of bedside devices, which, in a traditional ICU, are typically not networked together. This enhances the ICU's ability to collect, manage and analyze data from bedside devices, which in turn enables ICU managers to easily make decisions based on comprehensive medical data from their own ICU. Specifically, this data could help managers tailor ICU policies and procedures to local caseload and patient flow, further facilitating the operations in their particular ICU.

Placing data from multiple bedside devices onto one, integrated network also enables the ICU to efficiently and effectively communicate its comprehensive patient data to other areas of the hospital. ICU doctors and nursing staff may also take advantage of the networked data to access information about patient status remotely from home or from a nursing station, thus allowing them to respond more quickly to changes in a patient's condition, even when they are not immediately available at a patient's bedside.

Installing a wireless ICU network

Converting to a wireless ICU clearly offers medical mobility and management advantages, but the thought of modifying or doing away with traditional, hard-wired devices may seem futuristic and daunting to many ICU managers. Creating a wireless ICU requires physical modifications to the existing, traditional ICU. The key to wireless networking is the installation of access points; these units are bi-directional "Wi-Fi" (802.11) transmitters that provide zones of wireless coverage. The access points link the medical devices wirelessly to the hospital network and enable device data to be accessible beyond the bedside. Because an ICU usually occupies a substantial amount of space, it may be necessary to install multiple access points, each providing wireless coverage for the devices in their zone (e.g. one ICU room). Thus, although the wireless ICU looks significantly less "busy" than a traditional ICU, it must be "wired for wireless" through the installation of the access points.

Wireless networking poses its own unique set of challenges. Physical changes in the area of wireless coverage may cause coverage limitations. Wireless zones may become overloaded with transmissions, thus slowing down data throughput. Access points themselves may fail. Security may become problematic as "hackers" attempt to engage the wireless network without proper rights. Thus, for wireless to function properly, a 24/7 monitoring system must be developed.

Moving to wireless

Once the ICU has installed a wireless coverage sufficient to meet its needs, it can begin the transition to wireless operations. All typical ICU devices are now available in wireless formats. Either the medical devices are constructed with integrated wireless cards or external wireless transmitters are added to the devices. Installation of a wireless network in the ICU, however, does not preclude maintaining traditional "wired" operations; so, the transition to wireless can take place gradually over time, depending on the needs and resources of the ICU. The wired and wireless systems can co-exist, as well. The following are a few examples of common bedside devices available in wireless format:

Neil A. Halpern, MD, FCCM
Chief of Critical Care Medicine
Department of Anesthesiology and Critical Care Medicine, Memorial Sloan Kettering Cancer Center, New York, USA
Professor of Clinical Medicine
Weill Medical College of Cornell University, New York, USA
halpernn@MSKCC.ORG

Monitors

Physiological monitors are among the most common ICU devices and are typically networked together through wired connectivity. Monitoring companies also support wireless integration and many of their devices already in the marketplace contain wireless technology installed directly within the monitor. Thus, peripheral or external wireless transceivers are not required to link the monitor to the ICU's wireless data network. Electrocardiogram (EKG) leads and pulse oximetry devices are also available in wireless format. Invasive blood pressure monitoring is one of the few monitoring capabilities that has lagged behind and remains wireless-incompatible; however, research into adding this capability to invasive monitoring is currently underway.

Ventilators

Ventilators are typically stand-alone devices and are not networked with a data management system. However, since it is nonetheless important to track the status of ventilated patients and to receive remote alarms when significant changes occur, wireless ventilator management systems that can transmit data on a wireless ventilator network are now available. A wireless transmitter however, must be externally attached to the ventilator. Using this technology, ICU doctors can review patient and ventilator data within their facility via any computer or handheld device with access to the wireless network. The ventilators in turn, can transmit alarm notifications of changes in a patient's condition to remote paging devices.

Infusion pumps

Intravenous infusion pumps, like mechanical ventilators, have largely been used and viewed as stand-alone devices. To date, the pumps have had minimal programming capabilities; today, however, the newer generation of infusion pumps, referred to as "smart pumps" incorporate multiple comprehensive drug libraries and infusion error reduction systems. Wireless connectivity, however, is recommended to optimally use, maintain, and update the pumps and their software. Wireless also permits the infusion pumps to continuously link to the patient, pharmacy and information management systems. Thus, smart infusion pumps are available with integrated wireless connectivity to enable them to function under a care model that enhances patient safety.

Bedside terminals

Traditionally, each ICU bedside has a computer terminal, which is stand-alone, immobile and difficult to see. To be efficient, an ICU needs computers that are both mobile and visible. A decade ago, mobile terminals were rare and expensive. Today, vendors offer wireless carts that provide mobility and connectivity throughout the wireless ICU. In our ICU, we have even introduced telephonic capabilities through the wireless computer carts.

Two conceptual wireless ICU constructs thus emerge. First, the wireless medical devices at the bedside can be grouped with the patient and caregivers to form a cohesive "bedside" patient-device-provider network that is linked to the hospital-wide information system. Second, each group of wireless devices (monitors, ventilators, infusion pumps, etc.), while scattered throughout the ICU, can be viewed remotely as their own virtual device communities. In such a circumstance, these devices can be remotely tracked and monitored in a systematic fashion, and data can be bi-directionally transmitted to and from the devices.

New technologies, new possibilities

In addition to the traditional bedside devices mentioned above, hospitals are introducing non-traditional applications for wireless connectivity into their ICU environments. For example, some hospitals have introduced remote-presence robots, which enable ICU doctors to complete patient rounds remotely. Live images of the patient and bedside devices are transmitted via the wireless network to the doctor's computer. A live feed of the doctor, in turn, is transmitted through the network to the robot's screen, adding a personal touch to a remote visit. Other hospitals have used their wireless network to support patient bar-coding initiatives. Through bar coding, the medical staff can identify the patient, link the patient to the medical or nursing caregivers and to the bedside devices and transmit patient-specific medication orders to the infusion pumps throughout the wireless coverage area. These and other technologies, made possible with wireless ICU coverage, enhance mobility, patient-centered care and data management in ways that could only be dreamed of in a traditional, wired ICU.

Conclusion

In conclusion, wireless technology has unique applications in the ICU. Wireless networking applies to the patient, the ICU itself, and the entire hospital. It allows for centralization of devices that previously lacked interoperability, creating better data and device management possibilities, and enhanced mobility throughout the ICU. However, wireless networks require access point installation, introduction of wireless connectivity to medical devices and plans to overcome security and maintenance challenges that are different from those encountered in a traditional, wired ICU. Nevertheless, the benefits of a wireless ICU demand that we consider moving towards wireless technology in the near future.

Forward Surgical Teams in Iraq and Afghanistan

This article is an overview of the role of Forward Surgical Teams in support of American soldiers in Iraq and Afghanistan.

Introduction

As of February 2006, there were 2,247 deaths and 16,653 wounded among American soldiers in Iraq. Critical care medicine has played a significant role in the management of these patients. This review focuses on the role of the US Army's Forward Surgical Teams (FST) in the care of these combat-wounded casualties.

FST development

During Operations Desert Shield and Desert Storm, it became clear that the mobile army surgical hospitals (MASH) and combat support hospitals (CSH) were not agile enough for modern warfare (Place et al. 2003). The speed at which the front moved during these operations prolonged transportation times to these more traditional medical units. The FST was conceived as a highly mobile surgical unit that could perform damage control surgery near the front line. It is intended to provide a rapid response to the 10-15% of patients that need surgical stabilization of their condition (generally involving hemorrhagic shock) before transportation to a higher level of care, such as a CSH.

The FST generally consists of a 20-person team, which ideally includes an orthopedic surgeon, three general surgeons and two nurse anesthetists. It is designed to be deployed and operational within one hour of arrival in the combat zone. The FST is intended to have two operating tables with resources for up to 30 operations and the required post-operative care. This includes the ability to provide six hours of intensive care for up to eight patients. Given the limited quantity of supplies necessary to keep the FST mobile, resupply is required after 72 hours of operations (DOD, USA 2004).

FSTs in action

Recently, the 555th FST detailed their experience providing forward surgical care during the main assault phase of Operation Iraqi Freedom (Patel et al. 2004). Over the period described, the unit was moved to multiple locations and was able to "open for business" within 30 minutes of reaching a new site. Over 23 days, the unit evaluated 154 patients and performed 25 major operations. Of note, US soldiers comprised only 51% of their patients; the rest were Iraqi prisoners of war and civilians.

The 250th FST was deployed in both Afghanistan and Iraq, during which time it performed 127 surgical procedures (Rush et al. 2005). In Iraq, the unit had a remarkable average time to operative intervention of 1.5 hours after injury, lending support to the FST concept. The 250th FST also played a significant role in combat-related humanitarian missions. The 250th FST performed 105 operations with local surgeons (more than the number of combat operations). Their other humanitarian projects included revamping the local emergency medical system, re-establishing surgical grand rounds at local hospitals and forming the Iraqi-American Surgical Association (Rush et al. 2005).

The US Marine Corps has a smaller version of the FST, called the Forward Resuscitation Surgery System (FRSS). During the first month of the Iraqi conflict, six FRSS teams performed 149 procedures on 90 casualties (Chambers et al. 2005). Two-thirds of their patients were Iraqi (Chambers et al. 2005). The FRSS teams' patients were received within a median of one hour of injury, and the critically injured were received within 30 minutes. The FRSS teams deemed that 8 of their 21 most critical patients would have died without the Forward Surgical Team in the combat theater.

Although FSTs offer life-saving, rapid-response medical care, they do have some limitations. For example, the 250th FST reported that thoracic injuries are almost 67% more likely if the patient was not wearing body armor at the time of injury (Rush et al. 2005). Unfortunately, civilians (including children), who do not benefit from advances in body armor, have suffered injuries requiring FST treatment in both Iraq and Afghanistan. Because of FSTs' limited equipment capacity, however, the FSTs often lacked the pediatric equipment necessary to care for the children that were brought to them. Operating within several kilometers of the front line also carries inherent danger. The FST is lightly armed and is occasionally responsible for its own defense. The 555th FST was fired upon on multiple occasions and was actually involved in taking several prisoners of war (Patel et al. 2004).

Conclusion

The Forward Surgical Team is a relatively new concept. American FSTs have recently had their first real combat test in Iraq and Afghanistan. Initial published reports support that the concept is feasible: quality surgery and critical care can be rapidly provided in austere conditions. It will be important to the future of far-forward surgery to evaluate results from the Iraq conflict to determine if this concept results in improved combat mortality.

Jon Fuerstenberg MD
Department of Surgery
University of Minnesota
Minneapolis, USA

Greg Beilman, MD
Department of Surgery
University of Minnesota
Minneapolis, USA

Jon Fuerstenberg
fuer0006@umn.edu

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Equipment challenges
during critical care aeromedical evacuation

Equipment used during aeromedical evacuation (AE) must meet airworthiness standards, and the interactive effects of the AE environment on the equipment and patient should be considered. Recommendations for AE practice are provided.

The opinions and assertions contained herein are the private views of the authors and are not to be construed as the official policy or position of the United States government, the Department of Defense, or the Department of the Air Force.

Elizabeth Bridges
PhD RN CCNS, Lt Col USAFR NC
University of Washington School of Nursing, Seattle USA
Clinical Investigations Facility, Travis AFB USA

Joseph Schmelz
PhD RN, Lt Col USAF NC (Ret)

Karen Evers
MSN RN, Lt Col USAF NC (Ret)

Arthur D. Johnson
PhD RN, Col USAFR NC (Ret)

Marla De Jong
PhD RN, Lt Col USAF NC
59th Clinical Research Squadron, Lackland AFB USA

Elizabeth Bridges
ebridges@u.washington.edu

The aeromedical evacuation (AE) environment is characterized by the stresses of flight, including changes in barometric and partial pressure, humidity, temperature, gravitational forces, vibration and noise. In addition to equipment airworthiness testing, the interactive effects of the stresses of flight on the patient and AE equipment should be considered. This article addresses equipment challenges during long-distance, military critical care AE.

Mechanical ventilation and suctioning at altitude are complicated by decreased barometric pressure and hypoxia (Beninati and Jones 2002; Kashani and Farmer 2006). A standard, ground-based protocol, which was performed using the Impact Uni-Vent® Eagle 754 Transport Ventilator, was effective in preventing suctioning-induced hypoxemia at 6,000 to 10,000 feet (Schmelz et al. 2000); yet, a safety modification caused repeated, unexpected ventilator failures during suctioning at altitude. A suction pressure of 80 to 120 mm Hg is recommended for optimal suctioning. However, higher pressures, which were required to maintain the optimal suction flow rate at altitude, caused a ventilator-induced safety shutdown. In-flight providers must be aware that increasing altitude decreases flow rates, that 80 mm Hg suction pressure is inadequate at any altitude, and that suction pressures greater than 115-125 mm Hg in a closed-suction system may cause ventilator failure at higher altitudes (Bridges et al. 2000).

Liquid oxygen is used onboard the aircraft, but supplies may be rapidly exhausted (Alkins and Reynolds 2002). Oxygen generators offer a solution; however, producing 100% O_2 is challenging. Under a worst-case scenario (ARDS model at 10,000 feet) pre-oxygenation with 90% O_2 prevented suctioning-induced hypoxemia (Schmelz, personal communication); thus, a generator that produces a lesser O_2 concentration may be adequate.

SpO_2 monitoring is imperative during AE, as the P_AO_2 decreases and occult pulmonary compromise (e.g. pulmonary blast injury) may become manifest (Alkins and Reynolds 2002). The cold environment onboard military cargo aircraft (50°F - 59°F/10°C - 15°C) causes thermoregulatory vasoconstriction (Bridges 2003), which may interfere with pulse oximetry. In a study comparing peripheral oximetry to a forehead sensor (Nellcor®, MAX-FAST), healthy subjects were acclimated to 57°F - 62F° (14°C - 17°C) followed by two bouts of transient hypoxemia (SaO_2 to 70%) (Bebout et al. 2001). In 68% of the observations, the lag time for the peripheral sensors to detect the desaturation, compared to the forehead sensor, was 60 to 120 seconds. This lag is of concern in AE, where critically ill patients may have altitude-induced worsening in pulmonary status, along with compensatory and thermoregulatory vasoconstriction. Recognition of the effects of the stresses of flight on pulse oximetry and interpretation of discrepant vital signs (e.g. an acute increase in heart rate, suggesting hypoxemia, without an acute decrease in the SpO_2) is essential.

Invasive pressure monitoring systems are not affected by barometric pressure changes, due to the transducer design; however, the fluid-filled pressure line requires special preparation (Bridges et al. 2005a). Ground-based protocols for pressure line preparation do not effectively remove all microbubbles, and these microbubbles expand at altitude, causing an under-damped system. Modification of ground-based protocols to include use of < 50 mm Hg pressure during line priming, completely filling the drip chamber, and performance of a "rocket flush" (i.e. rapid bolus of 10 ml of saline through the system before attachment to the patient) to flush out the microbubbles significantly improves the dynamic response characteristics of the system at sea level and flying altitude.

Prevention of hypothermia in trauma victims is imperative. A common hospital-based intervention (i.e. forced-air warmer) is neither safe nor effective during AE. Under AE conditions, passive heat loss prevention (i.e. space blankets and wool blankets) do not prevent hypothermia in a hemorrhagic shock model (Bridges et al. 2005b; Schmelz and Bridges 2003). A combined approach, using passive methods and active heat transfer via an intravenous fluid warmer (Blizzard Blanket™ + Thermal Angel™), was effective in preventing hypothermia under AE conditions (10C/airflow = 0.3 m/sec) (Bridges et al. 2005b), and the passive Blizzard Blanket™ plus active warming from the ReadyHeat™ (a combined non-woven blanket, chemical heating element and a polybag) prevented hypothermia under more rigorous conditions, consistent with rotary wing transport (2C/airflow = 3.6 m/sec) (Schmelz, personal communication 2006).

