ICU MANAGEMENT

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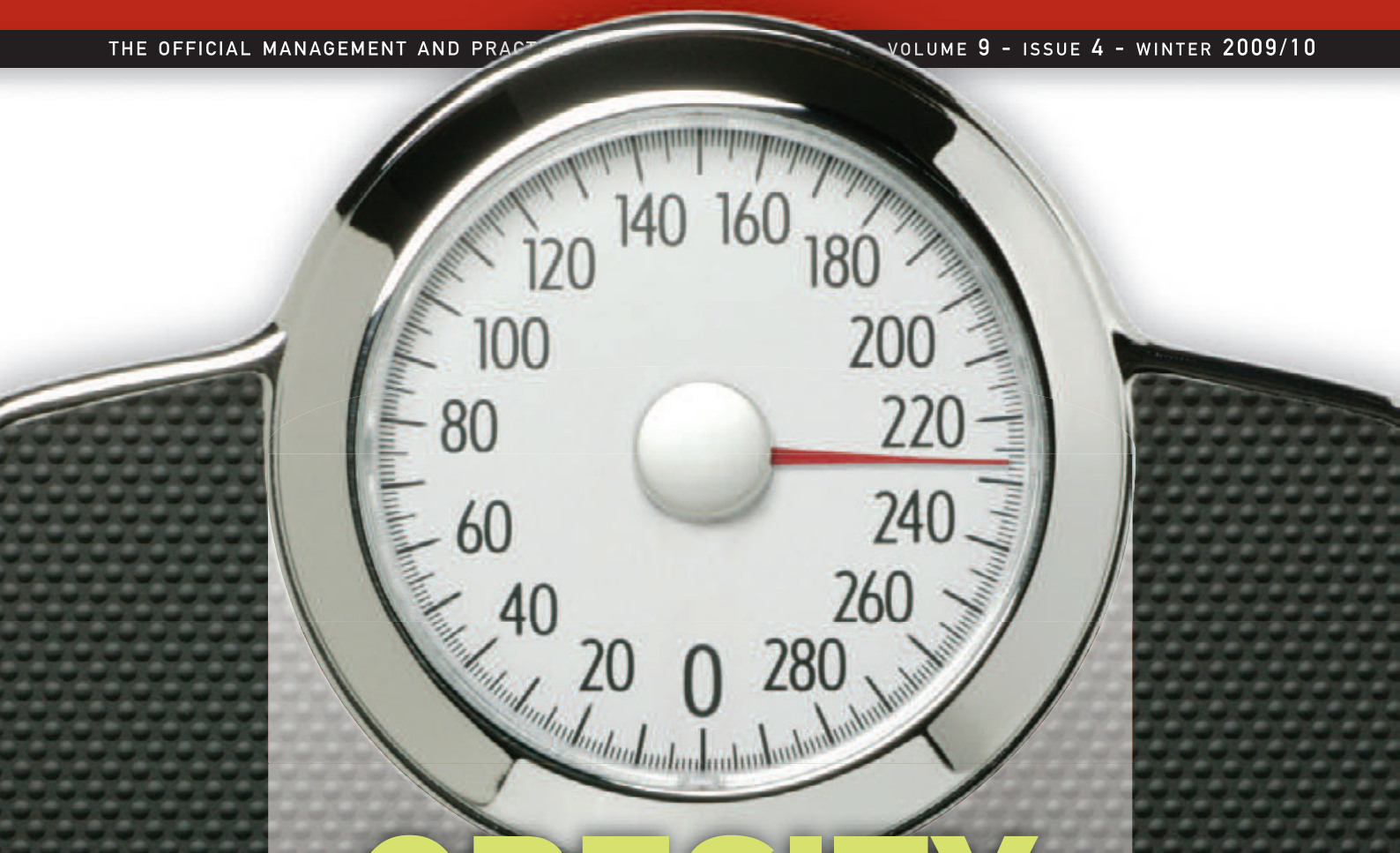

