ICU Management

Volume 5 • Issue 3-2005 • Autumn

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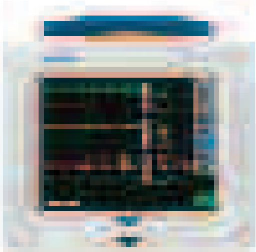
Care of Sepsis

Comparison charts: defibrillators/monitors
Conflict management
Intensive care in the Benelux



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Australian and New Zealand Intensive Care Society
World Federation of Societies of Intensive and Critical Care Medicine

Deadline for abstract submission: December 15, 2005

Infection management

Infections are common in many hospital departments, but no more so than on the intensive care unit (ICU) where, in a recent European study of more than 3000 ICU patients, 37% were infected at some point during their ICU stay (Vincent et al. 2005). While some patients will, of course, be admitted to the ICU with a community-acquired infection, perhaps of greater concern are the risks of nosocomial infection. Early and adequate diagnosis and treatment are essential to maximize outcomes, but hospital- or ICU-acquired infections are notoriously difficult to diagnose and treat, largely due to problems in identifying causative organisms in patients who have recently received or are still receiving antimicrobial agents and the increased incidence of antibiotic (multi)-resistant organisms. Nosocomial infections are responsible for considerable morbidity, mortality and costs. Severe sepsis occurring as a result of ICU-acquired infection has been associated with a threefold increase in workload and costs (Adrie et al. 2005). The 'best' way of managing such infections is thus to avoid them in the first place and there are various strategies that have been shown to be effective in preventing the risk of nosocomial infection (Vincent 2003). Many hospitals and ICUs have now developed infection control programs, which, when adhered to, can reduce nosocomial infection rates, resulting in improved patient outcomes, shorter ICU/hospital stays, and reduced costs. An important consideration in the running of such programs is the inclusion of an infection surveillance system, whereby data related to the infections and to causative organism(s) and antimicrobial sensitivity patterns are systemically collected, so that infection control programs can be adapted such that all patients receive the most appropriate and effective prevention and treatment.

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News from the European **institutions**

Parliament committee issues report on services directive

In Early 2004 the European Commission tabled a draft directive for the liberalisation of services within the EU, designed for example, to enable doctors or nurses to work anywhere in Europe. Many in the medical profession, however, feared that this liberalisation would undermine national regulators´ ability to ensure that EU staff coming to work in their health services were sufficiently competent.

European Parliament Member Evelyne Gebhardt, the rapporteur for the Internal Market Committee, Parliament's leading committee on the draft services, completed her consideration of the proposed directive in May, and proposed a series of major amendments to the text. For example, she calls for health to be excluded from the scope of the proposal given that its inclusion would bring the directive into conflict with the manner in which competences are divided between the Union and member states.

Mrs. Gebhardt also proposes replacing the country of origin principle with the principle of mutual recognition, based on the concept of 'equivalence'. Under this principle and in accordance with the established case law of the European Court of Justice, the conditions laid down in the legislation of the country of destination may not duplicate equivalent conditions which have already been satisfied in the country of origin. Thus qualifications or experience satisfied under the regulations of one country must also be recognized in another.

The draft report will form the basis for further discussions in the European Parliament.

Medical devices directives under review

Regulations on medicinal products and medical devices are currently contained in three EU directives: the medicinal products, active implantable medical devices and in-vitro diagnostics directives. The Commission has decided, on the basis of technical differences between the three directives to make a series of changes to the texts. According to the EU executive, these will deliver improvements in the following areas:

- clinical evaluation through clarification of the requirements;
- post-market surveillance to increase transparency for the general public;
- consistency between the medical devices and the active implantable medical devices directives;
- the decision-making process by allowing binding decisions in the event of conflicting national interpretations on whether a product is a medical device.

Around 8,000 types of medical product are currently available on the market. They include items such as life-saving implants, advanced machines for screening and diagnosing health conditions and diseases, and instruments for performing minimally invasive surgery. Taking information from a recently concluded consultation process into consideration, the Commission is now working on a legislative proposal.

Divisions on working time directive remain unresolved

At the end of 2004, the Commission proposed changes to the existing EU Working Time Directive, which would affect

- the length of the reference period for calculating the maximum weekly number of hours worked;
- the definition of working time (introducing a new definition of "on-call duty" and "inactive on-call duty");
- the conditions under which an exemption from the maximum working week can be exercised.

In June a group of member states, led by the United Kingdom, refused to approve the Commission proposal to remove, from 2012 onwards, the existing opt-out clause under which member states may choose not to adopt the provisions on maximum working hours. However, Ministers have not yet forced the issue to a vote in the Council. The European Parliament had already voted on the proposal in May. Among the key decisions were:

- All time spent on-call should be counted as working time. Any inactive on-call duty should therefore be taken into account when calculating the average maximum working week in line with the law or contracts of employment.
- Rest periods to compensate for extra hours worked should be taken as soon as possible after the extra time worked.
- The reference period over which the average maximum working week is calculated should be extended by law or employment contract to 12 months (from the current 17 weeks).

MEPs also rejected the suggestion that employees and employers could enter into contracts to agree an extension of the maximum working week beyond the currently agreed 48 hours. In other words, they voted against an opt-out from the maximum working week. Furthermore, they want countries, which already use this opt-out clause to phase it out over a 36 month transition period. The Commission is now seeking a compromise solution.

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Series on European Institutions
- This article: European Commission
- Winter issue 2005: European Parliament
- Spring issue 2006: Council of European Union
- Summer issue 2006: The Court of Justice

The European **Commission**

Helicia Herman introduces the EU's executive body, the European Commission

Presenting the EU´s executive body and working

The European Commission is the European Union´s executive body and fulfils its day-to-day tasks. Its official seat is in Brussels (Belgium), although it also has offices in Luxembourg, representations in all EU countries and delegations in many capital cities around the world. The Commission comprises the President, currently Mr. José Manuel Barroso, 25 Commissioners, one for each country and approximately 24,000 members of staff. The Commission must be able to act with complete independence from the governments of Member States; its members represent the EU as a whole, and not their respective native countries.

Staff

An administrative staff of 24,000 manage the daily work of the Commission, and is organised into departments, known as "Directorate-Generals" (DGs) and "services", such as the Legal Service. Each DG is responsible for a particular policy area and is headed by a Director-General who is answerable to one of the Commissioners.

Directorate-General organigram

Commissioner + personal Cabinet
Director General
(Dep. Director-General) if appointed
Directors
Heads of units
Normal staff in a unit

Designing a legislative proposal

Under the Treaty, the Commission has the "right of initiative"; in other words, it is responsible for drawing up proposals for new European legislation. The Commission proposes action at EU level only if it believes that a problem cannot be solved more efficiently by national, regional or local action. This principle is called the "subsidiary principle". For example, if the Commission recognizes a need for EU legislation to protect the health of workers, the Directorate-General for Employment draws up a proposal, based on extensive consultations with employment ministries in the Member States and international employment organisations.

The proposed legislation is then discussed with all relevant Commission DGs and amended, if necessary. It will then be checked by the Legal Service and approved by the Commissioners' "cabinets", which comprise the Commissioners' personal political staff.

Once the proposal is completed, the Secretary-General places it on the agenda for a forthcoming Commission meeting. The "college" of 25 Commissioners meets once a week, usually on Wednesdays in Brussels. At this meeting, the Employment Director-General explains the reasons for the proposal to colleagues. If agreed, the college of Commissioners "adopt" the proposal and send it to the Council and the European Parliament for consideration. If there is disagreement among the Commissioners, the President initiates a vote. If a majority is in favour, the proposal is adopted by the Commission and forwarded for consideration by the Council and Parliament.

Proposing legislation to the Commission?

Individuals or national or European organisations can raise an issue directly at European level by correspondence with the European Commission, either on a service level, i.e. by mail to the unit heads in a relevant DG, or on political level through correspondence to the responsible Commissioner. For more information on the relevant DGs for ICU Managers, please see "Your relevant DGs" on page 8). The appropriate Commissioner is often easiest to identify and forwards all correspondence to the responsible persons within the Commission. Through such correspondence, an idea can be presented or a meeting requested etc.

Alternatively, if individuals or organizations establish a relationship with a Member of the European Parliament, this channel can be used to address a question to the Commission, i.e. via the European Parliament. In this case the Parliament requires a formal institutional answer from the Commission.

Other roles

As the European Union's executive body, the Commission is also responsible for managing and implementing the EU budget and the policies and programmes adopted by Parliament and the Council. Most of the actual work and budget expenditure is managed by national and local authorities, but the Commission is responsible for its supervision.

The Commission moreover acts as "guardian of the Treaties". This means that the European Commission, together with the Court of Justice, is responsible for ensuring that EU law is properly applied in all the Member States.

Finally the European Commission represents the European Union on the international stage, for example negotiating international agreements on its behalf.

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Interview with **Peter Arlett**: proposing a medicinal products regulation

Peter Arlett's responsibilities include amongst others medicines for children, the safety of medicines, orphan medicines and international relations. In this interview with Helicia Herman, he describes the development of a draft regulation by the Commission on medicinal products for paediatric use.

How was the idea initiated?

The Commission, along with the Council and the Parliament, were made aware of the public health issue relating to medicines for children through dialogue and correspondence from patient organisations, doctor organisations and individuals affected by the issue. Moreover a Council resolution in December 2000 invited the Commission to find solutions to the issue of inadequate medicines for children. There were also calls from the European Parliament for a proposal.

At this time the French Government had the Presidency of the European Union. The French Medical profession had raised the issue previously with the French Department of Health and the French Presidency had therefore put the issue on the agenda for the Presidency. If there is political pressure in this way, the Commission is then under pressure to react. In general, if an issue is brought to the attention of a national government, it is during that country's EU Presidency that they have the most power to initiate European action.

Ideas may therefore stem from local, national or European groups. If the Commission needs to prioritise its work, it prioritises demands from European groups. This is simply because inviting national associations is not always easy to accomplish logistically and budget resources for organising meetings with possibly 25 national associations are limited. Moreover European groups such as those from industry associations in the pharmaceutical sector are usually well organised.

How did the Commission progress the idea?

The Commission researched the problem and potential solutions intensively. Part of the research included study of how other regions are tackling this issue and how regulation has dealt with similar but distinct problems, such as how to stimulate the development and authorisation of medicines for rare diseases (orphan medicines).

Because of the complexity of healthcare delivery and the pharmaceutical sector, the Commission conducted a detailed assessment of the social, economic and environmental impacts of its proposal on the different stakeholders involved (e.g. children and their families, healthcare workers, the pharmaceutical industry and those that pay for medicines). The results of the 'Extended Impact Assessment' (EIA) show that the proposal will lead to the availability of more and better medicines for children and that the pharmaceutical industry will benefit through increased innovation.

How are responsibilities assigned?

When a request for action or a question arrives with the Commission, for example with the Secretariat General, it is sent to whichever Directorate General (DG) has the most relevance. The Secretariat General has a horizontal overview of all activities of the Commission and usually the responsible DG is clearly defined.

Within the DG there are coordinating units who direct the matter to the attention of the responsible person in the unit.

In case of a competence overlapping between two DGs, one is assigned as responsible and the other is consulted (and hence informed) on all matters. Difficulties can arise when the European Commission has low competence on a topic, for example on delivery of healthcare. In this case the request is responded to by the Commission, but the scope for action is limited.

Initiators of requests can correspond directly with the responsible DG; contact details are available on the Europa-server (http://europa.eu.int/comm/index_en.htm). All DGs have their own website, including a description of their policy field.

Who participates and how?

This proposal was the subject of an extended impact assessment (EIA) of the overall proposal and the specific measures included. An EIA assesses the economic, social and environmental effects of the proposal on the key stakeholder groups. The Commission's EIA is principally based on an independent, externally contracted study. The EIA also draws on experience with the existing EU pharmaceutical market and regulatory framework, experience with legislation on paediatric medicines in the US, experience with orphan medicines in the EU, extensive consultation with stakeholders, the published literature and other available data.

The Commission consulted extensively on the issue of

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medicines for children and on its proposals for a draft paediatric regulation.
This consultation included:
• Workshops and roundtable meetings
• Stakeholder interviews during the EIA (including the externally contracted study)
• Public consultation

In the course of conducting the EIA Study, interviews took place with representatives of the following organisations:
Association of the British Pharmaceutical Industry (ABPI, United Kingdom)
Aventis Pharma
AOK Health Insurance (AOK Krankenkassenverband, Germany)
BLISS (United Kingdom)
British Medical Association, General Practitioners Committee (BMA, United Kingdom)
Dutch Medicines Evaluation Board (College ter Beoordeling van Geneesmiddelen (CBG), The Netherlands)
Dutch Healthcare Insurance Board (College voor Zorgverzekeringen (CVZ), The Netherlands)
Confederation of European Specialist in Paediatrics (CESP)
Direzione Generale dei Farmaci e dei Dispositivi Medici (Italy)
European Agency for the Evaluation of Medicinal Products (EMEA)
European Federation of Pharmaceutical Industries and Associations (EFPIA)
European Generic Medicines Association (EGA)
European Network for Drug Investigation in Children (ENDIC)
European Organisation for Rare Diseases (Eurordis)
European Society of Clinical Pharmacy (ESCP)
Medicines and Healthcare products Regulatory Agency (MHRA, United Kingdom)
National Perinatal Epidemiology Unit (United Kingdom)

This kind of list is not necessarily definitive. In the present case the list was compiled through research and by talking to people in the field. To a certain extent it was created by word of mouth. Another party may show interest in the matter and could be added to the list at any point. Budget constraints at some point may force the Commission to restrict invitations to participate in face to face meetings, however. In that case, once again the Commission would prioritise European over national groups, or organisations over individuals.
The Commission's public consultation was split in two. Between 28th February 2002 and 30th April 2002, the public consultation focussed on the key elements to be included in a regulation. Between 8th March 2004 and 9th April 2004, public consultation was based on the draft legislative text. For the latter part of the consultation, the consultation document was placed prominently on the Commission website and sent by e-mail to key stakeholder organisations.

How quickly was a draft completed?

The Council resolution of December 2000 was the true start of the Commission's preparatory work. The Commission formally adopted the proposed regulation on medicinal products for children in September 2004. Three and a half years were spent researching the issue together with possible solutions, conducting the EIA, consulting stakeholders, and drafting the regulation and supporting documents (in the 20 official languages of the EU).

What happens if Commissioners disagree?

At the end of the process to prepare a legislative proposal, the Commission as a whole (meaning all Commissioners) vote on the draft. All internal disagreements need to be resolved before the Commission decides on a proposal. The discussions between the DGs are very formalised and overseen by the Secretariat General. For all initiatives (legislative or others) there is an Interservice-consultation at service level. DGs who are interested may comment on the matter.
The controversial issues are usually resolved in meetings between the heads of cabinets, who meet before the "college" of Commissioners schedules the issue on its agenda. Uncontroversial decisions can be taken by written procedure. If controversial issues still remain after the discussions between the heads of cabinets, the Commissioners discuss the matter during the "college" meeting. A decision can be taken with a simple majority. All decisions, once taken, are considered as unanimous, meaning that all Commissioners must defend it in public. Externally the Commission therefore acts with one voice.

Thank you very much for this interview.

Your relevant **Directorate-Generals** and **Commissioners**

Helician Herman overviews the European Commission Directorate-Generals, active in policies relevant to ICU Managers and presents examples of their legislation, activities and contact details.

DG Enterprise & Industry Commissioner Günter Verheugen

Relevant to intensive care, this DG is responsible for EU policy on:
- pharmaceuticals
- medical devices
- tissue engineering

Examples of EU legislation in these fields:
- The proposal for a regulation on medicines for children (see also ICU Management Summer 2005).
- A regulatory framework on human tissue engineered products, currently in process
- With regards to medical devices, the European Community's involvement concerns mainly the regulatory framework for market access, international trade relations and regulatory convergence, and the competitiveness of industry. In May this year the Commission started a public consultation process to improve public health and safety of medical devices.

Correspondence *European Commission, Enterprise DG, Rue de la Loi 200, B - 1049 Brussels, Belgium*

DG Health and Consumer Protection (known as DG "SANCO") Commissioner Markos Kyprianou

Relevant to intensive care, this DG is responsible for EU policy on:
- Public health: including health information, threats to health, health determinants and the EU public health programme including possible funding opportunities for projects in the field
- Patient mobility issues

Examples of EU legislation in these fields:
- A decision in December 2004 to set up the 'Executive Agency for the Public Health Programme', for the management of Community action in the field of public health
- Recent legislation aiming to further the development of a variety of communicable disease surveillance networks and early warning and rapid response systems, i.e. setting up the European Centre for Disease Prevention and Control
- Legislation to address the problems of antimicrobial resistance and bioterrorism, and develop strategies for preventing and responding to communicable disease (e.g. influenza preparedness and protection against intentional epidemics) and non-communicable disease threats
- Directives in the field of quality and safety of substances of human origin (e.g. blood, tissues and cells, and organs), in order to prevent the transmission of pathogens by these therapeutic materials.

Correspondence *European Commission, DG Health and Consumer Protection, Rue de la Loi 200, B-1049 Brussels, Belgium*

DG Employment and Social affairs and Equal Opportunities Commissioner Vladimir Spidla

Relevant to intensive care, this DG is responsible for EU policy on:
- Labour law and work organisation
- Health and safety at work
- Free movement of workers
- Condition of social security schemes
- Social dialogue
- Corporate social responsibility

Examples of EU legislation in these fields:
- The directive concerning certain aspects of the organisation of working time, currently in revision
- Legislation on the European Health Insurance Card, launched in June 2004
- Directives on workplaces in general and work equipment in particular
- A directive on working conditions for temporary workers
- A directive on the right of citizens of the Union and their family members to move and reside freely within the territory of the Member States.

Correspondence *European Commission, DG Employment and Social Affairs and Equal Opportunities, Rue Joseph II 37, B-1049 Brussels, Belgium*

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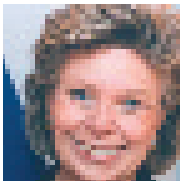
DG Internal Market
Commissioner Charlie McCreevy

Relevant to intensive care, this DG is responsible for EU policy on:
- Patient mobility issues
- Free movement of persons, i.e. mutual recognition of professional qualifications, patient mobility
- Free movement of services
- Public procurement

Examples of EU legislation in these fields:
- A draft directive on the liberalisation of services in the internal market, proposed in January 2004 and currently in the legislative pipeline
- A directive relating to the recognition of professional qualifications, adopted on June 6th 2005
- A directive on the coordination of procedures for the award of public works contracts, public supply contracts and public service contracts in force since April 2004.

CORRESPONDENCE *European Commission, Directorate General for the Internal Market, Rue de la Loi 200, B - 1049 Brussels, Belgium*

DG Information Society
Commissioner Viviane Reding



Relevant to intensive care, this DG is responsible for EU policy on:
- eHealth developments in the European Union

Examples of EU activities in these fields:
- Europe 2005 action plan
- Annual Conferences on eHealth
- Political action calling on governments and the private sector to make better use of information and communication technologies (ICT) in Europe's healthcare system

CORRESPONDENCE *European Commission, DG Information Society, BU 24 0/41, Rue de la Loi 200, B-1049 Brussels, Belgium*

DG Research
Commissioner Janez Potocnik

This DG is responsible for EU policy on:
- Research and technological development, thereby contributing to the international competitiveness of European industry
- The coordination of European research activities with those carried out at the level of the Member States
- Promoting a better understanding of the role of science in modern societies and stimulating a public debate about research-related issues at European level.

Examples of EU activities in these fields:
- A European Research framework programme (the 7th programme currently in preparation due to start in 2007). The programme helps to organise and financially support cooperation between universities, research centres and industries
- the creation of a European Research Area which is regrouping all Community supports for the better coordination of research activities and the convergence of research and innovation policies, at national and EU levels.

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ESA poster awards

There were three awards for abstracts at Euroaneasthesia this year. The full abstracts are available in the European Journal of Anaesthesiology, volume 22, supplement 34, 2005.

Fish oil could prove cost-effective for intensive care

Dr Heller and colleagues from University Hospital Carl Gustav Carus in Dresden won first prize for their research into the impact of omega-3 fatty acids on mortality and length of hospital stay in severely ill patients (see page 28 in this issue of **ICU Management**).

Visual processing during anaesthesia

Dr Rieck and colleagues from the University of Cologne won an award for their research into functional imaging of the visual cortex during wakefulness and intravenous propofol/remifentanil anaesthesia. In a study using functional magnetic resonance imaging (fMRI), funded by Koln Fortune (66/2001), they studied eight patients and four wakeful subjects. The researchers provided visual stimuli to the subjects and activation of the visual cortex was assessed using the fMRI technique and the software tool BrainVoyager 2000. They concluded that early visual information processing is preserved during general anaesthesia induced by the intravenous anaesthetics propofol and remifentanil. The fMRI method may be appropriate for further studies into the effect of different anaesthetics on various neuronal networks.

Avoiding systemic inflammation with esophagectomy

Dr Michelet and colleagues from Hopital Sainte Margeurite won their award for researching the effect of a protective ventilation strategy on systemic inflammation after esophagectomy. In a prospective, randomised study with 50 patients undergoing esophagectomy, they compared two ventilatory strategies on the systemic peri-operative pro- inflammatory response. The groups were differentiated by tidal volume of 9ml kg^{-1} during two and one lung ventilation, no positive end-expiratory pressure (PEEP) (control group) and 9ml kg^{-1} during two-lung ventilation and 5ml kg^{-1} during OLV PEEP 5cmH_20 (intervention group). Successive arterial blood samples were collected for analysis after induction of anaesthesia and following surgery. They concluded that the protective ventilatory strategy lead to a decrease in peri-operative systemic pro-inflammatory response for these patients.

Websites

ESA
www.euroanesthesia.org

ISICEM
www.intensive.org

Maquet
www.maquet.com

SIRS-Lab
www.sirs-lab.com

BIOSITE ® Inc.
www.biosite.com

Zoll
www.zoll.com

ISICEM poster awards

This year at ISICEM, there were three poster awards relevant to management in intensive care. Brief descriptions are included here below and the full abstracts can be found in Critical Care Volume 9, Supplement 1, March 2005 (http://ccforum.com).

Reducing morbidity and hospital stay with high risk surgery

The study of Dr Pearse and colleagues from St George's hospital in London evaluated the effect of an early goal directed therapy (EGDT) protocol commenced immediately after high risk surgery and showed reduced morbidity and length of hospital stay. High-risk surgical patients on a general ITU were randomized to conventional treatment (n=60) or EGDT (n=62) for 8 hours immediately following surgery. The goals for EGDT were to optimize volume status by maximizing stroke volume with fluid challenges and then to increase the oxygen delivery index (DO_2I) to 600 ml/min/m^2 with dopexamine, if required. Control group patients received fluid guided by central venous pressure. There were no significant differences between the two groups at baseline. The EGDT group developed fewer complications (0.7 vs 1.5 per patient, p = 0.002) and had a shorter median duration of hospital stay (11 days vs 14 days, p = 0.001). Fewer patients in the EGDT group developed infectious complications (18 patients [29%] vs. 30 patients [50%]; p=0.03).

Bleeding control in severe blunt trauma

Dr Rossaint and colleagues concluded an improved clinical outcome with rFVIIa (200 + 100 + 100 µg/kg) as an adjunctive therapy for control of bleeding in patients with severe blunt trauma, from a placebo-controlled double blind study. Total RBC transfusion was significantly reduced with rFVIIa relative to the placebo (estimated reduction of 2.6 total RBC units; 90% confidence interval). The need for massive transfusion was significantly reduced: 14% in rFVIIa-treated vs 33% in placebo group (P= 0.03). There were significant reductions in 48 hour requirements for FFP and platelets. Improved haemostasis was accompanied by a significant decrease in ARDS (5% of rFVIIa-treated vs 18% of placebo- treated patients (P=0.047), and also a significant decrease in risk of developing organ failure (either MOF or ARDS: 9% for rFVIIa-treated vs 25% for placebo-treated patients: p = 0.047).

Prophylaxis of contrast-induced nephropathy

Dr Huber and colleagues in Munich compared the

effects of acetylcysteine (A), theophylline (T), acetylcysteine + theophylline (A+T) and placebo (P) for 254 patients with impaired renal function in a randomized trial. Patients from all groups were comparable with regard to baseline creatinine, amount of contrast–medium and incidence of other risk factors. The incidence of contrast-induced nephropathy (CIN) was 6.5% in group A, 4.7% in group T, 10.6% in group A + T, and 16.1% in group P. Overall, the incidence was lower under prophylaxis (7.3%) than under placebo (16.1%; P = 0.0386). Patients of group T had a significantly lower incidence of CIN than patients under placebo (P = 0.0348), whereas neither group A nor group A + T had a lower incidence of CIN than group P. Compared with baseline, serum creatinine levels significantly increased after 48 hours in groups A, A+T and P, but there was no significant increase in group T. In patients with impaired renal function, theophylline significantly reduces the incidence of CIN, whereas acetylcysteine alone or in combination with theophylline was not effective.

Maquet

The latest version of MAQUET's SERVO-i ventilator introduces new features specifically for neonatal ICU patients (see figure 1), including nasal continuous positive airway pressure (Nasal CPAP) functionality, which can be used with a variety of patient interfaces. Additionally, a new Y-piece measurement sensor for all SERVO-i models allows near-patient measurements of pressure and flow with minimal dead space. Other new features which aim to improve clinical efficiency and safety in ICUs include:

- Fi02 trend values can be stored and viewed
- Reference loops can be presented on the screen together with the current loop
- The patient circuit can be tested independently of the pre-use check
- Alarms for airway pressure upper limit can be muted
- Apnea alarm limit has been extended from 15 to 45 seconds.

SIRS-Lab and BIOSITE® Inc.