Equipment used for long-distance critical care air transport must meet airworthiness standards. Ongoing research has identified equipment limitations, as well as recommendations to optimize its use during AE.

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Scott A. Dulchavsky MD, PhD

David S. Kwon MD

Henry Ford Health Systems, Department of Surgery, Detroit, USA

Douglas R. Hamilton MD, PhD

Ashot E. Sargsyan MD

Shannon Melton BSc

Wyle Laboratories, Houston, USA

Scott A. Dulchavsky
sdulcha1@hfhs.org

The development of solutions for medical care in the resource-scarce environment of space flight is an ongoing demand for the International Space Station (ISS), where the care providers are not medical professionals; further efforts in this direction are essential for exploration-class space missions. The science and practice of space medicine have progressed significantly in recent years, and many of these advances may enhance medical care delivery on Earth.

No significant mission-impacting or mission-terminating medical events have yet occurred on the ISS, and the probability of such events occurring in the future is low. The current plan for medical care on National Aeronautics and Space Administration (NASA) shuttles and the ISS relies on a non-physician Crew Medical Officer (CMO), who is trained for approximately 70 hours to serve as a medical technician for a variety of medical conditions. It is impossible to predict the exact nature of critical care and life support procedures which the CMO, with limited medical training, may be asked to perform aboard the ISS. Many of these procedures, however, may be challenging even for a trained physician.

In terrestrial settings, critical care is generally provided in intensive care units (ICU) by intensivists, critical care nurses, respiratory therapists and others. The use of telecommunications partially compensates for the absence of such expertise onboard the spacecraft. Experiments onboard the ISS and ground-based experiments with "CMO analogs" (non-medical professionals given training equivalent to that of the astronauts) have examined the feasibility of performing state-of-the-art diagnostic and treatment procedures using expert remote guidance. The procedures were designed to be compatible with current equipment and training constraints aboard the ISS.

The Advanced Diagnostic Ultrasound in Microgravity (ADUM) project, developed by NASA-selected researchers, has effectively trained and remotely guided non-physicians to perform diagnostic and therapeutic image-guided ultrasound procedures. Remote clinicians were able to effectively guide the CMO in a number of diagnostic and therapeutic procedures. Musculoskeletal injury, pneumothorax, hemothorax and ocular trauma, among others, can be readily visualized by non-physician crew members and communicated to the medical expert for diagnosis. In addition, remotely guided micro-laparoscopy with a 3-mm endoscope has been successfully completed in the microgravity conditions of parabolic aerial flight. Such exploration of the abdomen could be used to evaluate and treat abdominal pathology, including appendicitis, biliary disease, abdominal trauma, or gynecologic disease. Percutaneous cholecystostomy and suprapubic cystostomy were also successfully performed in these experiments, providing potential alternative treatment modalities for crewmembers with surgical conditions such as cholecystitis, urinary retention or urolithiasis, in lieu of acute evacuation from the ISS.

In addition to the validation of new microgravity sonographic imaging and therapeutic techniques, our group also evaluated new critical care life support and monitoring equipment. An advanced ventilator was evaluated in aerial microgravity trials to address scenarios in which crewmembers require intensive care, including physiologic monitoring, over a period of time. A compact, 12-pound, closed-loop mechanical ventilator was developed that allows remote clinicians to monitor and control all ventilator parameters while the data are stored in the integrated electronic medical record. The closed-loop control can also manage oxygen delivery from a digitally controlled compact concentrator or a 100% oxygen source.

A large body of unpublished data demonstrates the ability to perform cardiopulmonary resuscitation (CPR), intravenous access with infusion of fluids and medications, intravenous anesthetic techniques and central arterial, central venous and intracerebral pressure monitoring in microgravity conditions. In a consortium with NASA, a partner in industry is currently developing lightweight modules that provide a universal medical data station to accept a wide variety of data types, from sensor readings to video streams, and to control devices such as a ventilator, an oxygen source or an IV pump.

Established critical care approaches and innovative, minimally invasive diagnostic and treatment techniques, coupled with advanced training methodologies and remote expert guidance, significantly expand the potential critical medicine capabilities for use in future space flight programs. The application for elements of the above investigations in terrestrial medicine seems to be promising. In the case of planetary exploration, the latency of medical telemetry signals between the experts and the patient's site will increase, thus making the speed of light the only remaining limitation to critical care delivery in space.

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Antibiotic strategies for prevention of **nosocomial infections** in mechanically ventilated patients

Ventilator associated pneumonia (VAP) still remains a leading cause of morbidity and mortality from hospital-acquired infections. Antibiotic strategies for VAP prevention include antibiotic rotation and antibiotic mixing, preventive topical antibiotics in the respiratory tract, selective digestive decontamination (SDD) and preventive systemic antibiotic therapy. However, these strategies have limited utility in the critical care setting. It is, therefore, imperative to select the subgroup of patients that could benefit from antibiotic prevention. Rational antibiotic use is the most useful pharmacological strategy for prevention of nosocomial pneumonia in the ICU.

ICU Stakeholder

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

R. Ferrer

A. Navas

A. Artigas

Critical Care Center, Sabadell Hospital, Parc Tauli University Institute, Barcelona Autonomous University, Spain

Ricard Ferrer
rferrer@cspt.es

Introduction

Ventilator-associated pneumonia (VAP) is the specific type of nosocomial pneumonia (NP) that occurs after the first 48 hours of initiating mechanical ventilation (American Thoracic Society 1996). NP still remains a leading cause of death from hospital-acquired infections. Crude mortality rates range from 24% to 76% depending on the population and clinical setting studied (Fagon et al. 1989; Kollef 1993; Torres et al. 1990).

A variety of measures has been described for the prevention of NP (Dodek et al. 2004; Tablan et al. 2004; Torres & Carlet 2001). The non-antibiotic strategies for preventing NP have been reviewed before (Ferrer et al. 2005). The antibiotic strategies are the main topic of this review (see table 1).

Antibiotic rotation and antibiotic mixing

Previous antibiotic treatment is a risk factor for the presence of potentially drug-resistant bacteria, requiring a much more potent antimicrobial regimen than would normally be employed (Trouillet et al. 1998). It is therefore important to be rational in our choice and use of antibiotics, restricting excessive and inappropriate use. When antibiotics are needed, an adequate and inexpensive measure could be to change the antibiotic class used in the ICU according to an annual schedule, to avoid the development of local resistance. Data from a study, investigating this issue for suspected gram-negative bacterial infections in patients undergoing cardiac surgery, suggested that scheduled changes can reduce the incidence of VAP attributed to antibiotic-resistant gram-negative bacteria (Kollef et al. 1997). However, when more than one antibiotic is employed, mathematical modeling indicates that sequential use of different antibiotics is always inferior to treatment strategies in which, at any given time, equal fractions of the population receive different antibiotics – a type of antibiotic use called mixing (Bergstrom et al. 2004). A recent comparison showed that a strategy of monthly rotation of antibiotics performed better than a strategy of mixing in preventing the acquisition of resistant P. aeruginosa (Martinez et al. 2006).

Preventive topical antibiotics in the respiratory tract

Although early studies found that the application of prophylactic topical polymixin B or aminoglycosides to the lower respiratory tract reduced the incidence of nosocomial pneumonia in intubated patients, there was no overall reduction in mortality. Indeed, the microorganisms causing pneumonia were often resistant, and in many cases the pneumonia proved fatal (Feeley et al. 1975). Consequently, this method of prevention is not recommended today.

Selective digestive decontamination (SDD)

Bacterial oropharingeal and gastric colonisation is an important aetiopathogenic mechanism to develop VAP. The systematic use of topical antibiotics (usually polymyxin, tobramycin and amphotericin B) in the oropharynx and stomach, together with intravenous administration of cefotaxime, has been shown to reduce the incidence of nosocomial pneumonia(Abele-Horn et al. 1997; Cockerill et al. 1992; Vandenbroucke-Grauls & Vandenbroucke 1991), although not all studies have confirmed this finding (Ferrer et al. 1994; Hammond et al. 1992; Wiener et al. 1995).

The effect of SDD is difficult to assess, because the trials were performed in different types of patients, with different antibiotic agents and with non-specific clinical criteria for diagnosis of pneumonia. However, in a recent meta-analysis of 15 years of clinical research in antibiotic prophylaxis, D'Amico et al. concluded that a combination of systemic and topical antibiotics can reduce respiratory tract infections and overall mortality in critically ill patients. In this meta-analysis, the reduction in mortality was observed only when topical and systemic antibiotics were administered. The authors also concluded that the use of topical antibiotics alone would not have been justified by the available data. (D'Amico et al. 1998)

> "It is ... important to be rational in our choice and use of antibiotics"

When using SDD, a microbiologic control is necessary to detect the overgrowth of resistant organisms during the prophylaxis. The long-term risk for emergence of antibiotic-resistant bacteria when topical antibiotics are administered in the digestive tract or the trachea is unclear and is potentially harmful. This method of prevention is not universally accepted for prevention of nosocomial pneumonia, although it may be useful in selected populations, such as trauma patients, immunosupressed patients (i.e. transplant patients) or in some specific risk surgical patients (i.e. esophageal cancer patients) with a high incidence of nosocomial pneumonia.

Preventive systemic antibiotic therapy

Four decades ago, systemic antibiotics were used as a method of prophylaxis for nosocomial pneumonia. However, the results were discouraging (Pertersdorf et al. 1957): incidence and mortality did not differ between treated patients and the placebo group. In addition, the microorganisms involved in lung infection in the treated group were more resistant to the antibiotic resources available at that time. For these reasons, the use of systemic antibiotics as a method of VAP prevention was discontinued.

In an Italian multicentre study in 23 ICUs in 1989, Mandelli et al. analysed the utility of intravenously administrated antibiotics in the prevention of early-onset pneumonia in mechanically ventilated patients (Mandelli et al. 1989). The authors administered antibiotics during the first 24 hours of mechanical ventilation, and divided the patients into three groups: a control group, a group treated with cefoxitin, and a group treated with penicillin. The incidence of early-onset pneumonia was 6.1% in the groups with antibiotic prophylaxis, and 7.2% in the control group.

However, the administration of cefuroxime (two 1,500-mg doses, 12 hours apart after intubation) to patients with structural coma after head injury or stroke represents an effective prophylactic strategy (Sirvent et al. 1997). The incidence of microbiologically confirmed pneumonia could be reduced from 50% in the control group to 24% in the group of patients who received cefuroxime. No difference was found with regard to morbidity in the two study groups, but the authors reported a decrease in total hospital stay when patients with pneumonia were compared to those without.

Our personal view is that the administration of short–term, high doses of antibiotics is a useful preventive measure for early-onset aspiration pneumonia. We cannot extrapolate these results to late-onset pneumonia. Further investigations are necessary to determine the safety and the utility of this strategy in this type of patient.

Conclusion

Antibiotics have a limited utility for prevention of nosocomial pneumonia in the ICU. Rational antibiotic use seems the most useful pharmacological strategy for this goal.

ICU Stakeholder

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

Table 1: ANTIBIOTIC STRATEGIES FOR PREVENTION OF NOSOCOMIAL PULMONARY INFECTIONS IN MECHANICALLY VENTILATED PATIENTS

1. Antibiotic rotation and antibiotic mixing
2. Preventive topical antibiotics in the respiratory tract
3. Selective digestive decontamination (SDD)
4. Preventive systemic antibiotic therapy

A multidisciplinary approach in the development of a **hospital-based sepsis protocol**

At Caritas St Elizabeth's Medical Center, a multidisciplinary care group successfully devised and implemented a Sepsis Protocol for the hospital. Medical, pharmacy and nursing health professionals were involved in all facets of the process, from construction of the protocol to implementation and education of medical, nursing and other health professionals.

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

Introduction

Fourteen months ago, we instituted a sepsis protocol at our hospital, Caritas St Elizabeth's Medical Center (CSEMC), based on the emergency department (ED) centric model. For the initial period, the protocol has been operating successfully, and our mission now is to expand awareness of sepsis and its treatment hospital-wide, as well as to continue to evaluate/improve the existing sepsis program.

Development of the Protocol

In January 2005, members of the Intensive Care Unit (ICU) Executive Committee at CSEMC set forth the proposal to implement a sepsis protocol targeting septic patients in the ED. The committee, comprised of medical, nursing and pharmacy practitioners in intensive care and emergency medicine, introduced this concept based on favorable outcomes from recent studies and on recently published guidelines. There is a full compliment of healthcare professionals on the committee; thus, it provides an ideal forum to address such a task, especially regarding the delegation of various duties crucial to a successful implementation. For example, since we did not have the resources to create a formal sepsis team, the protocol had to operate within the existing framework of emergency and critical care personnel, who would be assigned extra responsibilities in taking care of these patients. One potential obstacle was deciding who was responsible for the early insertion of central lines in septic patients presenting in the ED. This and other issues were relatively easily solved, because all personnel affected by the protocol had representation on the committee and were motivated to realizing its success.

A Sepsis Subcommittee was formed, with multidisciplinary input and chaired by the ICU pharmacist. The subcommittee constructed a draft protocol, negotiated the procurement of PreSep® catheters and an in-house lactate assay and set up an education schedule for house staff. The pharmacist and nursing educator undertook the majority of the educational duties, with input from the medical ICU director. Educational endeavors were targeted at ICU and ED nursing staff, medical house staff and pharmacists, with the goal of achieving competency in recognizing and managing sepsis patients urgently and, in the case of ED nursing staff, achieving skills in central venous pressure and oximetry monitoring. This intensive instructional phase lasted six months before the new sepsis protocol was implemented; however, educational activities are ongoing, as we continue to expand and improve the protocol.

We saw some significant improvements within three months of launching the protocol. Administration of antibiotics, insertion of central lines, lactate sampling and initiation of an aggressive fluid resuscitation plan were all accomplished within the median goal time of six hours. There was also good compliance for median 24 hour goals, including glycaemic control, as well as consideration of steroids and activated protein C (Xigris®). The ICU pharmacist collected data for the first six months and reviewed these with the Sepsis Subcommittee on a regular basis. This prompted some changes in the protocol, most notably the option was given to insert a central venous line with a one-time blood sample for central venous O_2 saturation ($SCVO_2$), rather than using the PreSep® catheter, which monitors $SCVO_2$ continuously. Subsequently it was determined that the majority of physicians opted to insert the regular central line, possibly because they found the PreSep® catheter more cumbersome. A second recommendation was to procure the FloTrac® sensor, which permits continuous cardiac output monitoring in more complicated cases. This sensor has been used frequently since its introduction, especially in patients with shock of mixed origin and in those with persistent pressor-dependent hypotension. Overall, from previous observation and from our database of almost 60 protocol patients, it is evident that reversal of septic shock has been more rapid and more successful since the introduction of the sepsis protocol.

Conclusions

The introduction of a systematic, organized plan to recognize and treat sepsis using a multidisciplinary approach has led to greater success in reversing the initial shock episode in septic shock patients admitted to the ICU from the ED.

M.Claire McManus
Pharm.D.
Pharmacy Department,
Caritas St. Elizabeth's
Medical Center,
Boston, USA

clairemcmanus@mac.com

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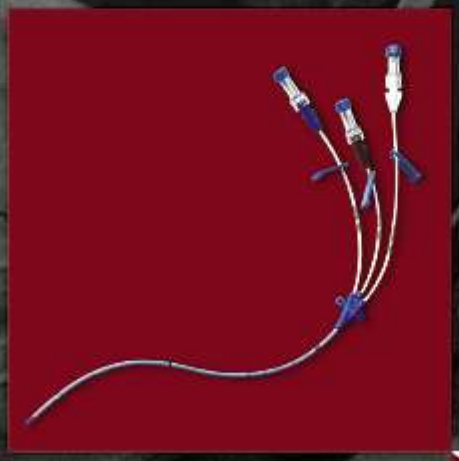

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Pain management in the ICU

This article reviews the need to improve pain management for ICU patients. Regular evaluation of pain using scales adapted to the patients level of consciousness is the primary step towards such improvement.