OBESITY

PLUS:

- **Risk Assessment of Patients with Severe Community-acquired Pneumonia**
- **Prioritising:** Is it the Way to Counter Today's Economic Crisis Within the Healthcare System?
- **Belgian Healthcare:** Overview of the Health System and Financing
- **Product Comparison Chart:** Intensive Care Ventilators

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OBESITY

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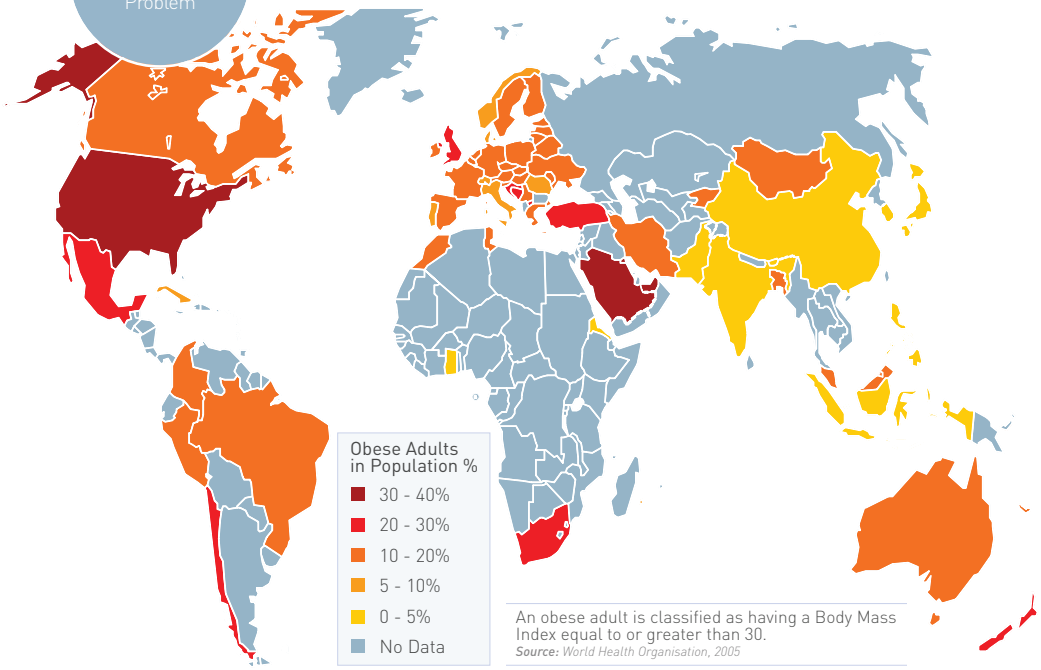
The World Health Organisation predicts there will be 2.3 billion overweight adults in the world by 2015 and more than 700 million of them will be obese. Within the critical care field, this changing population is set to trigger a new set of requirements for clinicians – both with regards to equipment and staffing needs and demands as well as for specific management and treatment practices.

In our focus on OBESITY, we begin with an article that discusses the effects of this growing problem on the paediatric population and the specific obstacles that these younger patients encounter in the ICU. Drs. Mungekar and Conway from Beth Israel Medical Centre in New York highlight several common key concerns- from impaired glucose tolerance to asthma and obstructive sleep apnoea (OSA) and their influence on the management of critically ill obese children.

When management of obese patients is discussed, the optimal positioning of these patients is often debated. Drs. Klaus and Monika Lewandowski from Essen, Germany offer an overview of the most common positions and the best cases for the utilisation of each as well as a very useful diagram clearly illustrating the proper positioning. In his review, ICU Management Editorial Board Member Prof. Paolo Pelosi focusses on utilising a physiological based approach of perioperative management in obese patients.