On 25th August SIRS-Lab and BIOSITE® Inc. announced their collaboration to develop diagnostics for sepsis. Under the collaboration, SIRS-Lab will provide access to selected biomarkers for sepsis. Biosite will then make antibodies to those selected targets using the Company's proprietary antibody development process, which combines immunization of mice and phage display to generate highly diverse libraries of Omniclonal® antibodies with high affinity and low cross-reactivity. The antibodies will be used to generate assays for the measurement of the selected biomarker targets in blood samples. Validated biomarkers will then be assessed for commercialization potential, with high-value markers added to Biosite's product development process.

Figure 1. MAQUET's SERVO-i neonatal ventilator

Zoll

While manual CPR remains a front-line treatment of sudden cardiac arrest, even the best manual chest compressions only provide 30-40% of normal blood flow to the brain, and only 10-20% of normal blood flow to the heart. The ZOLL AutoPulse™ Non-invasive Cardiac Support Pump, as an adjunct to CPR efforts, can do chest compressions that humans can't possibly do, while circulating much more blood, more effectively, to the heart and brain.

- Two separate animal studies showed that the AutoPulse generated pre-arrest levels of blood flow to the heart and brain.
- An end-of-life human study showed the AutoPulse generated 33% greater coronary perfusion pressure (CPP) than manual CPR conducted by medical residents.

References are available on request to editorial@icu-management.org.

Figure 2. ZOLL AutoPulse™ in action

Improving outcomes: ANZCA annual scientific meeting

The Australian & New Zealand College of Anaesthetists Annual Scientific Meeting (ANZCA ASM) in May centred on improving outcomes in intensive care, anaesthesia and pain medicine. Participants explored scientific, cultural and management data that might benefit patients.

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Examining the evidence

Professor Ngan Kee (Hong Kong) opened the meeting with a critical appraisal of established obstetric anaesthetic practice and an examination of controversies surrounding newer methods and developments. Dogma founded in history and tradition is so well established that even small deviations from protocols run the risk of criticism (e.g. the benefits of pethidine (Tsui et al. 2004) or maternal oxygen (Khaw et al. 2002) during labour, spinal anaesthesia for delivery (Roberts et al. 1995) while new dogma rapidly establishes itself (e.g. new local anaesthetics are associated with less motor blockade (Lee et al. 2004). Professor David Menon (Cambridge, UK) reiterated the necessity of research in academic departments (Kitz and Biebuyck 1974). He discussed the establishment of a foundation course in scientific methods and research techniques, complemented by competitive, fully-funded, 12-month academic trainee attachments (the Cambridge SMART Course; Menon et al. 2004).

Subsequent sessions examined evidence for aspects of current practice. For example, data from the recent multi-centre study of intraoperative hypothermia for intracranial aneurysm surgery suggest no improvement of outcome with hypothermia (Todd et al. 2005). Professor Murkin (Ontario, Canada) discussed the impact of anaesthesia upon neurological outcomes in cardiovascular surgery (Iglesias and Murkin 2001; Murkin 2001). Neonates with congenital cardiac defects often present with abnormal MRI scans before surgery. After surgery new or worsening lesions may occur. The long term impact and our ability to effect pre-existing lesions or neurobehavioural outcome remains poorly quantified (Hovels-Gurich et al. 2002; Licht et al. 2004).

Cultural aspects

Both New Zealand (NZ) and Australia were outposts of the British Empire with large indigenous populations. Currently these indigenous peoples, along with others throughout the Pacific, share disproportionately poor health status when compared to their non-indigenous counterparts. The importance of developing services that are effective, efficient, acceptable and appropriate for NZ Maori and the provision of culturally specific services were elaborated. End of life issues and organ donation present the opportunity for misunderstanding because of different spiritual beliefs. The provision of intensive care and anaesthetic services by Australia and NZ to Pacific Nations through medical training, outreach programs, volunteer work and the establishment of structural frameworks was outlined.

One novel approach to servicing poor rural communities with predominant Maori populations within NZ was the use of a fully equipped operating room contained in a bus. Telecommunication links with major centres and the use of both trained operating personnel from a tertiary centre and local medical staff is proving highly beneficial to all parties. The service is funded by the NZ Government and provides a free service to patients.

Elements of management

A dramatic event in the life of an anaesthetist was explored using professional actors to present the drama. This format proved extremely effective. Substance abuse, health and the welfare of physicians along with practical issues concerning crisis intervention were outlined (Swanson et al. 2003). Physician physical and cognitive competence decline with age, but this may be balanced by skill and knowledge acquisition. The creation of expertise requires three essential factors – motivation, optimal environmental conditions and deliberate practice. Mistakes (e.g. drug errors) can be minimised by system improvements (Jensen et al. 2004; Runciman and Merry 2005).

External experts with business backgrounds and industrial psychologists with strong backgrounds in the health industry were used to found management and leadership discussions. The benefit of encouraging clinicians into leadership roles across all levels of medicine has advantages. There is a difference between leadership and management. Leadership must be nurtured, trust is important, organisation-wide learning and connectedness improves the workplace. Directors need to know how management distributes its resources and how funding is sourced in order to run a department. Ethical considerations need to be considered by all medical practitioners to provide justice for patients considering the rising cost for high quality care. The inclusion of medical staff outside our specialty and input from non medical experts (managers, government agencies, ethicists, psychologists) broadens our horizons.

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Review: **Euroanaesthesia** 2005, Vienna

Dr Drummond reviews the extremely successful annual meeting of the European Society of Anaesthesiologists, held in Vienna this year.

A record number of delegates attended this meeting (see figure 1). About 80% of them were qualified anaesthetists, and most had come to listen, rather than present new data. The largest number came from Germany and the UK, but smaller countries such as Austria Holland and Switzerland were well represented. Generally the opinion was that the meeting was very well organised, and that the presentations were of a high standard.

What was drawing these people? Most had planned to come for some time, and it was the quality of the scientific programme first and foremost which attracted attendance.

What were the fields of interest? The most popular field was intensive care, followed closely by regional anaesthesia. This was even more evident for those who came from Eastern European countries. Thus, intensive care is an important interest for many specialist anaesthetists, reflecting the pattern of work of many countries. The refresher courses were considered the most instructive, followed by the symposia.

What was on offer? It's hard to pick out the gems from about 55 refresher courses, and an equal number of symposia, workshops, and 700 or so abstracts. However, for me, the refresher courses that not only summarised, but also questioned our current practice were the most memorable, such as perioperative hyperglycaemia, or hyperchloraemia caused by sodium chloride infusions. Some problems continue to tax us: the criteria for blood administration for surgical and intensive care patients, and how to improve patient safety in our intrinsically hazardous and harmful environment. Some help with such problems comes from the use of studies using high-level simulation.

A topical session was organised, at relatively short notice, to consider the recent withdrawal of Cox 2 inhibitors from the market: a remarkable story of optimism and market forces, followed by re-assessment of clinical data, and a realisation that the biology was more complex than had first been realised. All of these matters were brought out in an interesting session, with a final re-assessment of the place these agents may now have. Unfortunately the evidence base for short-term use of these agents is limited to a few specific circumstances. A startlingly clear example of what is perhaps a frequent feature of "new treatments": the pendulum of opinion.

We had two large symposia, combining inputs from different groups: one on hypothermia in a number of clinical circumstances, and a second on the new European Guidelines for Cardiopulmonary Resuscitation, held jointly with the European Resuscitation Council. Such extended inputs exemplify the wide ranges of interest and diverse talents of anaesthetists in Europe. A more traditional field of interest is management of the airway, and we welcomed the European Airway Management Society into the meeting, with a whole day of discussion and additional workshops.

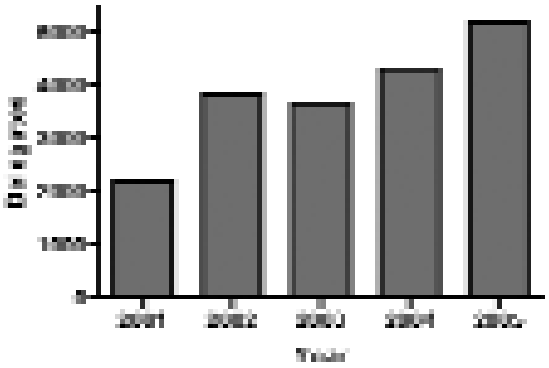

Figure 1. Euroanaesthesia Attendance

Finally of course, the cutting edge: the new material presented in the abstracts. Again, hard to choose: but some of the choice is made in the prize-winner session. Here, some superb presentations were made, including a very practical application of protective ventilation during surgery, and a series of impressive images of brain activity during visual stimulation during anaesthesia. The first prize went to an intriguing observational study that suggests that omega-3 fatty acid supplements improve survival in critically ill patients. This was a large study (661 patients) and shows what can be done by effective pooling of data from many centres (see the article by Dr Heller and colleagues on page 28 in this issue).

With this number of delegates, and the spread of sessions and topics, most people couldn't get to all the sessions they wanted to attend; most would have wanted to attend several more. We are probably at the "design limit" for a meeting such as this: we are now trying to think of more effective ways of presenting "something for everyone", perhaps along the fault line of education and research: but perhaps not too far apart since many would want to jump from one to the other!

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Antibiotics in the ICU: current use and future strategies

Professor Niederman discusses the reasons for increased antibiotic resistance, how to address these failings and innovative strategies for the future.

Nosocomial infection remains a major cause of morbidity and mortality in ICU patients throughout the world. Currently, the management of serious nosocomial infections is complicated by the high frequency of antibiotic resistance among the etiologic pathogens commonly present in critical care units. A number of factors, many under the control of physicians, contribute to this rising rate of antibiotic resistance (Niederman 2003):

- Using the wrong drug in the wrong patient;
- Overuse: antibiotics are not always needed;
- Failure to use the correct dose and optimize pharmacokinetics;
- Use of agents with broader spectrum than needed;
- Use of therapy for longer than needed.

There are three possible strategies to avoid excessive antibiotic usage: limiting use through better diagnosis, restricted access through antibiotic control programs, and "de-escalation", an approach of limited use after initial aggressive empiric therapy. This can be facilitated by the results of bacterial cultures and the patient's clinical response to initial therapy. De-escalation may be the most promising, assuring adequate therapy of infection while avoiding excessive use of antimicrobials (Hoffken and Niederman 2002; Ibrahim et al. 2001; Micek et al. 2004: Rello et al. in press).

Improving diagnostic methodology is a logical approach to avoid the overuse of antibiotics. For many infections (especially ventilator-associated pneumonia), antibiotics are used in patients who may not have infection, but perhaps fever and leukocytosis. Antibiotics could be used more rationally if they were limited to patients who definitely had infection, and improved diagnostic methodology might promote this goal. Unfortunately, in clinical practice, this approach can lead to some patients receiving therapy only when infection is far advanced and it is possibly too late to improve outcome. This controversy is most evident in the management of ventilator -associated pneumonia, where proponents of using a bacteriologic diagnosis have advocated the withholding of antibiotics unless lower respiratory tract samples confirm, or at least suggest, a high concentration of bacteria in lower respiratory secretions. Although such an approach can improve the specificity of diagnosis and use of antibiotics, it may do so at the expense of sensitivity and lead to certain patients being treated late in the course of illness (Luna et al. 2003; Niederman et al. 2005).

Control of resistance through restricted access to specific antibiotics has been attempted for years and this approach has been successful for altering and manipulating problem pathogens, but has not generally been successful at eliminating the problem of antibiotic resistance. One dramatic example of this experience occurred in a hospital in New York City in the mid-1990's, which experienced an epidemic of ceftazidime-resistant Klebsiella infections. The response to this epidemic was a restriction of the use of cephalosporins, which led to an 80% reduction in cephalosporin use and a 44% reduction in resistant Klebsiella organisms. Unfortunately, because antibiotic use could not be stopped completely, the reduction in cephalosporin use was accompanied by a 140% increase in the use of carbapenems, which resulted in a 68% increase in carbapenem-resistant Pseudomonas infection (Rahal et al. 1998). The editorial which accompanied the report of this epidemic described this phenomenon as "squeezing the balloon"; restricted access to antibiotics successfully manipulated the problem pathogens, without eliminating antimicrobial resistance.

De-escalation, which implies aggressive empiric therapy, using multiple antibiotics followed by narrowing, focusing, and shortening duration of therapy, as culture and clinical data become available, seems a more logical approach. De-escalation has been employed in patients with ventilator-associated pneumonia and has effectively led to good outcomes (Hoffken and Niederman 2002; Ibrahim et al. 2001; Micek et al. 2004: Rello et al. in press). In studies of this approach, the use of an algorithm for initial empiric therapy has resulted in a high frequency of initially appropriate therapy, which in turn has permitted a protocol-driven reduction in duration of therapy, with less total antibiotic usage, while still preserving good clinical outcomes. There are many opportunities to further enhance our use of de-escalation in patients with ventilator-associated pneumonia (Niederman 2004). These include stopping antibiotic administration in patients with negative cultures and an improving clinical course, since these patients may not even have infection. It may also be possible to shorten the

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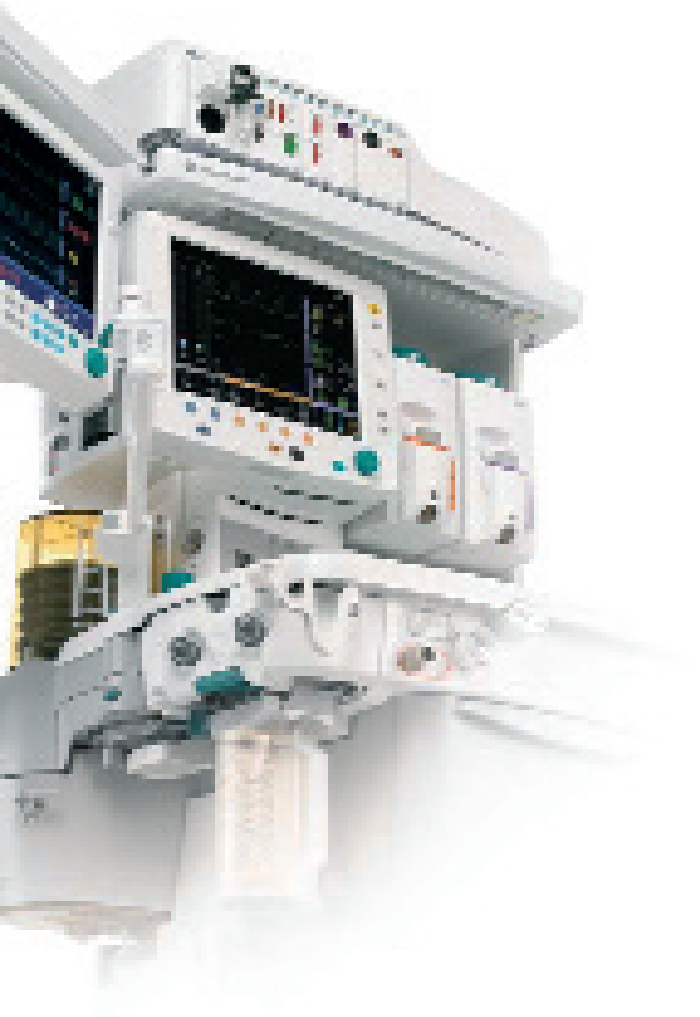

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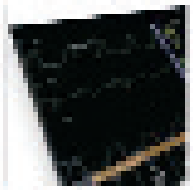

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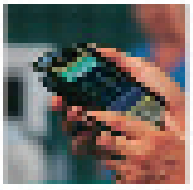

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imagination at work

durations of therapy, and also avoid the prolonged use of combination therapy in patients who are infected with highly resistant pathogens such as Pseudomonas aeruginosa. Future studies are needed to explore the limits of de-escalation therapy and its potential.

One way to further control antibiotic resistance is to optimize our treatment of infection, and often this requires the use of "adequate" therapy. Adequate therapy, as defined in the 2005 ATS/IDSA Nosocomial Pneumonia Guidelines, implies not only using an antibiotic that matches the sensitivities of the etiologic organism, but also using that antibiotic in the correct dose and having it penetrate to the site of infection (Niederman et al. 2005). Use of incorrect dosing has been a major problem in the treatment of seriously ill patients and current guidelines for nosocomial pneumonia have emphasized the need to maximize dosing to rapidly kill bacteria and minimize the selection of antibiotic resistance.

In the future, new approaches will be needed to combat antimicrobial resistance. These will focus on both the responsible usage of antibiotics and the development of new antimicrobial agents. While our current antibiotics are being challenged, responsible usage programs that emphasize the avoidance of therapy when not needed and the use of a tailored spectrum of therapy appropriate for the identified pathogens, is an achievable objective. More challenging is the development of new antimicrobial antibiotics.

Over the past decade we have seen a dramatic rise in antimicrobial resistance, accompanied by a decline in research and development into new antimicrobial agents. From 1983 to 2002, there has been a 50% decline in the United States' Food and Drug Administrations approval of new antimicrobial agents, and the majority of new molecular entities being developed by the pharmaceutical industry are focused on chronic diseases and not acute infections (Spellberg et al. 2004). Even in the area of infectious diseases, many new agents are being developed for HIV infection and not for bacterial diseases. Of the new products that have appeared in the last several years, there is very little innovation and generally products have been minor modifications of existing agents.

One challenge for the future will be to develop new drugs with new mechanisms of action (Cassell and Mekalanos 2001). For example, many bacteria, both gram-positive and gram-negative, develop antimicrobial resistance through efflux mechanisms, which act to remove antibiotics from the interior of the microbe. Development of a strategy to combat bacterial efflux mechanisms could potentially restore the efficacy of our existing agents. Other approaches could include the development of "xenobiotics", which are non-natural compounds never seen by bacteria that could potentially thwart antimicrobial resistance mechanisms; these could be achieved by synthetic chemistry advances. At the same time, bacterial genomics can help us to find new targets in the bacteria for the development of new types of therapy. Genomics would allow us to avoid adverse events by identifying agents that have bacterial targets that are different from human genes. In addition, functional genomics could define targets that are essential for bacterial growth, by identifying which genes are over-expressed during an episode of infection. In addition, genomics can help us identify bacterial virulence factors which are expressed during infection and these virulence factors themselves can be targeted with a variety of agents, including immunotherapy. Microchip gene arrays can help identify which bacterial genes are expressed during infection, and these too can be targeted by new agents.

A number of novel antibacterial substances could also be developed, which differ from our current antibiotics (Bryskier 1999). For example, peptides with antimicrobial activity currently exist, but are not used in humans. Protegrins are an example of an animal host defense system of peptide antimicrobials, which have the potential to serve as novel antibacterial agents for humans. Unfortunately, a recent clinical trial with iseganan, a peptide antimicrobial, was unsuccessful in preventing ventilator-associated pneumonia. Another approach would be the development of probiotics, which can be defined as microorganisms that can be put into patients because of their beneficial effects to humans. For example, bacteria that produce lactic acid could be applied to mucosal surfaces, where they could compete for nutrients and adhesion space with pathogenic bacteria. These organisms could also be immunomodulating, producing exo-products, which are inherently antibacterial.

Ultimately the challenge for the future will be a careful blending of preserving our current antimicrobial agents through a responsible usage program, and the development of new knowledge to better target bacteria and develop new antimicrobial agents. Unfortunately, the motivation for industry to do this may be limited by economics, at a time when these new agents are most needed for the well-being of our patients.

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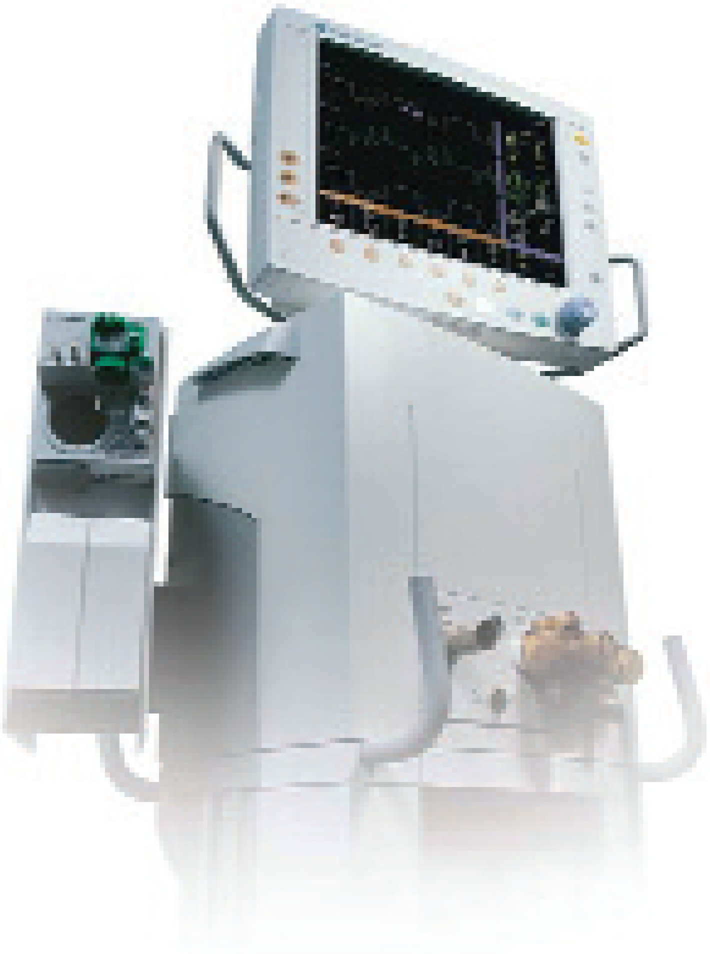

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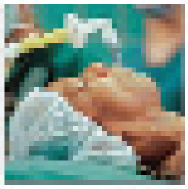

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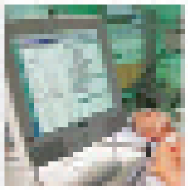

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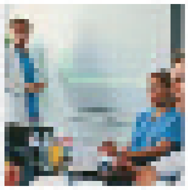

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Optimizing **antimicrobial therapy** in critically ill patients

Dr Laterre presents the case for appropriate dose adjustment of antimicrobial agents with critically ill patients.

Inadequate antimicrobial therapy during the first 24 hours of severe infection is associated with an increased morbidity and mortality. Antibiotic readjustment following pathogen susceptibility does not improve outcome. This has been demonstrated in various clinical conditions including community-acquired and ventilator- associated pneumonia (Alvarez-Luna 1996; Kollef 1999). Optimal antibiotic therapy in critically ill patients is not limited to adequate antimicrobial agent selection, but should include appropriate dose adjustment.

Bactericidal activity depends on pharmacokinetic and pharmacodynamic parameters. Typically, amino- glycosides and fluoroquinolones activity is concentration-dependent and these agents possess a prolonged post-antibiotic effect. High peak serum concentration to minimum inhibitory concentration (MIC) ratio and high area under the curve to MIC (AUIC) should be reached for aminoglycosides and fluoroquinolones to achieve clinical success. For many other antimicrobials including all beta-lactams, bactericidal activity depends on the length of time that the concentration remains above the MIC for the causative pathogen. It has been recommended to maintain a serum concentration 4 to 5 times above the MIC with these agent, to achieve maximal killing activity (Graig 1992; Mouton 1994).

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Most dosage regimens for drugs have been based on pharmacokinetic data obtained from healthy volunteers. However, drug disposition in critically ill patients varies significantly from healthy subjects. Physicians initiating antimicrobial therapy in critically ill patients face multiple challenges; empirical treatment should be prompt and cover all expected pathogens often presenting a reduced susceptibility. The inoculums may be large and the drug penetration poor. The drug distribution volume is rarely predictable, the serum concentration is not well correlated to tissue concentration and antibiotic protein-binding determination may not available at the bedside. Finally, severe sepsis is a dynamic process and pharmacokinetic parameters present at baseline change rapidly within a few days. All these elements may lead to clinical failure, emergence of resistance or toxicity.

To achieve optimal therapy, loading dose should be adjusted for severity and not based on renal function. Drug distribution volume is increased in most critically ill patients at the time shock develops and the first dose should be maintained or increased compared to less severe patients, even in the presence of acute renal failure. The subsequent doses will be adapted on creatinine clearance for the vast majority of antibiotics. For aminoglycosides in particular, peak serum concentration to MIC ratio should be above 10. This corresponds to a target peak serum value of 40 to 60 µg/ml for amikacin (Bartal 2003). Data from studies in critically ill patients demonstrate that this can only be achieved in all patients if the loading dose of amikacin is well above 15 mg/kg.

For beta-lactams, the time above the MIC is considered as the best parameter to predict bactericidal activity and the antibiotic serum concentration should reach 4 to 5 times the MIC to exert maximal killing rate. Also, serum drug concentrations too close to MIC are at risk of bacterial regrowth and potential emergence of resistance. These in vitro data support the indication of beta-lactams administration by a continuous infusion in the ICU setting. This method of administration provides a steady state serum drug concentration, eliminates the problem of the short half-life of most of these agents, and the values obtained in the serum are much more predictable compared to intermittent infusion. Also, antibiotic tissue and extravascular fluids concentrations are higher than the ones obtained by bolus infusion (Buijk 2002). To date, no large randomized controlled trial has been performed to demonstrate the impact on outcome of this mode of antibiotic administration, but in vitro studies and pharmacokinetic data collected in critically ill patients support the potential benefits of this mode of administration on bacterial killing rate, emergence of resistance and eventually on the clinical success rate. A normal to increased loading dose of beta-lactams must be given first to initiate the continuous infusion. After day one, the total daily dose needs to be adjusted for renal function.

The large variability in distribution volume together with a modified drug half-life supports the need to monitor antibiotics serum concentration in severely ill patients. Unfortunately this is not possible routinely for the beta-lactams, but should be recommended for aminoglycosides and glycopeptides. This would not only help to limit the risk of toxicity, but also optimize antibiotic therapy in critically ill patients.