ICU Stakeholder
- Anaesthesiology
- Cardiology
- Pharmacy
- Internal medicine
- Microbiology
- Nephrology
- Respiratory
- ...

Patients admitted to the intensive care unit (ICU) are likely to experience pain during their stay. The Study to Understand Prognoses and Preferences for Outcomes and Risks of Treatment (SUPPORT) reported pain in 50% of seriously ill patients and severe pain in 15% of them (Desbiens et al. 1996). These patients experience pain and anxiety related to a number of factors, including underlying diseases, invasive procedures, therapeutic devices, immobility and even routine nursing care, such as mobilisation, airway suctioning and physical therapy. Moreover, patients in the ICU may be at particular risk for poor pain management, since little is known about pain assessment and control in these patients.

Appropriate alleviation of pain begins with the use of effective strategies for recognizing, evaluating and monitoring pain. Improvement in pain documentation indeed leads to improvements in pain management. The Joint Commission for the Accreditation of Healthcare Organisations (JCAHO) has developed standards on pain assessment and management (www.jcaho.org). Guidelines from the Society of Critical Care Medicine (SCCM) recommend pain assessment followed by therapeutic response, using a scale appropriate to the patient population and regular pain documentation (Jacobi et al. 2002). However, documenting pain is difficult in the ICU, because most patients cannot express their pain, and the validity of a sedated patient's elicited response about pain is questionable.

Viviane CHALHOUB*
MD, Resident
Department of Anaesthesia and Intensive Care, Hôpital de l'Hôtel-Dieu, Beirut, Lebanon

Dan BENHAMOU
MD, Professor and Chairman
Department of Anaesthesia and Intensive Care, Hôpital de Bicêtre, Cedex, France

Accurate assessment of pain in critically ill patients is a challenging but essential component of quality of care. To date, few studies have analysed pain assessment in critical care units. Pain assessment studies in critical care settings may be difficult to conduct, because pain assessments are often inadequately documented. Inadequate documentation may be caused by a failure to understand the importance of using a standard measure to document patients' pain, a lack of consistently available tools, such as cards to measure pain scores, and practitioners' failure to report pain scores.

The most accurate and valid indicator of pain is the patient's self-report (Acute Pain Management Guideline Panel 1992). Assessment of pain intensity may be performed with multidimensional or unidimensional tools. Multidimensional tools, such as the McGill Pain Questionnaire (MPQ) and the Wisconsin Brief Pain Questionnaire (BPQ), measure pain intensity and sensory, affective and behavioural components of that pain. These tools have not been evaluated in the ICU and may not be practical for ICU patients. Unidimensional tools, such visual analogue scale (VAS), verbal rating scale (VRS) and numeric rating scale (NRS), may be useful when the patient is able to communicate. VAS is reliable, valid and used frequently in the ICU, but has not been specifically tested in the ICU environment (Ho et al. 1996). VAS also has limits, particularly in elderly patients or those with cognitive dysfunction (Puntillo 1994). NRS is valid in acute care settings, correlates with VAS and is applicable in many age groups. Because the most reliable indicator of pain intensity is the patient's self-report, the SCCM recommends the use of NRS to assess pain in critically ill patients (Jacobi et al. 2002).

Often in the ICU, however, patients are unable to communicate clearly about their pain. When patients cannot communicate and are thus unable to self-report pain intensity, assessments must be based upon observation of pain indicators. It is important to note that changes in physiologic variables in response to a nociceptive action are non-specific and may be affected by medications. The Behavioural Pain Scale (BPS) has recently been validated as a tool for pain assessment in sedated and mechanically ventilated patients and has been found easy to use (Payen et al. 2001).
It should be noted that pain and agitation may be linked but generally have different causes. Pain and agitation, therefore, require different methods of assessment. Although agitation can be caused by pain, it is more often associated with factors such as extreme anxiety, delirium or adverse drug effects. The Riker Sedation-Agitation Scale (SAS) is a reliable tool for scoring the level of consciousness and agitation in critically ill adults, using a seven-item list describing patient behaviours (Riker et al. 1999). The Riker SAS is extremely useful for evaluating the patient's level of consciousness and guiding sedation, but should not be used to evaluate the pain level or to guide analgesia in sedated patients.

The use of a detailed, standardised pain assessment and intervention algorithm that incorporates behavioural and physiological indicators may assist healthcare

professionals in providing adequate pain therapy. There are very few research papers dedicated to pain therapy in ICU patients. In deeply sedated patients, high doses of opioids usually form the basis for pain treatment, while in less sedated or awake patients, a multimodal approach, similar to what is used in postoperative patients, can be proposed. In most ICU patients however, non-steroidal, anti-inflammatory drugs cannot be used, due to the risk of aggravation in patients with haemodynamic instability, renal dysfunction or uncontrolled infection. Regional anaesthesia (epidural analgesia or peripheral nerve blocks) can be used in selected cases, as discussed in a previous issue of this journal (Casati et al. 2005). Dosages of other systemically administered analgesics should be adapted individually according to the nature and severity of organ failures (Murphy 2005). Paracetamol half-life is prolonged only in patients with extreme renal dysfunction, while nefopam dosing intervals should be increased in patients with moderate renal dysfunction. Opioid scheduling should be adapted to the underlying degree of respiratory distress, while morphine itself should not be used as the first choice agent in patients with renal dysfunction (Mercadante and Arcuri 2004).

> **"Pain management is an essential component of quality care delivery for the critically ill patient."**

In conclusion, pain management is an essential component of quality care delivery for the critically ill patient. High quality pain management and palliative therapy should be a goal for every patient. Improvement in pain management requires improvement in pain assessment, and it is difficult to evaluate and improve performance without using a standard metric for pain. In order to optimise pain management in a critical care setting, ICU staff need to conduct repeated, standard pain score measures that are appropriate for critically ill patients. Based on these measures, ICU staff should follow appropriate analgesic protocols for all patients.

Airway management and cardiopulmonary arrest in obstetric patients

Airway management in obstetric patients carries significant risk of complications.

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

Introduction

The potential need to manipulate the airway is perhaps the leading cause of concern in pregnant patients (Chadwick et al. 1991). Anatomic and physiologic changes, including upper airway mucosal edema, aspiration, preeclampsia, weight gain and morbid obesity, breast enlargement and changes in the respiratory, cardiovascular and gastrointestinal systems, place parturient patients at greater risk for airway-related complications. Failed tracheal intubation is well documented in the obstetric population, with an incidence of 1 in 280–300 in parturient patients, versus 1 in 2,330 in general patients (Munnur and Suresh 2004).

Morbidity and mortality

According to Chadwick et al., complications leading to death in obstetric patients because of airway management problems include aspiration of gastric contents, problems with intubation, esophageal intubation, inadequate ventilation and respiratory failure (Chadwick et al. 1991). Three mechanisms accounted for nearly three-quarters of the cases that were judged to be substandard in claims for adverse respiratory events: inadequate ventilation (38%), esophageal intubations (17%) and difficult intubation (18%) (Caplan et al. 1990). Proper and timely communication between obstetricians and anaesthesiologists can contribute significantly to reducing maternal morbidity and mortality rates.

Predicting a difficult airway

Basic knowledge of the practice guidelines and the American Society of Anesthesiologists Difficult Airway Algorithm can minimise airway-related maternal catastrophes. Failure to assess the airway was found to be responsible for death in 10% of the cases in one of the Confidential Enquiries into Preoperative Deaths in 1997 (Her Majesty's Stationery Office 2001). Munnur and Suresh showed that a simple physical examination of the airway may be used to identify indicators of a difficult intubation, such as long upper incisors or a short, thick neck (Munnur and Suresh 2004). Obstetricians' knowledge of difficult airway predictors facilitates the management of difficult airway and reduces the likelihood of adverse outcomes.

The role of obstetricians and gynaecologists

The American College of Obstetricians and Gynecologists (ACOG) recommends that the obstetric watch for factors that place parturient patients at risk for complications from emergency general or regional anaesthesia (ACOG 1992). The obstetric team could be of tremendous help in an emergency situation by alerting anaesthesiologists to airway-related problems. In their assessment of obstetricians' skill in identifying parturient patients with difficult airways, Gaiser et al. found that the attending obstetricians could request prophylactic implementation of early epidural analgesia in patients who were judged to be difficult to intubate (Gaiser et al. 1999).

Cardiopulmonary arrest

Cardiopulmonary arrest in a pregnant patient could be a crisis for everyone involved, and early involvement of an obstetrician is crucial. New resuscitation guidelines will probably require all healthcare workers (including obstetricians and midwives) to attend appropriate training every year (Clarke and Butt 2005). Obstetricians, anaesthesiologists, neonatologists and nursing staff must work efficiently, using a coordinated team approach to resuscitate these patients. Failed intubation in obstetric patients should seriously be addressed, particularly in light of the recent report of the Confidential Enquiries into Maternal Death in the United Kingdom. Multidisciplinary training and fire drills may help medical staff respond to these situations (Scrutton 2005).

Cannot ventilate, cannot intubate scenario (CVCI)

Gas exchange is a primary concern, and it should be restored as quickly as possible when mask ventilation is not possible and the patient cannot be intubated. In 2003, the practice guidelines for the management of difficult airways were updated. Under these new guidelines, laryngeal mask airway (LMA) is the tool of choice in a CVCI situation. When placing the LMA, cricoid pressure needs to be released transiently. If the LMA fails, other devices, such as Combitube, transtracheal jet ventilation or surgical airway, are the procedure of choice. Since the LMA was introduced, it has gained tremendous popularity as an airway device. Because the LMA is readily available, widely known and highly successful among new and experienced users alike, it should be used as a routine airway technique (American Society of Anesthesiologists 2003).

Summary

Difficult intubation is a common occurrence in obstetric patients. It is imperative that appropriate equipment is immediately at hand in patient areas. Skilled obstetricians' assistance is also a necessity. Therefore, obstetricians should strive to learn the airway management skills that may, one day, save their patients' lives.

Mariam A. Al-Ansari
MD, FRCSI

Consultant Intensivist

Salmaniya Medical Complex
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dr_mariam5@hotmail.com.

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Introduction

This product comparison covers stand-alone and modular multiple medical gas monitors (MMGMs) that can determine concentrations of aesthetic and respiratory gases (oxygen [O_2], nitrous oxide [N_2O], carbon dioxide [CO_2] and halogenated agents) in the patient breathing circuit during anaesthesia. MMGMs continuously sample and measure inspired and expired (end-tidal) concentrations of respiratory and aesthetic gases during and immediately following aesthetic administration. An overdose of aesthetic agent and/or too little O_2 can lead to brain damage and death, while an underdose of agent will result in insufficient anaesthesia.

Some deaths related to anaesthesia use might be preventable with adequate respired and aesthetic gas monitoring in the operating room (OR). During general anaesthesia, the patient's physiologic status must be continuously assessed and trends and sudden changes quickly identified. Gas monitoring provides the anaesthetist with information about the patient's physiologic status, verifies that the appropriate levels of delivered gases are administered, and warns of equipment failures or abnormalities in the gas delivery system. MMGMs display inspired/expired gas concentrations and sound alarms to alert clinical personnel when the concentrations of measured gases and the physiologic parameters fall outside set limits. In most units, the gases are automatically identified and quantified, although some MMGMs require that the user select the halogenated agent being used or that the monitor be equipped with a special option to identify the halogenated agent.

Reported problems

The accumulation of water-vapour condensation or other materials in the sampling chamber can interfere with the accuracy of MMGMs. Some monitors circumvent this problem by trapping condensate before it reaches the chamber, while others use special tubing (Nafion) and hydrophobic filters to prevent water vapour from affecting monitor performance; however, some manufacturers still recommend periodically cleaning the chamber, particularly to prevent the accumulation of secretions or other foreign matter.

The presence of nitrogen (N_2) in the inspired gases indicates that air is being aspirated into the breathing circuit, thereby diluting the delivered gas concentration. Although most MMGMs do not monitor N_2 concentration, such leaks can often be identified from changing O_2 and CO_2 trends.

For MMGMs that cannot identify halogenated agents, the user must set the agent selection control according to the halogenated aesthetic being used. Clinical personnel must be relied on to fill the vaporizers with the proper agent (a keyed filling system will help avoid errors) and to connect the breathing circuit correctly to preclude accidental use of the wrong or multiple anaesthetics.

The presence of alcohol or other organic vapour in the room, in a sample line, or in a patient's breath can cause inaccurate concentration readings on monitors that cannot distinguish these compounds from aesthetic agents. MMGMs that both identify and quantify halogenated agents can eliminate interference from these compounds because these monitors measure concentrations of halogenated agents at a wavelength where organic vapours do not have a peak in the infrared absorption spectrum.

Purchase considerations

ECRI recommendations

The MMGM should continuously sample and measure inspired and expired concentrations of respiratory and aesthetic gases during and immediately following aesthetic administration. The device may also include monitoring of other variables such as oxygen saturation (SpO_2), airway pressure, and volume monitoring.

The MMGM should display inspired and expired gas concentrations of CO_2 and halogenated agent, inspired (or mean) concentrations of O_2 and N_2O, and respiration rate. Monitors should accurately measure gas concentration over the range that is encountered clinically and should compensate for the interference effects between gas constituents. The range that a monitor should be able to measure and the accuracy that it should achieve for each of the analyzed gases should be as follows:

- 0-6% halothane with an accuracy of 0.25 volume %.
- 0-6% enflurane with an accuracy of 0.25 volume %.
- 0-6% isoflurane with an accuracy of 0.25 volume %.
- 0-10% sevoflurane with an accuracy of 0.25 volume %.
- 0-20% desflurane with an accuracy of 0.25 volume %.
- 0-80% nitrous oxide with an accuracy of 10% of reading or 5volume %, whichever is greater.
- 0-10% carbon dioxide with an accuracy of 10% of reading or 0.4 volume %, whichever is greater.
- 0-100% oxygen with an accuracy of 5% of reading or 2 volume%, whichever is greater.

Interference with measurements caused by the presence of water vapour, aspirated fluid, or pressure in the breathing circuit should be eliminated or automatically compensated for by the MMGM.

The MMGM should remain zeroed and calibrated for at least six months. Measurements should remain accurate over commonly used ventilation rates (i.e., 25 b/min for adults and up to 60 b/min if the monitor is intended for neonatal or paediatric applications.) The rise time for O_2 measurements should be less than 20 seconds.

Alarm limits should be easy to review and set. The anaesthetist should be able to view all alarm limits and gas concentration displays simultaneously while reviewing and setting alarm limits. Alarms should be available for all parameters that the MMGM monitors. The unit should alarm to indicate an occluded sampling line or a system failure. For safe, effective monitoring, units should meet several minimum critical alarm criteria:

- The apnea alarm (associated with CO_2 monitoring) and the low O_2 alarm limit are critical in all situations and should be impossible to disable.
- The low haemoglobin SpO_2 alarm limit (associated with pulse oximetry) is also critical; however, this alarm limit may be turned off, provided a visual indicator warns of this condition.
- For both low O_2 and low SpO_2, it should not be possible to lower alarm limits to values that are not clinically useful (minimum settings of 18% and 50%, respectively).
- Monitors should allow flexibility in setting alarm limits and help minimize the use of inappropriate settings, and the alarm limits should be easy to review on a single screen.