In the Matrix, Dr. Salluh and his team from Brazil discuss the use of scoring systems in risk stratification of patients presenting with CAP in our emergency departments. In addition to the standard clinical practice tools widely utilised, he highlights how new scoring systems (SMART-COP and CAP-PIRO) can predict intensive care support needs. The article further discusses how biomarkers may be incorporated into clinical practice in supporting the assessment of severity of illness and response to treatment. Our early mobility series also continues this issue with an article that discusses the feasibility and benefits of early mobility, describing how ICUs could utilise available personnel and equipment to facilitate early rehabilitation.

Figure 1.
The Global Obesity Problem



An obese adult is classified as having a Body Mass Index equal to or greater than 30.
Source: World Health Organisation, 2005

As the need to weather the financial storm that has hit the global healthcare sector continues, so does our quest to find new strategies to improve cost effectiveness while ensuring the continuation of quality care for our patients. To this end, prioritising has become the newest management concept geared towards bridging the gap between the depletion of resources and improved patient outcomes. The team from Gothenburg, Sweden led in this article by Dr. Khorram-Manesh, considers whether prioritising can be an effective way to counter the current economic crisis within the healthcare system, and outlines how it might be utilised.

In this edition of the journal, we look to Belgium for our country focus, where Drs. Vandijck and Annemans give us a brief overview of the health system and its financing, and Sonia Labeau lends a nurse's perspective to the topic of infection control. In our Viewpoints section, we feature a lively opinion piece from Dr. Baker of New Jersey Medical School, which serves as a timely follow-up to our discussion of the state of the US healthcare system in a prior issue of ICU Management.

The countdown is on: In just a few short months, we will celebrate the 30th Anniversary of the International Symposium on Intensive Care and Emergency Medicine (ISICEM), in Brussels. After three decades of gathering together more than 5000 critical care professionals for the most current scientific discussion, debates and social networking, we are proud to once again invite you to join us in the centre of Brussels from March 9 - 12… If you've missed the meeting in recent years, this is definitely the year to reconnect – This year's ISICEM promises to provide more opportunities than ever to network with colleagues from around the globe and will surely offer more than a couple of surprises!