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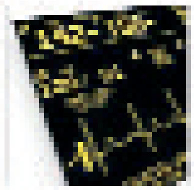

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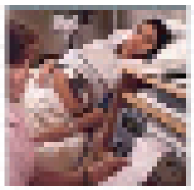

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GenOSept: **genetics** of sepsis and septic shock

Frank Stüber introduces an EU funded project, GenOSept, which aims to unravel the genetic predisposition of sepsis and septic shock.

Introduction

The European Society of Intensive Care Medicine (ESICM) has recently signed a contract with the European Commission to conduct a large diagnostic trial funded by the EU's 6th framework programme. ESICM leads a consortium of 14 partners which conducts the project GenOSept to unravel the genetic predisposition of sepsis and septic shock. For the first time, a major genetic epidemiologic study in intensive care medicine has been granted by public European funds. This represents an outstanding opportunity to conduct cutting edge diagnostic research on a European level, for ESICM as an international scientific society to ultimately contribute to improvement of intensive care.

Genetic studies within the intensive care research community have gained considerable attention throughout the last decade. Many genotyping results in intensive care have been published to date. Most of them relate to the genetic predisposition for the development of severe sepsis or death from systemic infection. There is a major publication bias regarding genotyping results. Most of the published studies show significant positive associations between gene variants and the phenotype (i.e. severe sepsis or adverse outcomes of sepsis). These results are indeed exciting, but on the other hand, many genotyping results which do not show positive association with disease remain unpublished. Some studies appear to be statistically underpowered which is usually reflected by low numbers of patients included, prompting a high probability of beta type error. A statistically significant result ($p<0.05$) of an underpowered study may not be reproducible. Therefore, large well designed genetic epidemiologic trials are needed to provide conclusive answers to the question of the genetic predisposition for sepsis and septic shock.

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Why GenOSept is important

Morbidity and mortality of critical illness is still mainly determined by the incidence and course of sepsis and its sequelae. Evidence based efforts to improve standard care of sepsis patients are bundled in major campaigns like the surviving sepsis campaign of the Societies of Intensive Care Medicine of Europe and North America, as well as the International Sepsis Forum. In addition, new definitions and diagnostic concepts are in the process of evaluation to facilitate early diagnosis and evidence based therapies. These advances comprise the PIRO concept, which is designed to classify states of sepsis in the future. The PIRO concept's P stands for predisposition and GenOSept is designed to deliver information on patterns of genomic variation associated with predisposition in this context. Genetic predisposition for the incidence and outcome of sepsis has been recognized and suggested as a possible powerful tool for future risk stratification and even as inclusion criteria for therapeutic trials. Genomics research has, therefore, entered a new area of complex diseases of which sepsis remains the greatest challenge in acute medicine. Genomic research and genotyping in the critically ill will not stand isolated, but will be integrated in the field of functional genomics. GenOSept also contains a module which links patterns gene expression with patterns of genomic variation in corresponding genes. Genomic variants may influence the individual phenotype including gene expression levels and patterns as well as protein levels and protein structure. Genotyping techniques have advanced to high throughput methodology employing a high degree of automation; genomic microarrays for genotyping have become technically feasible. Standards as well as quality control measures of genotyping are currently being implemented and tested in ongoing and oncoming large scale genetic epidemiologic studies in intensive care medicine, not only in Europe but also in the United States. It will be finally of major importance, also to understand the impact of genomic variants on the fate of intensive care patients of diverse ethnicity. As a possible result, future intensive care physicians may have access to readily available genetic risk patterns including pharmacogenetics of their patients which not only allows for better risk stratification, but may also help tailor individual patient care and drug therapy.

Basics of genomic variation

Human genotyping depicts a biochemical analysis of human DNA. DNA consists of a long chain of some 6 billion molecules, i.e. nucleotides Adenine- Cytosine- Guanine- and Thymine, carrying the genetic code (genes) for peptides and proteins, which constitute living organisms. DNA is found in the nucleus of cells where it is organized into highly specific nucleotide sequences that define each gene on the 23 chromo-

somes, which occur in a set of two in somatic cells (46 chromosomes) and in a single set in germline cells. An organized sequence of nucleotides that "spells out" the information necessary to construct a specific messenger called "messenger RNA", in turn, translates into a specific protein. The human genome project's results have reduced our expectation of the number of genes existing in the human DNA code from initially 100,000 to some 25,000. All human beings carry the same genes, apart from the genes coded on allosomes defining gender – the X and Y chromosomes.

In contrast to the comparable set of genes between individuals, there is considerable interindividual difference in base sequences encoding these genes. When the chromosomes of two humans are compared, their DNA sequences can be identical for hundreds of bases. But at about one in every 1,200 bases, on average, the sequences will differ. One person might have an Adenine at that location, while another person has a Guanine, or a person might have extra bases at a given location or a missing segment of DNA. Each distinct "spelling" of a chromosomal region is called an allele, and a collection of alleles in a person's chromosomes is known as a genotype. Although many "spellings" of a gene, i.e. alleles, may exist, just two of them, because of the two sets of chromosomes, form the genotype.

Differences in individual bases are the most common type of genetic variation. These genetic differences are known as single nucleotide polymorphisms, or SNPs. Approximately 10 million SNPs have been estimated to occur commonly (frequency > 1% in the population) in the human genome. Rare variants (frequency < 1%) are called "mutations". For geneticists SNPs act as markers to locate genes in DNA sequences. Say that a spelling change in a gene increases the risk of suffering from organ failure when the host is systemically infected, but researchers do not know where in our chromosomes that gene is located. They could compare the SNPs in patients who have organ failure with the SNPs of patients who do not. If a particular SNP is more common among patients with organ failure, that SNP could be used as a pointer to locate and identify the gene involved in the disease.

Goal of the project

The goal of GenOSept is to identify patients at high risk for fatal outcome from severe sepsis based on community aquired pneumonia, fecal peritonitis, necrotizing pancreatitis and meningococcal disease by means of genetic analysis. Some 5000 patients will be recruited throughout Europe, followed up on their clinical course and will have their individual genetic variations associated with outcome parameters. Finally, a diagnostic set of genetic markers might be provided to be used for risk stratification and as determinants of genetic predisposition within the PIRO concept.

Progress of the project

GenOSept started officially in February 2005. Many preparations for the clinical study, namely the recruitment of patients, needed to be done and are still in progress. The consortium has also developed applications to local ethics boards and these have been approved by a European ethics committee appointed by the European Commission. The ethics review process at local institutions is ongoing. A web based electronic case report form has been developed for easy online data entry. European intensive care institutions and their ICUs are welcome to participate in GenOSept; please do not hesitate to contact public@esicm.org and visit the website at www.esicm.org. ESICM is happy to refer you to national GenOSept coordinators. Start of recruitment will be the autumn/winter period of 2005.

Possible impact on management of sepsis

GenOSept hopefully will contribute to further fill the PIRO concept to determine the individual predisposition of sepsis and its sequelae. There are many aspects how genetic studies ultimately can impact management of sepsis. GenOSept is one of the first large scale genetic studies in intensive care medicine to focus on identification of high risk sepsis patients.

First of all, genetic information is for a lifetime, it does not change. It can be used to stratify preoperative patients undergoing high risk surgical procedures. Special preventive measures may be taken or surgical procedures adjusted. Some high risk patients appear to have higher release of primary or secondary sepsis mediators because of their genetic predisposition. Future interventional studies in sepsis patients may stratify cohorts according to genotype. Ultimately, genotyping may help to direct specific therapeutics and resources to those who benefit. GenOSept is a first, but important step in this direction.

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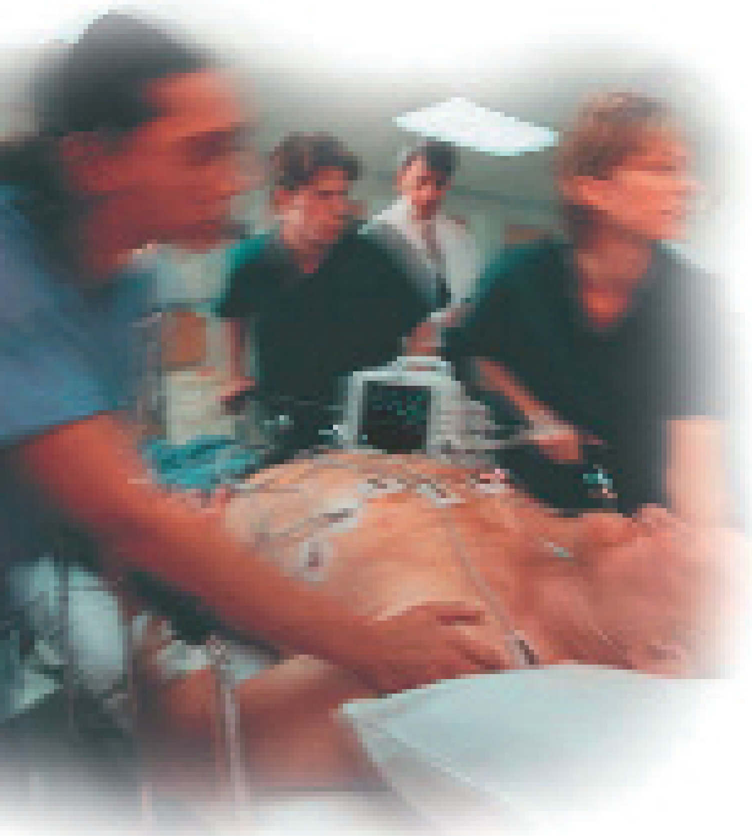

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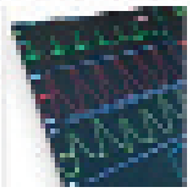

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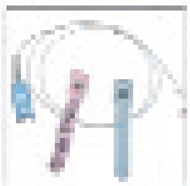

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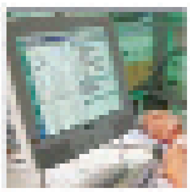

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Pulse high volume **haemofiltration** (PHVHF): novel treatment for sepsis

Pulse high volume haemofiltration (PHVHF) in the treatment of sepsis may offer a practical, efficacious and relatively inexpensive compromise between continuous renal replacement therapy (CRRT) and high volume haemofiltration (HVHF).

Severe sepsis represents the leading cause of mortality and morbidity in critically ill patients world wide. (Angus et al. 2001; Friedman et al. 1998; Laupland et al. 2004). The cornerstone of therapy continues to be early recognition, prompt initiation of antibiotic therapy, and elimination of the source of infection. Goal-directed haemodynamic, ventilatory, and metabolic support are also crucial. To date, the adjuvant treatment of sepsis remains a major therapeutic challenge. Based on humoral theory of sepsis, both pro- and anti inflammatory factors become upregulated with complex interactions leading to hyperinflammation and/or immunoparalysis. Trials to improve survival with anti inflammatory therapeutic strategies have been disappointing (Wheeler and Bernard 1999). Novel therapies, such as drotrecogin alfa (activated), are promising. Interestingly, these new tools do not act on specific targets, but rather act globally or non-specifically.

Blood purification using continuous renal replacement therapy (CRRT) is theoretically attractive potentially providing a restoration of humoral homeostasis by avoiding both excessive inflammation and counter-inflammation. Non specific and continuous removal of pro- or anti-inflammatory soluble mediators, may be the most logical and adequate approach to a complex and long-running process like sepsis.

CRRT has commonly used three types of mechanisms: convection, diffusion and adsorption. In addition to removing excess fluid, convective modalities have the advantage of removing higher molecular weight substances, which include many inflammatory mediators. Adsorption to the membrane is a process that saturates in a few hours. An increased efficiency can be obtained by increasing membrane sieving or the rate of ultrafiltration (Langsdorf and Zydney 1994) as in a modality called high volume haemofiltration (HVHF).

In vitro studies have shown that haemofiltration is capable of removing nearly every known substance involved in sepsis to a certain degree (De Vriese et al. 1999). Animal studies have shown a beneficial effect of HVHF on survival (Grootendorst et al. 1992; Rogiers et al. 1999; Yakebas et al. 2001), haemodynamics (Bellomo et al. 2000; Rogiers et al. 1999; Yakebas et al. 2001), and improvement in immune cell hyporesponsiveness in endotoxemic models (Rogiers et al. 1999). Human studies have demonstrated that HVHF improves haemodyamics decreasing vasopressor requirement (Cole et al. 2001; Honore et al. 1998; Jannes-Boyau et al. 2004) and survival of septic patients (Jannes-Boyau et al. 2004; Oudemans-van Straaten et al.1999). Because of the requirements of high blood flows, tight ultrafiltration control, and large amounts of sterile fluids, HVHF is difficult to perform over 24 hours. Nevertheless, continuity of treatment seems to be as important as the high volume fluid exchange.

We therefore proposed "Pulse high volume haemofiltration" (PHVHF), which is a daily schedule of HVHF (85 ml/kg/h) for 6-8 h followed by continuous venovenous haemofiltration (CVVH) (at 35 ml/kg/hr) for the remaining time. This leads to a cumulative dose of approximately 50 ml/kg/hr. We studied 15 critically ill patients (7 male, mean APACHE II score 31.2, mean SAPS II 62, mean SOFA 14.2) with severe sepsis (Ratanarat et al. 2005). PHVHF was performed with a blood flow rate of 250-300 ml/min. Bicarbonate-based replacement fluid was used at the ratio of 1:1 in simultaneous pre-post- dilution. No treatment was prematurely discontinued because of extracorporeal circuit clotting. Haemodynamics improved, allowing a significant reduction of noradrenaline dose and this effect was maintained at 6 and 12 h after treatment (p=0.001). SBP also improved (p=0.04). Mean daily Kt/V was 1.92. Predicted mortality were 72% (APACHE II score) and 68% (SAPS II score), and the observed 28-day mortality was 47%. There is growing evidence for the role of apoptosis in organ injury during sepsis and inflammation. We found that septic plasma had remarkably pro-apoptotic effect on U937 human monocytic cells compared with control. Pulse HVHF, but not CVVH, significantly reduced the pro-apoptotic plasma activity already at 1h and this was maintained unvaried at 4 and 12h (Brendolan et al. 2004).

In summary, PHVHF appears to be a feasibly promising technique for the treatment of severe sepsis providing haemodynamic benefits, positive biological effects and improved survival while it represents a practical and less expensive compromise between CRRT and HVHF.

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Omega-3 fatty acids in the ICU - a remunerative investment?

Omega-3 fatty acids improve recovery and patient outcome by lowering the overwhelming self-destructing inflammatory response but at the same time improving host defence. Despite higher costs, this strategy seems to be a remunerative investment.

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Introduction

Most recent recommendations of the "surviving sepsis campaign" by the Society of Critical Care Medicine and others set the goal of devising a single concept (Levy et al. 2004). In the light of the "PIRO" concept therapeutic options of critical illness should be intensively investigated regarding individual Pre-existing disease, type of Infection, Response of the organism and the respective degree of Organ failure. Our group and others have been working on the cutting edge of omega-3 fatty acid (FA) research for more than a decade, beginning in animal models of acute illness and then further developing and introducing concepts into clinical practice (Heller et al. 2003, 2004 & 2005). Commercially available omega-3 FA enriched solutions are available for an optimal clinical (enteral and parenteral) nutrition therapy. Present data indicate definitive dose-related beneficial effects of omega-3 FA on outcome in PIRO-selected patients in various diseases (Heller et al. 2005).

The Gordian knot

The key issue in the development of systemic inflammatory response syndrome (SIRS) and septic organ failure is the complex pathophysiologic sequelae, characterized by a pro-inflammatory and simultaneous compensatory anti-inflammatory response. This, to a degree, represents a sort of chaos within the mechanisms of host response termed Mixed Antagonistic Response Syndrome (MARS). The net effect depends on the predominance of either anti-inflammatory or pro-inflammatory reactions and may vary time dependently (Bone 1996).

We know today that critical illness may be beneficially modulated by augmentation of distinct defence mechanisms, while other mechanisms need to be suppressed simultaneously. The nutritional state of man is determined by the constituents of nutrition (see figure 1). Concerning Lipids, the ratio between omega-3 and omega-6 FA determines the type and intensity of the inflammatory reaction, in terms of lipid mediators and cytokine production. While arachidonic acid (AA)-metabolites (black boxes in figure 1) may induce hyper-inflammation, eicosapentaenoic acid (EPA)-derived mediators are more immunoneutral. The magic solution to this multiplicity of tasks, reducing overwhelming systemic inflammatory reaction and preventing organ failure, has still to be found. However, the effects of omega-3 FAs supplementation may be one key (Heller et al. 2005).

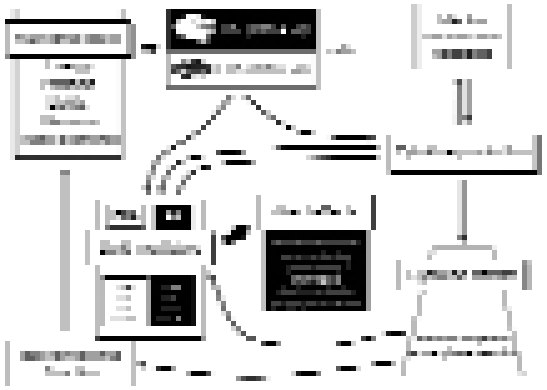

Figure 1. Effects of the omega-6 (black) / omega-3 (white) FA ratio on the regulation of inflammation.

Putting pieces together to improve patient care

During the last decade pharmacological aspects of omega-3 FA have been intensively investigated (Mayer et al. 2002; Pacht et al. 2003) and have contributed to a better understanding of the effects associated with FA administration (see table 1). Besides being compact energy carriers and membrane components, lipids hold crucial functions as modulators of biochemical processes (Heller et al. 2003). Therefore the combination of energetic, pharmacological, and essential properties must be the object of an optimized individual nutritional concept.

Accordingly, a down-regulation of the inflammatory response, and, simultaneously, a smaller postoperative immune suppression was associated with less severe infections after omega-3 FA. In addition, a shorter ICU- and hospital stay has been observed after perioperative fish oil supplementation (see figures 2 and 3). In the critically ill, on the other hand, early use is advisable, before complex inflammatory host actions and overshooting reactions during SIRS and sepsis commencing (Heller et al. 2005).

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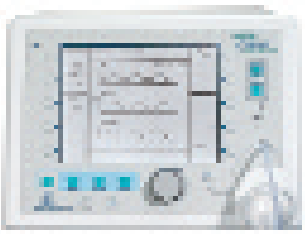

Table 1. Effects of dietary supplementation with omega-3 FAs (fish oil) in various diseases

Disorder	Effect of Omega-3 FAs
Coronary heart disease	re-infarction rate, coronary sclerosis and re-stenosis after PTCA decreased antiarrhythmic effects
Neoplasia/ tumour growth	modulation of oncogene expression, improvement of tumoricidal mechanisms, reduction of cachexia
Surgical patients	complications and infection rates reduced
Peritonitis and abdominal sepsis	nosocomial infections and antibiotic demand reduced, survival improved, length of hospital stay reduced
Acute lung injury/ ARDS	decrease of capillary leakage, shorter ventilator support, earlier ICU discharge
Bacteraemia	rapid termination bacteraemia and improvement of macrophage activity
Endotoxaemia	improvement of splanchnic blood flow and bacterial killing
Cystic fibrosis	improvement of vital capacity
Rheumatoid arthritis	improvement of clinical condition
Psoriasis	improvement of clinical condition
Ulcerative colitis	improvement of clinical condition
Bipolar disorder	longer event-free intervals in manic-depressive disease

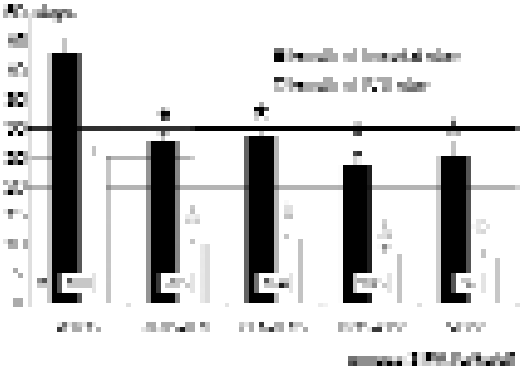

Figure 2. Dose-related length of stay (mean and SD) black columns in hospital, white columns in ICU. Between-group comparisons are SAPS II and mortality adjusted in statistical analysis. White asterisk ICU stay p<0.001 vs. dose lower than 0.05g/kg/d; black asterisk hospital stay p<0.001 vs. dose lower than 0.05g/kg/d; observational multi-centre trial.

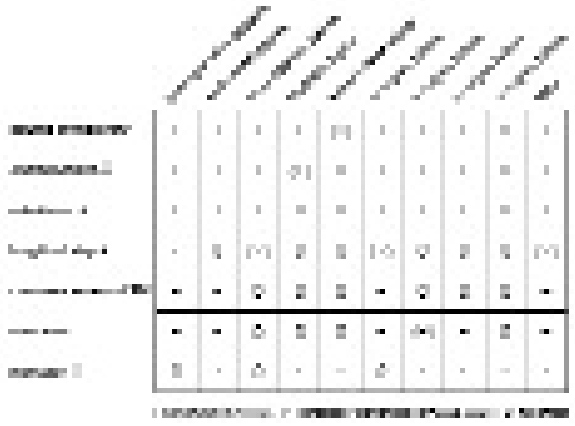

Figure 3. Effect of supplementation with omega-3 FA on the global course of recovery, reduction of complications of any cause, reduction of infections, reduction of length of stay, the ability to commence enteral nutrition (EN), and tolerance of omega-3 lipid emulsion in diagnoses- and organ failure subgroups as judged by the attending physician and reduction of mortality as predicted by SAPS II; observational multi-centre trial with 664 patients.

Consequently, lipids should cover 30-50% of the energy demand. They can be infused after securing haemodynamic stability of the patient (about 15-30 hours after trauma). New concepts of fat nutrition therapy should aim to reduce arachidonic acid precursors (omega-6 FAs) to their level of essentiality. Fish oil should be added up to 0.1-0.2 g/kg/d. To what extent olive oil, a monounsaturated FA, may play a role in the future cannot not be assessed at the moment. Nevertheless, an ideal FA combination still needs to be defined. Future combinations administered in patients could consist of 30-40% LCTs with 40-50% MCTs (ideally as structured lipids), 15-20% fish oil and possibly 15-20% olive oil.

Outlook

Several recent studies suggest beneficial effects of omega-3 FA on recovery- and outcome-parameters in patients with major surgical interventions and in critically ill patients by lowering the extent of overwhelming self-destructing inflammatory response (Gadek et al. 1999; Grecu et al. 2003; Mayer 2002), but at the same time improving host defence. Furthermore, increasing clinical data supports the hypothesis that an optimum preoperative composition of cell membranes, before initiation of the inflammatory cascade, is more effective with respect to modulation of cytokine biology and patient recovery than mere postoperative nutrition therapy (Tsekos et al. 2004; Weiss et al. 2002). According to the most recent recommendations, we found omega-3 FA to be a valuable nutritional additive to improve outcome in patients with peritonitis, trauma, abdominal SIRS and sepsis, but also to reduce infections and complication rates in postoperative patients. Despite higher costs for omega-3 FA emulsions in clinical nutrition, in our view this strategy is a remunerative investment.

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Treatment of severe sepsis and septic shock in Germany – the gap between **perception and practice**

Research into perceived and actual treatment behaviour in German ICUs highlights the barriers to the adoption of evidence based guidelines for the treatment of sepsis and septic shock.

Epidemiology

The German Competence Network for Sepsis (SepNet) has completed a prospective observational cross-sectional and representative study, "Prevalence of severe sepsis and septic shock in Intensive Care Units in Germany". From this study, the incidence of sepsis in German ICUs can be estimated to be 75,000 cases per year (110 per 100,000 inhabitants), comparable to the incidence of acute myocardial infarction (143 per 100,000 inhabitants). With an estimated 40,000 deaths per year, sepsis is the third most frequent cause of death in Germany, after coronary artery disease and acute myocardial infarction (German Ministry of Science and Education 2004). Furthermore, sepsis substantially reduces the quality of life of those who survive and is a major economic burden for the healthcare system. In Germany 21-46% of total costs of intensive care are spent on sepsis treatment (direct costs: 1.7 billion Euro, indirect costs: 4.5 billion Euro).
Recently several studies have demonstrated that various therapeutic and preventive strategies can reduce sepsis mortality and the incidence of sepsis by between 6.1 to 16% (absolute, not relative mortality reduction) compared with the non-interventional study groups (Dellinger et al. 2004; The International Sepsis Forum 2001). For example low-pressure ventilatory strategies have resulted in relative mortality reduction from 39.8 to 31.0%, goal-based haemodynamic support (EGDT) from 46.5 to 30.5%, targeted treatment with hydrocortisone 65.0 to 50.0% and treatment with rhAPC 30.8 to 24.7%. SepNet has defined recommendations for the diagnosis and treatment of sepsis. These recommendations are graded based on a modified Delphi methodology and have been developed in accordance with the recommendations of the International Sepsis Forum (2001) and the International Surviving Sepsis Campaign (Dellinger et al. 2004).