If the displayed CO_2 concentration is changed between mm Hg and percent CO_2, the actual alarm-limit setting should not be altered, and preferably, the alarm limit will be converted into the new units. It should not be possible to indefinitely silence the apnoea alarm
.
Agent monitoring should activate automatically when the unit is turned on. It is acceptable, however, for the unit to require that agent be selected before monitoring begins, provided that the unit warns the user when agent is detected but has not been selected. MMGMs equipped with pulse oximetry should have a probe failure/disconnect alarm and audible alarms for low and high SpO_2 and low and high pulse rate. The monitor should indicate when SpO_2 and pulse rate readings are likely to be inaccurate due to a weak pulse.

The MMGM should display the CO_2 waveform. It is preferable that the unit allow the user to select at least two additional graphical displays (e.g., waveforms and trends).

Exhaust gas from the MMGM must be returned to the patient's breathing circuit or scavenged. Performance should not be affected by attachment to a scavenger. When gas is to be scavenged, an easy-to-access port to which the sampling tube cannot be connected should be provided with the monitor. Manufacturers should provide tubing (of a smaller diameter than the breathing circuit) with the appropriate fittings to connect the exhaust port to the expiratory breathing circuit (22 mm tee) or a scavenger (19 mm tee).

Other considerations

MMGMs are produced as either a configured unit or a modular part of a physiologic monitoring system. A facility should consider the status of its present physiologic monitoring system before purchasing an MMGM. A modular MMGM may allow all information and alarms to be integrated into one display. MMGMs can also be integrated into anaesthesia delivery units.

The variety of MMGM configurations available permits a facility to add modules to expand the capabilities of its monitoring equipment. For example, if a hospital has pulse oximeters, it can purchase units without the pulse oximeter option. If a facility is planning to replace its current aesthetic delivery equipment, it may want to consider an anaesthesia system with optional modules for combined CO_2, N_2O and agent monitoring and/or for pulse oximetry.

To achieve the degree of accuracy and performance reliability necessary for aesthetic monitoring, MMGMs require careful maintenance by qualified biomedical engineering personnel. Users may want to check the availability of service and the repair turnaround time before selecting multigas monitors for their facilities.

Cost containment

Whitcher et al. reviewed studies of related-related incidents and determined the cost- benefit ratio of OR monitors used to detect specific problems (Whitcher et al. 1988). The authors concluded that the savings in malpractice insurance alone would cover the cost of equipping each OR with monitors that measure each variable recommended by the American Society of Anesthesiologists.

Multiple medical gas 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 multiple medical gas monitors, designed for use in critical care from its Healthcare Product Comparison System (HPCS), which contains over 280 reports. The HPCS reports contain extensive information about the technology, its purpose, its principles of operation, stage of development 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 2004 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.

ECRI Europe
Weltech Centre Ridgeway
Welwyn Garden City
Herts AL7 2AA,
United Kingdom

Tel. +44 (0)1707 871511
Fax. +44 (0)1707 393138

info@ecri.org.uk
www.ecri.org.uk

Footnotes used in pages 29 and 30

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

2 As required by clinician.

3 Part of the INFINITY Patient Monitoring System.

4 Microfuel fast chemical O2 cell for oxygen.

5 15.1-20 ±1 for desflurane only.

6 With Passport 2.

7 Also nurse call and Ethernet (with Passport 2 and Spectrum patient monitors).

8 Includes water trap and 2.6 m of sample tube.

Healthcare Product Comparison System

	ECRI RECOMMENDED SPECIFICATIONS[1]	GE Healthcare	GE Healthcare	GE Healthcare
MODEL	**BASIC MULTIGAS MONITOR**	**CAPNOMAC ULTIMA**	**CARDIOCAP 5**	**S/5 AM ANESTHESIA MONITOR**
WHERE MARKETED		Worldwide	Worldwide	Worldwide
FDA CLEARANCE		Yes	Yes	Yes
CE MARK (MDD)		Not specified	Yes	Not Specified
MODULAR/CONFIGURED	Any	Configured	Configured	Modular
OPERATING PRINCIPLES	NDIR, paramagnetic cell/ sensor	NDIR, paramagnetic sensor	NDIR, paramagnetic sensor	NDIR, paramagnetic sensor
SAMPLING FLOW, mL/min	>=50	200	200	200
AUTOMATIC ANESTHETIC AGENT ID	Preferred	Yes	Yes	Yes
GAS CONCENTRATION RANGE, volume %				
Halothane	0-6	0-5	0-6	0-6
Enflurane	0-6	0-5	0-6	0-6
Isoflurane	0-6	0-5	0-6	0-6
Desflurane	0-20	0-18	0-20	0-20
Sevoflurane	0-10	0-8	0-8	0-8
N_2O	0-80	0-100	0-100	0-100
CO_2	0-10	0-10 (or 76 mm Hg)	0-15 (or 113 mm Hg)	0-15 (or 113 mm Hg)
O_2	0-100	0-100	0-100	0-100
RISE TIME, msec				
Agent		< 530	< 400	< 400
N_2O		< 500	< 450	< 450
CO_2		< 360	< 400	< 400
O_2		< 470	< 400	< 400
ACCURACY				
Agent, volume %	0.25	0.2	0.2	0.2
N_2O, volume %	5	2	3	3
CO_2, mm Hg	0.4	1.5	0.3	0.3
O_2, volume %	2	2	2	2
CALIBRATION	<2/year	Standard sample	Standard sample	Standard sample
WATER TRAP VOL, mL	>8	10	10	10
OPERATING TEMPERATURE °C (°F)		10-35 (50-95)	10-40 (50-104)	10-35 (50-95)
DISPLAY TYPE	No preference	CRT	Color LCD	Color CRT
ALARM LIMITS HIGH/ LOW, %				
Agent	User Selectable[2]	0.1-5.1, off	Adjustable	Adjustable
N_2O	User Selectable[2]	82/off	High fixed @ 82	High fixed @ 82
$ETCO_2$	User Selectable[2]	0.1-13, off	0-15	0-15
Inspired CO_2	User Selectable[2]	1, 2, 3, off	1, 2, 3, off	1, 2, 3, off
O_2	18-100	19-99/18-99, off	18-100	18-100
ADDITIONAL ALARMS	Apnea, SpO_2, pulse[2]	Apnea, occlusion	Apnea, occlusion, respiratory rate	Apnea, occlusion, respiratory rate
ALARM SILENCE	Temporary	Yes	Yes	Yes
AUXILIARY OUTPUTS	Analog, RS232	Analog, RS232, parallel trend	Analog, serial	Analog, serial
LINE POWER, VAC	Standard	115	100-240	100/120, 220/240
Watts		60	80	Not specified
H x W x D, cm (in)		21.6 x 33.2 x 34.3 (8.5 x 13 x 13.5)	30.1 x 33.2 x 22.2 (11.8 x 13 x 8.7)	Not specified
WEIGHT, kg (lb)		11.8 (26)	11.2 (24.8)	26.3 (58)
PURCHASE INFORMATION				
List price		$10,500	$14,200 (includes hemodynamics)	$34,000 (includes hemodynamics)
Warranty		1 year	1 year	1 year
OTHER SPECIFICATIONS		3 configurations available; hydrophobic filter; automatic agent ID; fast oxygen and nitrous oxide and balance gas; optional SpO_2 and sidestream spirometry.	Fully integrated modular monitoring system; automatic identification for 5 agents; 6 waveforms; color, configured monitor; optional sidestream spirometry and neuromuscular transmission monitoring.	Fully integrated modular monitoring system; automatic identification for 5 agents; gas modules available for S/5 anesthesia and compact monitors; fast oxygen and nitrous oxide and balance gas; optional sidestream spirometry and parameter modules for ENTROPY, NMT, and EEG.

Healthcare Product Comparison System

	ECRI RECOMMENDED SPECIFICATIONS[1]	Dräger medical	Dräger medical	SPACELABS	
MODEL	**BASIC MULTIGAS MONITOR**	**SCIO GAS MODULE[3]**	**VAMOS**	**90518 ULTRAVIEW MULTIGAS ANALYZER**	
WHERE MARKETED		Worldwide	Worldwide	Worldwide	
FDA CLEARANCE		Submitted	Yes	Yes	
CE MARK (MDD)		Yes	Yes	Yes	
MODULAR/CONFIGURED	Any	Modular or configured	Configured with options	Modular	
OPERATING PRINCIPLES	NDIR, paramagnetic cell/ sensor	Solid-state infrared	NDIR	NDIR (CO_2, N_2O, anesthetic agents)[4]	
SAMPLING FLOW, mL/min	>=50	200	150	50-200 (user selectable)	
AUTOMATIC ANESTHETIC AGENT ID	Preferred	Yes	No	Automatic/manual	
GAS CONCENTRATION RANGE, volume %					
Halothane	0-6	0-8.5	0-8.5	0-10	
Enflurane	0-6	0-10	0-10	0-10	
Isoflurane	0-6	0-8.5	0-8.5	0-10	
Desflurane	0-20	0-20	0-22	0-20	
Sevoflurane	0-10	0-10	0-10	0-10	
N_2O	0-80	0-100	0-99	0-80	
CO_2	0-10	0-10	0-10	0-10 (0-80 mm Hg)	
O_2	0-100	5-100	NA	5-100	
RISE TIME, msec					
Agent		< 500 @ 200 mL/min	< 500	< 400	
N_2O		< 500 @ 200 mL/min	< 500	< 500	
CO_2		< 350 @ 200 mL/min	< 500	< 400	
O_2		< 600 @ 200 mL/min	< 500	< 300	
ACCURACY					
Agent, volume %	0.25	0.15 + 15% rel	0.15	0-5 ± 0.2, 5.1-10 ± 0.3, 10.1-15 ± 0.5[5]	
N_2O, volume %	5	2 + 8% rel	2	0-40 ± 4	
CO_2, mm Hg	0.4	0.5 +15% rel	0.5	0-40 ± 2	
O_2, volume %	2	3	NA	2	
CALIBRATION	<2/year	Standard gas sample	Automatic	External gas mixture	
WATER TRAP VOL, mL	>8	250 (reusable)	13	12	
OPERATING TEMPERATURE °C (°F)		10-40 (50-104)	10-45 (50-113)	10-40 (50-104)	
DISPLAY TYPE	No preference	Color TFT w/INFINITY Modular Monitoring Series	Electroluminescent	CRT, LCD, or electroluminescent with touchscreen	
ALARM LIMITS HIGH/ LOW, %					
Agent	User Selectable[2]	0-8.5 (iso, hal), 0-20 (des), 0-10 (enf, sev)	0.1-7; 0.1-9.9 (sev), 0.121.9 (des)	0.1-20/0-19.9	
N_2O	User Selectable[2]	None	None	5-80/0-75	
$ETCO_2$	User Selectable[2]	4-95 mm Hg	1-75 mm Hg	0.1-10/0-9.9 (1-80/0-79 mm Hg)	
Inspired CO_2	User Selectable[2]	2-10 mm Hg	1-10 mm Hg	0.1-9.9(1-80 mm Hg)	
O_2	18-100	10-100	NA	20-100/18-95 insp, 20-100/15-95 exp	
ADDITIONAL ALARMS	Apnea, SpO_2, pulse[2]	Via INFINITY Modular Monitoring Series	Apnea, SpO_2, PR	Respiration rate (high/low), apnea, water trap full/missing, filter door open, occlusion	
ALARM SILENCE	Temporary	Yes	Yes	Yes	
AUXILIARY OUTPUTS	Analog, RS232	RS232 (physiologic monitoring system)	RS232	None	
LINE POWER, VAC	Standard	100/240, 0.8/0.4 A	100-240	100-240	
Watts		Not specified	<20	External power supply	
H x W x D, cm (in)		11.5 x 19 x 27 (4.5 x 7.5 x 10.6)*	16.6 x 24 x 16.6 (6.5 x 9.5 x 6.5)	26 x 15.2 x 32 (10.2 x 6 x 12.5)	
WEIGHT, kg (lb)		3 (6.6)	1.9 (4.2)	7.4 (16.3)	
PURCHASE INFORMATION					
List price		$11,450	$7,355	Not specified	
Warranty		1 year	1 year	1 year	
OTHER SPECIFICATIONS		None specified.	Optional pulse oximetry battery backup.	Automatic pressure and temperature compensation; menudriven touchscreen operation (via monitor) for ease of use; easy-access filter system; standby mode allows analyzer to remain warm between cases. Meets requirements of CSA and ETL.	

*with water trap

ECRI RECOMMENDED SPECIFICATIONS[1]	MEDRAD	DATASCOPE	PHILIPS	PHILIPS
BASIC MULTIGAS MONITOR	**MEDRAD 9500 MR MONITOR**	**GAS MODULE SE**	**INTELLIVUE G1 - ANESTHETIC GAS MODULE (M1013A)**	**INTELLIVUE G5 - ANESTHETIC GAS MODULE (M1019A)**
	Worldwide	Worldwide	Worldwide	Worldwide
	Yes	Yes	Yes	Yes
	Yes	Yes	Yes	Yes
Any	Both	Modular	Modular	Modular
NDIR, paramagnetic cell/ sensor	NDIR, piezoelectric	NDIR, paramagnetic sensor	IR technology (CO_2, N_2O, agents), paramagnetic (O_2)	IR technology (CO_2, N_2O, agents), paramagnetic (O_2)
>=50	140	180 ± 20 under normal conditions	200	200
Preferred	No	Yes	Manual, single agents	Auto, mixed agents
0-6	0-20	0-5.8	0-8.5	0-8.5
0-6	0-20	0-5.8	0-10	0-10
0-6	0-20	0-5.8	0-8.5	0-8.5
0-20	0-20	0-20	0-20	0-20
0-10	0-20	0-7.8	0-10	0-10
0-80	0-100	0-100	0-100	0-100
0-10	0-100 mm Hg	0-111 mm Hg	0-10	0-10
0-100	0-100	0-100	5-100	5-100
	425	< 400	< 500[8]	< 500[8]
	425	< 450	< 500[8]	< 500[8]
	<300 @ 200 mL/min	< 400	< 350[8]	< 350[8]
	425	< 400	< 500[8]	< 500[8]
0.25	0.2	0.15 ±5 % of reading	±0.15% vol +15% rel	±0.15% vol +15% rel
5	5	2 + 2% of reading	±2.0% vol +8% rel	±2.0% vol +8% rel
0.4	2 (0-50)	0.2 + 2% of reading	±0.5% vol +12% rel	±0.5% vol +12% rel
2	2	1 + 2% of reading	±3.0% vol	±3.0% vol
<2/year	Factory	Standard sample, automatic	Not required	Not required
>8	<12	10	>20	>20
	10-30 (50-90)	10-40 (50-104)	10-40 (50-104)	10-40 (50-104)
No preference	Electroluminescent	Active-matrix color LCD	Any IntelliVue Display (color, touch/non-touch, various sizes) or user's choice of XGA/SXGA	Any IntelliVue Display (color, touch/non-touch, various sizes) or user's choice of XGA/SXGA
User Selectable[2]	0.1-20, off/ 0-19.9, off	Off/2-10/0.5-5 iso, enf, hal, sevo; off/2-20/0.5-10, des[6]	See footnote 2	See footnote 2
User Selectable[2]	1-80/0-79, off	Off/10-80; off/5-70[6]	0-660 (high)	0-660 (high)
User Selectable[2]	1-99, off/0-98, off	Off/20-80; off/5-50[6]	20-76 mm Hg (high), 10-75 mm Hg (low)	20-76 mm Hg (high), 10-75 mm Hg (low)
User Selectable[2]	1-99 mm Hg, off	Off/5-30 mm Hg[6]	2-20 mm Hg (high), n/a	2-20 mm Hg (high), n/a
18-100	1-100, off/18-99	Off/40-100/18-60[6]	100-800 mm Hg (high), 90-790 mm Hg (low)	100-800 mm Hg (high), 90-790 mm Hg (low)
Apnea, SpO_2, pulse[2]	Apnea (3-30 sec), pulse (high/low: 5-250, off/0-245, off)	Apnea, variety of patient alarms including arrhythmia when paired with patient monitors	Apnea, AWRR, various technical alerts	Apnea, AWRR, various technical alerts
Temporary	Yes	Yes	Yes	Yes
Analog, RS232	Remote display with RS232 data output	Remote display (Passport 2 only), serial port, analog[7]	RS232, analog	RS232, analog
Standard	100, 115, 230	90-250	100-240	100-240
	184	15	150	150
	21.6 x 47.6 x 34.2 (8.5 x 18.8 x 13.5)	10.7 x 31.8 x 24.4 (4.2 x 12.5 x 9.6)	9 x 30 x 23, (3.5 x 11.8 x 9.1)	9 x 30 x 23, (3.5 x 11.8 x 9.1)
	27.5 (60.5) with battery	4.5 (10)	4 (8.8)	4 (8.8)
	$ 34,500 as of March 2002	Not specified	Starting from $8,181	$12,700
	1 year, 90 days cables	1 year	1 year	1 year
	Designed for use in MRI; fiberoptic technology for SpO_2, ECG, and IBP; operating principles for anesthetic agent analysis; referencestandard gas used to verify gas values (calibration). Meets requirements of IEC 601-1, TUV, and UL.	Modular component for Datascope Passport 2 and Spectrum patient monitors; compact; lightweight design; other parameters include arrhythmia, ST segment analysis, SpO_2 with pleth waveform, NIBP, IBP, CO (Expert and spectrum only), and temperature.	Modular component of a physio-logic monitoring system (IntelliVue family). Complies with CSA, IEC, and UL.	Modular component of a physio-logic monitoring system (IntelliVue family). Complies with CSA, IEC, and UL.