Jean-Louis Vincent

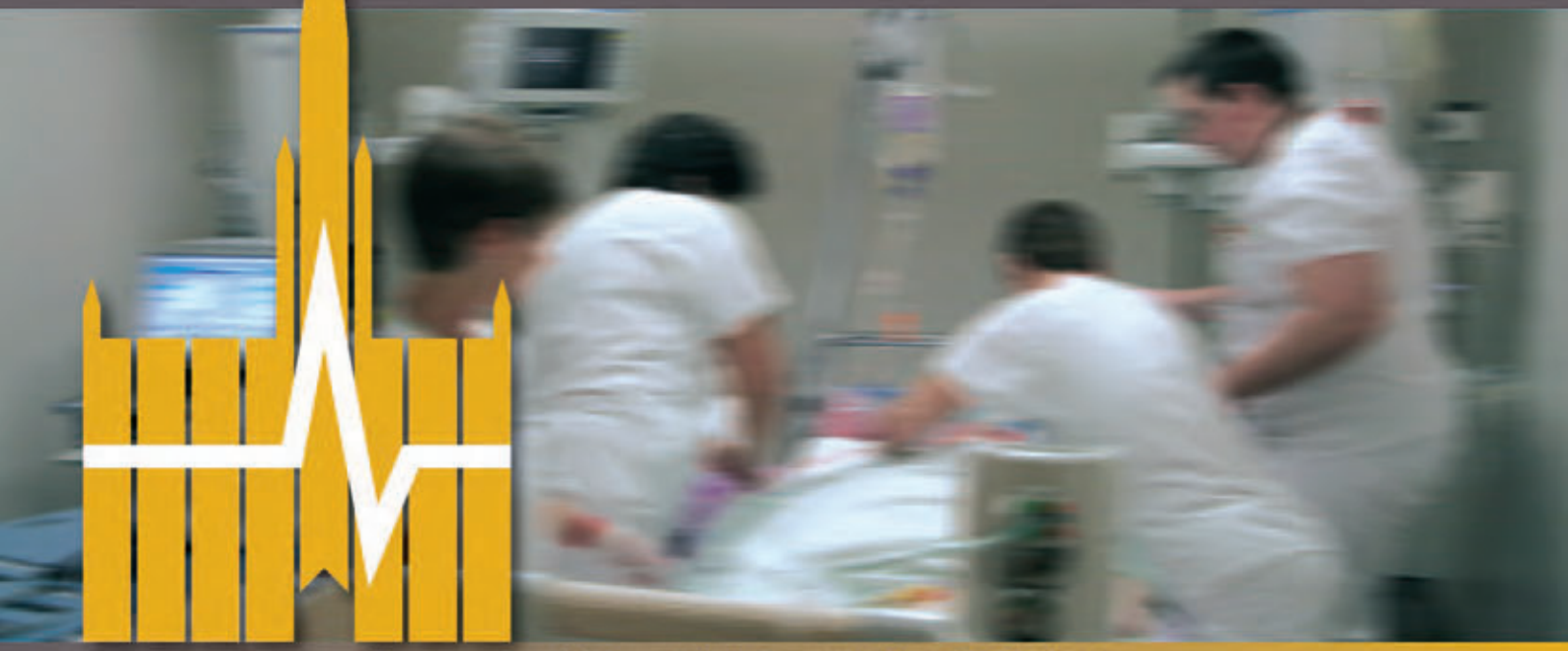
30th Anniversary

International Symposium on Intensive Care and Emergency Medicine

BACK TO BRUSSELS CONGRESS CENTER

(now: THE SQUARE)

March 9-12, 2010



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ICU Management

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WORLD - WHO Pandemic Updates

Public Health Significance of Virus Mutation Detected in Norway

The Norwegian Institute of Public Health has informed the World Health Organisation (WHO) of a mutation detected in three H1N1 viruses. The viruses were isolated from the first two fatal cases of pandemic influenza in the country and one patient with severe illness.

Norwegian scientists have analysed samples from more than 70 patients with clinical illness and no further instances of this mutation have been detected. This finding suggests that the mutation is not widespread in the country.

The virus with this mutation remains sensitive to the antiviral drugs, oseltamivir and zanamivir, and studies show that currently available pandemic vaccines confer protection.

Worldwide, laboratory monitoring of influenza viruses has detected a similar mutation in viruses from several other countries, with the earliest detection occurring in April. In addition to Norway, the mutation has been observed in Brazil, China, Japan, Mexico, Ukraine, and the US.

Although information on all these cases is incomplete, several viruses showing the same mutation were detected in fatal cases, and the mutation has also been detected in some mild cases. Worldwide, viruses from numerous fatal cases have not shown the mutation. The public health significance of this finding is thus unclear.

The mutations appear to occur sporadically and spontaneously. To date, no links between the small number of patients infected with the mutated virus have been found and the mutation does not appear to spread.

The significance of the mutation is being assessed by scientists in the WHO network of influenza laboratories. Changes in viruses at the genetic level need to be constantly monitored. However, the significance of these changes is difficult to assess. Many mutations do not alter any important features of the virus or the illness it causes. For this reason, WHO also uses clinical and epidemiological data when making risk assessments.

Although further investigation is under way, no evidence currently suggests that these mutations are leading to an unusual increase in the number of H1N1 infections or a greater number of severe or fatal cases.

Safety of Pandemic Vaccines

To date, WHO has received vaccination information from 16 of around 40 countries conducting national H1N1 pandemic vaccine campaigns. Based on information in these 16 countries, WHO estimates that around 80 million doses of pandemic vaccine have been distributed and around 65 million people have been vaccinated. National immunization campaigns began in Australia and the People's Republic of China in late September.