Barriers to implementation of guidelines

Guidelines, however, are not self implementing. Manifest difficulties arising when clinical trials are translated into clinical practice suggest multiple physician, patient and health system related barriers to implementation. In the aforementioned German Prevelance Study, 454 ICU-directors from 310 hospitals – chosen as a random sample representing a total of over 2000 ICUs with approximately 20,000 beds nationwide – were interviewed about whether guidelines recommended by the Surviving Sepsis Campaign (SSC) with varying degrees of evidence were implemented ("interview"). These data were compared with

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Table 1. Example inconsistencies in ICU Directors' perceptions of treatment behaviours and actual treatment behaviours

ICU directors' perceptions of their treatment behaviours (interviews)	Actual treatments (audit of patient files)
91.6% using lung protective ventilation (tidal volume: 6 ml/kg/adjusted BW) in patients with Acute Lung Injury (ALI) or Acute Respiratory Distress Syndrome (ARDS) with severe sepsis always or frequently.	4.2% adherence to guidelines in patients with ALI/ARDS
67.4% using intensive insulin therapy for glycemic control always or frequently	8.8% of patients had blood glucose levels between 80-110 mg/dl 34.6% had blood glucose levels between 80-150 mg/dl
79.0% using low-dose hydrocortisone for treatment of patients with septic shock	30.6% of patients with septic shock were treated with low-dose hydrocortisone
0.9% using activated protein C (low compared to recommendations)	0.9% of patients were treated with activated protein C (low compared to recommendations)
92.4% adherence to the recommendation not to use low-dose dopamine for protection of renal failure and antithrombin as adjunctive therapy	94.6% of patients did not receive these treatments

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data from 415 files of patients with severe sepsis on the day of the study ("audit"). Table 1 shows four examples of poor correlation between perceived and actual implementation of evidence based guidelines and one example of good correlation.

In this highly representative sample of German ICUs, actual therapy habits in severe sepsis and septic shock differ from perceived therapy habits and furthermore do not comply with recommended guidelines. It is known from other areas of medical care that a gap exists between trial results and realisation into clinical practice (Spiegel et al. 2003).

Solutions

Additional strategies are necessary to encourage physicians, nurses and hospital boards to accept and actually use these guidelines. Novel technologies must be used which are derived from total quality management and other quality improvement methods. Multifaceted interventions that have proven to be most successful combine real time feedback, education, marketing, academic detailing, and reminders or prompting (Bero et al. 1998; Davis and Taylor-Vaisey 1997; Smith 2000; Weingarten et al. 1994). An "opinion-leader" and a local research nurse should be responsible for the implementation and documentation of the goals of care (quality indicators) in each hospital, and staff kick-off meetings about the goals of care. A Sepsis Tool Kit" should be prepared, with preset orders, critical pathways for nurses, pocket guidelines for physicians, signs and visual cues at the bedside and visual triggers within charting systems.

To achieve a 25% reduction in sepsis mortality within five years (by 2009) by implementing evidence-based guidelines for the management of septic patients as outlined by the SSC, the Institute for Healthcare Improvement (IHI) has recently developed bundle elements for sepsis treatment (http://www.ihi.org/). This benchmark IHI project uses an Internet-based data collection tool enabling ICUs to improve their standards of care over time.

The 2nd International Congress on Sepsis and Multiorgan Dysfunction, Weimar, September 7-10 (www.sepsis-gesellschaft.de), will focus on implementation strategies to close the gap between perception and practice.

Performance evaluation of European pressure sensors

Dr Cochard explains the significance of inaccuracy with pressure sensors, describes a simple technique to evaluate accuracy and reports on tests with eight European products.

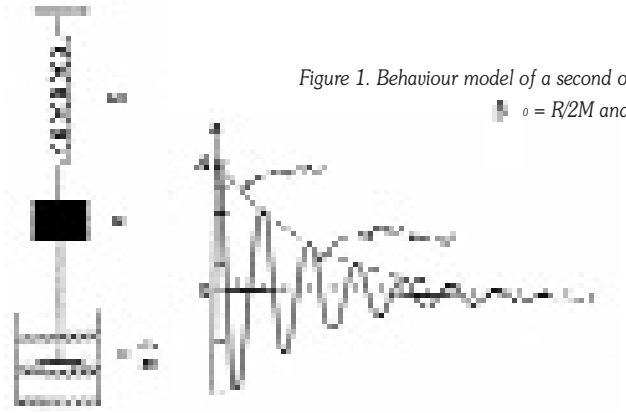

Figure 1. Behaviour model of a second order system. $\omega_0 = R/2M$ and $\omega_d = [R/2M]$

Introduction

The arterial pressure is a basic haemodynamic parameter used in routine clinical work to assess the cardiovascular status, particularly in intensive care patients. Measuring it serves as a guide to therapeutic interventions. Inaccurate measurement may lead to erroneous diagnosis or to an inadequate, unnecessary or potentially dangerous intervention. However, the biomechanical characteristics of these devices can modify the response of the sensor to a pressure signal (Gardner 1997; Kleinman 1989), affecting the accuracy of measurements.

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Principles

The pressure signal is recorded in an artery by means of a catheter and transmitted to the sensor by tubing filled with physiological serum. The sensor comprises a deformable membrane on which is fixed a Wheatstone bridge. This transforms the signal of deformation of the membrane produced by the pressure signal into an electrical signal transmitted to the monitor, which is then converted into an analogue signal. This measurement depends directly on the biomechanical characteristics of the system used: strictly speaking it is a sensor but in reality there are tubing and accessories forming the relay between the pressure signal and the monitor. Biomechanical characteristics confer visco-elastic properties on the intervening system that are capable of modifying the scale of the required clinical criteria, the quantitative value of the arterial pressure and the shape of the curve, which is not without interest in the analysis of a given haemodynamic situation (Promonet et al. 2000; Todorovic et al. 1996).

Typically the pressure system (catheter pressure transducer system) used in intensive care is a 2nd order dynamic system whose behaviour, when one applies or releases a stress to it abruptly, is analogous to the behaviour of a mass, joined to a fixed point by a spring on one side, and to a disk immersed in a liquid possessing a given viscosity, on the other side. The system will oscillate at a certain frequency, known as the natural frequency, and with an amplitude of oscillation decreasing over time (see figure 1) (Nichols et al. 1990).

These characteristics (oscillation frequency and amplitude decay) depend on the rigidity of the spring, on the mass M and on the viscosity of the liquid (resistance to displacement). The same relaxation dynamic is observed for the pressure sensor:

- the rigidity of the system corresponds to the rigidity of the tubing, accessories, and membrane of the sensor;
- the mass to that of the mass of liquid displaced;
- the viscosity to the resistance to displacement of the liquid.

All these characteristics depend on the architecture of the system, the length and section of the different constituents and the biomechanical characteristics of the industrial materials used (type of polymerisation, thickness of the materials, etc.).

If a sinusoidal periodic pressure signal is recorded of the increasing frequency generated by a pressure generator, a response is obtained which within a certain frequency range of the signal will correspond to a Response Amplitude / Signal Amplitude ratio = 1. Beyond a threshold value of the frequency, the amplitude of the response is amplified in comparison to that of the signal, the maximum amplification being produced for a frequency equal to the natural frequency of the sensor.

The frequency of the signal from which the response is amplified depends on the natural frequency of the system; the value of the amplification for these frequencies depends on a coefficient known as the damping coefficient (zeta). This distortion of the response is connected with the phenomenon of resonance (sum of the amplitudes of the incident waves and the waves given back by the system). The zone of distortion is called the zone of resonance.

In the cardiovascular system, the pressure curve generated by the heart is a complex phenomenon that depends on the systolic ejection volume and the viscoelastic properties of the vascular system. This periodic phenomenon may be broken down by Fourier

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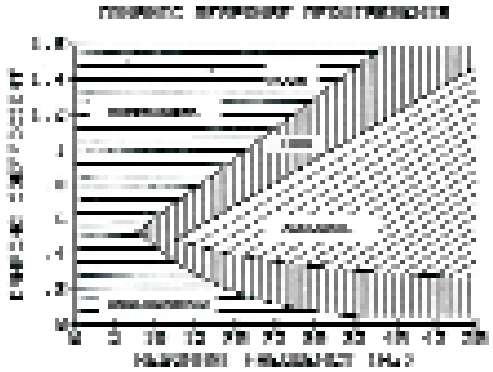
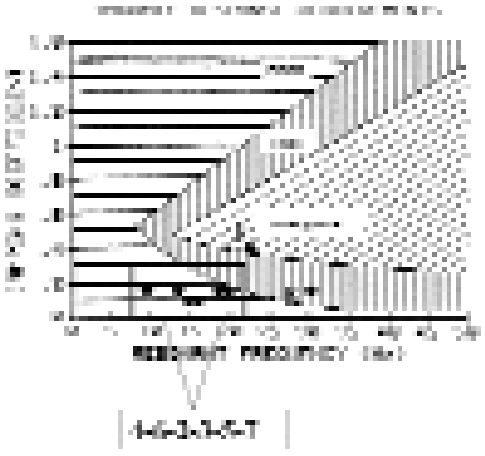


Figure 2. Quality of the sensor response as a function of the natural frequency and the coefficient of damping. The underdamped zone is a zone where the signal is amplified and uneven; the overdamped zone is a zone where the signal is deadened and smoothed

transformation into the sum of simple sinusoidal signals (harmonics), with frequencies that are multiples of the frequency of the pressure signal (fundamental) and of given amplitudes. It is considered that the first eight harmonics of the pressure signal are sufficient to obtain an adequate reconstituted signal. Thus, the weaker the natural frequency of the sensor, the greater the number of harmonics inadequately returned. The amplitude of the signal distortion for each harmonic involved depends on the damping coefficient of the sensor.



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7 Abbott
8 BD/Ohmeda

Figure 3. Position on the Gardner curve of the eight sensors analysed

From these two easily measurable parameters, Fn and zeta, we can evaluate the reliability of a pressure sensor by anticipation. By modifying these two parameters, Gardner (1981) defined the performance of a sensor according to the quality of its response to a calibrated pressure signal generated by a pressure generator reproducing a physiological pressure signal. He defines four zones evaluating the signal reproduction (adequate, acceptable, underdamped and overdamped: see figure 2).

Testing pressure sensors

The dynamic characteristics, Fn and zeta, of eight pressure sensors available in Europe were tested on a test bed to determine their reliability from the Gardner diagram.
The pressure sensors were linked to a Marquette Tramscope, monitor; the analogue pressure signal was recovered by an analogue-to-digital converter with a sampling frequency of 200 Hz for electronic processing. A connection to an arterial pressure signal calibrated at 140/92 generated by the Biotek, 601 generator at frequencies of 1 Hz and 1.5 Hz was made to verify and measure any possible distortions of the signal. The results are given in table I and reproduced on the Gardner diagram (see figure 3).
These results show great diversity in the quality of the pressure sensors currently available in Europe. This diversity is not connected with the quality of the deformable membrane, but rather with the quality of the intermediary line (section surface, architecture, materials, accessories). All the sensors except one are of the "underdamped" type, amplifying the signal and thus overestimating the values measured. This overestimation is well above 5% for the least reliable sensors and increases with increased frequency of the signal, which is often the case with the most seriously ill patients. This overestimation may give rise to errors of diagnosis and potentially to errors of treatment (an absence of decision in falsely normotensive patients or prescription of antihypertensives in falsely hypertensive patients).

Conclusion

The analysis of the biomechanical characteristics of eight devices available in Europe for measuring the arterial pressure by an invasive method reveals a great diversity of performance of this equipment. Because of the risk of diagnostic and therapeutic errors possibly engendered by the mediocre performance, it is necessary for the clinician to understand the factors at the origin of this performance. The evaluation of these factors (which are the natural frequency and the damping coefficient of the device) is easy to perform in routine clinical practice and would appear to be a step that is not to be omitted when choosing a commercial device.

Table 1. Natural frequencies and damping coefficients for each sensor

Type	Fn (Hz)	Zeta
SMITHS/PVB	12.8	0.17
MEDEX MX95904	15.6	0.14
MEDEX LOGICAL	15.0	0.13
BD/OHMEDA	30.0	0.18
ABBOTT	20.0	0.17
EDWARDS	22.0	0.40
B/BRAUN	9.8	0.16
PULSION/PICCO	17.8	0.18

ICU **Europe**: What do we know and how can we improve?

David Edbrooke calls for intensive care professionals to participate in a new initiative to identify and publish ICU statistics from across Europe in **ICU Management**.

Introduction

Intensivists are well versed in clinical ICU research. Little attention, however, has been focused upon the number of beds that are available, how many nurses and doctors are used to run these ICUs and how these numbers vary between countries. Should significant differences exist, this then leads to questions about why, and ultimately what represents the most efficient use of resources.

What are we trying to achieve

With **ICU Management**, we hope to improve the situation by asking healthcare professionals working within the ICU environment to contribute to a picture of "ICU Europe". This will not be the work of one person but the summation of data to which everyone can contribute. This will be an ongoing project, which will be updated regularly. We intend to start in a simple way by trying to achieve a better estimate of the number of beds per 100,000 population within Europe. Currently available data are reviewed in table 1.

Our research question is: How many adult general intensive care beds are available in your country?

Table 1. ICU bed data currently available

Country	Research study	Year of publication	Beds/100,000 population
Netherlands	Miranda Euricus study	1992	10.0
Germany	Burchardi New Horizons	1994	25.0
Switzerland	De Torrento New Horizons	1994	11.1
Italy	Apolone New Horizons	1994	4-9
Denmark	Miranda Euricus study	1998	6.5
United Kingdom	Miranda Euricus study	1998	1.8-3.0

The main problems with the data shown in table 1 are:

- The data span a number of years and are all at least 7 years out of date
- There is no clear and common method employed in the data collection
- There is no common definition of intensive care

Varying statistics are also available at a national level to inform on the number of intensive care units, but these may not necessarily always be accurate.

So please join us

This initiative will only work if you, the readers, are willing to take part. We need enthusiastic intensive care professionals from each country to make this project happen. Any data received for the study will be attributed to the individual providing the data, and by publishing updates regularly in **ICU Management**, readers will be able to follow the project progress.

- We need a researcher from each country to establish numbers of the number of ICU beds
- In addition to calculating the numbers and sharing these with us, you must specify how you arrived at the figures
- Retrospective data needs to be collected for 2004.
- For standard comparisons, all neonatal, paediatric, neurosurgical, cardiac or surgery beds should be excluded
- We define an intensive care unit as "a specific area within a hospital capable of treating patients with more than one organ system failure" for the purposes of this initiative.

What happens next?

Our objective is to develop and publish European wide ICU statistics with the help of ICU Management. Data will be reported in future issues of the journal following validation by Medical Economics and Research Centre Sheffield (MERCS). If successful, we will all learn a great deal more about the systems in place, and perhaps benefit from this knowledge. We then hope to collect further data, for example on numbers of ICU physicians and nurses per 100,000 population. The project will be ongoing and will deliver validated results to readers on a regular basis.

Contacts

I hope that you will be interested enough to join us in this venture and feel free to contact either **ICU Management** or me personally: DEdbrooke@aol.com

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Time to treatment is key to **outcome** in acute myocardial infarction (AMI)

Time to treatment of ST segment elevation heart attack patients continues to be of major concern. The penalty for delay is increased mortality, while the reward for early treatment is increased survival.

A dramatic form of benefit from early treatment is aborted infarction, which some have termed the ultimate degree of myocardial salvage. An example comes from the recent work of Taher and colleagues, (2004) who prospectively collected sequential electrocardiograms and clinical data from patients participating in the ASSENT-3 trial, which employed the thrombolytic agent tenecteplase (Metalyse®, Boehringer Ingelheim) given with three different antithrombotic strategies.

Of the 6,095 patients enrolled in the ASSENT-3 trial, 5,470 were evaluable, and 727 or 13.3% of them met the criteria for aborted infarct, which was defined as maximal creatine kinase of two times or less the upper limit of normal coupled with typical evolutionary electrocardiographic changes.

As might be expected, considering the relationship between time to treatment and outcome, the percentage of aborted infarcts was highest – 25% – among patients treated within one hour of symptom onset.

What might not have been expected is that patients experiencing aborted infarct were those whose characteristics are typically associated with higher risk: female gender, older age, hypertension, and diabetes. These patients also had a history of previous heart attack. The trialists concluded that familiarity with the signs and symptoms of myocardial infarction is the spur that drove these patients to early presentation at hospital, with consequent earlier thrombolytic therapy and a good chance for better outcome.

Indeed, after adjusting for baseline characteristics, mortality at both 30 days and one year was lower in the aborted myocardial infarction group than in those with an actualized or true infarct. This was a reflection of the fact that complete ST segment resolution at both 60 and 180 minutes was more common in the aborted-MI group, and these patients had significantly smaller infarct sizes, as demonstrated by QRS scores on hospital discharge.

Some have argued that the outcome of thrombolytic therapy, whether in clinical trials or everyday practice, has always been known to be time-dependent, and that one of the great advantages of primary percutaneous intervention is that its outcome is free of time dependency.

Such a position has been seriously disputed by the results of several recent publications, among them the work of De Luca and colleagues, (2004) who analyzed the relationship between delays to treatment and one-year mortality in 1,791 ST-elevation myocardial infarction (STEMI) patients who underwent primary percutaneous intervention (PCI).

The trialists found that successful reperfusion was linked to total ischaemic time. Specifically, they calculated that after adjustment for baseline characteristics the risk of one-year mortality increased by 7.5% with every 30 minutes of delay. This, they noted, was in accordance with what had previously been seen in animal models: longer ischaemic time resulted in a lower rate of myocardial salvage and increased risk of death, even when an optimal reperfusion technique was employed.

According to De Luca et al., the recognition of the relationship between elapsed time and PCI outcome in man has been slow in coming. One reason for that may be that many clinical trials have enrolled low-risk patients, and the penalty for delayed treatment is typically paid by higher-risk patients.

For, they emphasize, "although primary angioplasty, in comparison with thrombolysis, may guarantee a higher rate of reperfusion in patients presenting late, it cannot prevent myocardial necrosis, which is related to the duration of occlusion, particularly in higher-risk patients."

They add that the results of their study "strongly support the prognostic implication of time delay in patients with STEMI undergoing primary angioplasty," and that every effort should therefore be made to shorten the patient's ischaemic time, whether that patient is receiving thrombolytic therapy or PCI.

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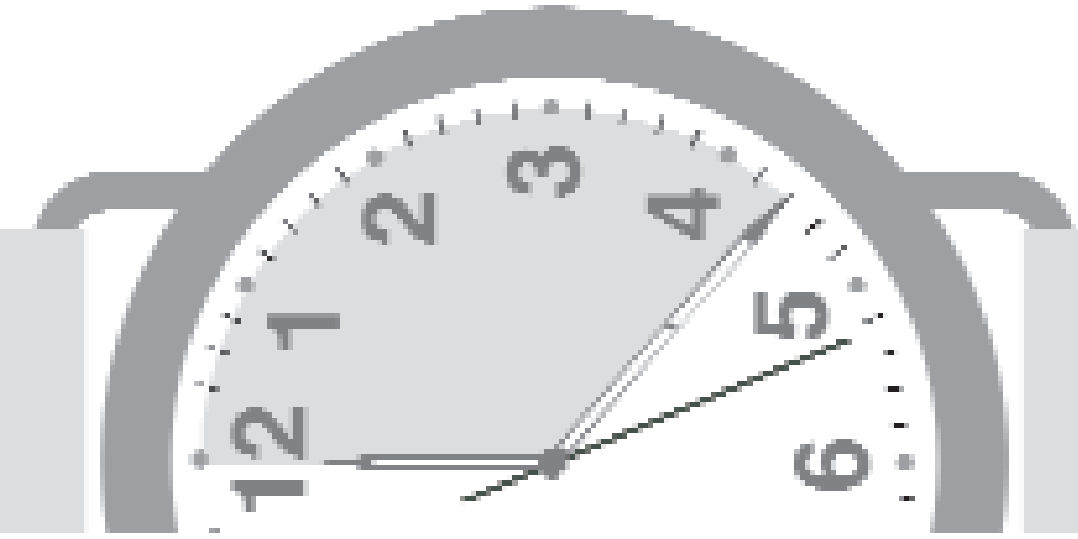

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Prehospital Thrombolysis in AMI: Time saved = Muscle saved

As compared to in-hospital treatment, prehospital thrombolytic therapy for heart attack:

- Reduces time to treatment*
- Aborts more myocardial infarctions*
- Improves outcome*

metalyse®
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ENGINEERED TO SAVE LIVES.

*[illegible]

[illegible]

Defibrillator/monitors for ICU and hospital use

Professor Gazmuri and Erika Kube review features and application of defibrillators which need to be taken into account in purchasing policies.

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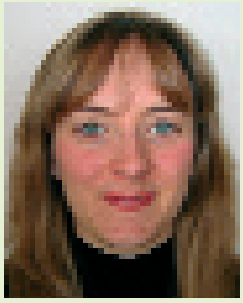

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The risk (or presence) of life-threatening cardiac dysrhythmias often justifies admission of patients to hospital areas with capability for continuous electrocardiographic (ECG) monitoring and availability of personnel competent in the recognition and management of such dysrhythmias (i.e. intensive care units, emergency departments, telemetry units) (Gazmuri & Gopalakrishnan 2005). Comparable capabilities are needed during specific episodes of care such as surgical procedures, electroconvulsive therapy, cardio-respiratory stress testing, and transport of high-risk patients. For patients at low risk of life-threatening cardiac dysrhythmias – who are not admitted to monitored areas – hospitals have "safety-nets" composed of resuscitation carts and teams that can be summoned within minutes to the patient's bedside.

Defibrillators are devices designed primarily to store electrical energy for subsequent delivery in the form of an electrical shock. Defibrillators are typically battery powered, but some can operate connected to an AC or DC power-line. The term defibrillation refers to the rapid delivery of electrical shocks, unsynchronized to the electrocardiogram, for the purpose of terminating ventricular fibrillation or other rhythms in which synchronization is precluded by either the urgency or lack of identifiable QRS complexes (i.e. pulseless ventricular tachycardia, ventricular flutter, and Torsade de Pointes). The term cardioversion refers to the delivery of electrical shocks synchronized to the R-wave of the ECG and is used for terminating organized tachyarrhythmias in patients who are usually haemodynamically stable (i.e. atrial fibrillation, atrial flutter, ventricular tachycardia, etc.). The shock is delivered immediately after recognition of the R-wave to avoid delivery during the vulnerable period which can precipitate ventricular fibrillation. The vulnerable period extends from 60 to 80 msec before, to 20 to 30 msec after the apex of the T-wave (Hou et al. 1995).

Automated External Defibrillators (AEDs) refer to devices with built-in capability for automated recognition of "shockable" rhythms (i.e. ventricular fibrillation and rapid wide complex tachycardia) (Liddle et al. 2003; van Alem et al. 2003). AEDs deliver only unsynchronized electrical shocks and are purposely designed for operation by individuals with training limited to basic life support (BLS) or no training at all. AEDs feature voice and screen commands that guide the rescuer through the process of shock delivery and resuscitation without requiring the rescuer to visualize and react to the underlying rhythm. AEDs are commonly available for public access defibrillation (PAD) and are carried by rescue squads with BLS trained first responders (i.e. police force, firefighters). However, AEDs can also be placed inside the hospital in non medical areas and in crash carts for use by individuals without advanced life support training (ALS) (Destro et al. 1996).

Manual Defibrillators on the other hand are designed for use by skilled operators – typically with advanced life support (ALS) training – capable of recognizing and treating life-threatening cardiac dysrhythmias. The devices include a screen for ECG display and are also known as defibrilla-tor/monitors. Manual defibrillators have the capability for delivering synchronized or unsynchronized electrical shocks. Many current defibrillator/monitors have included AED capability with mechanisms for rapid switch from AED to manual mode enabling the device to be operated by BLS and by ALS trained individuals. Manual defibrillators with AED capability may be useful in areas in which BLS providers are expected to respond first, followed by ALS providers as a part of cardiac arrest or emergency response teams. Automated defibrillation requires prolonged hands-off intervals for rhythm analysis and shock advice, which during cardiac resuscitation may result in detrimental interruptions in chest compression (Berg et al. 2003). Thus, manually operated defibrillators should substitute AEDs or advisory modes as soon as trained personnel arrive. In addition to shock delivery, most defibrillator/monitors have capability for external transcutaneous pacing with ventricular sensing, useful for the temporary management of bradyarrythmias.

Modern-day defibrillators are not only defibrillation/cardioverter/pacemaker boxes; they are equipped with an increasingly sophisticated array of features some of which include capability for monitoring temperature, blood pressure, pulse oximetry, end-tidal CO_2, and the ECG based on 3-, 5-, 7-, and 12-lead configurations. Most defibrillators also have capability for data recording and retrieval featuring electronic storing devices and protocols for data transfer to a PC or directly to a printer.
It is worth noting that the advanced monitoring capability of manual defibrillator/monitors is usually available in acute care areas (intensive care, operating rooms, and

emergency departments), and integrated to clinical information systems. However, the advanced features become exceedingly useful when defibrillators are used outside monitored areas. Such is the case when defibrillator/monitors are used for transport of high-risk patients or when responding to a cardiac arrest elsewhere in the hospital. Measurement of end-tidal CO_2 in the setting of cardiac arrest enables verification of proper placement of an endotracheal tube and also serves to assess the amount of systemic blood flow being generated during cardiac resuscitation (Gazmuri & Kube 2003). Pulse oximetry allows continuous assessment of arterial oxygenation obviating the need for repetitive blood gas analysis. Blood pressure monitoring may help identify needs for additional haemodynamic interventions. The light weight of most available devices facilitates transport to the scene of cardiac arrest and other emergencies. In addition, Cardiac Science offers a defibrillator/monitor designed for use in individual patients throughout the hospital stay with capability for recognition of shockable rhythms and automatic delivery of electrical shocks (PowerHeart CRM).

With regard to defibrillation waveforms and energy levels, new AEDs and most manual defibrillators are engineered to deliver biphasic waveform shocks. Some manual defibrillators still feature monophasic waveform shocks and some have both waveforms available. With monophasic waveforms the current delivered flows in one direction. With biphasic waveforms the current reverses polarity through the shock enabling successful defibrillation with less peak current and less energy than with monophasic shocks, possibly causing less post-resuscitation myocardial dysfunction (White 2004). Manufacturers continue to develop variations around the basic waveform configuration; however, substantive clinical differences have not yet been demonstrated beyond today's consensus favouring biphasic waveforms. The lower energy requirement of biphasic waveforms has enabled the construction of lighter and more portable units. With regard to the energy levels, most defibrillators present a wide range starting from 1 or 2 Joules and ending with 200 or 360 Joules, with 200 Joules being the recommended maximum for biphasic shocks, and 360 Joules for monophasic shocks. The wide range of energies allows defibrillation in patients of all ages (neonates, infants, children, and adults) and internal and external defibrillation.