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How to use data analysis from clinical information systems to help manage intensive care units

Secondary analysis of patient-related data from clinical information systems offers potential for ICU management support, quality and cost improvements. Dr. Imhoff discusses processes and examples of Clinical Information System (CIS) data analysis.

Introduction

Clinical Information Systems (CIS) facilitate the acquisition of patient-related data in electronic format with little or no extra clinical work. While electronic medical documentation at the point of care can improve clinical workflows, the cross-sectional or longitudinal analysis of patient-related data from CIS on a patient, departmental, or hospital basis can provide information to help manage intensive care units. This secondary data analysis aims at cost reductions, quality improvements and quality control, coding and charge capture and scientific research. This article will give an overview of the processes of data analysis, present some clinical examples, and conclude with a discussion of the value of secondary data analysis.

The process of data analysis

The process of data analysis includes data acquisition, transfer, filtering and extraction, quality control, presentation and, finally, analysis.

When planning data acquisition, both primary and secondary data analysis needs should be taken into account. Only 5-10% of all variables in a CIS are acquired automatically. These variables are gathered from bedside devices, e.g. physiologic monitors, ventilators, and IV devices. Additional data are interfaced from the hospital information system (HIS), the laboratory information system (LIS) or other information systems. Although automated data account for only a relatively small number of variables, they can, depending on the sampling rate, generate large amounts of data. Nevertheless, most patient-related data are acquired directly at the bedside, where most variables are entered by hand. It appears very unlikely that the entry of variables such as clinical observations, nursing procedures, therapeutic measures, medications or doctor's orders can be automated in the foreseeable future.

All data collected must be structured, so that they can be subjected to statistical analysis. Numeric or alpha-numeric data (e.g. vital signs, fluid balance and medication administration) are directly accessible for most statistical applications. Free text data, which traditionally makes up large portions of medical documentation (e.g. physician's or nursing notes), cannot be easily analyzed with statistical methods. Therefore, free text entries into a CIS should be avoided wherever possible. For instance, clinical observations or interventions should be documented in a strictly structured fashion, coding terms with selection lists and menu items. This structured qualitative data can, in contrast to free text information, be exported directly for statistical analysis. Highly structured data acquisition provides the best basis for successful data analysis.

Quality, accuracy and reliability of all data are initially determined at data entry. Quality assurance measures should include plausibility checks at data entry or data transfer, selection lists or menu items (as mentioned above) and automated reminders for required data fields. Moreover, data need to be acquired and entered in a timely fashion. All data must be time stamped, both for the time when the data were acquired and for the time when the data were entered into the system.

Prior to initiating data analysis, it is advisable to export data from the clinical database to a secondary database (Ledbetter and Morgan 2001; Mill and Staggers 1994). This is especially important, because the primary clinical database represents the medical-legal patient record, and because complex queries against the primary database may compromise bedside performance of the CIS. During this export process, data can also be filtered and de-identified, if needed.

Clinical examples

A few examples show how analysis of CIS data can help to manage ICUs. The analyses discussed were done on data from a 16-bed surgical ICU in a tertiary referral centre in Germany. A commercially available CIS was installed in the ICU in 1992. All data used for the analyses were acquired as part of the standard clinical documentation done with the CIS. Before using data for clinically and management relevant analyses, the accuracy of the data was verified.

In one study, medication documentation from 3,537 consecutive treatment days was compared to pharmacy records. Medication volume showed a difference of less than 5% to the phar-macy records. This difference was attributable to inevitable loss during drug preparation, only partially used packages and damaged deliveries. It was constant over time and across medication groups. Precision of documenta-

Michael Imhoff
MD PhD

Department for Medical Informatics, Biometrics and Epidemiology
Ruhr-University
Bochum, Germany

mike@imhoff.de

tion was checked in random samples and showed a very close correlation between medication documentation, doctor's orders, and pharmacy records. Therefore, the medication documentation in the CIS appeared sufficiently precise for further cost evaluation (Imhoff 1997).
In another study for selected drugs and infusions, the precision of dose documentation and the relation in time between charted dose and effect on online hemodynamic variables was evaluated applying time series analysis of these variables. The analysis of a total of 34,604 time series with 5,264 catecholamine or fluid interventions revealed an average time difference between intervention as charted and calculated hemodynamic effect was 12.34 minutes (0 - 29 min) (Imhoff et al 1999). Such time lags may affect automated decision support, but rarely affect management-related data analysis.
After establishing adequate precision and completeness of CIS data, post hoc data analysis was used to support ICU management. Such data analyses can be a single analysis for a specific question run once, or an automated analysis run repeatedly:

Charge capture and calculation of reimbursement codes:
Most intensive care related International Classification Procedures in Medicine (ICPM) codes and the majority of intensive care International Classification of Diseases (ICD) codes, as well as other charge codes, can be generated from the CIS database without additional workload (Coleman et al. 1997; Dexter et al. 1998; Grewal and Reed 1994). Examples include the inference of codes for renal replacement therapy from the fluid balance data, or complex intensive care codes from Simplified Acute Physiology Score (SAPS) and Therapeutic Intervention Scoring System (TISS) scores, as required in the German Disease Related Groups (DRG) reimbursement system. Even if some codes cannot be calculated and physician supervision is still recommended, this process can save more than 80% of the coding time for physicians and markedly improves the DRG coding quality (Imhoff 2004).

Nursing scoring:
In a prospective study with 602 consecutive ICU patients, TISS-76 calculated from the CIS database was compared to TISS-76 done manually. It showed that manual scoring underestimated the actual TISS by at least 20%([Imhoff 1997).

Cost control:
Over two years, duration of antibiotic application was calculated, and outliers were identified on a patient-by–patient basis. For the first four quarters of the analysis, mean duration was 7.1 days, but outliers were between 35 and 69 days. After identifying this discrepancy and re-educating the residents, occurrence of antibiotic treatment for more than 21 days with the same drug was significantly reduced. The average antibiotic cost per treatment day decreased by 38% (Imhoff 1998).

Quality control:
In 105 patients scheduled for extensive visceral surgery, data analysis determined how many patients did actually reach the therapeutic goals of a hemodynamic protocol and what therapeutic effort was necessary. After 12 hours in the ICU, 94 patients (89.5%) had reached the therapeutic goals. The CIS medication and fluid balance data showed that only very moderate therapeutic interventions were necessary on the average (Imhoff et al. 1998). This information could be used to inform management decisions regarding the therapeutic interventions employed in the ICU.

Discussion and conclusions

Clinical documentation alone does not justify the cost and effort for a CIS or an electronic patient record and often cannot provide adequate return on investment in financial terms (Imhoff 2001). But the electronic capture of all patient-related data opens a potential for data analysis and management support that cannot be realized with traditional documentation tools, as shown in the examples above. CIS is also an invaluable tool to capture data for prospective clinical studies. In conjunction with decision support tools, such as computerized, rule-based treatment protocols, CIS can provide a platform for standardized single- and multi-center studies (East et al. 1999; Morris 1999).
The use of CIS data for secondary data analysis offers several undisputable advantages in comparison to paper-based documentation tools:

- Data must be entered only once.
- Detailed analyses beyond the scope of handwritten documentation are easily feasible.
- Detailed analyses facilitate strategic decision making.
- Analysis of CIS data also allows for control of processes, including the continuous validation of clinical protocols and pathways.

With secondary data analysis and ICU management support, CIS can show significant return on investment, both in medical and financial terms. But these benefits can only be realized if data capture, transfer and filtering are meticulously planned from the very beginning, data quality is maintained at a high level and data analyses are designed in a way that they really answer the questions of interest to ICU managers.

Communication with **families** in the ICU

Effective communication is key when working with ICUpatients' family members

Communications series
Effective communication - winter 2005
Communicating with administration - spring 2006
Communication with families - summer 2006

Introduction

Effective communication with the family members of critically ill and injured patients is a very important aspect of what we do as intensive care professionals and has significant implications for patient care, family members and the ICU team. The ICU environment can be overwhelming for the families of critically ill patients, introducing high levels of stress, anxiety and depression, and few family members are prepared for the ICU experience (Buchman et al. 2003). In this setting, the ICU team must communicate information regarding the patient's diagnosis, prognosis and treatment, even engaging family members as surrogate decisionmakers for their sick or injured relative. Often, communication with families involves difficult discussions, including end-of-life issues or organ donation (Williams et al. 2003).

Why communication is important

The importance of establishing a good line of communication with the family is often underestimated. Early discussions with family members lay the groundwork for establishing their understanding of their sick relative's wishes and values. This often leads to involving them as surrogate decisionmakers, in collaboration with the ICU care team. Azoulay and Sprung have emphasized this two-step model for establishing a family-physician relationship predicated on early and effective communication of information, followed by obtaining family input with regard to decisionmaking and meeting specific needs of critically ill patients (Azoulay and Sprung 2004).

Studies of ICU team communication with patients' families have demonstrated a number of positive effects on meeting family needs and facilitating their coping process with the stress induced by a critical illness in a family member. These effects include improving the effectiveness of communication and decreasing conflict between families and the ICU team (Way et al. 2002). Markers used to evaluate the quality of information provided to families include evaluation of comprehension of the information, satisfaction scores and the prevalence of anxiety and depression in family members (Azoulay and Pochard 2003). Effective communication may have an important impact on limiting the incidence of post-traumatic stress in family members (Azoulay et al. 2005). Additionally, effective communication can also ease the transition from curative to palliative care and reduce the use of futile therapies (Lilly et al. 2000).

Forms of communication

It is important to recognize that the information provided to families comes from different members of the care team and can occur in a variety of settings. The source of information may impact the families' comprehension of and overall satisfaction with communication. Communication can occur in a formal setting, such as a scheduled family meeting. This is perhaps the best studied of communication formats, since the encounters are held at pre-determined times and are amenable to obtaining family permission to collect data. Furthermore, formal, scheduled communication allows for more preparation and integration of team beliefs and concerns prior to the session, thus avoiding conflicting information. Communication, however, most frequently occurs in a more casual manner when family members are present at the bedside. This is the most common format for communication and carries the highest risk of miscommunication, as less preparation is done. Written communication through descriptive brochures is another common method of communicating information concerning the ICU environment, physical resources of the hospital and support resources available to family members (Azoulay et al. 2002). As technology becomes available, this sort of general, predetermined information can be made available through web pages accessible both on-site through an intranet and off-site through the Internet.

Aspects of Communication

Team members' communication styles depend on their skills and preferences and their ability to be good listeners. This, in turn, may be influenced by the context in which the discussion is taking place, the anticipated content of the discussion and preconceived attitudes about healthcare. The fact is that many physicians do not like to be the bearers of bad news and may not, in fact, be very good at relating it. From the family perspective, the timing and frequency of communication of information (including prognosis) is important in determining satisfaction, and the frequency of communication often needs to change throughout the course of an ICU stay, especially as it prolongs (LeClaire et al. 2005). The duration of interactions with the team also affects the family perception of satisfaction, and these sessions should

Ronald Pauldine
MD, Fellow

Todd Dorman
MD, FCCM

Associate Professor
Department of Anesthesiology and Critical Care Medicine
Johns Hopkins University School of Medicine,
Baltimore, USA

Todd Dorman
tdorman@jhmi.edu

be carried out in a non-hurried manner. Too often, the healthcare team uses the communication session only to get its point across, despite the fact that allowing family members a greater opportunity to speak during family conferences has been associated with increased satisfaction (McDonagh et al. 2004). Satisfaction is also highly associated with the completeness of information received, along with compassion and respect shown to patient and family members (Heyland et al. 2002).

Family members often have differing views about the quality of information provided by different members of the care team. Nurses are more often viewed as compassionate, concerned and informative (Buchman et al. 2003). Surprisingly, for physicians, the experience level of the provider speaking with the family seems to make little difference, as house officers can be as effective as senior physicians and fellows in communicating with families (Moreau et al. 2004). Bedside communication may be improved through utilization of a goal sheet, as this provides consistency to the information and keeps everything framed as goals. It also offers the opportunity to discuss and explain why goals are sometimes not met and the implications for outcome.

Limiting factors

Factors that can limit the effectiveness of communication relate to both care team and family dynamics. Since critically ill patients are often unable to make decisions for themselves, their interests are represented by their family. Communication with the family is critical, regardless of whether the physician or the family serves as the primary decisionmaker. The extent to which families want to participate as surrogate decision makers varies significantly, with a predominance of physician-driven decisionmaking employed throughout Europe, and patient/family autonomy favored in North America (Azoulay et al. 2003; Azoulay et al. 2004).

Failure to recognize the expectations of the family can undermine communication efforts from the beginning. Members of the care team may miss opportunities to listen and respond to the needs and values of the family or explore the specific wishes of the patient (Curtis et al. 2005). The nature of multidisciplinary intensive care models may also introduce barriers to communication when information is provided by a variety of members of the care team and there is lack of consistency with the information conveyed to the family.

For the family's part, cultural differences also influence expectations and the preference for involvement or non-involvement in decisionmaking. The educational level of the family may interfere with their ability to comprehend information or their comfort with seeking answers to their questions. As mentioned previously, anxiety may be heightened by a lack of adequate information and may impact an individual's ability to understand further communication from the ICU team. In some cases, family members may not know the wishes of their relative and therefore be unwilling to make decisions on their behalf. Often, historic family interactions can influence decisionmaking, as well. Language and cultural differences are among the most common barriers to communication, as elements of uncertainty may occur with communication through interpreters, and some things just do not translate well between languages and cultures (Norris et al. 2005).