Vaccination campaigns currently under way to protect populations from pandemic influenza are among the largest in the history of several countries, and numbers are growing daily. Given this scale of vaccine administration, at least some rare adverse reactions, not detectable during even large clinical trials, could occur, underscoring the need for rigorous monitoring of safety. Results to date are encouraging.

Common Side Effects

As anticipated, side effects commonly reported include swelling, redness, or pain at the injection site, which usually resolves spontaneously a short time after vaccination.

Fever, headache, fatigue, and muscle aches, occurring shortly after vaccine administration, have also been reported, though with less frequency. These symptoms also resolve spontaneously, usually within 48 hours. In addition, a variety of allergic reactions has been observed. The frequency of these reactions is well within the expected range.

Guillain-Barre Syndrome

To date, fewer than ten suspected cases of Guillain-Barre syndrome have been reported in people who have received vaccine. These numbers are in line with normal background rates of this illness, as reported in a recent study. Nonetheless, all such cases are being investigated to determine whether these are randomly occurring events or if they might be associated with vaccination.

WHO has received no reports of fatal outcomes among suspected or confirmed cases of Guillain-Barre syndrome detected since vaccination campaigns began. All cases have recovered. WHO recommends continued active monitoring for Guillain-Barre syndrome.

Investigations of Deaths

A small number of deaths have occurred in people who have been vaccinated. All such deaths, reported to WHO, have been promptly investigated. Although some investigations are ongoing, results of completed investigations reported to WHO have ruled out a direct link to pandemic vaccine as the cause of death.

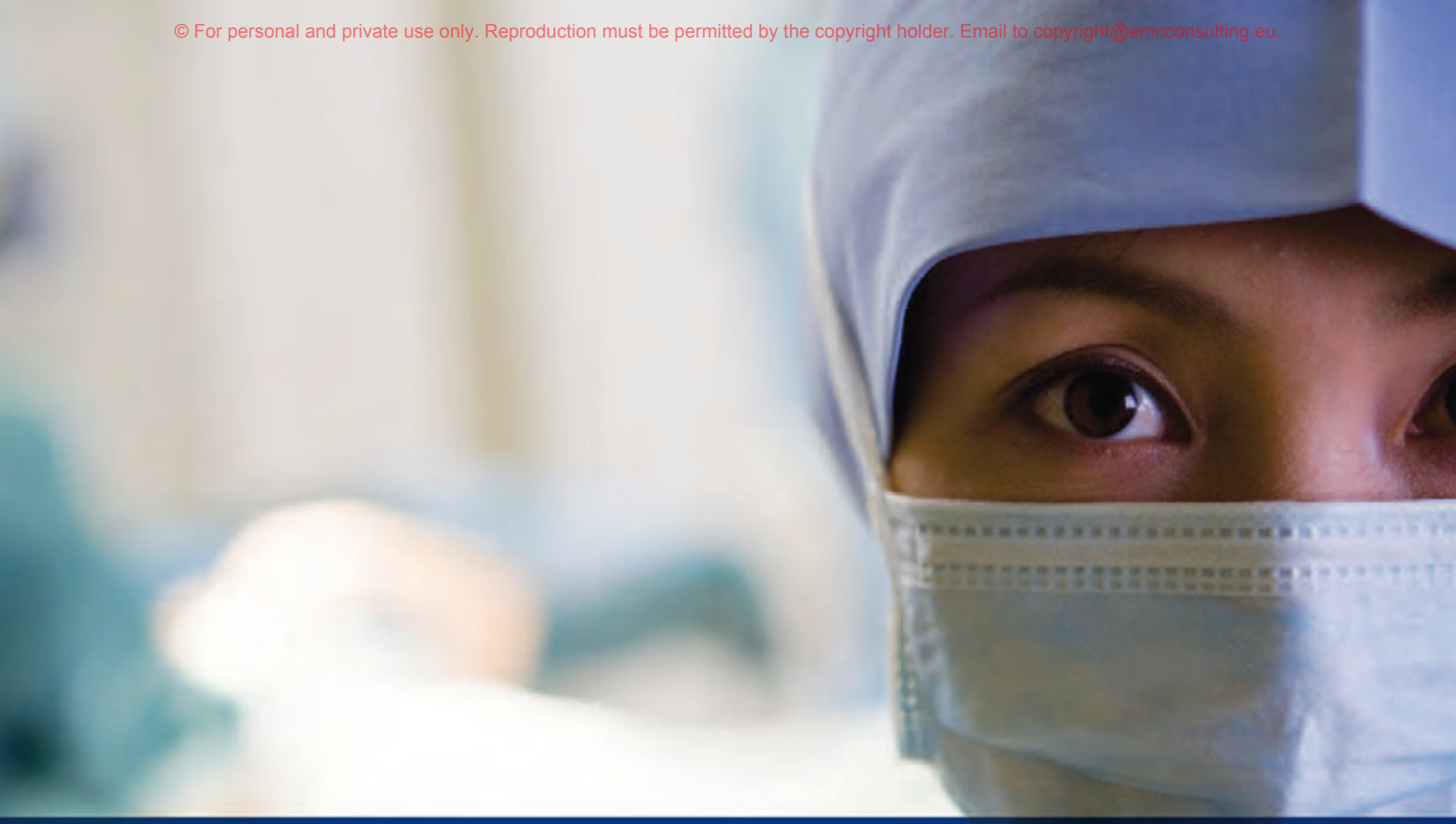
In China, for example, where more than 11 million doses of pandemic vaccine have been administered, health authorities have informed WHO of 15 cases of severe side effects and two deaths that occurred following vaccination. Thorough investigation of these deaths, including a review of autopsy results, determined that underlying medical conditions were the cause of death, and not the vaccine.