When deciding which defibrillator/monitors to purchase, cost is not likely to be a deciding factor among brands, because prices of basic units (defibrillator/monitor) are similar. However, cost increases in proportion to added features. A purchasing decision should consider the intended use of the defibrillator/monitors identifying the specific features required. Ideally such decisions should be part of a hospital-wide initiative in which issues related to training, compatibility, service contracts, bargaining power, data integration, and track record of specific manufacturers are also considered. The solution for many hospitals has been to devise systems in which crash carts are equipped only with AEDs and code teams carry more advanced manual defibrillator/monitors stationed in acute care areas.

Defibrillators: from science to **guidelines**

Dr Nolan previews the new European Resuscitation Council guidelines to be published in December, which reflect an international consensus on state of the art resuscitation practice.

Introduction

New guidelines for resuscitation will be published by the European Resuscitation Council (ERC) and American Heart Association (AHA) on 13th December 2005. The existing ERC resuscitation guidelines were derived from the Guidelines 2000 for Cardiopulmonary Resuscitation (CPR) and Emergency Cardiovascular Care (ECC) (AHA in collaboration with International Liaison Committee on Resuscitation 2000; de Latorre et al. 2001; Handley et al. 2001; Monsieurs et al. 2001; Phillips et al. 2001[1-3]). Resuscitation science, particularly defibrillation technology, continues to advance and clinical guidelines must be updated regularly to reflect these developments and advise healthcare professionals on best practice. The new guidelines have been derived from an extensive review of the science by almost 300 experts from 18 countries.

Consensus on science

The International Liaison Committee on Resuscitation (ILCOR) was formed in 1993 (The Founding Members of the International Liaison Committee on Resuscitation 2005). Its mission is to identify and review international science and knowledge relevant to CPR, and to offer consensus on treatment recommendations. The process for the latest resuscitation guideline update began in 2003, when ILCOR representatives established six task forces: basic life support (BLS); advanced life support (ALS); acute coronary syndromes; paediatric life support (PLS); neonatal life support (NLS); and an interdisciplinary task force to address overlapping topics, such as education. Each task force identified topics requiring evidence evaluation and appointed international experts to review them. To ensure a consistent and thorough approach, a worksheet template was created containing step-by-step directions to help the experts document their literature review, evaluate studies, determine levels of evidence, and develop recommendations (Morley and Zaritsky 2005). A total of 281 experts completed 403 worksheets on 276 topics. The worksheets were posted on the Internet for public review and comment in December 2004 (www.c2005.org); at the time of writing, they can still be viewed at this website. Two hundred and forty nine worksheet authors from 18 countries attended the 2005 International Consensus Conference on ECC and CPR Science with Treatment Recommendations, which took place in Dallas, Texas in January 2005. Worksheet authors presented the results of their evidence evaluations and proposed summary scientific statements. After discussion among all participants, these statements were refined and, whenever possible, supported by treatment recommendations. These summary science statements and treatment recommendations will be published simultaneously in the journals Resuscitation and Circulation in November 2005 (International Liaison Committee on Resuscitation 2005[1-2]).

Consensus on science for defibrillation

Defibrillation topics that were reviewed and debated at the 2005 Consensus Conference included: CPR before attempted defibrillation, the optimal waveform for defibrillation, the optimal energy level for defibrillation, one-shock versus three-shock strategy for defibrillation, public access defibrillation, and in-hospital use of automated external defibrillators (AEDs). Several of these defibrillation topics were particularly controversial, often because high-level evidence was lacking.

Science to guidelines

The resuscitation organisations forming ILCOR, e.g. ERC, AHA, will publish individual resuscitation guidelines that are consistent with the science in the consensus document, but will also consider geographic, economic and system differences in practice, and the availability of medical devices and drugs. The ERC Guidelines for Resuscitation 2005 will represent consensus among members of the ERC Executive Committee.

Guidelines for defibrillation

In the ERC Guidelines for Resuscitation 2005, defibrillation topics will be covered in two sections: electrical therapies, and BLS and the use of AEDs. A section on PLS will include guidelines on defibrillation for children. The defibrillation guidelines take into account the first shock efficacy of modern biphasic defibrillators and data on the decreasing probability of successful defibrillation associated with interruptions in chest compressions (Eftestol et al. 2002).

Dissemination of the new guidelines

In addition to the full version, an abridged version of the guidelines will be published as a pocket book. The guidelines are being incorporated into training materials, and revised resuscitation courses (ERC ALS Course, ERC BLS and AED Course, European PLS Course, NLS Course) will be available by Spring 2006. Individual healthcare organisations will need to determine how and when they wish to adopt the practices reflected in the new guidelines; clearly, this will vary with local circumstances.

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Defibrillator/monitors: comparison charts

Introduction

ECRI is a totally independent non profit research agency designated as a Collaborating Centre of the World Health Organization (WHO). Such organizations are appointed to contribute to WHO's public health mission by providing specialized knowledge, expertise, and support in the health field to the WHO and its member nations. Established as an Emergency Care Research Institute, ECRI opened its European Office in May 1995 with the goal of serving the particular needs of Europe and the UK. It is widely recognized as one of the world's leading independent organizations committed to advancing the quality of healthcare with over 240 employees globally.

ECRI's focus is medical device technology, healthcare risk and quality management, and health technology assessment. It provides information services and technical assistance to more than 5,000 hospitals, healthcare organizations, ministries of health, government and planning agencies, voluntary sector organizations and accrediting agencies worldwide. Its databases (over 30), publications, information services and technical assistance services set the standard for the healthcare community.

The Healthcare Product Comparison System

Amongst its many products and services ECRI is pleased to provide readers of **ICU Management** with sample information on defibrillator/monitors 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. The defibrillator/monitors comparison charts include ECRI's 'Recommended specifications' (generic templates) which can be used for comparison and tendering purposes.

All of ECRI's products and services are available through the European Office, addressing the special requirements of Europe and the UK. Utilising some of the world's largest health related databases, help, support and guidance can be given to our European clients at a local level. The comparative tables overleaf are extracted from ECRI's 2002 database. For full information, please refer to ECRI. These data have additionally been reviewed and updated by the respective manufacturers.

Footnotes for product comparisons on pages 44-46

[1] These recommendations are the opinions of ECRI's technology experts. ECRI assumes no liability for decisions made based on this data. [2] CardioServ will be sold in China and Korea until December 31, 2005; Responder 3000 will be discontinued December 31, 2004. [3] 3-channel. [4] Sterilizable, nonsterilizable, external paddles; internal switched and switchless sterilisable and disposable paddles [5] adult, paediatric, radiolucent, and radiotransparent (reduced skin irritation) disposable electrodes. [6] shock delivery, disarm, battery status [7] 5 hr of monitoring per battery with ECG, SpO_2, and CO_2 monitored continuously and NIBP measured every 15 min or at least fifty 200 J shocks. [8] and paediatric. [9] 5-lead patient cable, external paddles, internal spoons, 12-lead ECG, carrying case. [10] Delivers energy within 60 ms. [11] 2 user-configurable sequences. [12] 2-10, 15, 20, 30, 50, 70, 100, 125, 150, 175, 200, 225, 250, 275, 300, 325, 360 J; 3 userconfigurable sequences (100-200, 100-300, and 100-360 J). [13] Edge Quik-Combo for pacing/defib/ECG, Edge Quik-Pace, Edge Paediatric Quik-Combo, REDI-PAK Quik-Combo (Edge REDI-PAK Quik-Combo available December 2002). [14] 14.1 x 10.6 cm (5.5 x 4.2 in) LCD, 16.5 x 12.4 cm(6.5 x 4.9 in) EL. [15] diag 0.05-150. [16] and critical event record. [17] 2.9 x 9.5 x 13.6 cm (1.1 x 3.7 x 5.4 in) Ni-Cd, 7.2 x 9.5 x 13.6 cm (2.8 x 3.7 x 5.4 in) SLA. [18] voice recording; 2 IBP inputs; 100 mm printer; opt SpO_2& diagnostic interpretive 12- lead ECG. [19] 0.5-35 at -3 dB with patient cable 1-35 Hz at -3dB with defibrillation electrodes [20] Equipotential terminal, vehicle power supply, connector.9-pin connector.

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Healthcare Product Comparison System

MODEL	ECRI RECOMMENDED SPECIFICATIONS[1] ADVANCED	GE Healthcare CARDIOSERV[2]	GE Healthcare RESPONDER 3000[2]	PHILIPS HEARTSTART MRX M3535A
WHERE MARKETED		Worldwide, except USA	Worldwide, except USA	Worldwide
FDA CLEARANCE		Yes	Yes	Yes
CE MARK (MDD)		Yes	Yes	Yes
DEFIBRILLATOR				
Internal energy selection, J	5-50	2, 5, 7, 10, 20, 30, 50	2, 5, 7, 10, 20, 30, 50	1-10, 15, 20, 30, 50
External energy selection, J	50-360 monophasic, 50-200 biphasic, 2-20 paediatric/neo	2, 5, 7, 10, 20, 30, 50, 70, 100, 150, 200, 300, 360	2, 5, 7, 10, 20, 30, 50, 70, 100, 150, 200, 300, 360	1-10, 15, 20, 30, 50, 70, 100, 120, 150, 170, 200
Paddle controls	Charge, discharge, energy select	Charge, shock, print	Charge, shock	Charge, discharge, impedence indication
Waveform shape	Biphasic preferred	Edmark monophasic sinusoidal	Edmark monophasic sinusoidal	Biphasic truncated exponential
Biphasic, energy, J	50-200	NA	NA	1-10, 15, 20, 30, 50, 70, 100, 120, 150, 170, 200
Synchronizer	Yes	Yes	Yes	Yes
Paediatric paddles	Yes	Yes	Yes	Yes
Optional paddles	Any (based on user requirements)	Internal, hands-free	Internal, hands-free	External anterior/ posterior[4]
Disposable electrodes	Adult and paediatric	Multifunction	Multifunction	See footnote[5]
ECG MONITOR				
Type	No preference	LCD	Active colour LCD[3]	Integral
Screen, cm (in)	No preference	11.5x8.6 (4.5x3.4)	13x9.7 (5.1x3.8)	12.8x17.1 (5.1x6.8)
Sweep speed, mm/sec	25	25	25	25
Trace freeze	Optional	Yes	No	No
Lead configuration	I, II, III (3-lead), optional 5- and 12 lead	I, II, III, aVR, V, aVL, aVF, paddles	I, II, III, aVR, aVL, aVF, paddles, V1-6	I, II, III, aVR, aVL, aVF, V
Thru-the-paddles monitoring	Yes	Yes	Yes	Yes
HR display	Yes	Yes	Yes	Yes
HR alarms	Yes	Yes	Yes	Preset, adjustable
Freq response, Hz	0.67-40	0.5-35 (-3 dB) or 0.5-180	0.15-100 or 0.08-100	0.15-40
Lead-fault indicator	Yes	Yes	Yes	Yes
EXTERNAL PACEMAKER	Optional	Yes	Yes	Yes
Pacing mode	Demand, fixed rate	Demand or fixed rate	Demand or fixed rate	Demand, fixed rate
Pacing rate, ppm	50-150	30-180	30-200	30-180
Output current, mA	0-140	0-200	0-200	10-175
Pulse width, msec	>20	40	20	40
ECG RECORDER	Yes	Thermal array	3-channel 90 mm thermal array	Thermal array
Paper speed, mm/sec	25	25	25	25
Auto/manual print	Auto, manual	Manual, auto print on alarms	Manual, auto print on alarms	Both
Annotation	Time, date, lead, gain, heart rate, operating mode	Time, date, lead, gain, HR, diagnostic monitoring mode, set energy, shock number, charge, discharge mark, disarm, mode, rate, current	Time, date, lead, gain, HR, diagnostic monitoring mode, set energy, shock number, charge, discharge mark, disarm, mode, rate, current	Date, time, alarms, patient type, HR, NIBP, SpO_2; pulse, ETCO, AwRR, mode, sync, pacer mode, lead, marked events, drug annotations [6]
Summary feature	Yes	Yes (see Other Specifications)	Yes	Yes
BATTERY/LINE POWER	Both	Both	Yes/optional	Both
Number and type	No preference	1 Ni-Cd	2 Ni-Cd	2 Lithium Ion
Integral or remove	Either	Removable	Removable	Removable
Charging method	Any	In-unit charger, opt separate charger	Separate charger, mains direct	AC line
Charge time	<24 hr	<=3 hr in charger, <=18 hr in unit	2 hr (charger), 8 hr (mains)	3 hr (100%), 2 hr (80%)
Operating time	20 discharges or 2 hr continuous ECG monitoring	35 maximum energy discharges or 2 hr monitoring	50 maximum energy (360 J) discharges or 2 hr monitoring	See footnote [7]
Battery pack				
- HxWxD, cm (in)		Not specified	Not specified	16.51x9.6x4 (6.5x3.8x1.6)
- Weight, kg (lb)		0.5 (1)	1 (2.2)	0.73 (1.6)
UNIT				
HxWxD, cm (in)		17.2x43.2x37.6 (6.8x17x14.8)	20.2x30.7x 41.2 (8x12.1x16.2)	31.5x21x30 (12.4x8.3x11.7)
Weight, kg (lb)	<9.1 (20)	8 (17.6)	8 (17.6) with battery	6 (13.2)
External outputs	1 V ECG out	None	RS232, infrared port	1 V ECG
LIST PRICE		$6,000-10,000	$7,500-17,000	$9,250
WARRANTY		1 year	1 year	5 year, repair and return
OTHER SPECIFICATIONS		Internal data recording of 40 ECG events; SpO_2	Internal memory; 250 text events; HR; trends; 3 hr full disclosure, 1-channel ECG; integral automated battery conditioning program; 8 userconfigurable code markers; PC service tool; SW; optional $ETCO_2$, SpO_2, 12-lead ECG with interpretation.	AED function is standard. Optional Parameter: SpO_2 NIBP, $ETCO_2$ (incl. Airway resp. rate), Pacing, 12-lead ECG and ECG Transmission; optional 5-lead ECG cable and 12-lead cable. All options are upgradable.

ZOLL	ZOLL	WELCH ALLYN	MEDTRONIC	SCHILLER
M SERIES - PROFESSIONAL MANUAL DEFIBRILLATOR	M SERIES CCT - CRITICAL CARE TRANSPORT DEFIBRILLATOR	PIC 30	LIFEPAK 12	DEFIGARD 1002
Worldwide	Worldwide	Worldwide	Worldwide	Worldwide, except North America
Yes	Yes	Yes	Yes	Not specified
Yes	Yes	Yes	Yes	Yes
1-10, 15, 20, 30, 50	1-10, 15, 20, 30, 50	2-10, 15, 20, 30, 50	5, 10, 20, 30, 50	5, 10, 15, 20, 25, 30, 35, 40, 50
1-10, 15, 20, 30, 50, 75, 100, 120, 150, 200	1-10, 15, 20, 30, 50, 75, 100, 120, 150, 200	2, 5, 7, 10, 20, 30, 50, 70, 100, 150, 200, 300, 360	2-10, 20, 30, 50, 70, 100, 150, 200, 300, 360 [11]	5, 10, 20, 30, 50, 100, 200, 300, 360
Energy select, charge, discharge, recorder on/off	Energy select, charge, discharge, recorder on/off	Charge, discharge, energy select	Charge, discharge, print	Charge, energy selection, record, discharge, advise (with AED option)
Rectilinear biphasic	Rectilinear biphasic	Truncated exponential biphasic	Edmark sinusoidal or biphasic	Damped sinusoidal
1-10, 15, 20, 30, 50, 75, 100, 120, 150, 200	1-10, 15, 20, 30, 50, 75, 100, 120, 150, 200	User selectable	See footnote [12]	NA
Yes	Yes	Yes [10]	Yes	Yes
Integral	Integral	Yes	Optional	Yes
Adult/pediatric, internal, anterior/posterior 1	Adult/pediatric, internal, anterior/posterior 1	Adult, internal, pediatric, remote hands-free	Peds, posterior, internal, external sterilizable	Internal, adhesive pads, paediatric
Multifunction, sterile, radiolucent 2 [8]	Multifunction, sterile, radiolucent 2 [8]	Yes	Quik-Combo [13]	Adhesive electrodes
Integral, High-res EL	Integral, High-res colour TFT	Integral LCD colour	LCD or EL	Integral LCD
14.4 (5.7) diagonal	16.5 (6.5) diagonal	16.5 (6.5) diagonal	See footnote [14]	6x12 (2.4x4.7)
25	25	25	25	25-50
No	No	Yes	No	Yes
I, II, III (3-lead); I, II, III, aVR, aVL, aVF, V (5-lead)	I, II, III (3-lead); I, II, III, aVR, aVL, aVF, V (5-lead)	Paddles (pads), I, II, III, aVR, aVL, aVF, V	I, II, III, paddles, aVL, aVR, aVF, V1V6, opt 12-lead	I, II, III, aVR, aVL, aVF, V1-V6, paddles
Yes	Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes	Yes
Selectable 20-280	Selectable 20-280	User selectable or automatic	Adjustable, configurable	No
0.05-150	0.05-150	0.5-40, 2-20, 0.05-150; user selectable	Monitor 0.5-40, paddles 2.5-30 [15]	1-25
Audible alert and on display	Audible alert and on display	Yes	Yes	Audible and visual
Optional	Optional	Yes	Optional	Optional, removable
Demand or fixed rate	Demand or fixed rate	Demand or asynchronous	Demand or nondemand	Fixed, demand, overdrive
30-180	30-180	30-180	40-170	40-210
0-140	0-140	30-180	0-200	0-150
40, rectilinear	40, rectilinear	20	20	40
Thermal array (80 mm width)	Thermal array (80 mm width)	Thermal	Thermal array, 50 or 100 mm	Thermal array
25	25	25	25	5, 10, 25, 50
Auto, manual	Auto, manual	Both	Both	Both, selectable
Time, date, energy, heart rate, pacer output (pacer version only), QRS sync mark, ECG-size lead, alarm, defib test (OK/fail), pads off, more	Time, date, energy, heart rate, pacer output (pacer version only), QRS sync mark, ECG-size lead, alarm, defib test (OK/fail), pads off, noisy ECG, advisory prompts, more	Time, date, ECG lead, ECG gain, heart rate, defibrillation and pacing parameters, event type	Time, ECG lead, ECG gain, HR, therapy parameters, sync, discharges, SpO_2, presenting rhythms, 12-lead, AED analysis, pacing parameters, $ETCO_2$ and NIBP parameters	1 or 2 waveforms, all events and data measurements, data from the removable module (NIBP, $ETCO_2$, SpO_2), optional voice recorder
				2 or 6 hr of trends
Yes	Yes	Yes	Enhanced code summary [16]	Battery and vehicle supply
Both available	Both available	Both	Both	2 Ni-Cd
1 SLA rechargeable	1 SLA rechargeable, XL	1 Ni-MH 12 V (SuperPac)	2 Ni-Cd or 2 SLA	Removable
Removable	Removable	Removable	Removable	Charging console
AC or DC	AC or DC	Line cord or separate charger	External system or internal w/adapter	40 min to 90%
<4 hr	<7.2 hr	7.5 hr to 80%, 9.5 hr to 100%	1.5 hr Ni-Cd, 6-12 hr SLA	6 hr monitoring or 120 360 J shocks with 2 batteries
35 discharges at max energy or 3 hr continuous monitoring	40 discharges at max energy/2.5 hr continuous monitoring	3-4 hr monitoring or 110 shocks at 360 J		
3.8x18.3x7 (1.5x7.3x2.8)	3.8x18.3x7 (1.5x7.3x2.8)	2.5x2.5x18.4 (1x1x7.2)	Typical discharges: 220 minwith Ni-Cd, 180 min with SLA	12x10x3.5 (4.7x3.9x1.4)
0.9 (2)	1.7 (3.7)	0.45 (1)		0.7 (1.5)
17x25.8x20.5 (6.8x10.3x8.2)	26x26x22 (10.2x10.2x8.7)	42.2x31.8x13.5 (16.6x12.5x5.3)	See footnote [17]	19.5x30.5x38.5 (7.7x12x15.2)
5.2 (11.5); 6.1 (13.5) with paddles	7.8 (17.2)	6 (13.2)	0.8 (1.7), 1.3 (2.8)	7 (15.4)
1 V ECG out	1 V ECG out	Not specified		Vehicle power supply
contact ZOLL representative	contact ZOLL representative	$6,900-8,400	31.7x38.9x21.7 (12.5x15.3x8.5)	Not specified
1 year	1 year	3 years	6 (13.3)	1 year
Full-featured professional external defibrillator; available in a manual configuration, in a manual configuration with advisory function, or as an AED with manual override mode. Available options include: NIBP, SpO_2, $ETCO_2$ (Sidestream and/or mainstream) [9]	Critical care transport defibrillator for transport of critically ill patients. Features a large colour screen, an Advisory function, and the M Series standard user interface. Options include: IBP, Temperature, NIBP, SpO_2, $ETCO_2$ (Sidestream and/or mainstream) [9]	Welch Allyn biphasic technology; optional advisory defibrillation, external pacing, and handsfree defibrillation.	ECG, data transfer via modem/serial $8,395-30,000 5 years, hosp; 1 year, out of hosp AED and manual defib; data storage; NIBP/SpO_2/$ETCO_2$; Muse CV and LifeNet compatible; battery system using smart battery technology; configurable; upgradable; fax [18]	Can operate in 4 modes (external, AED, internal, pads); 180° display rotation for restricted areas; can receive parameters module of same size as battery (NIBP, $ETCO_2$, SpO_2, pacemaker, temp, int pacemaker); opt PC card, 12-lead ECG, advise mode.

Healthcare Product Comparison System

MODEL	DEFIGARD 3002 IH	DG 1002 BIPHASIC	DG 6002	DG 5000
WHERE MARKETED	Worldwide, except North America	Worldwide	Worldwide	Worldwide
FDA CLEARANCE	Not specified	Not specified	Not specified	Not specified
CE MARK (MDD)	Yes	Yes	Yes	Yes
DEFIBRILLATOR				
Internal energy selection, J	5, 10, 15, 20, 25, 30, 35, 40, 50	No	2, 4, 6, 8, 15, 30	2, 4, 6, 8, 15, 30
External energy selection, J	5, 10, 20, 30, 50, 100, 200, 300, 360	2, 4, 8, 15, 30, 50, 90, 110, 130, 180	2, 4, 6, 8, 15, 30, 50, 70, 90, 110, 130, 150, 180	2, 4, 6, 8, 15, 30, 50, 70, 90, 110, 130, 150, 180
Paddle controls	Charge, energy selection, record, discharge	Charge, energy selection, record, discharge	Charge, energy selection, record, discharge	Charge, energy selection, record, discharge
Waveform shape	Damped sinusoidal	Biphasic multipulse biowave	Biphasic multipulse biowave	Biphasic multipulse biowave
Biphasic, energy, J	NA	130, 130, 180 (AED Mode)	90, 130, 150	130, 130, 150
Synchronizer	Yes	Yes	Yes	Yes
Paediatric paddles	Yes	Yes	Yes	Yes
Optional paddles	Internal, adhesive pads,paediatric	Adhesive pads, paediatric	Internal, adhesive pads, paediatric	Internal, adhesive pads,paediatric
Disposable electrodes	Adhesive electrodes	Adhesive electrodes	Adhesive electrodes	Adhesive electrodes
ECG MONITOR				
Type	Colour LCD	Colour LCD	Colour TFT	LCD Colour
Screen, cm (in)	17.9x12.7 (7.1x5)	6x12 (2.4x4.7)	13.3x9.5 (5.2x3.7)	21.12x15.84 (10,4")
Sweep speed, mm/sec	25	25-50	25-50	25-50
Trace freeze	Yes	Yes	Yes	No
Lead configuration	I, II, III, paddles or pads	I, II, III, aVR, aVL, aVF, V1-V6	I, II, III, aVR, aVL, aVF, V1-V6	I, II, III, aVR, aVL, aVF, V1-V6
Thru-the-paddles monitoring	Yes	Yes	Yes	Yes
HR display	Yes	Yes	Yes	Yes
HR alarms	4 preset values	No	Yes	Yes
Freq response, Hz	0.5-35 at 3 dB [19]	1-25	1-25	1-35 or 1-150 (acc. to EGC source)
Lead-fault indicator	Audible and visual	Audible and visual	Audible and visual	Audible and visual
EXTERNAL PACEMAKER	Optional	Optional	Optional	Optional
Pacing mode	Fixed, demand, overdrive	Fixed, demand, overdrive	Fixed, demand, overdrive	Fixed, demand, overdrive
Pacing rate, ppm	40-210	40-160	40-210	40-210
Output current, mA	0-150	0-150	0-150	35-150
Pulse width, msec	40	20	40	40
ECG RECORDER	Thermal array	Thermal array	Thermal array 72 mm, 3 traces	Thermal array 72 mm, 3 traces
Paper speed, mm/sec	25 or 50	25, 50	25, 50	25, 50
Auto/manual print	Both, selectable	Both, selectable	Both, selectable	Both, selectable
Annotation	1 or 2 waveforms, all events and data measurements	1 or 2 waveforms, all events and data measurements, data from the removable module (NIBP, $ETCO_2$, SpO_2)	1 or 2 waveforms, all events and data measurements, data from the removable module (ECG, resp, NIBP, $ETCO_2$, SpO_2)	3 waveforms, all events and data measurements, data from the removable module (ECG, resp, NIBP, $ETCO_2$, SpO_2)
Summary feature	2 or 6 hr of trends	2 or 6 hr of trends	1, 2, 4, 8, or 24 hr of trends	1, 2, 4, 8, or 24 hr of trends
BATTERY/LINE POWER	Both, and vehicle	Battery and vehicle supply	Battery and vehicle supply	Battery and vehicle supply
Number and type	1 Ni-Cd	2 Ni-Cd	2 Ni-Cd	one + one in option (type Li-ion)
Integral or remove	Integral	Removable	Removable	one integral + one removable (opt.)
Charging method	Charger incorporated	Charging console	Internal, 90-240 VAC and 9-48 VDC	Internal, 100-240 VAC and 9-48 VDC
Charge time	16 hr to 80%	40 min to 90%	1.5 hr	1 hr for 80%
Operating time	2 hr monitoring or fifty 360 J shocks	6 hr monitoring or 2x110 shock (180 J)	2 hr monitoring or 110 shock (180 J)	2 hr monitoring with 1 battery
Battery pack				
- HxWxD, cm (in)	Not specified	12x10x3.5 (4.7x3.9x1.4)	12x10x3.5 (4.7x3.9x1.4)	2,3x9,5x10,2
- Weight, kg (lb)	Not specified	0.7 (1.5)	0.7 (1.5)	338 g
UNIT				
HxWxD, cm (in)	21x34x30.5 (8.27x13.4x15.17)	18.5x30.5x38.5 (7.3x12x15.2)	18x34.5x29 (7.1x13.6x11.4)	28.9x17,7x27.1 (11.4x7x10.7)
Weight, kg (lb)	9.75 (21.5)	7 (15.4)	6.7 (14.8)	5.6 with 2 batteries and paddles
External outputs	Mains socket [20]	Vehicle power supply	RS232, USB, IrDA, Ethernet	RS232, USB, Ethernet
LIST PRICE	Not specified	Not specified	Not specified	Not specified
WARRANTY	1 year	1 year	1 year	
OTHER SPECIFICATIONS	Available with SpO_2; 4 modes of defib (external with paddles, AED, internal, pads); pacemaker detection; messages displayed on LCD.	Can operate in 4 modes (external, AED, internal, pads); 180° display rotation for restricted areas; can receive parameters module of same size as battery (NIBP, $ETCO_2$, SpO_2, pacemaker, temp).	Can operate in 4 modes (external, AED, internal, pads); 180° display rotation for restricted areas	

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The essentials of **conflict** management

Skill in conflict resolution and management is an important tool for those involved in any aspect of critical care medicine, but especially for those in leadership positions. Failure to accurately assess and manage conflict can result in a number of deleterious effects with important implications for patient care.