Conclusions and recommendations

Recommendations for providing information about critical illness to family members include scheduling structured meetings between the health care team and the family, designating a specific clinician to coordinate communication for the ICU team, providing information in an open, unhurried fashion in simple terminology and emphasizing the expected quality of life related to the clinical situation (Nelson et al. 2005). Ensuring adequate visiting hours for family members and providing comfortable surroundings along with quiet areas to meet with family members without interruption can improve the frequency and quality of communication and the satisfaction of family members. Interdisciplinary progress notes have also been advocated as an effective tool to avoid miscommunication and clarify pertinent information (Whitmer et al. 2005).

It should always be remembered that while communication is an art, skills can be honed. Listening is crucial, and its importance must be stressed if the wishes of the patient and their family are to be appreciated and respect for their values, belief systems and culture maintained. Finally, further research is needed to determine aspects of communication with families in the ICU environment that can be improved to increase satisfaction with care and avoid the consequences associated with inadequate communication.

Added value from **nursing research**

Christina Jones discusses the ways in which nursing research, with its emphasis on holistic care of the patient, can enhance patient care in the intensive care unit (ICU).

Introduction

Nursing research has been criticised in the past for its poor quality and has been accused at times of adding little to existing knowledge (Gelling 2003). This is most probably a reflection of a lack of academic support for nursing research and an over-reliance on qualitative methodologies, when quantitative methods might have been more appropriate.

The real strength of nursing research, however, may be in its holistic approach to care of patients and their families. Nurses spend more time than other health-care professionals with patients and their families by virtue of the type of care that they provide. Chance observations made during such routine contact can form the basis of astute research questions. Nurses need encouragement and support to carry the research process through to completion, using the most appropriate and robust methodology.

Nursing research changing practice

Pick up any intensive care nursing journal and the emphasis of nursing research – improving the quality of patient and family care – is clear. For example, a recent nursing study completed in neonatal intensive care examined whether the goal of family-centred care was actually practiced by nurses at the bedside (Petersen 2004). This was a good, quality study using a validated questionnaire that elicited responses from 62 nurses. The study showed that there was a gap between the knowledge that family-centred care was necessary and the delivery of family-centred care in practice. This discrepancy between ideal and practice could have a significant impact on the care delivered to both the baby and the family unit.

Our own research group's work has revolved around improving physical and psychological recovery from critical illness and investigating the factors that impact on that recovery, both in the intensive care unit (ICU) and after discharge. While the research group is headed by a doctor, as a nurse the author is encouraged and supported to think of research questions, write proposals, gain funding, and co-ordinate and publish the research. To give an example, while following up on ICU patients discharged to the general wards, nurses observed that the patients were very distressed by delusional memories (e.g. hallucinations, nightmares and paranoid delusions) of their stay in the ICU. This chance observation turned into a research question: "Do delusional memories trigger symptoms related to post traumatic stress disorder (PTSD)?" The results of this research project suggested that the nurses' chance observation was right – delusional memories are a potent trigger for PTSD-related symptoms (Jones et al. 2001).

To facilitate the PTSD research, a tool was developed and validated by our research group that allowed us to recognise these delusional memories (Jones et al. 2000). This tool has been used extensively by our own research group and others to start examining what factors, such as depth of sedation, may precipitate patients' delusional memories and increase the risk of PTSD. Medical research in the area of sedation had previously concentrated on weaning patients quickly from the ventilator and reducing the costs by shortening the ICU stay (Kress et al. 2000). Until recently, such research failed to address the effects that this has on patients' long-term psychological health after ICU discharge. Nursing research has helped bring this patient care focus to the fore.

Conclusions

Each professional group brings their unique point of view to research, and patient care benefits accordingly from this cross-fertilisation of ideas. Critical care nurses, with their intense involvement in patient and family care, should think of research as something that can revolutionise the way that critical care is delivered and as something that nurses can do and do well.

Christina Jones
BSc, MPhil, PhD, Dip, Couns

Nurse Consultant Critical Care Follow-up, Intensive Care Unit, Whiston Hospital, Prescot, UK & Intensive Care Research Group, Dept. of Medicine, University of Liverpool, UK

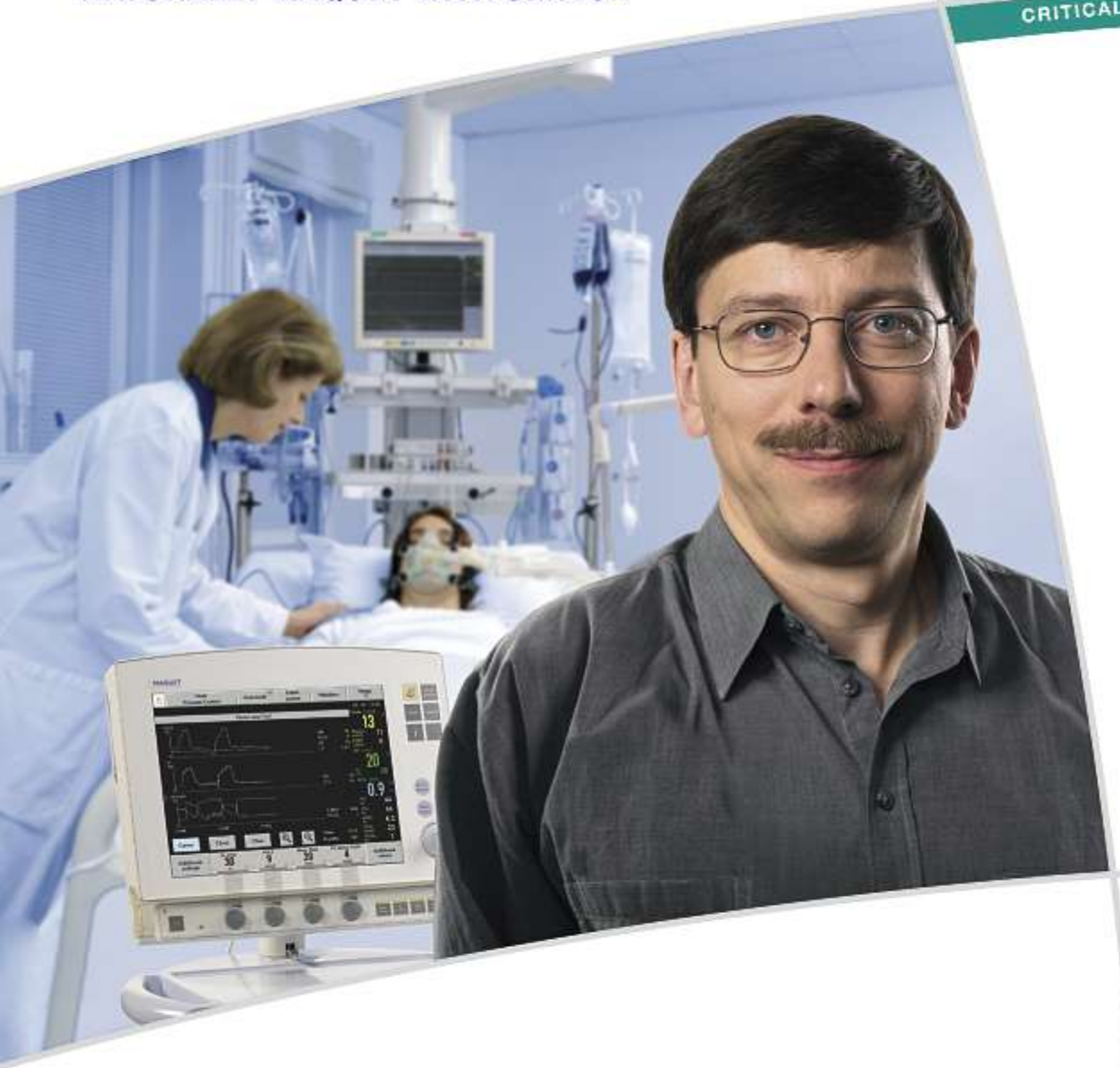
christinajonesc@aol.com

MAQUET

WHO'S SETTING THE STANDARD IN PATIENT INTERACTIVE VENTILATION?

NATURALLY MAQUET WITH SERVO-i

CRITICAL CARE



"The human body is a remarkable machine, but sometimes nature needs a helping hand. At MAQUET we see SERVO-i as a natural extension of the lungs. I have been working with the SERVO ventilator for more than 20 years. During that time the needs of the patient have always driven development.

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Anders Vass, System Architect/ Technical Project Manager

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An interview with Dr. Peter Angood

Dr. Peter Angood served as the President for the Society of Critical Care Medicine from January 2005 to January 2006. In this interview he shares some of his achievements during that time.

Peter Angood, MD
FRCS(C) FACS FCCM

Vice-President & Chief
Patient Safety Officer
Joint Commission on
Accreditation of Healthcare
Organizations

Chief Patient Safety Officer
& Co-Director
Joint Commission
International Center for
Patient Safety

pangood@jcaho.org

What was your own personal career path to accepting the role as President?

At an early career stage, I chose the path of critical care, intuitively recognizing that looking after critically ill and injured patients was the area where you could provide the most impact for patients. I have spent 25 years in different institutions both in Canada and in the United States, gradually gaining more experience by directing trauma centres, critical care units, and educational programmes. I have recently made the shift from a clinical academic career path to a non-clinical path by joining the Joint Commission on Accreditation of Healthcare Organizations (JCAHO), where I am a Vice-President and the Chief Patient Safety Officer. I also co-direct the Joint Commission International Center for Patient Safety.

What have the main achievements of the Society been in the last 5 years?

I think the main achievement for our organization has been the transition from a relatively young professional society to one that is really quite mature in terms of its membership growth, its financial stability and the overall depth of its educational programmes. These improvements have increased our influence with intensive care practitioners, other professional organizations, accrediting agencies and the US Government. Overall, the Society is now in a very good position to positively impact patient care. In addition, this organization has been on the leading edge for developing disaster preparedness documents, education programmes and organizational strategies to cope with the modern medical challenges of emergency preparedness.

What are the main personal objectives you aimed to achieve in your role as Society President?

Much of my focus for the Society was to help refine its processes of governance and broaden its scope of influence. I also wanted to further refine the strategic planning process, so that we could have a longer-range view of where we needed to go as an organization. Coupled with all that, my priority has been to reach out for a wider variety of collaborative relationships around the world. I believe we have been very successful with all of these activities.

What are the main challenges the Society recognizes in intensive care now and in the future?

There is clearly a shortage of manpower in nursing and other critical care professions. And that's going to get worse. We have high-stress work environments that don't have the processes and the systems in place to allow people to do their job optimally. They get stressed, they get burnt out, they come across themselves making mistakes and they don't like it. So they quit.
Because of the staffing shortage, people are working more hours, and therefore, are finding less time to pursue training or be involved in professional societies. So, a part of our strategy as an organization is to try to help practitioners remain involved with us as a society, without necessarily having to leave home or work. We are also helping healthcare institutions to build better systems so that people can do their job better, more safely, more efficiently and with a higher quality outcome. The biggest challenge is promoting a change in the culture of healthcare.

Did your position, and what you could do as a president, meet your expectations?

Becoming president for this type of an organization, that deals with so many members in a wide variety of countries and is focused towards a segment of healthcare that is really a high priority area – for me, it's been personally gratifying to be able to contribute in whatever small way that I have. This is an organization that is gaining momentum and influence within healthcare, so it has been rewarding to see how the organization continues to meet its goals and challenges.

What has been your most pleasant experience as President to date?

That is so tough. I think that the best experience is near the end of your year when you're reflecting back on what you came in to try to do and appreciate that, yes, you were able to achieve your goals.

And what has been the worst?

We had to refocus our relationships with industry, due to the increasing scrutiny of regulation in our country, and that's been very difficult, because it has stressed us in terms of what our values and standards are as an organization. It has been a turbulent year, but I expect we shall be a stronger organization as a result of the decisions made by the SCCM Board.

The Court of Justice of the European Communities

Sonja Planitzer
Editor European Affairs

The Court of Justice of the European Communities ("the Court" or ECJ) is the judicial institution of the European Union (EU). It was originally established under the European Coal and Steel Community in 1952 and is based in Luxemburg. The Court upholds the Treaties of the EU and ensures that EU legislation is interpreted, applied and enforced in the same way in all member states. In addition, the Court has the power to settle legal disputes between EU member states, EU institutions, businesses and individuals.

The ECJ's work

The Court has an enormous workload, and it hears cases year round. In 2004, the Court concluded 665 cases, a significant increase from the 494 cases brought to a close during the previous year. The four most common types of case heard at the Court are:

- References for a preliminary ruling, in which a national court may request the ECJ's assistance in ruling on the application of EU laws, when a decision cannot be reached at the national level.
- Actions for failure to fulfil an obligation, in which an EU member state or the European Commission ("the Commission") may commence proceedings to force another member state to comply with EU law.
- Actions for annulment, in which an EU member state, the Commission, the Council of the EU (the "Council") or the European Parliament may request the annulment of an EU law that conflicts with the EU Treaties. Private individuals with the proper legal representation may also initiate annulment proceedings before the Court, if the law in question directly impacts them.
- Actions for failure to act, in which EU member states, European Community institutions and (under certain conditions) individuals or businesses may lodge a complaint about the failure of the European Parliament, the Council or the Commission to render a decision as required by the EU Treaties.

Who works in the Court?

The Court is comprised of one judge per member state, so that all 25 of the EU's national legal systems are represented. For the sake of efficiency, however, the Court usually sits as a "Grand Chamber" of just 13 judges or in chambers of 5 or 3 judges. In addition, there are eight advocates general, who must present publicly and impartially reasoned opinions on the cases brought before the Court. France, Germany, Italy, Spain and the United Kingdom each appoint one advocate general; the others are appointed on a six-year, rotating basis from the remaining EU member states. Judges and advocates general must either be eligible to serve in their highest national courts or must be qualified academic lawyers. While serving on the ECJ, judges and advocates general may not hold any other office of an administrative or political nature nor engage in any other occupation, paid or unpaid.

The organisation of the Court

Prior to 1989, the Court primarily ruled on cases regarding the application of EU law. In 1989, the Court incorporated a "Court of First Instance," with the power to hear a broader range of cases, including cases involving competition law, breach of commercial policy or social policy and disputes concerning EU staff regulations. The Court of First Instance helps the Court to cope with its large number of cases and offers citizens better legal protection. Decisions of the Court of First Instance may be appealed to the ECJ. Recently, a new judicial body, the "European Civil Service Tribunal," was created under the Court of First Instance to adjudicate disputes between the EU and its civil service.

Court procedures

All cases are submitted to the ECJ's registry, and a specific judge and advocate general are assigned to each case. The procedure that follows is comprised of two stages: first a written, then an oral phase.

During the first stage, all the parties involved submit written statements, and the judge assigned to the case draws up a report summarising these statements and the legal background to the case.

Then comes the second stage – the public hearing. Depending on the importance and complexity of the case, this hearing can take place before a chamber of three, five or 13 judges, or before the full Court. At the hearing, the parties' lawyers put their case before the judges and the advocate general, who can question them. The advocate general then gives his or her opinion, after which the judges deliberate and deliver their judgement.

Since 2003, advocates general are required to give an opinion on a case only if the Court determines that the case raises a new point of law. The Court is not required to follow the advocate general's opinion.

Can I take a case to the Court?

Perhaps surprisingly, private individuals are also allowed to bring proceedings to the Court to have an EU law annulled, if the law affects them directly. The individual must have legal representation, but does not need to go through the national courts before bringing proceedings to the ECJ. However, there is a stiff penalty if the court decides against the complainant. Individuals who lose their case may be liable to pay the costs of both sides. On the other hand, if they win, the EU pays the costs, and the law will be declared null and void throughout the European Union.

How can I get information about the judgments of the ECJ?