Safety profile of different vaccines

Campaigns are using nonadjuvanted inactivated vaccines, adjuvanted inactivated vaccines, and live attenuated vaccines. No differences in the safety profile of severe adverse events among different vaccines have been detected to date.

Although intense monitoring of vaccine safety continues, all data compiled to date indicate that pandemic vaccines match the excellent safety profile of seasonal influenza vaccines, which have been used for more than 60 years.

www.who.int



We all know endotracheal tubes leak.

The question is: What does that mean?

A recent study by *The New England Journal of Medicine* found pneumonia to be the second most common cause of rehospitalization within 30 days after surgery.[1] It's this kind of real-world need that drives our search for relevant innovations—innovations like the Mallinckrodt™ TaperGuard™ endotracheal tube, shown to reduce microaspiration an average of 90% compared with our own Mallinckrodt™ Hi-Lo™ cuff.[2]

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1 Jencks SF, Williams MV, Coleman EA. Rehospitalizations among patients in the Medicare fee-for-service program. N Engl J Med. 2009; 360(14): 1418-1420.

2 FDA 510(k) clearance.

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OBESE PAEDIATRIC PATIENTS REQUIRING INTENSIVE CARE

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Childhood obesity is increasing in prevalence worldwide. In the United States, studies estimate that among children aged six to nineteen, 16.5% are overweight (Body Mass Index [BMI] 85th to 94th percentile for age and gender) and 17.1% are obese (BMI ≥ 95th percentile for age and gender) (Ogden et al. 2006). This trend will likely lead to an increase in obese paediatric patients requiring intensive care. Studies have shown that obese adults in intensive care units (ICUs) have increased length of stay, poorer outcomes, and increased mortality (Pieracci et al. 2006); however, similar studies in children are lacking. Obesity is associated with physiologic derangements similar to critical illness including chronic inflammation, impaired immunity, insulin resistance, and hypercoagulability. Excess body mass requires increased work from all major organ systems, causing a decrease in the physiologic reserve (Pieracci et al. 2006). Practitioners in the paediatric intensive care unit (PICU) should be familiar with some of the basic physiologic derangements that may be seen in these patients.