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Introduction

Conflict is an inevitable event for those caring for critically ill patients. Conflict may occur throughout all levels of healthcare organizations and clearly affects providers, staff, patients and their families. Conflict occurs within and between these entities and is the natural result of a variety of factors. It is important to remember that conflict is not necessarily bad. Indeed, if properly managed conflict results in mutually beneficial change. However, if mismanaged, conflict can cause lost productivity, erosion of trust, and lead to additional conflict with clearly negative implications for patient safety and care (Siders and Aschenbrener 1999). We will briefly review sources of conflict in the ICU, provide several examples and discuss methods of conflict resolution and management. The subsequent manuscript will describe some specific strategies utilized for patient-centred conflicts.

Factors creating conflict in the ICU

A myriad of factors in the ICU represent sources of or contributors to potential conflict. Individual needs, preferences and values may be in opposition to those of the organization. The dynamic nature of healthcare delivery may create conflict for providers. Examples include the implementation of best practices, process improvement, changing requirements and expectations of regulatory agencies and insurers, as well as pay for performance criteria all occurring in an environment of dwindling resources. Shortages of critical care providers and nurses are well documented and clearly contribute to conflict (Kelley et al. 2004). Culture, gender, individual beliefs and professional roles are diverse. The ICU is unquestionably complex with aspects that may be vague or uncertain and many physicians are averse to conflict (Andrew 1999.) Human factors such as fatigue, sleep deprivation and stress result from the 24 hour operations implicit in ICU care (Marco and Smith 2002). Frustration with systems problems may be directed at individuals (Marco and Smith 2002). The nature of ICU care involves teams that are constantly rotating and changing with disruptions in important relationships between team members, patients and families and team cohesiveness can vary widely (Hawryluck et al. 2002). Additionally, technology may influence conflict in unintended ways by creating difficulty interpreting emotional aspects of communication in email, because important verbal or body language cues are absent (Zweibel and Goldstein 2001). Finally, medical professionals often lack formal training in conflict resolution (Hawryluck et al. 2002; Marco and Smith 2002)

Aspects of conflict

There are recurrent themes that are common to most definitions of conflict. These include perceived incompatibility of interests and a degree of interdependence of involved parties (Aschenbrener and Siders 1999). Low to mid-intensity conflict includes behaviours often observed in the ICU including clash of personalities, differences of style, disagreement and overt hostility. In addition to intensity, conflict may be categorized based on duration ranging from acute to chronic (Aschenbrener and Siders 1999).

Costs of conflict

The costs of failure to manage conflict appropriately are extensive. Diversion of administrative resources to deal with problems can result in lack of attention to other pressing matters. Loss of time of involved parties and other stakeholders can undermine productivity. In extreme cases cost of litigation and lost labour are substantial. Additional liability exposure may result in cases involving labour, compliance, or harassment (Andrew 1999). Deterioration of the work environment, erosion of morale and decreased employee satisfaction can impair quality of work and produce staffing problems. These issues lead to decreased quality of patient care with increased risk of medical error.

Examples of Conflict in the ICU

Examples of conflict in the ICU include a vast array of issues. Conflict may arise over staffing patterns, personnel shortages and administrative procedures. Interpersonal conflict between physicians may lead to failure to obtain an appropriate consultation due to past conflict with the consulting physician (Andrew 1999). Differing views of how professionals interact as part of the ICU team are well documented and are an area of potential conflict (Thomas et al. 2003). Counterproductive staff communication patterns may be adopted by house staff leading to increased potential for interpersonal conflict (Lingard et al. 2002). The care team, patient and family values may conflict in end of life care decisions (Fetters et al. 2001).

Techniques to manage conflict

Conflict management implies the use of various strategies to produce resolution of the dispute while avoiding escalation of the conflict and preserving a quality relationship between parties (Aschenbrener and Siders 1999). In the best-case scenario, effective management of conflict taps the creativity and problem-solving skills of involved parties, while providing solutions with input from diverse groups.

A number of techniques may aid in conflict management. Assessment of the conflict should include a systematic approach that identifies critical information central to defining the conflict situation including pertinent issues, historical perspective, key players and other stakeholders. Organizational factors such as policy and environment should be considered. Personal issues should be explored and attention given to anger management. The nature of the problem and influence of individual behaviour on the conflict should be elucidated along with a realistic examination of what is at stake and what can be changed. It is important to focus on those issues relevant to the situation and avoid diversion to peripheral matters, while focusing on the problem and refraining from directing blame or hostility at individuals (Siders and Aschenbrener 1999).

After defining the nature of the conflict, a number of strategies are available. Understanding the position of all involved players and clearly determining the stakes will aid in choosing an appropriate strategy. Strategies include competition, avoidance, compromise, accommodation, and collaboration (Aschenbrener and Siders 1999). Each approach has advantages and disadvantages and no single strategy will be best in all situations.

Competition will produce winners and losers. This approach may be considered in situations where the resources in question cannot be divided, time constraints limit the negotiation, or the parties in question refuse to take another approach. The loser may never fully engage team concepts again. Avoidance can lead to prolonging or intensifying the conflict and an impression of weakness. Avoidance is used when the nature of the conflict is extremely minor or when used strategically to allow a "cooling off" period before returning to manage the conflict in a more productive manner. Compromise, although commonly sought, also produces winners and losers. Compromise may be useful for a temporary settlement in a shorter period of time than is necessary for a collaborative agreement. Additionally, it may function as a back-up strategy when collaboration fails. Accommodation involves one side giving up their personal interests in order to preserve the relationship with the other party. This may be beneficial when the assessment of the conflict indicates that the issue is of much greater importance to the other party. Collaboration, or win-win, has the advantage of allowing the parties to understand the nature of complex issues and interdependent systems. Since resolution is achieved via building consensus for implementation, it increases the likelihood of sustainable change. The major drawback to this approach is that it is time consuming.

Sometimes third parties are used for conflict management. These alternative dispute resolution methods vary in the role of the third party, the control that the parties in dispute maintain in the process, and in the partiality of the third party. Negotiation involves the entrance of a third party at the invitation of one of the parties in conflict. By definition the negotiator is partisan and seeks a resolution that is favourable to their side. In negotiation the parties in conflict maintain complete control. In mediation, a neutral third party is employed to aid the parties in dispute and the parties continue to have an intermediate level of control of the process as the decision of the mediator is a recommendation for resolution. Arbitration involves the use of an arbiter at the request of both parties to act as judge. The parties sacrifice significant control of the process to the arbiter. (Gerardi 2004; Orr 2001). The unbiased arbiter reaches a decision based on the merits of the case and their decision is usually final.

While it is impossible to prevent all episodes of conflict, many issues can be prevented or have guidelines for resolution defined by contracts (Andrew 1999). Principles of practice documents generated by collaborative agreement of professional groups have been recommended to provide such guidance (Andrew 1999). When conflict does occur, control of anger can be useful in preventing escalation of a conflict, preserving the quality of relationship between the parties, and achieving a higher rate of settlement (Friedman et al. 2004).

Closing thoughts

Skill in conflict resolution and management is an important tool for those involved in any aspect of critical care medicine, but especially for those in leadership positions. Failure to accurately assess and manage conflict can result in a number of deleterious effects with important implications for patient care.

Team management of **patient-centred conflicts** in the ICU

Team management is important in running an ICU. Team members have little faith that conflicts can be dealt with effectively. In this article indicators of (impending) conflicts are provided. Patient-centred team meetings are a powerful tool to deal with these conflicts, for which a model is presented.

Introduction

There is general awareness amongst intensivists that good management of the ICU team is of vital importance to the quality of care that can be delivered, and it is also true that working with people who are satisfied in their jobs results in a good atmosphere, in which people enjoy working. To create these circumstances, we need to understand which items are important for ICU staff and, practically, which interventions have a high pay-off. In general, for people working in a team, things that matter include: worthwhile work, participation in goal achievement, offering and receiving interpersonal support, and leadership delivered with respect and responsible authority, rather than power. We also know from a Canadian study, that for workers in an ICU there is another important item: faith that conflicts can be dealt with effectively (Ohlinger et al. 2003).

A recent study by Studdart et al. (2003) shows that conflicts in the ICU frequently occur over long-term patients. In a group of 656 patients exceeding the 85th percentile of length of stay, a total of 248 conflicts were found for 209 patients. These conflicts were classified as between the team and family, intra team and intra family (Studdert et al. 2003).

Knowing that conflicts occur frequently and that resolving them is important for ICU workers, gives us the opportunity to improve communication and team work. The first thing, therefore, is to recognize a conflict. Also from the work of Studdart and colleagues, we know that nurses and doctors hold discordant views about whether a conflict exists. In Studdart's study, consensus was reached for only one-quarter of the conflicts researched. Nurses are more likely to identify conflicts, regardless of their type or source.

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How to recognize a conflict: indicators of trouble

Over the years, we have identified a set of circumstances that may indicate that a conflict is present or impending. I present these circumstances here, in more or less random order:

- A patient with no plan or progress
- A situation where many specialists are involved
- Short, or even worse, no contact time at the bed of the patient during rounds
- Different approaches during different shifts/supervision periods
- Nurses seeking external opinions
- Nurses wanting you to talk more often than usual to the family
- Discussion at the bedside
- Discussions about the patient taking place outside the regular moments/places (especially at night between nurses and residents)
- Doctors growing irritated when the case is brought up
- Residents minimising care
- Individual nurses starting to avoid caring for a patient
- Separate coffee breaks (doctors and nurses) behind closed doors
- And the worst one: "if it was my husband/father/mother……."

What can we do?

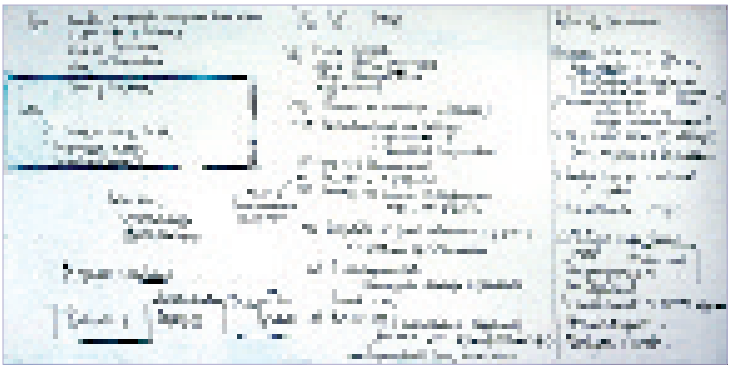
The earlier a conflict is detected and handled, the better. The longer you wait, the more difficult it will be to deal with. Also, clearly stating that there is a conflict acts as a signal to the team that the problem is taken seriously, and provides an opening for it to be dealt with.

Over the years these meetings have acquired the name, "lange ligger bespreking" or in English, "long-stayer meetings". The goal of these meetings is to provide the whole team with the same information, agree upon a plan of action, and set goals to be reached for the patient by targeted times.

How do we do it?

The first thing is to act fast: if a problem is identified, a meeting is organized the same day or the day after. We try to gather as many people and disciplines involved in the care of the patient together. A typical meeting therefore includes the medical supervisor (chair), residents, nurses, physiotherapist, referring and all other specialists who are involved. To structure the information, we use a white-board. We start by reviewing the facts: prior medical history, reason of admittance, results of diagnostic procedures, interventions etc. The next step is drawing up an inventory of the actual situation, listing the current (medical) problems. From these two steps it becomes clear what information is missing and needs to be acquired. We then try to find out why a problem is perceived and here the nurses' input is vital. Everyone is encouraged to contribute and we use the white-board to list the perceived problems.

Figure 1. Example white board content from a multidisciplinary meeting. Items are categorized: social factors, needs, who else involved, prognosis, DNR order (column 1); treatment history (column 2); current problems and plan (column 3)



This gives us a good idea of what is going on. The fact that we write every point down acknowledges the relevance of input from individual participants and prohibits repetition of facts and arguments over and over. From this collection of information, we try to make an honest estimation of the prognosis for the patient. Although it's possible to deal with each of the separate issues related to a disease within the ICU environment (e.g. pneumonia, renal insufficiency, peritonitis), we need to evaluate whether everything to be dealt with is compatible with the reserves of the patient. It may be necessary to make restrictions, such as a Do Not Resuscitate order, for example.

The next step is to make a plan to tackle each of the current problems: do we need extra information or should others be involved? What is needed to wean the patient off the ventilator? How can we treat a depression or delirium? Does the family need a special intervention? This leads to a structured daily program, written down, for everyone to follow. In this phase, creativity is required from everyone: dealing with non-standard problems requires finding non-standard solutions. Examples are: allowing the partner to sleep on the ward for a night, providing more privacy for the patient, taking the patient out of the ward while still on mechanical ventilation, or providing the right music or movies on DVD.

Lack of progress is one of the reasons why it is very difficult to care for long-term patients. We therefore try to set goals in time: the effort that we make to improve the situation should also be visible. Such goals might be: with the proper antibiotics started today and adequate treatment of the delirium, the patient should be able to breathe by him or herself for two hours a day in a week from today, or, if we will perform a CT-scan of the abdomen, but find no treatable cause of infection, there are no other options for this patient.

Following the meeting we write a report, so that all team members are informed. In this report who is responsible to do what and goals in time are clear, and everyone is informed when the next meeting to discuss this patient conflict will be held. Usually we plan weekly meetings, and these last as long as necessary.

From the above, a small check list can be derived to evaluate whether the meeting has covered everything:

- Has the prognosis been honestly evaluated?
- Has limitation of treatment or a DNR-order been discussed?
- Have goals been set in time?
- Has a daily program been discussed?
- Is it clear who will do what?
- Has a follow-up meeting been planned?
- Is there a written résumé of the meeting?

Other considerations

A team meeting does not need to cost much time: we usually achieve this in 30-45 minutes. In exceptional circumstances, especially when doctors and nurses are highly emotionally involved, we have been using an external chair for the meeting, usually a psychiatrist highly respected by the conflicting parties.

Although it is important to understand that conflicts in an ICU often erupt over patient management, the root of the conflict may not always be sourced in this area. If conflicts keep recurring and you are unable to solve them at this level, then the source is probably from another area. Theoretically there are four other domains to be taken into account (although not within the scope of this article):

- conflicts relating to tasks/organization of the unit;
- conflicts arising from needs, goals or achievements of the individual co-workers;
- conflicts related to identity or vision;
- conflicts linked to social or emotional aspects of individuals or the whole team.

Conclusion

Resolving the conflicts encountered in patient management are important for ICU-teams. These types of conflict occur frequently, especially in the patient group that exceeds the average length of stay. Early recognition of conflicts through a set of indicators and a standard process for dealing with them can promote good team management and lead to more satisfied workers.

Medical emergency teams (METS): let us be **careful**

Professor Vincent presents his concerns over MET-type systems and proposes alternative solutions.

Background: agreed

The development of medical emergency teams (METs) or "outreach teams" started with the observation that patients on the general floor often deteriorate in the hours preceding cardiorespiratory arrest or emergency admission to the intensive care unit (ICU). Medical care on the general ward is often suboptimal, with low staffing levels per patient, and staff who are often less than optimally prepared. In this situation, healthcare professionals often under-evaluate a patient's downward progression towards a catastrophe, and earlier intervention could prevent such a patient from needing urgent ICU admission. In the future, ICU doctors will more often leave their sector to intervene on the general floor of the hospital. This is why the North-Americans wish to separate critical care medicine – the specialty dealing with the critically ill patient – and the ICU – the area of the hospital where intensive care is provided.

Where will we find the doctors to fill these posts?

Some studies have shown that METs can indeed improve quality of care. For example, Bellomo et al. (2004) have shown that the introduction of a MET team can result in fewer adverse outcomes including respiratory failure, stroke, severe sepsis and acute renal failure, can decrease the number of emergency ICU admissions and postoperative deaths, and can result in shorter hospital stays. Hence, the evidence is there that METs may represent a valuable option in some settings.

Benefit: Controversial

The risks with METs are that the medical doctors who are responsible for the general ward may no longer initiate treatment of the acute condition or even have the necessary expertise to do so. The reaction to pass responsibility onto others may ultimately decrease the level of care provided by physicians on the floor as they will become increasingly less familiar with the management of such patients.

Another concern is that if the MET includes a critical care physician, this needs to be considered in the shortfall of critical care physicians forecast for the future. The Committee on Manpower for Pulmonary and Critical Care Society's (COMPACCS) study (Angus et al. 2000) indicated that the demand for critical care physicians will increase substantially in the next decades whereas supply will increase only slightly; thus, we must be prepared to face a shortage of well-trained critical care physicians. Indeed, current plans include regionalization of ICUs and telemedicine approaches to cope with inadequate medical coverage of ICUs, rather than placing already limited staff in other positions.

One could argue that by providing an earlier intervention the need for a prolonged ICU stay may be prevented and the MET approach may therefore be cost effective. However, this is far from established. ICU beds are at a premium and someone else will rapidly occupy the ICU bed that would have been freed by the MET managed patient, so that the workload will increase on the floor, but not decrease in the ICU. Caring for the 'ICU patient' on the general floor will require considerable input from the intensivist in terms of patient management, in providing detailed explanations to the healthcare staff who may be unfamiliar with ICU protocols and treatments, and in discussions with the family, etc.

Again, where will we find the doctors to fill these posts?

Alternatives to the MET

If METs are not the answer, what alternatives are there? One alternative would be to provide better-qualified general floor physicians. For this strategy to be effective, three key elements would be needed:

1. Appropriate and ongoing training.
2. Audit in cases of suboptimal management with appropriate and constructive feedback.
3. Availability of critical care physicians at all times for advice.

Conclusion

There is no doubt that most life-threatening events in hospital are preceded by a period of deterioration during which aggressive intervention can improve outcomes. However, easy access to a MET may bypass the intervention of a general floor resident and ultimately decrease the quality of care provided in the hospital. To improve the care provided by non-ICU doctors in the hospital, I would rather argue in favour of providing better and ongoing training to general floor physicians, introducing constructive audit of patients admitted to the ICU from the floor, and ensuring easy access to senior intensivists for advice.

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Medical emergency teams (METS): **preventive** practice

Professor Hillman discusses the preventive potential of MET-type systems in the aim towards hospital-wide patient safety.

The specialty of Intensive Care Medicine is over 50 years old, but like any new specialty, took some time to be accepted. Clinicians were used to attending to most aspects of care for their patients. Gradually colleagues came to accept the special training and expertise of Intensivists. Initially it was important that the specialty was nurtured within the four walls of an Intensive Care Unit (ICU). However, it soon became apparent that many patients outside the ICU were also seriously ill, or at-risk of becoming so.

Outreach and MET-type systems have been shown to decrease unplanned admissions to the ICU and to reduce the number of cardiac arrests and deaths in a hospital

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For example, over 80% of patients who had a cardiac arrest on the general wards had evidence of a slow deterioration in their vital signs, often over many hours (Schein et al. 1990). Similarly, patients who had an expected death (Hillman et al. 2001) or unplanned admission to the ICU (Hillman et al. 2002) showed signs of gradual deterioration, rather than this being a sudden and unanticipated event. This situation is compounded by the increasing specialisation in medicine. Undergraduates are taught little intensive care medicine. Up until recently the patient was not seen by specialists in acute medicine until they had deteriorated enough to require admission to the ICU. At the same time, research has demonstrated that no matter how excellent management is after patients have been admitted to the ICU, the outcome is poor if hypoxia and ischaemia have not been reversed at an early stage (Hayes et al. 1994; Hinds and Watson 1995; Gattinoni et al. 1995).

It made intuitive sense that early detection and rapid resuscitation would result in better outcomes for patients. In 1989 the Medical Emergency team (MET) was first introduced (Hourihan et al. 1995; Lee et al. 1995). It was based on criteria used to identify at-risk patients at an early stage, the so-called MET criteria. These included vital signs such as abnormal extremes of pulse rate, respiratory rate, and blood pressure. Other criteria included a sudden drop in the level of consciousness, seizures and, of course, cardiorespiratory arrests. The team could also be called by any staff member who had serious concerns about a patient. Once the MET criteria had been observed, a MET call was made in much the same way as a cardiac arrest call is made. Thus, intensive care specialists are involved with the seriously ill anywhere in the hospital at an early stage in patient illness.

Other systems to care for the seriously ill across the whole hospital have also been developed. These include the "patient at-risk team" (PART: Goldhill et al. 1999) and the "Modified Early Warning System" (MEWS: Stenhouse et al. 2000), each with slightly different criteria and responses. The concept of Outreach has been implemented in many British hospitals (Bright et al. 2004) and involves intensive care staff, usually nurses working with staff in general wards, educating them and increasing general awareness of at-risk patients and how to recognise signs early and call for help from the ICU.

Obviously, extra resources are required of the ICU if they are to provide a service across the hospital. Many hospitals now have an "outside" doctor as well as a MET co-ordinator attached to the ICU, dealing with issues related to hospital-wide patient safety. In the current climate of increased attention to making hospitals safe, this is seen as a minimal investment to achieve an around the clock system designed to prevent serious adverse events.

In the few studies completed so far, Outreach and MET-type systems have been shown to decrease unplanned admissions to the ICU (Bristow et al. 2000) and to reduce the number of cardiac arrests and deaths in a hospital (Bellomo et al. 2003; Buist et al. 2002). It is difficult to imagine that we will not continue to develop systems, which identify seriously ill patients no matter where they are in the hospital, and to manage illnesses at the earliest possible stage. Intensive care physicians are uniquely equipped to lead development of these systems, as seriously ill patients in the general wards are merely part of a spectrum of an illness, which intensivists are trained to manage.

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The software either runs on a stand alone PC or across a network. There is also the option of Pocket MedICUs OUTREACH, a handheld system to collect data and print assessment reports at the bedside.

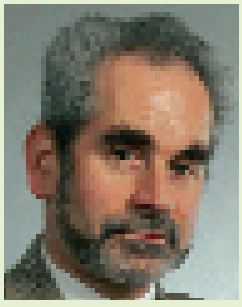
Interview with the Dr Julian F. Bion, President of ESICM

In an interview with Kirstie Edwards, Dr Julian Bion explains the Society's activities towards developing integrated acute care and improving patient safety.

How can we establish a common definition of intensive care?

There is considerable international diversity in the provision of intensive care. Although the majority of countries (and the ESICM) recognise intensive care as a multidisciplinary speciality, in some it is 'owned' by different medical and surgical specialities without common agreement on standards of training and practice. This also means that there is no definition of 'an intensivist' in terms of shared competencies – a common set of knowledge, skills and attitudes expected of a specialist in ICM.

The Society is addressing this lack of a 'product specification' for an intensivist through our innovative project, Competency Based Training in Intensive Care in Europe (CoBaTrICE), part-funded by the EC (www.esicm.org/PAGE_cobatrice?2cu9). Involving 43 countries worldwide, this is the first such initiative across national borders for any medical speciality. We are gathering the views of many clinicians and non-clinicians on what competencies a specialist in intensive care should possess, and will link the final core competence set to educational resources and common methods of assessment.



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Is global harmonization of standards of care feasible and desirable?