Judgments of the Court are decided by a majority rule and pronounced at a public hearing. Dissenting opinions are not expressed. Decisions are published on the day of delivery. You can view all the ECJ's judgments on the ECJ's website at:
http://europa.eu.int/cj/de/content/juris/index.htm

The EU law

The European Union is based on the rule of law. Therefore, its actions are governed by treaties, which are agreed on voluntarily and democratically by all member states. All of the EJC's rulings are guided by these treaties. The most important treaties are:

- Treaty of Nice – signed on 26 February 2001, entered into force on 1 February 2003. It dealt mostly with reforming EU institutions so that the EU could function efficiently after its enlargement to 25 member states.
- Treaty of Amsterdam – signed on 2 October 1997, entered into force on 1 May 1999. It amended and renumbered the EU and EC Treaties, and it provided consolidated versions of the EU and EC Treaties. This treaty also changed the articles of the Treaty on European Union.
- Treaty of the "European Union" – signed in Maastricht on 7 February 1992, entered into force on 1 November 1993. The so-called "Maastricht Treaty" changed the name of the European Economic Community (EEC) to simply "the European Community" and introduced new forms of co-operation between the member state governments – for example, in the areas of defence and "justice and home affairs."
- Treaty of Rome – signed on 25 March 1957, entered into force on 1 January 1958. It established the EEC. The Treaty establishing the European Atomic Energy Community (Euratom) was signed at the same time, and the two treaties are therefore jointly known as the "Treaties of Rome."
- Treaty establishing the European Coal and Steel Community –signed in Paris on 18 April 1951, entered into force on 23 July 1952. It expired on 23 July 2002.

These treaties form the EU's primary law, from which secondary laws are derived. Secondary laws include three types of legislation:

- **Regulations**, which become directly part of the national law of the member states, with no further legal action required by the member states.
- **Directives**, which must be implemented by member states' national laws.
- **Decisions**, which address a specific problem and may apply only to specified states.

Not to be mixed up!

Sometimes, the many expressions at the European level are confusing. It is important to know that the "**European Court**," or the "**Court of the European Union**," has nothing to do with the "**European Court of Human Rights**" (ECHR). The ECHR is not even associated with the EU. Rather, the ECHR is an institution of the "**Council of Europe**" and was created to systematise the hearing of human rights complaints from Council of Europe member states. The court's mission is to enforce the conventions for the protection of human rights and fundamental freedom.

The fight for a simplified EU law

In October last year, the European Commission initiated a plan to modernise EU legislation and cut unnecessary red tape and over-regulation. It presented a three-year programme to simplify the existing thousands of pages of EU legislation adopted since 1957. The Commission will repeal, codify, recast or modify 222 basic legislations (all-in-all more than 1,400 related legal acts) within the next three years. The most heavily regulated sectors, such as cars, waste and construction will be reviewed first, followed by other sectors, such as foodstuffs, cosmetics, pharmaceuticals and service. Commission President José Manuel Barroso said, "Simpler EU legislation is one of the main elements of our better regulation programme. It will boost the competitiveness of our companies."

Announcement from Luxembourg

On March 16th and 17th, the Forum Europa Foundation hosted an international seminar in Luxembourg on the subject "Border regions: simple meeting places or areas of cutting edge integration?" This was the second seminar in a five-part series of conferences under the heading "Europe tomorrow: crisis or prosperity?" The series is being organised by the Forum Europa e.V. in Saarbrücken, the Neuchatel based Maison de l'Europe transjurassienne and the Netzwerk Müllerhaus (Müllerhaus Network) in Lenzburg.

Among those represented at the seminar were four of the so-called first wave of border regions: Euregio Maas-Rhein, the combined area known as Saar – Lor – Lux - Rheinland-Pfalz - Wallonie, the REGIO PAMINA (on the Franco-German border) and the International Bodenseekonferenz (regions around Lake Constance). Experts discussed a diverse range of key topics including: cross border cooperation in healthcare, the many facets of cross border commuting, young people, education and the question of sustainability as a factor in successful regional development.

In the "Announcement from Luxembourg", the participating border regions agreed among other things to continue to promote cross-border cooperation and further develop inter-regional exchanges. At the same time, they underlined the importance of cooperation with EU institutions. A Europe of regions is also a Europe of border regions which should get together and exchange views on their experiences of cooperation. And of course, it was pointed out that cross border cooperation needs a certain level of funding if it is to work properly. Most importantly, though, it needs "the strong political will of all those involved". The first priority therefore is to remove the barriers in people's heads.

Helicia Herman
Editor European Affairs
Europe@emceurope.com

Green light for EU Services Directive

Following the example of the EU Parliament, European heads of state and government leaders have now reached a compromise on the Services Directive. At the EU start of year summit, central and east European States endorsed the view of other EU States and unexpectedly voted in favour of a limited free market in the provision of services. Previously these countries had insisted on an immediate and complete opening of borders for the provision of services within the EU.

In particular, the current solution means that local health, safety and employment standards will be protected. At the beginning of April, the EU Commission will submit a revised proposal which is expected to receive rapid approval. The Services Directive will then contribute to promoting both competition and growth within the EU. The Directive covers not only traditional economic activities, but also the so-called essential social services such as old people's homes, facilities for the disabled, waste disposal, etc.

EU ban on measuring instruments containing mercury.

The EU Commission intends to introduce a ban on the use of measuring equipment containing mercury. The proposal is part of the EU's strategy on mercury to reduce the amount of toxic mercury which ends up in waste disposal sites. Until now, individual EU States have worked to different regulations. The EU will now set out clear guidelines governing the sale of measuring equipment containing mercury. The new regulations will mainly affect thermometers (for measuring either body or room temperature), barometers and equipment for measuring blood pressure. Special measuring instruments for medical purposes will be exempt from the proposals, since no suitable alternatives currently exist. The Commission's proposal has yet to be approved by the EU Parliament, the Council and Ministers.

Expert network on the use of antibiotics

The GRACE (Genomics to Combat Resistance against Antibiotics in Community – acquired Lower Respiratory Tract Infections in Europe) research project is to investigate the growing resistance to antibiotics. The project will focus in particular on respiratory diseases, such as lung infections and bronchitis. Expert teams in nine EU States will work together in the search for new treatments.
Across Europe, top research institutes, medical care centres and leading international research representatives specialising in areas such as hospital medicine, basic healthcare and epidemiology will be linked by a common network. A total of 11.5 million euros has been set aside for the project between now and 2011.

Author guidelines

Content

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

Submission guidelines

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

Length

- Articles: maximum 700 words (less if figures or tables are included)
- Viewpoints: maximum 700 words
- Letters to the editor: maximum 175 words

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

Structure

Article texts must contain:

- a title;
- names of authors with abbreviations for the highest academic degree;
- affiliation: department and institution, city and country;
- main authors are requested to supply a portrait photo (see specifications below);
- a summary of one or two sentences (no more than 30 words) describing the content;
- one contact name for correspondence and an e-mail address which may be published with the article;
- website, if appropriate;
- acknowledgements of any connections with a company or financial sponsor;
- an introduction, main text and summary/conclusion, with subheadings as appropriate;
- authors are encouraged to include checklists and/or guidelines which summarise findings or recommendations;
- references or sources, if appropriate, as specified below.

Writing style

Articles must be written in English, with short sentences, a clear structure (see above) and no bias. Full stops in numbers may only be used to indicate a decimal place; otherwise use commas as separators.

Images

Main authors are invited to supply a portrait photo for publication with their article. This and any other relevant images for publication with an article should be sent by e-mail as separate files (only high resolution images with 300dpi) and their order of placement in the article must be clearly indicated. Only the electronic formats ".tif" or ".jpg" can be used for images, i.e. not Microsoft Word or PowerPoint. Images must be no smaller than 9cm x 9cm at 100% scale. Only images meeting these specifications can be published. If an image has been published before, permission to reproduce the material must be obtained by the author from the copyright holder and the original source acknowledged in the text, e.g. "© 2004 Amanda Heggestad".

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Please use the Harvard reference system. Citations within the text for a single author reference should include the author surname and year of publication; for a citation with two authors include both author surnames and year of publication; for more than two authors, include the first author surname followed by "et al." and the year of publication. Multiple citations should be separated by a semicolon, and listed in alphabetical order.
Example of within text citation: (Edwards 2004; Edwards and Miller 2002; Miller et al. 2003).
The format for listing references in submitted articles should follow the Harvard reference system.
Example of standard journal reference: Sydow Campbell, K. (1999) "Collecting information; qualitative research methods for solving workplace problems", Technical communication, 46 (4) 532-544.
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Authors are responsible for the accuracy of the references they cite.

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It is always at the discretion of our editorial board to accept or refuse submissions. We will respond to submissions within 8 weeks of receipt. We reserve the right to revise the article or request the author to edit the contents, and to publish all texts in any Euromedical Communications journal, on the Internet and to list them in online literature databases.

Thank you
The ICU Management Editorial Team
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Spanish National Health System

This article presents a description of the Spanish National Health System.

Juan Roca Guiseris MD
President of Spanish Society Critical Care and Coronary Units (SEMICYUC)
Critical Care and Emergency Department
Hospital Universitario Virgen de las Nieves, Granada, Spain
juan.roca.sspa@juntadeandalucia.es

Spain: General information

Spain occupies 505,182 km^2 and had a population of 42,197,900 inhabitants in 2004 (Instituto Nacional de Estadística 2005). In 2004, Spain's Gross Domestict Product (GDP) was $991,442 million, and its Gross National Income (GNI) per capita was $21,210 (World Bank 2005). The fertility rate in Spain is one of the lowest in the European Union (EU), although it recovered somewhat in 1993, reaching a rate of 1.3 children per woman (Instituto Nacional de Estadística 2005). In recent years, the aging of Spain's population has decelerated, due to the arrival of foreign young people. The median age of the population is 40.2 years (40.99 for Spanish citizens and 32.82 for resident foreigners).

Health indicators

The classical indicators of health in Spain are among the best of the world. For example, in 2003, the life expectancy of Spanish men and women was 77.2 and 83.7 years respectively, which places Spanish women as the most long-lived in the EU. Spanish men occupy the second position, coming in just behind the Swedes (77.9 years).

In addition, in 1992, Spain reached the world lead for donation and transplant of organs. In 2003, there were 34 donors for every million inhabitants (Instituto Nacional de Estadística 2005).

Morbidity

The leading causes of death in Spain fit the profile of a developed country. The incidence of death from lung cancer, cardiovascular disease and work-related accidents is increasing, but deaths from infectious diseases and traffic-related accidents are down (European Observatory on Health Care Systems 2002).

Spanish National Health System

History and evolution:

Up to the arrival of democracy and the approval of the Spanish Constitution, Spain's healthcare system was based on the model of Social Security. Today, the Constitution establishes the right of all Spanish citizens to the protection of health, and healthcare is provided through the National Health System.

The National Health System is decentralized, and in accordance with the General Law of Health, the public healthcare system is managed totally by Spain's 17 autonomous community governments (Ley 14 1986). The National Health System shares the following fundamental characteristics of public health services in Europe:

- Belonging to the same insurance provider according to citizenship, rather than membership in a specific union (as in the case of social insurances).
- Financing primarily through taxes and not through social healthcare fees.
- Predominance of public health providers.

In Spain, 99% of the population has public health coverage through the obligatory national system. The comprehensiveness of the National Health System's Catalogue of Services and the practical absence of co-payment (only required for pharmaceutical services) make our system one of the most generous in the EU (Jimenez 1997; Temes et al. 1992).

Financial aspects:

Healthcare financing and the provision of services are predominantly public. Approximately 71.2% of the health expense is public, with numbers very similar to those of other EU countries (OECD Health Data 2003). The total health expense in Spain is 7.7% of the GDP (versus 9% in the EU). The healthcare expenditure per capita in Spain is $1,835, whereas the average of the 15 member states of the EU is around $2,621. Nevertheless, the pharmaceutical

expense in Spain is seven percentage points greater than in other EU countries (Organization for Economic Co-operation and Development 2005).

Primary care:

The organization of primary care in Spain is based on the Centers of Health (buildings or places where primary healthcare assistance is exercised) and in Teams of Primary Attention (multidisciplinary sets of professionals, fundamentally formed by doctors and nurses). The centers are public, and the healthcare professionals there are civil servants. This is atypical in Europe, where primary care is generally comprised of independent professionals who enter into a contract with the public system.

Primary healthcare benefits covered by the National Health System include medical and paediatric healthcare, prevention of disease, health promotion and rehabilitation. The main benefit historically excluded is dental care (Instituto Nacional de la Salud 1990).

Secondary care:

Specialized inpatient and outpatient healthcare cover all medical and surgical specialties in acute care. Secondary care providers offer specialized surgical or medical consultations and hospital care and are charged with diagnosing and treating illnesses that, due to their complexity, cannot be addressed by primary care providers. Secondary care in Spain is provided by hospitals. Prior to the healthcare reforms initiated in 1982, secondary care specialty centers often shared consultation space with primary care centers. Thus, specialty centers are often considered consultation centers external to the hospital in which they are located (Cuervo et al. 1994).

The coverage provided by the National Health System does not include social and community care. These services are partly managed by the Ministry of Labour and Social Affairs, and partly by the 17 autonomous communities. Local governments are also involved, especially in the planning and management of services. There are high co-payments for most social services.

Hospital infrastructure:

The number of hospitals in Spain, according to the National Catalogue of Hospitals on December 31, 2005, is 779, with an average capacity of 202.8 beds. 59.05% of these hospitals are general hospitals, 14.5% are geriatric or long-term stay hospitals, and 11.8% are psychiatric hospitals (Ministerio de Sanidad y Consumo 2005). In 2003, there were 3.1 acute care beds for every 1.000 inhabitants (Organization for Economic Co-operation and Development 2005).

Health professionals:

The number of doctors in Spain, according to information from the Instituto Nacional de Estadística (INE), was 194,668 in 2004, with a rate of 4.5 doctors per 1,000 inhabitants. This is the second largest number of doctors in Europe, after Italy. Almost 60% of Spain's doctors are men, although if we restrict ourselves to doctors under 45 years old, 56% are women. The number of collegiate nurses is 225,487, with a rate of 5.2 nurses per 1,000 inhabitants. The percentage of women is 81.6% (Instituto Nacional de Estadística 2005).

Challenges of the future:

The quality plan for the National Health System (Ministerio de Sanidad y Consumo 2006) offers six major areas of performance that try to answer the questions that affect the major principles and challenges of our healthcare system:

1. Protection and promotion of health and prevention of illness.
2. Encouragement of equity.
3. Support to human resources planning in the healthcare sector.
4. Realization of clinic excellence.
5. Use of information technologies to improve healthcare for Spanish citizens.
6. Increased transparency.

Hospital Universitario Virgen de las Nieves, Granada, Spain

Educational programme on **intensive care medicine in Spain**

This article describes the development of intensive care medicine in Spain as a primary speciality and its specific, five-year training programme, initiated in 1979.

Introduction

The idea of grouping critical patients in a common area was a natural result of the advances of medicine. The configuration of intensive care medicine as a new speciality was gradually justified by the evidence of homogeneous physiopathological and clinical characteristics in critically ill patients from different backgrounds. In addition, intensive care medicine filled the need to incorporate new therapeutic strategies and technological developments.

Definition of the speciality

Intensive care medicine is defined as that part of medicine which deals with patients who suffer physiopathological alterations that have reached such a level of severity that they represent a current or potential threat to the patient's life, but who may, nevertheless, recover. Intensive care units (ICUs) are the main places where the work of this speciality is done. They are multidisciplinary, central service centres that operate in close collaboration with the rest of the hospital and treat both medical and surgical patients. Critical care may be performed in the ICU, intermediate care unit or emergency room and at any location where critical care may be necessary, especially during transport of a critically ill patient or a disaster situation (Murillo et al. 2003).

Overview of intensive care training

In Europe, the national intensive care training programmes show diversity in access, structure, regulation and assessment, making it difficult to recognise this specialty from one European state to another. It should be necessary to establish a common minimum standard of training throughout the European Union. The Competency-Based Training in Intensive Care in Europe (CoBaTRICE) project, a project of the European Society of Intensive Care Medicine (ESICM), strives for a consensus to harmonise a common core curriculum in the European Union's member states and promotes the need to establish an international agreement about a common "end product."

The most common structure of training in Europe is the supra-speciality model, which permits multidisciplinary access to a common intensive care medicine training programme. In contrast, in the primary speciality model, intensive care medicine is an independent speciality, which can be accessed directly after undergraduate medical training. Switzerland and Spain are the two best examples of this model in Europe.

Intensive care training in Spain

In our country, anaesthetists and internists were the primary specialists involved in critical care until 1978. That year, legal regulation established intensive care medicine as a primary speciality, named *Medicina Intensiva* (Intensive Care Medicine), with a specific postgraduate training programme (whose interns and residents are referred to as MIR) (Esteban et al. 1987; Esteban et al. 1993). The total training period for *Medicina Intensiva* was set at five years. In 1979, the first generation of MIR began training, obtaining their official qualification in 1984. In those years, it was only possible to pursue primary specialities, without an option for supra- or sub-speciality.

The National Commission of Medical Specialities, under the Spanish Health Ministry, regulates training and recommends diplomas for approval by the Education Ministry (Law 44/2003). The intensive care medicine commission, which incorporates both ministries and helps regulate intensive care training, is composed of eleven members elected from among prestigious professionals to fill the following positions:

- Four members appointed by the Health Ministry's commission of human resources,
- Two members appointed by the Education Ministry,
- Two members appointed by the Spanish Society of Intensive Care Medicine (SEMICYUC),
- Two members representing residents (trainees) of the speciality, and
- One member representing the General Council of Medical Colleges.

The first two years of general medical training are dedicated to rotations in the hospital's departments of internal medicine, medical specialities and emergency medicine. Tutorial and supervision of the training programme is conducted by the head of service and the trainee's tutor within the teaching ICU. During the three years of specific intensive care training, a minimum of 70% of the student's time is dedicated to the ICU. The training status of an ICU is based on the ability of the ICU to offer complete training and on the basis of the number and kind of patients treated, human and material resources, ICU structure, research capacity and scientific output. All intensive care training objectives are completed under a regime of progressive responsibility. The evaluation of the trainee is done each year in a timely manner by tutors, staff and the head of service. Ultimately, a diploma for the successful candidate is recommended by the Health Ministry and approved by the Education Ministry.

Dr Gumersindo Gonzalez Diaz
Unidad de Cuidados Intensivos
Hospital Universitario Morales Meseguer
Murcia, Spain
gumersindoj.gonzalez@carm.es

Pre-hospital care of critically ill patients in Catalonia: Past, present and future.

The Catalan Medical Emergency System (SEM) is thirty years old. Demographic and socio-economical changes, as well as improvement in emergency medicine and in new technologies, demand some changes to the SEM to face the future.

Introduction

Located on in the northeast of Spain, Catalonia has a surface area of 32,000 square kilometres and a population of about 7 million people, 60% of which live in or around the capital, Barcelona. The Catalan public health system integrates all resources, public and private, in a unique net of public utility and universal access.

Historical development of pre-hospital care in Catalonia

Pre-hospital medicine in Spain began about mid-decade in the nineteen-eighties. Before that, except for some unique cases, this service was covered by local or Spanish Red Cross basic ambulances.

In 1986, the Catalan Government, through its Health and Social Security Department, created the Sistema de Coordinació d'Emergències Mèdiques de Catalunya (SCEM), or Catalan Medical Emergency Coordination System, which coordinates secondary medical transport. Towards the end of 1987, they launched primary assistance and transportation plans, which developed into the present Sistema d'Emergències Mèdiques (SEM), or the Medical Emergency System. At the same time, Barcelona's Town Council created the Servicio de Atención Médica Urgente (SAMU), or Urgent Medical Care System, which provides primary medical response, with the aid of a nursing staff. SAMU also takes care of the Spanish national medical emergency telephone number, 061, and soon after its inception became the Servicio Coordinador de Urgencias de Barcelona-061 (SCUBSA-061), or the Barcelona-061 Emergency Coordination Service. As a result, SAMU experienced increasing medicalisation of its formerly nurse-equipped units. In January 2005, SEM and SCUBSA-061 joined to form a single coordination and pre-hospital care service, which now covers the whole of the Catalan territory, under the name of SEM.

Present situation

At present, SEM has a single telephone line (061) for urgent and emergency healthcare. In addition, the service has two other numbers for specific purposes: one is used for secondary (inter-hospital) transport; the other one, Sanitat Respon (Health Service Answers), answers general inquiries on health topics.

The Catalan system for medical emergencies combines two models, which affect medical as well as response issues. One of the models covers the city of Barcelona, and the other one covers the rest of Catalonia. The city of Barcelona has an extra-hospital medical model and a wide range of response possibilities: Basic Health Units (USVB), equipped with technicians; Intermediate Health Units (USVI), with nursing staff and Advanced Health Units (USVA), with a doctor. The rest of Catalonia follows a hospital medical model, with a response mechanism in two consecutive stages, basic and advanced. The basic stage is not directly controlled by SEM. Inter-hospital transfer of critical or potentially critically ill patients is made by Advanced Vital Support Units (USVAs), with the assistance of hospital paediatricians for paediatric cases. The advanced stage incorporates a doctor and a nurse in the emergency response.

SEM and the hospitals in the area of Barcelona have developed a protocol for some of the prevalent, time-depending pathologies: serious trauma, acute coronary syndrome (pre-hospital fibrinolysis), stroke, intoxication cardiorespiratory arrest (including donor at cardiac arrest). These protocols have contributed to the continuity of service, while granting homogeneous pre-hospital and hospital care in service areas that border or overlap.

Future

Accumulated experience in coordination and management of both models helped us decide on the most convenient one for the future. The polyvalent Barcelona model will be extended to the rest of Catalonia, maintaining the two-stage response in rural areas only, where all medical response units will be indiscriminately used for both primary and secondary transportation. Telemedicine will be used as a support tool in transportation of potentially critical cases, by means of USVIs. The medical decisions that can be made using telemedicine will help us lighten the demand for and make more efficient use of the more advanced USVAs.

In addition, a unique coordination centre will manage all public health resources and will respond to all demands for urgent and emergency care, granting a more homogeneous and integral response throughout the whole territory of Catalan. The efficiency of the present medical regulation model will be increased by shared decision-making and quality control computer systems. In conclusion, we believe that, by combining existing elements of Catalan's two emergency medical service models, we can improve emergency response throughout the region.

Gilberto Alonso Fernández, M.D.
Regional Chief. Catalan Emergency Medical System

Fernando García Alfranca, M.D.
Director. Catalan Emergency Medical System

Antonio Artigas Raventós, M.D, Ph. D.
Director. Critical Care Department
Sabadell Hospital, Spain

Graded levels of intensive care in Spain

This manuscript describes the rationale for the development of intermediate care units in Spain and the main characteristics of this development.

Francisco Baigorri
MD, PhD
Head Intermediate Care Unit
Critical Care Center, Hospital de Sabadell – University Institute Parc Taulí, Autonomous University of Barcelona
Sabadell, Spain

Antonio Artigas
MD, PhD
Professor University Institute Parc Taulí, Autonomous University of Barcelona
Director Critical Care Center
Hospital de Sabadell – University Institute Parc Taulí, Autonomous University of Barcelona
Sabadell, Spain

Francisco Baigorri
fbaigorri@cspt.es

As in neighbouring countries in Europe and also in North America, the healthcare system in Spain has to face rising costs associated with technological innovation, population ageing and increasing patient expectations. These factors favour a series of organisational changes, moving to more patient-centred care models. This is especially relevant where critical care is concerned.

The cost associated with caring for patients in the intensive care unit (ICU) is very high. At the same time, ICUs, born when the management of illness in hospitals had been divided into specialty areas, endanger the continuity of care by imposing an important gap between the care provided in specialty areas and the general ward. These factors have resulted in a crisis in the availability of intensive care beds. Providing graded levels of care to critically ill patients was proposed as one strategy to deal with these problems.

In this context, about ten to fifteen years ago, intermediate care units began to develop in our country. In a recent survey in Catalonia, intermediate care beds comprised 25% of total adult critical care beds. Patients admitted to intermediate care units are those who do not require intensive care but need more care than is provided in the general ward – mainly frequent monitoring of vital signs and/or nursing interventions. These units try to increase accessibility to the scarce intensive care beds for patients requiring active treatment and provide an alternate destination for patients after ICU discharge (reducing readmission and post-ICU mortality). Moreover, intermediate care units attempt to be a cost-effective alternative to ICU admission. Certainly, patients in intermediate care units require a lower nurse-to-patient ratio and may require fewer investigations and interventions when compared to patients in ICUs.

To date, however, there is not enough evidence to affirm that these units are a cost-effective alternative to the traditional organisation, with only ICU and general ward beds. This analysis is troublesome, because there are a variety of models of intermediate care units currently in use, with different policies for admissions and discharge and, also, different nurse-to-patient ratios. There are units that specifically monitor and support patients with single organ failure, such as those attending patients with acute myocardial infarction. Other units act as "step-up" or "step-down" units, between the level of care delivered on a general ward and ICU. Moreover, there are several structural and organisational approaches to forming an intermediate care unit. These range from freestanding intermediate care units, independent of a main ICU, to intermediate care units adjacent to an ICU, sharing the same physical layout and resources. Each one of these models has its own drawbacks and advantages. The approach in a particular centre is determined by the specific health problem to solve, the number and abilities of the personnel available, other resources (including space available) and even historical factors.

The intermediate care unit in our hospital dates from 1997, and it is a ten-bed unit adjacent to the ICU. It was formed by fusing two formerly independent areas. The nurse-to-patient ratio in this intermediate care unit is 1:5 versus 1:2-3 in the ICU. Patients are mainly surgical, trauma and coronary patients. Moreover, this unit receives about one-third of ICU patients before the definitive discharge. The same team of nurses and doctors takes care of patients in both the ICU and the intermediate care unit, avoiding unnecessary transfers of patients between medical teams. The intermediate care unit's occupancy rate is above 90%, and the mean length of stay remains less than 72 hours.

Although the multiple structural and organisational models for intermediate care units may seem somewhat chaotic, we maintain that it reveals hospitals' efforts to respond to the aforementioned challenges imposed by our society, improving quality of care at the lowest cost. The need to respond quickly to these challenges may preclude awaiting further evidence about cost-effectiveness of the different approaches before taking decisions about the necessary changes. In fact, in moving toward models of care that focus on the level of care that individual patients need rather than physical structures, some organisations could jump directly to a range of practices that share the same aim of having medical services graded and flexible, moving up and down the continuum of illness. These could include critical care education and training for general ward staff and direct support at the bedside for varying periods. Modern trends in information technology may have soon a profound impact, expediting these changes.

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Global challenges, patient centred solutions

Dr. Rhodes previews the interaction, learning and dissemination of scientific knowledge offered by the ESICM's annual Congress in September.

This year, the 19th annual congress of the European Society of Intensive Care Medicine (ESICM) will take place at the Barcelona International Convention Centre (CCIB) from the 24th to the 27th of September. The motto and theme for this year's meeting is 'Global challenges; patient centred solutions'. The meeting will be an exciting opportunity to catch up on research, science and educational matters relating to intensive care and emergency medicine.

The ESICM annual congress has grown in popularity and stature over recent years. It is now consistently one of the biggest critical care meetings in the world. The meeting is now so popular that it has outgrown many of the smaller congress centres, and this is the reason it is using the CCIB. The CCIB is a brand new, state of the art, convention centre that should enable ESICM to host the meeting in the most modern of environments, right in the centre of Barcelona. Delegates will have the opportunity to enjoy the science and education of the congress, as well as sample the social delights of this exciting and cosmopolitan city.

This meeting hopes to bring the best of science and education together in a format that will prove to be stimulating for our attendees. The Congress Committee, which is derived from the Sections of the Society, seeks to improve on previous years' meetings and ensure the overall quality of what is presented. As in previous years, there are a number of different session formats that should cater for all tastes. Original research will be presented either as an oral presentation or around a poster board, with discussion from suitable experts in the field. 'State of the art' thematic sessions will present current thoughts on all major topics. We also have a 'Continuing Professional Development' (CPD) track that is aimed at trainees taking the European Diploma in Intensive Care (EDIC) exam or specialists aiming to update themselves on a particular topic. In recent years, new sessions have been introduced, discussing clinical challenges and the core competencies that are deemed necessary to be a practicing clinician in intensive care. The ESICM has a number of educational tools that it is deservedly proud of. These include the distance learning programme, Patient-centred Acute Care Training (PACT), and the international harmonization programme CoBaTrICE (Competency-Based Training in Intensive Care in Europe). Both of these will be integrated into the programme in a number of formats, both to demonstrate their utility and to improve the quality of the sessions.

One of the main aims of the meeting is the advancement of cutting-edge research related to intensive care. Much of the programme is, therefore, available for researchers to present their work; over the last years we have consistently had over 1,000 abstract submissions! This is a higher amount of original papers submitted than any other critical care meeting. These original presentations are crucial to disseminate new research, for researchers to get peer review and debate their work, and also for young researchers to learn how to present their work. These sessions are chaired and directed by senior researchers, who help their junior colleagues present, discuss and debate the work. We don't just encourage interaction; we make it happen.

As in previous years, the Congress will be preceded by a number of postgraduate, educational courses. These include a Fundamental Critical Care Support (FCCS) instructors' course and a postgraduate course on major disasters: readiness and responsiveness. Other courses include infection and sepsis, neuro-intensive care, weaning from mechanical ventilation, peri-operative cardiac intensive care and echocardiography for intensivists. Some of those postgraduate courses also include hands-on workshops. These are always extremely popular and usually over-subscribed. Pre-booking is essential.

This year, there will be more thematic sessions covering more topics than ever before. It is anticipated that there will be 5,000 delegates instructed by over 200 international experts. This year's meeting has already attracted more industry support than before, and the trade exhibition is likely to be ESICM's most extensive ever. All in all, this meeting is too good to miss. Mark the dates in your diary now! We look forward to meeting with you in Barcelona.

Dr Andrew Rhodes

Chair, Division of Scientific Affairs, ESICM

arhodes@sgul.ac.uk

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European Society of Intensive Care Medicine (ESICM)
Annual Congress secretariat
Mrs Estelle Flament
Avenue Joseph Wybran, 40
B-1070 Brussels
Tel +32 2 559 03 55
Fax +32 2 527 00 62
Email public@esicm.org
Internet www.esicm.org

Agenda

JUNE 2006

3-6 Euroanaesthesia
Madrid, Spain
www.euroanesthesia.org

9-11 5th Summer conference in Intensive care Medicine
Prague, Czech Republic
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

12-13 Cours d'Echocardiographie-Doppler en soins intensifs et réanimation
Brussels, Belgium
www.intensive.org

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

NOVEMBER 2006

16-17 Cours d'Echocardiographie-Doppler en soins intensifs et réanimation
Brussels, Belgium
www.intensive.org

DECEMBER 2006

5-7 12th Postgraduate Refresher Course
Brussels, Belgium
www.intensive.org

FEBRUARY 2007

5-9 15th Winter Symposium on Intensive Care Medicine
Crans-Montana, Switzerland
www.intensive.org

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

MARCH 2007

27-30 27th Annual International Symposium on Intensive Care and Emergency Medicine
Brussels, Belgium
www.intensive.org

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10:21

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www.IntelligentVentilation.org, www.hamilton-medical.com

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