There are very large differences in healthcare systems across the world, in resources, medical practice, ethics and culture. There will always be variations in the 'art' of medicine, but we should ensure that the 'science' is applied equally and appropriately. It is not the purpose of the CoBatrICE project to homogenise the practice of intensive care, but to ensure that we train specialists to a common standard and thereby ensure best practice in terms of outcomes for our patients and their families. The Surviving Sepsis Campaign is another example: with the Society of Critical Care Medicine, the International Sepsis Forum, the Institute for Healthcare Improvement, and many other professional societies we are promoting best practice (sepsis care bundles, www.ihi.org/IHI/Topics/CriticalCare/Sepsis/Tools/SevereSepsisBundle.htm) in the challenging area of severe sepsis and septic shock, with the aim of reducing the mortality of this syndrome by 25%. This requires a new focus on integrating acute care across hospital disciplines, between different locations and over time.

Why and how is the ESICM progressing integrated acute care?

Most hospital care is provided in vertically oriented disciplines with relatively little horizontal integration between them. While this may work adequately for patients requiring elective treatment, acutely ill patients present special problems (Bion and Heffner 2004). They often require care from more than one clinical discipline, their condition changes rapidly over time, the clinical course is difficult to predict, and they are more susceptible to healthcare error, including nosocomial infection, prescribing errors, and failures in communication and discontinuities in medical and nursing care.

As an example, in the UK, the professionally-led National Confidential Enquiry into Patient Outcomes & Deaths (a permanent grouping within the National Patient Safety Agency) has recently investigated (www.ncepod.org.uk/2005report/NCEPOD_Report_2005.pdf) the care of acutely ill medical patients admitted to intensive care. This demonstrated deficiencies in timely identification and effective treatment by medical and nursing staff before referral to intensive care, and inadequate involvement by senior medical staff at the time of admission to intensive care. These problems are not unique to the UK, but are common to all healthcare systems.

As emergency care now constitutes between 30%-70% of the work of most health services, we need to find a new model for caring for the acutely ill patient based on patient needs rather than the traditional hierarchies of medical disciplines. Healthcare managers, the pharmaceutical industry, hospital architects, medical educators and patient groups amongst many others will need to collaborate with intensive care and emergency and acute medicine, to re-engineer hospital systems to improve the safe care of this 'hidden population' of acutely ill patients. Key components will include better process control (managing the entire patient journey), transdisciplinary collaboration and teamworking, and methods for translating advances in speciality-based research into improvements in education and training in generic aspects of acute patient care.

At local level, healthcare systems need to re-engineer acute care as an integrated service. Following the patient journey is a powerful concept which makes it easier to identify local problems and solutions. Currently, the acutely ill patient moves through different locations and clinical teams with varying expertise and resources. Rapid

Response Teams (RRTs) such as medical emergency teams, nurse-led critical care outreach, or hospitalists, are helping to change medical culture and improve outcomes for patients by providing early support and medical intervention where required, and improving communication between teams. These developments require similar integration of planning and funding at national level.

At national & international levels, in addition to funding these new developments, we need to focus on education and competency-based training. Competencies break down barriers, and make it easier to build teams by identifying shared competencies. CoBaTrICE is the tool we are using for this purpose. Our Professional Development division is also providing training in team working in emergency situations; at each Congress, we hold two instructor courses with the Society of Critical Care Medicine (SCCM): Fundamental Critical Care Support and Fundamentals of Disaster Medicine. Our multiprofessional distance-learning programme, Patient-Centred Acute Care Training (PACT), covers all aspects of acute care including team working and communication, integrating knowledge and skills in critical care and supporting continuing professional development for specialists. Some countries such as the UK are also building competency-based training in acute care at undergraduate and junior doctor level, as essential components in developing acute care clinicians.

To support this complex set of interventions, I am proposing to develop an international multidisciplinary Forum for Integrated Acute Care representing all stakeholders, including managerial and patient organisations. The proposal is being considered by the World Alliance for Patient Safety for potential adoption as a strategic concept. We will also apply for EU funding.

Who are the members of the ESICM and how does it function?

The ESICM is a society of over 3000 members, mostly senior intensivists, and a growing number of trainees, nurses and managers. We have recently completed a comprehensive restructuring of the society into three divisions: Administration, Scientific Affairs (Research and Congress), and Professional Development (Education & Training, and Editorial & Publishing). The statutes permit any full member to stand for office including the presidency, whether medical or nursing. The Society's council comprises one member per country and one per scientific section. All officials serve the ESICM voluntarily, without reimbursement, and all are active practicing clinicians. We are supported by an outstanding office team led by Mme Suzanne Smitz Der Smet, by the goodwill of our colleagues, and by our families.

The mission of the ESICM is to promote the highest standards of multidisciplinary care of critically ill patients and their families through education, research and professional development. The ESICM has many achievements of which it can be proud, including two EC grants, one for CoBaTrICE and the second for GenOSept (see the article in this issue by Frank Stueber on pages 22 to 24). The society is also actively funding research, and at this congress we will be announcing grants worth over 300,000€ from society funds and industry partnerships. Our professional development programme led by Dr Dermot Phelan includes the internationally recognised European Diploma of Intensive Care. Our journal, Intensive Care Medicine, led by Professor Laurent Brochard as Editor-in-Chief, is one of the highest rated intensive care journals worldwide.

What is the Society's relationship with other organisations, including industry?

We have exceptionally good relationships with other international organisations, as exemplified by the Consensus Conference programme, and the Surviving Sepsis Campaign. Relationships with industry are excellent, and I intend to develop these further while ensuring that we maintain the highest standards of ethical practice in terms of identifying and managing potential conflicts of interest.

How do clinical practice and the ESICM Presidency complement each other?

I and my ESICM colleagues remain in full-time clinical practice, which ensures that we retain a very good grasp of the practical and emotional difficulties of being a front-line clinician. At the same time I can see how healthcare can be improved from an international perspective. The ideas which we create in the Society must in the end bring improvements in care to our patients and their families. Some can be delivered in a year or two, others require a medical life time. This is the power of an organisation; it outlives us and if set up properly, continues independently of any one person.

Does the ESICM Presidency meet your expectations?

Yes. It's a privilege to work for an organisation when you are voted in by the members, and I'm aware that there are many first class people around the world who could do this job as well. I hope that I can meet people's expectations. My main ambition is to take intensive care into the arena of the whole of acute medicine and to place it at the centre of the modern hospital, to improve patient safety and acute care.

I also have a smaller ambition, which is to improve the Society's social interactions. To this end I have instituted a wine tasting in the industrial exhibition reception, which this year in Amsterdam will be accompanied by an international buffet for all participants at the opening of our annual Congress on 25th September. Please join us!

Thank you, Dr Bion.

Healthcare in the **Netherlands**: trends

Healthcare in the Netherlands is undergoing considerable changes. Dr Aghina describes some of the current trends and their implications on care provision.

Functions of primary and secondary healthcare

In the Netherlands, most questions and complaints concerning physical and mental health are directed towards a primary healthcare provider (General Practitioners, physiotherapists, pharmacists). A strong primary healthcare is therefore an essential pillar of efficient healthcare. Primary healthcare professionals are the gatekeepers to specialist care and prevent unnecessary (and costly) medical care.

Primary healthcare has a large number of tasks: providing information, giving advice about self-care and prevention, nursing and caring, diagnosing and treatment. Additionally, primary healthcare is responsible for the management of medical records and referrals to medical specialists. Based on a new legislation effective from 2006, the communities will organise some parts of the care for elderly and disabled persons.

Co-operation

In the future, as co-operation between primary and secondary healthcare improves, the importance of primary healthcare will increase further. An example of this is the consultation between professionals in primary and secondary healthcare, which has already been implemented successfully in mental healthcare. Possibilities for consultation will increase because of telemedicine, the electronic assessment of medical questions.

Personal responsibility

In principle, citizens are responsible for their own health. Where physical and mental symptoms are concerned, a citizen can decide for him- or herself whether or not to seek primary healthcare. Primary healthcare stimulates this (re-)taking of the patient's personal responsibility, the prevention of disease, the recuperation and revalidation, and adaptation to a chronic disease or handicap. Primary healthcare must be offered according to demand, must be reachable (close by), must be organised efficiently, and must provide care of high quality. The new Health Insurance Act no longer differentiates between two groups of citizens based on their income. The "privately insured" and those funded by "sickness funds" will both have the same arrangements. If the costs for this new insurance are too high for an individual, the government will reimburse costs.

The status of general hospitals

The hospital sector is characterised by its dynamic nature. The demand for care and the provision of care by hospitals influence each other greatly, and this influence is becoming more and more direct.

New developments, possibilities and issues related to the demand for care (patient rights, a multicultural society, growth in prosperity, and an ageing population), the supply of care (explosive growth of technology and scientific knowledge, professionalisation, micro-specialisation and multidisciplinary collaboration), and care policy (the administrative process of localisation and deregulation, the rise of the integrated medical specialist company, the establishment of the chain of care, the boom in inter-facility care and the process of economies of scale) demand a new look at the status, administration, quality, organisation and accessibility of the hospital sector.

The hospital as an integrated medical specialist company

The next few years will see a continuation of the transformation of the hospital into an integrated medical specialist company. The concept is based on the patient-driven demand for care and will allow all the care processes both inside and outside the hospital to be organised around the patient. What this means is that there will be a whole spectrum of care that progresses from general, to inter-facility to specialised care.

Functions and duties of the hospital

Even though the administration, organisation and working practices of hospitals are facing enormous changes, the primary duty of the hospital will not change.

The hospital will still be a primary care facility that provides specialist medical care in combination with associated services. In order to realise improvements such as faster treatment and processing of patients, providing care closer to home and improving the match between the supply and demand, the current working practices and care processes need to be streamlined. In order to achieve a fluid transition from primary to secondary to tertiary care, the existing barriers have to be eliminated and all providers must actively want to collaborate with one another.

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Organisational aspects of IC in the Netherlands

Dr Van Zanten describes the current and future trends in intensive care medicine in the Netherlands.

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Introduction

In recent years, the demand for Intensive Care capacity has increased markedly in the Netherlands. Factors such as the technical evolution and availability of new treatment modalities, more indications for high-risk surgery, increased number of co-morbidities in (elderly) patients and the awareness that optimal Intensive Care treatment can improve outcome have all contributed to this increased in demand for critical care facilities. However, the increased demand for Intensive Care in the Netherlands has not been matched by a similar increase in available ICU capacity, for two main reasons: the shortage of available trained ICU nurses and physicians and because of financial restraints due to a non-transparent budget system for hospitals. In practice this results in ICU beds incurring major costs for hospitals without adequate financial reimbursement. Although the Ministry of Health has allowed the number of ICU beds to increase to meet the rapidly growing demand, (for the previous mentioned reasons) hospitals have only slowly increased the ICU capacity due to budgetary constraints.

The capacity problems lead to major media attention in 2001 after a report was published on ICU bed shortage. In larger hospitals, 1 out of 10 adult patients with an indication for ICU admission were refused admission. Surgeries were either cancelled or patients were transferred to other hospitals, in some cases over long distances across the country with some critically ill patients not surviving the transportation. The resulting publicity forced the Minister of Health to take immediate action and institute a national platform on ICU to improve the accessibility of ICUs for patients in need of intensive care, and order an investigation into the actual need for ICU capacity.

Statistics on intensive care in the Netherlands

In May 2005 the total registered population of the Netherlands was 16,292 353 (male 8, 058 928; female 8, 233 425). Of this total, 12, 307 823 persons were older than 20 years of age. The ICU data presented mirrors the adult patients' population requiring ICU expertise. In 2001, we conducted a national survey on ICU capacity. In 131 ICUs, some combined with Cardiac Care, spread over 118 hospital locations, a total 1,189 ICU beds were available. This equals 19.4 ICU beds per 100,000 inhabitants over 45 years of age. Due to financial constraints or shortages of nursing staff, 148 beds were unnecessarily closed (12%). Of all ICU beds, 77.5% were equipped with mechanical ventilators. The ratio of ventilated beds was 73% in non-university hospitals and 89% in university hospitals. Specialised areas such as post-cardiac surgery intensive care (14 hospitals), post neurosurgical intensive care (17 hospitals) and solid organ transplant intensive care (7 hospitals) make up 235 of the 1,189 ICU beds.

Recently, a new survey was conducted after the Ministry of Health had instituted financial incentives to increase the number of ICU beds with mechanical ventilation. This resulted in a moderate growth of 820 in 2001 to 922 in 2004. Of all ICU departments, 61% are equipped with continuous renal replacement devices (in most cases CVVH).

Levels of care

The level of care can define Intensive Care units. In 2001 we used an artificial method to divide intensive care units into three levels:

Level I: More than 2000 ventilated days per year,

Level II: 1000-2000 ventilated days per year, and

Level III: less than 1000 ventilated days per year (high care).

Based on these specific criteria 25 level I, 23 level II and 70 level III units could be identified.

The proportions of ICU beds in each level are shown in table 1, together with the distribution of national mechanical ventilation capacity. This shows the relatively low mechanical ventilation capacity available in the level III units.

Specific data on mechanical ventilation

There is a large variation in the clinical experience of units with mechanical ventilation. The majority of ICUs (52%) treat patients with mechanical ventilation for less than 730 days per year (on average < 2 patients per day). A small number of ICUs, mainly located in university hospitals, deliver more than 6,000 mechanical ventilation days per year. In total about 150,000 days on mechanical ventilators in the Netherlands per annum are documented.

Personnel situation in Dutch ICUs: nurses

In the Netherlands 645,900 healthcare workers are providing care to the national population. Of those 152,900 are registered nurses. The number of formally trained ICU nurses in September 2004 was 4,842 (1,243 of these were working in university hospitals).

The full-time equivalent (FTE) is 36 working hours per week. There are large variations in part-time contracts, but on average, ICU nurses work 80% (28.8 hours per week). Absence for illnesses among ICU nurses is 6.5% excluding pregnancy related absences. 23% of ICU nurses in training are in eight university hospitals. In total 653 ICU nurses are in training.

Personnel situation in Dutch ICUs: intensivists

In the Netherlands, both officially recognised intensivists and other medical specialists, not formally registered for Intensive Care, treat patients in the intensive care environment. Following a retrospective registration in 1993, in total 446 intensivists are known (243 anaesthesiologists, 138 internists, 49 surgeons and 16 others from medical specialties such as cardiology, neurology and pulmonology. The numbers have increased over time after a new training programme for intensive care fellows was instituted (in 2000: 520 intensivists, in 2002: 539 intensivists and in June 2005: 592). The numbers of full-time intensivists are increasing gradually due to the fact that more level I and level II units have adopted closed-format organisation. In job adverts in medical journals in our country, intensivists are the most frequently sought out of any medical specialty.

Adult ICU population characteristics in the Netherlands

ICU patients, both male and female, have a mean age of 62.5 years on admission. Mean length of stay in the ICU is 3.12 days including cardiac surgery patients. Excluding cardiac surgery patients post ICU hospital length of stay is 9.31 days. Mean APACHE II scores are 14 and mean SAPS II scores, 28. National standardised mortality ratio of the 29 ICUs involved in the National Intensive Care Evaluation (NICE) project, based on APACHE II was significantly lower 0.88 (95% CI: 0.81-0.95) compared to the reference database.

National intensive care societies

The Netherlands' scientific society of intensive care specialists (Dutch Society of Intensive Care; NVIC; www.nvic.nl), founded in 1977, represents about 80% of all registered intensive care specialists. In total 1620 medical doctors (including medical specialists involved in intensive care without formal registration) are members of NVIC. The Dutch Society of Intensive Care Nurses (NVICV; www.nvicv.nl) has about 1000 members.

Quality management in intensive care

The National Society of Intensive Care (NVIC) has instituted a committee on quality of intensive care medicine. The author has the privilege to chair this body. Five subcommittees address different quality areas: hospital audits (visitation), evidence-based practice guidelines, quality indicators, care innovation projects, and complication registration.

Future perspectives

A 3% growth of jobs for ICU nurses is expected in the period of 2005-2008. The average retirement age of nurses is 59.7 years. In the future a higher age of retirement is expected due to shortage of personnel in the Dutch healthcare system. Data on intensivists are not available yet. In early 2006 the results of a national survey currently in process among medical specialists will be reported, including intensivists involved in intensive care medicine. Due to concentration of healthcare facilities, the number of ICU departments will decrease to 106 in 2010. A rapid increase in the number of intensive care step-down facilities (medium care, intermediate care, high care) is expected. A national practice guideline on alarming vital signs in patients on non-ICU wards will probably cause an increase in the number of intensive care outreach teams. At the moment less than 10 ICUs have such medical alert teams.

Recently, representatives of all medical associations involved in intensive care have developed evidence-based national guidelines on organisational aspects of intensive care. Although it is still a concept version, it has already been accepted by the medical associations most closely involved. This document will soon serve as the standard for quality management for Intensive Care of adults in the Netherlands. The guidelines address levels, coordination and continuity of care, staffing levels and quality of expertise, quality management, concentration/regionalisation of care and secondary transportation of ICU patients. The implementation is expected to take several years.

The new Diagnosis Related Groups financial reimbursement system for healthcare will probably induce new opportunities for intensive care in the Netherlands. Transparent budgets that are sufficient to meet the costs will probably lead to more ICU beds and staffing, and consequently reduce the number of patients refused admission.

Although there are still some hurdles to cross, the future for intensive care medicine in the Netherlands looks promising.

Table 1. Distribution of national ICU capacity and mechanical ventilation capacity across the levels of care

Level	% national ICU capacity	% national mechanical ventilation capacity
I	47% (483 beds)	63%
II	20%	19%
III	33%	18%

National IC Evaluation (NICE): a **Dutch quality control** system

The National Intensive Care Evaluation (NICE) is a quality system for Dutch intensive care, with registries including effectiveness and efficiency measures, analyses, feedback and reports, and an infrastructure for evaluating the implications of the registered data to improve intensive care treatment and organization.

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Introduction

Intensive care medicine has evolved rapidly over the last decades. Survival chances of severely ill patients have been improved due to technological innovation, including new possibilities in surgical procedures, and the use of highly specialized medical and nursing personnel. The drawbacks are high costs and the psychological burden of this kind of intensive treatment for patients and their families. It is important to treat critically ill patients efficiently and to demonstrate the effectiveness of treatment.

Both nationally and internationally, several quality systems have been developed which include registries enabling quality assessment of intensive care. Examples can be found in Australia/New Zealand (ANZICS www.anzics.com.au), the United Kingdom (ICNARC www.icnarc.org) and the Netherlands.

Quality assessment can be defined as the critical appraisal of the measured results of a healthcare program as compared with the formulated objectives (Donabedian1988). Two aspects can be distinguished: efficiency and effectiveness. Commonly used outcome measures for effectiveness of Intensive Care are mortality, morbidity and quality of life. Commonly used outcome measures for efficiency are costs and length of stay.

A quality system not only contains one or more registers including effectiveness and efficiency measures, but also the associated analyses, feedback and reports, and a structure in which the participating intensivists discover and discuss the implications of the registered data to improve intensive care treatment and organization. In 1996 in the Netherlands, the National Intensive Care Evaluation (NICE) foundation was established by the professional group of intensivists to enable such a quality system for Dutch ICUs (www.stichting-nice.org/introductie.jsp?lang=en). Since 1996 the number of participating ICUs has grown continuously. Currently, more than 120,000 ICU admissions in 28 Dutch ICUs are included in the NICE database (see figure 1).

Quality assurance and improvement with a national database

The NICE national database is an important tool to monitor the quality of Dutch ICUs in terms of effectiveness and efficiency. Mortality constitutes one of the most important outcome measures of effectiveness in intensive care and is the starting point of NICE. Observed in-hospital mortality within an ICU population can be compared with the severity of illness adjusted expected mortality. Specially developed prognostic scoring models such as APACHE II (Knaus 1985) and SAPS II (Le Gall et al. 1993) can be used to calculate severity of illness adjusted expected mortality. The Standardized Mortality Ratio (SMR) is the ratio between the observed and the expected mortality and thereby provides a measure of effectiveness corrected for severity of illness. The national database provides participating ICUs the opportunity for benchmarking. This means that an ICU may compare the characteristics of its population and the outcome, e.g. in terms of the SMR, to the average of the other participating ICUs, a best performing ICU or with their own performance during an earlier time period. Benchmarking plays an important role in a quality system because observed differences between SMRs provide the opportunity for discussion and explanation of these differences.

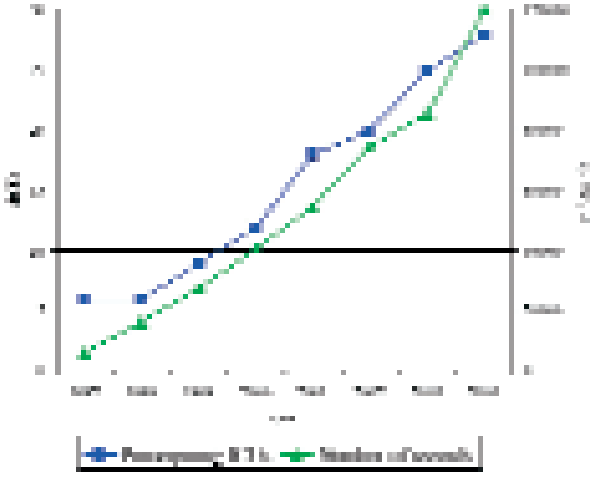

Figure 1. Number of participating ICUs and number of records in the NICE database

National database

Each participating ICU collects the minimal dataset for

each admitted patient (www.stichting-nice.org/introductie.jsp?lang=en). It includes demographic data (e.g. age, gender), admission and discharge data (e.g. referring specialty, ICU and hospital admission/discharge date), diagnoses (e.g. reason for admission, comorbidities) and physiological data (e.g. blood pressure, body temperature). The minimal dataset enables calculation of five prognostic scoring systems: APACHE II (Knaus et al. 1985), SAPS II, MPM0II, MPM24II (Lemeshow et al. 1993) and LODS (Le Gall et al. 1996). These models quantify the severity of illness, and predict the chance of in-hospital mortality. Most items of the minimal dataset can be collected in the first 24 hours. Some variables must be collected on ICU or hospital discharge (see figure 2).

In addition to the minimal dataset, ICUs may voluntarily collect the Sequential Organ Failure Assessment (SOFA) score on a daily basis. SOFA quantifies failure or dysfunction of six organ systems based on a limited set of variables (Vincent et al. 1996). The SOFA score cannot be used to predict mortality, but may give insight into the course of the severity of illness.

From data to information

The large amount of data in the NICE database is processed and represented in such a way that it provides ICU physicians and managers with information that can be used to assess and improve the quality of care. Benchmarking is the most important method used by NICE to contextualise data. Each quarter, the participating ICUs receive a report on patient characteristics and outcome compared to the national average. A yearly report includes trend information on patient population and outcome for the years the ICU has participated in the NICE registry. Based on this report, changes in population and/or performance can be detected.

In addition to these static reports periodically provided by NICE, a web-based application, called NICE online (see the article in **ICU Management** Winter 2005), enables the authorized participants to do online analysis on their own data and compare these with several benchmarks, e.g. university vs. non-university hospitals, descriptions of case mix and outcome of individual hospitals are presented anonymously.

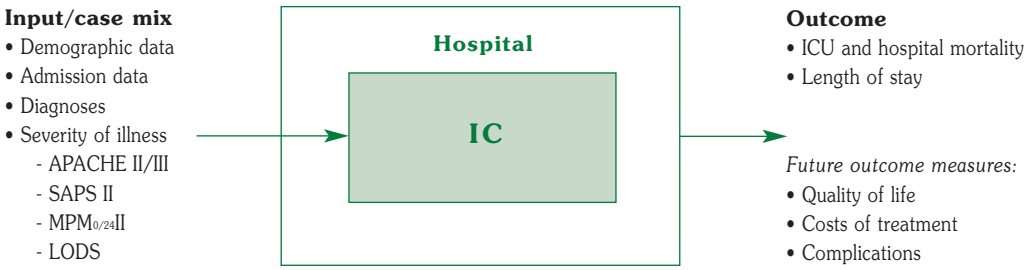

Figure 2. The NICE database contains data to describe case mix and outcome of ICU treatment

Only a few ICUs have a Patient Data Management System from which the data for the national database can be automatically extracted. Most ICUs collect the data manually and enter them into a specific computer application. Intensivists, ICU nurses or both are responsible for data collection. Dependent on the local situation it takes 10 to 20 minutes to collect the minimal dataset per admission. Collection of the SOFA score takes 3 to 5 minutes per patient per day.

To protect the privacy of patients and the confidentiality of the participating hospitals, only encrypted patient names and numbers are imported into the database and each hospital is encoded by a hospital number known only to the secretary of NICE. In all NICE documents, small (<600 admissions a year) vs. large (>=600 admissions a year) hospitals, or the same hospital for different time periods.

Once a year NICE organizes a meeting for all participating ICUs. During this meeting new initiatives are presented but most importantly, analyzed data are discussed. Prior to the meeting the participants receive a report with detailed analyses of some specific patient categories e.g. patients admitted with pneumonia or with heart valve surgery. Participants of the yearly meeting split up into subgroups and discuss the results of one specific patient group to explore possible explanations for differences in outcome. At the end of the meeting each subgroup summarizes their findings and presents

ideas for new research. Figure 3 shows an example of a graph used during the annual meeting to discuss differences in outcome between ICUs.

Data quality

Information from the NICE database is only meaningful if the quality of the data on which it is based is adequate. Adequate quality of data implies correct and complete data. Several procedures optimize the quality of the data (Arts et al. 2002). First extensive definitions and practical examples of each variable in the dataset are described in the NICE data dictionary (www.stichting-nice.org/introductie.jsp?lang=en) Secondly, at least two persons per participating ICU follow the NICE training program to learn the definitions of each variable and the potential pitfalls in collecting data. Training data definitions have been shown to reduce inter observer variability of the severity of illness scores (Arts et al.2003). Thirdly, each dataset is checked for missing and incorrect values before it is imported into the database. A report of observed data quality problems is sent to the ICU within a week after receiving the dataset. Fourthly, a biannual site visit is organized in which a random sample of patient records from the database is compared with the data found in the local medical records (de Jonge et al. 2003). Additionally, the organization which processes and maintains the NICE database has recently been NEN-EN-ISO9001:2000 certified for their quality management system, assuring the quality of the registry.

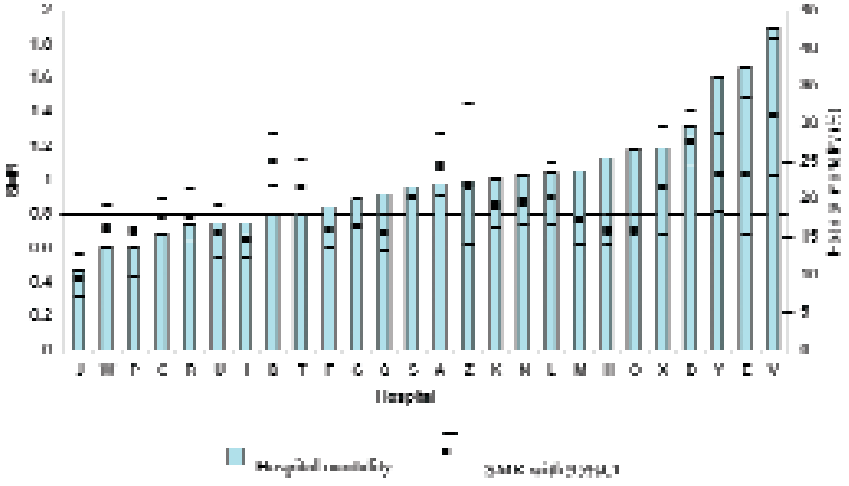

Figure 3. In-hospital mortality rates (bars) and standardized mortality ratio (SMR. Squares) of participating ICUs within the NICE registry in 2003.

Discussion, conclusion and future plans

NICE has set up a successful voluntary registry of anonymous ICU data. This registry supports the improvement of quality of care by benchmarking performance measures of different ICUs. Prognostic scoring systems are used to adjust the outcome measure mortality for severity of illness. These prognostic scoring systems were developed on large USA/European databases some decade(s) ago and may therefore not be perfectly adjusted for the Dutch situation. Recalibration of these models to the Dutch situation is planned for the future. Furthermore NICE feels the need to further adjust for differences in case mix. Therefore a terminological system to describe the reason(s) for admission is under development and will be implemented as a pilot in two hospitals next year (Arts et al. 2002).

Current variables in the database are more relevant for medical management than nursing personnel. To pay attention to outcome measures relevant to ICU nurses, we plan to extend the database with a TISS score module representing nursing workload. Contrary to the minimal data set which is collected once per admission, this TISS module will include a daily data collection such as the SOFA module.

Although the primary aim of NICE is quality improvement of Dutch intensive care medicine, the database is also valuable for epidemiological research (Bosman et al. 2003; de Jonge et al. 2003) and for planning clinical trials. The database can be used as a sampling frame to investigate the number of potentially eligible patients (Peelen et al. 2005 submitted).

NICE currently assesses the quality of intensive care, although quality assurance is not yet fully realized. Quality assurance can be defined as the critical appraisal of the measured results of intensive care to identify whether the formulated objectives are achieved and in case of discrepancies quality assurance implies a response to reduce the deviations from the objective (Donabedian 1988). In our annual meeting we are beginning to address what the causes of discrepancies between individual ICUs and the best performing ICU are, and to re-evaluate the performance of ICUs after implementation of improvements. Only when these steps are implemented will NICE become a complete quality assurance system.

Health and IC in **Belgium**

Dr Vandewoude and colleagues introduce the Belgian healthcare system and organization of intensive care.

Introduction

Belgium is in north-west Europe, covers about 30,500 km^2, and is a parliamentary, representative, constitutional monarchy. There are three official languages: Dutch (spoken by the Flemish, about 59.2% of the population), French (40.2%) and German (0.6%). Through constitutional reforms since 1970, Belgium has become a federal state with three separate regions (the Flemish, Walloon and Brussels-Capital), and three communities: Flemish, Walloon and German. The regions are responsible for territorial matters (e.g. agriculture, transport infrastructure); the communities are responsible for people- rather than territory-related policies (e.g. education, culture, healthcare and social support). Each region and community has a government and a legislative council. The federal authorities remain competent for matters surpassing regions and communities, including the major part of healthcare.

The Belgian population in 2001 was 10,309,725 with a population density of about 315/km^2. The chief causes of death for adults are cardiovascular disease and cancer. Life expectancy at birth is 81.0 for women and 74.3 years for men (1997). Within the EU, Belgium has one of the highest proportions of populations aged over 60, and the number of teenagers is declining. Key healthcare indicators are summarized in table 1. The Gross Domestic Product (GDP) comes to $316.2 billion (2004) or $30508.31 per capita. Total healthcare cost represents 9.6% of GDP (2003), about 1% higher than the mean value in the Organization for Economic Co-operation and Development (OECD) countries, but less than in the US, Canada and the surrounding countries.

Healthcare

During and after the Second World War, the Belgian Government developed a well organized healthcare system, in close co-operation with all stakeholders (employers, employees and "mutualities" or statutory sickness funds). healthcare insurance is compulsory. Each citizen and resident has easy access to all facilities and waiting lists are almost non-existent. Medical practice is independent, with a free choice of healthcare provider by the patient, and fee-for-service payment of providers with reimbursement by the public insurance via the mutualities

In 1963, the National Fund for Sickness and Invalidity Insurance (RIZIV-INAMI) was founded, with a strict separation of insurance system for medical care from that for invalidity. Financial and administrative agreements between mutualities and the healthcare providers are regulated by law. A fee schedule, by which different medical acts were given a price and a reimbursement rate, was established. INAMI-RIZIV oversees the general organization of the compulsory healthcare insurance, but the task of providing insurance falls to the mutualities (statutory sickness funds). Mutualities are private non-for-profit bodies, but have a public interest mission. They are active members of both the executive and advisory committees of INAMI-RIZIV. The Medical Care Service is managed by the General Council and an Insurance Committee. In the General Council, decision-making power is shared between contributors to the financing system (government, employers and employees) and its managers (the mutualities). The Insurance Committee is made up of representatives of insurers and healthcare providers.

Table 1. Key indicators of healthcare in Belgium sourced from 1) OECD healthcare data 2002, 2003 and 2) CIA world factbook 2005

Indicator	Value	Source
Healthcare funding – private per capita	$ 652	1
Healthcare funding – public per capita	$ 1,616	1
Total expenditure on healthcare/GDP (2003)	9.6%	1
Hospital beds	7.3 per 1000 people	1
Duration of hospitalization	8 days	1
Heart diseases deaths	64.6/100,000	1
HIV AIDS adult prevalence rate	0.2%	2
Life expectancy – female	81.78 years	1
Life expectancy – male	74.97 years	1
Life expectancy – total population	78.29 years	1
Motor vehicle deaths	15.4/100,000 people	1
Practising physicians	3.9/1000 people	1
Solid organ transplants	734	1

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Within the Medical Care Service, various committees are created, including a committee which negotiates fees-for-services between the insurers and the different healthcare providers.

Also in 1963, the Hospital Law was voted. This cornerstone law had four objectives: 1) to provide free hospital care for all citizens, 2) to improve the quality of hospital care using norms and accreditation, 3) to ensure the financial viability of public and private hospitals via a per diem financing system, and 4) to introduce planning in the hospital sector. healthcare providers are predominantly private, and doctors are mainly self-employed. About 60% of hospitals are non-profit private institutions; the rest are public.

Since 1982, a new mode of financing hospital operating costs has been gradually introduced in Belgium. It is a 'prospective pricing' system. Each hospital is assigned a budget envelope at the beginning of the fiscal year. This budget is calculated on a per diem basis. A portion of the budget is variable in function of the number of patient days. The annual budget of each hospital is determined by comparing its performance with the one of a reference group of similar hospitals. Furthermore, there is a shift to diagnosis-related groups- (DRG) based financing for services. Since 1990, all Belgian hospitals are obliged to register a number of data for each patient discharged (Minimal Clinical Data, MCD). This system integrates both medical and financial information at patient level. There is also a registration of data on nursing practices in hospitals (Minimal Nursing Data, MND). Information is being collected on the performed nursing activities (a list of 23 items) and on the principal medical diagnosis. Thus, a hospital financing system, based on real inpatient care, was created. Moreover, the MCD allow evaluation of effectiveness and quality of the provided healthcare.

Intensive Care

Intensive Care facilities developed generically in the late sixties and legal standards were developed in the nineties. Financing of Intensive Care is based upon a per diem budget and fees for medical acts.

Accreditation standards for Intensive Care are provided by the Royal Decree of April 27th, 1998, which is an integral part of the Belgian Hospital Law. The 'Intensive Care Function" is intended for 'patients with one or more vital organ functions compromised'. The Royal Decree describes minimal standards for architecture and equipment, functional organization, staffing, education, and registration of activities. The intensive care unit is managed by a physician specialist in internal medicine, surgery or anaesthesiology, holder of the special professional competence in intensive care medicine. If the intensive care function is specifically dedicated to children, a paediatrician can be chief of the unit. The physician in charge should be dedicated to intensive care on a full time basis. Continuation of medical care should be guaranteed by competent physicians, who are in the hospital around the clock, with the possibility of access to expert opinion and care depending on specific patient characteristics.

Table 2. ICU statistics in Belgium

Mean number of beds in IC facility	17.2 ± 12.1 beds
Number of ICU beds/total hospital beds	3.8 ± 1%
Number of beds in intensive care subunit	8.9 ± 4.4 beds
Activities in subunits	
post-cardiac surgery	6.5%
post-surgical ICU	7.4%
cardiology unit	8.3%
medical unit (non-cardiac)	10.2%
mixed medical-surgical	54.6%
other (including dedicated paediatric units)	13.1%
Total number of admissions/unit (2001)/unit	1210 ±889
Total number of admissions per ICU bed (2001)	73.8 ± 21.09
Average patient mix	
strict intensive care profile	46.16%
high dependency care profile	30.70%
medium care profile	14.64%
post-anaesthesia care profile	8.5%
Mean length of stay (days)	4 ± 0.9
Occupancy rate (%) (2001)	84.1 ± 8.7
Readmission rate (%) (2001)	5 ± 3.46
ICU mortality rate (%) (2001)	8.4 ± 3.84

Source: Federal Board of Physicians Specialists for Intensive Care

Table 3. ICU staffing in Belgium	
Basic specialty ICU director	
anaesthesiology	53.06%
internal medicine	34.69%
cardiology	8.16%
paediatrics	2.04%
pneumology	2.04%
Number of medical staff (FTE equivalent)	3.07 ± 2.27
Ratio FTE medical staff/number of ICU beds	1/6.56 ± 3.59
FTE nursing staff/bed	
morning shift	0.47 ± 0.11
afternoon shift	0.40 ± 0.08
night shift	0.31 ± 0.08
Physiotherapist dedicated to ICU	89.5% of IC facilities

Source: Federal Board of Physicians Specialists for Intensive Care

Each function of intensive care has a charge nurse, holder of the special professional competence in intensive care and emergency medicine, and the nurse to patient ratio per shift is at least 1:3. At least 50% of the nurses should hold the special professional competence in intensive care and emergency medicine. The law provides that intensive care units should be operating in a closed format in Belgium, but in reality most physicians have only a part time activity in intensive care and have other occupations in the operating theatre, the cardiology department and elsewhere.

Training and accreditation of intensive care physicians is regulated by the Ministerial Decree (MD) of October 5th, 1995, setting standards to obtain a special professional competence certification in intensive care. In Belgium, intensive care and emergency medicine are two distinct professional competences. Specialists in anaesthesiology, internal medicine, cardiology, pneumology paediatrics, and surgery (including plastic surgery, neurosurgery, orthopaedic surgery and urology) and neurology can obtain the special professional title after a training of two years in an accredited hospital intensive care service, including a 6 months training in an emergency care service. Usually, a part of this training is done in a tertiary care university hospital. Re-accreditation is not required, but the title can only be retained if the principal professional activity is devoted to intensive care.

The Royal Decree of February 15th, 1999 provides regulations for internal and external audit of medical activity in hospitals, and establishes the Federal Board of Physicians for the Function of Intensive Care. This Board is commissioned to determine quality indicators and for medical practice, infrastructure and staffing. All hospitals with intensive care facilities should cooperate with the Board for the registration of data based on predetermined indicators. The Board organizes nationwide surveys on quality, resulting in annual reports on predefined topics. In these reports, the Board can formulate specific recommendations for healthcare practitioners and also for healthcare policy makers. The annual reports also serve for benchmarking between intensive care facilities.

In 2002, the Federal Board set up a survey on ICU infrastructure, staffing and equipment. 54% of all accredited intensive care facilities participated in this inquiry, representing 988 ICU beds in Belgium. General information on ICUs in Belgium is summarized in table 2. The number of available beds in a Belgian ICU varies from 6 to 54; 1.63 to 5.56% of total hospital beds are dedicated to intensive care. Data on staffing are reported in table 3. The average ICU physician to ICU bed ratio is 1:6.56 ± 3.59, with more physicians in tertiary teaching hospitals. The generally accepted minimal nurse-to-patient ratio of 1:2 has not yet been achieved, but this correlates with the finding that about half of the admitted patients do not have a strict ICU profile, and hence do not require complex supportive care.

Conclusion

As in other developed countries, intensive care medicine in Belgium has developed from coronary and complex postoperative care units to the present well organized units for critically ill patients. In the context of the Hospital Law of 1963, intensive care structure and staffing has been provided by law since 1998.

The strict training requirements and accreditation standards for the professional medical and nursing competencies in intensive care guarantee a high level of qualification. Not all patients in intensive care facilities require complex intensive care, explaining a lower nurse-to-patient ratio than the international standard. Medical activity in intensive care is guarded by the Federal Board of Physicians for the Function of Intensive Care in a process of registration of quality indicators and peer review.

Organisation of IC in **Luxembourg**

Dr Hemmer describes the organisation of health- and intensive care in Luxembourg, one of the smallest countries in Europe.

Table 1. Luxembourg hospital and ICU statistics for 2004

Hospital	N° beds	N° ICU beds	% ICU beds	N° ICU days	ICU occupation	N° FTE	N° FTE per occupied ICU bed
1	650	53	8.15	15400	80%	121.65	2.89
2	487	34	6.98	9183	74%	69.82	2.78
3	337	22	6.53	?	?	?	?
4	275	16	5.82	4568	78%	40.9	3.28
5	250	14	5.6	3226	63%	24.22	2.75
6	216	9	4.17	2741	83%	25.24	3.37
7	127	6	4.72	1243	57%	9.01	2.65
8	87	5	5.75	1381	76%	12.94	3.43
9	15	8	53.33	2178	75%	21.8	3.66
Total	2440	167	6.90%				

FTE = Full time equivalent nurses budgeted for each ICU
Source: UCM with the agreement of the Directorate of Health.

Table 2. Fixed, variable and total costs of ICUs and hospitals

Hospital 2004	Fixed cost ICU M€	Variable cost ICU M€	Fixed cost hospital M€	Variable cost hospital M€	Total cost ICU M€	Total cost hospital M€	Part of ICU	Cost of ICU day €
1	11.6	4.2	93	31.5	15.8	124.5	12.70%	1026
2	6.6	1.6	72.6	18.4	8.2	91	9%	839
3	?	?	?	?	?	?	?	?
4	4.1	1.1	45.6	9.7	5.2	55.3	9.40%	1138
5	3.7	0.7	38.8	11.5	4.4	50.3	8.75%	1364
6	2.3	0.7	30.1	7.9	3	38	7.89%	1094
7	1.2	0.2	15.2	3	1.4	18.2	7.69%	1126
8	1.3	0.2	12.9	2.9	1.5	15.8	9.49%	1086
9	2	0.3	6.2	7.7	2.3	13.9	16.55%	1057

Source: UCM with the agreement of the Directorate of Health.

Healthcare in Luxembourg

Luxembourg is one of the smallest countries of the European Union, with a population of 468,571 and 15% over 65 years old. The fundamental principles of the national healthcare system are: free choice of the doctor by the patient, compulsory health insurance and compulsory fee-for service set by the insurance system.

Luxembourg's Ministries of Health and Social Security share the responsibility for the country's healthcare system. A number of organisations offer advice to the Ministry of Health and the Directorate of Health, including the Luxembourg Hospital Association (Entente des Hôpitaux Luxembourgeoise), the Physicians Association (AMMD) and the "College Médical", whose mission is surveillance of the medical profession and its deontology. Healthcare costs are paid by a compulsory health insurance which has three sources of financing: contributions from employers, employees and from the State.

Different Insurance Companies are grouped together in the "Union of Sickness Funds" (UCM).

Hospitals and ICUs

Several hospitals are owned by religious organisations and others belong to towns. The largest hospital, Centre Hospitalier de Luxembourg (CHL) is owned both by the state and by the City of Luxembourg. The number of hospitals and hospital beds as well as the number of ICU beds is defined by the National Hospital Plan (last version published in 2001). The country is divided into three hospital regions: the North (population about 70,000); the Centre (population about 250,000) and the South (population about 150,000). The hospitals with more than 175 beds are considered as general hospitals and those with less than 175 beds are considered as proximity hospitals. All general hospitals are equipped with ICU beds, 2 proximity hospitals have small ICU units (6 and 8 beds) and the National Institute for Cardiology and Cardiac Surgery (INCCI), which has only 15 beds, uses 8 ICU beds for cardiac surgery patients.

The figures in tables 1 and 2 display data for all hospitals in Luxembourg, including the total number of ICU beds, ICU days, ICU personnel and ICU costs, but do not distinguish true ICU from intermediate care beds. In reality, only half of these beds represent "true" ICU beds (80-85) i.e. use for patients with multi-organ failure with ICU therapies and technologies available. The other half

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represent intermediate care beds, either general or specialised. Specialised intermediate care beds are often located in the larger hospitals (neurosurgical, cardiology, stroke and neonatal units in CHL, cardiology, neurological and postoperative unit in the main hospital of the South-Centre Hospitalier Emile Mayrisch (CHEM). These units are usually run by different specialists (cardiologists, neurosurgeons, neurologists, neonatologists).

The "true" ICU beds in Luxembourg are mostly run by anaesthesiologists (Anesthesiste – Reanimateur) with the exception of the Polyvalent ICU of CHL, where 2 internists / intensivist are members of the ICU team. In the majority of hospitals the Anesthesiologists rotate in the three sections: Anaesthesiology, Intensive Care and SAMU (Medical Ambulance Service) with some members of the team being more exclusively dedicated to ICU work. The ICUs in the 6 largest hospitals are based on the closed ICU model, and in the smaller ICUs the anaesthesiologists share their activities with cardiologists and internists.

In 2004 about 1700 intubated and ventilated patients were treated in ICUs in Luxembourg. Global mortality for all ICU patients varied from 3.5 % to 11%; however the mortality of ventilated patients was as high as 21.5 to 30%.

All ICUS participate on voluntary basis in the NOSIX programme of surveillance of nosocomial infections which is a part of European IPSE programme. Surveillance of nosocomial infections in ICU is considered as a quality incentive, which may provide a financial bonus from the UCM. Some ICUs have adopted the EFQM model of total quality assurance.

Teaching and research

Several Luxembourg ICUs have recently participated in multi-centre prospective studies, (e.g. CHL in ENHANCE and Clinique Ste Thérèse in DOLOREA), organised by pharmaceutical companies or scientific societies from other countries. CHL and CHEM ICUs have also contributed substantial amounts of patient data to the SAPS III database.

With no Medical School in Luxembourg, medical students study abroad, mostly in Belgium, France, Germany and Austria. ICU physicians from Luxembourg participate actively in teaching activities of ESICM and ESA and also in the teaching of nurses specialising in Anaesthesiology and Intensive Care. The Department of Anaesthesiology and ICU of CHL regularly rotate interns with the Anaesthesiology Departments of Belgian university Hospitals, for example Liège and ULB.

Although there is no national scientific society of intensive care in Luxembourg, doctors are members of other national and international societies (French, Belgian, German, ESA, ESICM and SCCM).

SCCM **milestone**: 35th annual congress

This year the Society of Critical Care Medicine (SCCM) celebrates 35 years of continued educational excellence during the 35th Critical Care Congress, January 21st to 25th 2006, in New Orleans, Louisiana, USA.

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Obtain indispensable information about innovative treatments in critical care as well as fundamental business practices necessary to improve the intensive care unit (ICU) environment, during SCCM's 35th Critical Care Congress. The Society's Congress offers clinical benefits for every critical care professional that are unlike any other educational meeting. Because a multiprofessional team of critical care experts develops each session, you can be sure that you will receive a well-rounded perspective on the latest advances and treatments of acute conditions, helping you provide the highest-quality patient care to all critically ill and injured patients.

The Society's 35th Critical Care Congress offers participants the opportunity to attend numerous cutting-edge sessions, hands-on workshops, informative panel discussions and exciting social engagements. The 2006 Congress was developed by co-chairs Connie A. Jastremski and Lena M. Napolitano.

Prominent leaders in critical care will present engaging topics throughout the Plenary Sessions. Offered during unopposed timeframes, the thought-provoking Plenary Sessions explore the latest issues affecting the entire critical care community (see table 1).

The learning objectives for participants of the 35th Critical Care Congress are to:

- Recognize recent advances in drug design and development and their relevance to critical illness.
- Apply patient care to current and cutting-edge information regarding specific therapeutic interventions for the critically ill patient.
- Review, in the context of the intensivist-led multiprofessional care team, new knowledge and strategies to optimize the care and outcomes of critically ill and injured patients.

The Society has developed a variety of pre-Congress Educational Sessions packed with essential "need-to-know" information as well as hands-on workshops to provide a convenient, cost-effective way to receive an update or learn more about the latest advances in critical care. We recommend that you plan to arrive in New Orleans early to maximize your educational experience by attending any one of these courses. Additional ticketed events and sessions during the Congress are also available for those wanting to enrich their Congress experience further.

New Orleans holds a mystique unmatched anywhere in the world. As one of the most fascinating places to visit in the United States, New Orleans boasts first-class hotels, world-famous restaurants, exquisite art and antique shops, and energizing jazz and music entertainment. Visitors can take in the vibrant French Quarter or admire the opulence of the Garden District. New Orleans is infused with rich architectural and cultural history. Supplement your Congress experience by creating your own sightseeing adventure. Have your family, friends or colleagues join you on any of the fascinating tours available through SCCM, adding to your educational experience at the SCCM's 35th Critical Care Congress.

Register now to experience the only educational event designed for the entire critical care team.

Table 1. Plenary session topics and keynote speakers

Gordon R. Bernard, MD	*Vanderbilt University Medical Centre* *'Acute Respiratory Distress Syndrome Clinical Network (ARDSNet): Successes and Challenges of the National Heart, Lung and Blood Institute's (NHLBI) first Critical Care Research Network'*
Arthur Caplan, MD	*University of Pennsylvania* *'Ethics: The Terry Schiavo Case'*
Scott A. Dulchavsky, MD	*Wayne State University* *'Critical Care in Space'*
Brett P. Giroir, MD	*Defence Advanced Research Projects Agency (DARPA)* *'Getting Critical Care Research Out-of-the-Box: Defence Advanced Research Projects Agency (DARPA) Opportunities for Creating the New Biology'*
Cathie Guzzetta, RN, PhD, HNC	*Holistic Nursing Consultants* *'Family-centred Care in the ICU'*
Marco Ranieri, MD	*Universita di Torino Ospedale S. Giovanni Battista* *'Mechanisms of Ventilator-induced Lung Injury (VILI)'*
Brian Silverstein, MD	*Sg2, www.sg2.com* *'ICU of the Future'*

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Submitted by the Society of Critical Care Medicine

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35th Critical Care Congress

JANUARY 21ST - 25TH, 2006
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Awaken your senses with electrifying music, world-class cuisine and endless entertainment from the vibrant French Quarter to the grandeur of the Garden District, New Orleans holds an experience unmatched anywhere in the world.

The Congress experience offers critical benefits for every critical care professional unlike any other educational meeting. Because a multiprofessional team of critical care experts develops each session, you can count on sessions the tools to help you provide the highest-quality patient care to all critically ill and injured patients.

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Society of Critical Care Medicine

Reserve these dates today: January 21-25, 2006.

For further details on the 35th Critical Care Congress, and answers to any questions contact SCCM Customer Service at +1 847/ 827-6888.

AGENDA

SEPTEMBER 2005

7-10 2nd International Congress Sepsis and Multiorgan Dysfunction
Weimar Germany
webanae.med.uni-jena.de/WebObjects/ DSGPortal.woa/WebServerResources/jahreskongress/

17-21 European Respiratory Society 15th Annual Congress
Copenhagen, Denmark
www.ersnet.org/ers

25-28 18th Annual Congress European Society of Intensive Care Medicine / Facing the Challenge: Intensive Care without Walls
Amsterdam, The Netherlands
www.esicm.org

OCTOBER 2005

20-23 30th Australian & New Zealand Annual Scientific Meeting on Intensive Care
Adelaide, Australia
www.anzics.com.au/asm/index.htm

NOVEMBER 2005

10-12 2nd Congress of the European Federation of the Critical Care Nursing Association
Amsterdam, The Netherlands
www.efccna.org/congress2005.htm

JANUARY 2006

21-25 35th Critical Care Congress of the SCCM
New Orleans, Louisiana, USA
www.sccm.org/education/annual_congress/index.asp

FEBRUARY 2006

3-4 11th International Symposium on the Critically Ill Patient
Sevilla, Spain
www.infections-online.com

MARCH 2006

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

MAY 2006

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

JUNE 2006

3-6 Euroanaesthesia
Madrid Spain
www.euroanesthesia.org

References are available on request: editorial@icu-management.org

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