The metabolic syndrome describes a cluster of cardiovascular risk factors, including hypertension, dyslipidemia, insulin resistance, and central adiposity, caused by the release of inflammatory and vasoactive mediators from adipose tissue (Jolliffe et al. 2006). Approximately one-third of obese adolescents have the metabolic syndrome, compared to 7% of overweight adolescents and 0.6% of adolescents with normal BMI (Cook et al. 2003). Obesity is an independent risk factor for hypertension in children, defined as systolic and/or diastolic blood pressure ≥ 95th percentile for gender, age, and height. Obese children have reduced peripheral artery dilatation due to impaired endothelial and smooth muscle function (Aggoun et al. 2008) and decreased parasympathetic nervous system activity (Carchman et al. 2005). Increased left ventricular mass occurs in obese children regardless of blood pressure classification (Maggio et al. 2008). Uncontrolled hypertension may cause seizures, encephalopathy, stroke, and congestive heart failure (National High Blood Pressure Education Program 2004). Critically ill obese children should have close blood pressure monitoring using appropriate-sized cuffs that cover two-thirds the length of the upper arm with the bladder length encompassing the entire arm circumference (Aggoun et al. 2008).

Childhood obesity is associated with the release of catecholamines, cortisol, glucagon, and proinflammatory mediators, leading to impaired glucose tolerance and insulin resistance. Stress-induced hyperglycaemia is often seen in critically ill patients, and may be more pronounced in children with impaired glucose tolerance at baseline. While initially advantageous, providing energy to organs and tissues with increased demand, prolonged hyperglycaemia leads to free radical formation, cellular damage, and impaired immunity, ultimately causing poorer outcomes and increased mortality (Clark et al. 2008). Although there is a paucity of data on the relationship between glucose control and outcomes in critically ill children, studies in adults suggest that strict glucose control in ICUs improves morbidity and mortality (Wintergerst et al. 2006).

A subset of children with impaired glucose tolerance will develop type 2 diabetes (Velasquez-Mieyer et al. 2007). The symptoms are often subtle, which may lead to a delay in diagnosis. Children may present with Hyperglycaemic Hyperosmolar Syndrome (HHS), characterised by hyperglycaemia, elevated serum osmolality, and mild metabolic acidosis without ketosis. They can lose 15-20% of total body water, leading to severe hypovolemia and requiring aggressive fluid resuscitation. The adult mortality rate for HHS is 10-15%; the mortali-

ty rate in children is unknown, although case reports have shown poor outcomes, including rhabdomyolysis, multiorgan failure, and death (Carchman et al. 2005).

Asthma has increased in prevalence parallel to the rise in childhood obesity. Elevated BMI is associated with higher rates of asthma and wheezing (Shaheen et al. 1999). Leptin, a hormone produced by adipose cells, has a positive correlation with BMI and asthma; this may be due to its proinflammatory effects (Guler et al. 2004) or its association with hypoventilation in obese individuals (Phipps et al. 2002). In addition, obesity causes a restrictive lung pattern due to increased pulmonary blood volume and increased chest wall mass from adipose tissue. Obese children admitted to the PICU for status asthmaticus have increased lengths of stay and require longer courses of intensive therapy, including the need for supplemental oxygen and administration of continuous beta-agonists and intravenous steroids (Carroll et al. 2006).

> *"As the prevalence of childhood obesity increases, there will continue to be what were formerly considered "adult" diseases manifesting in children and adolescents."*

Obesity is a risk factor for obstructive sleep apnoea (OSA) and correlates with more severe symptoms. Approximately 37% to 46% of obese children have OSA (Shine et al. 2006). Obese children with OSA who undergo tonsillectomies and adenoidectomies have more intra-operative respiratory complications, including multiple intubation attempts and post-induction oxygen desaturations. They are more likely to be hospitalised postoperatively and have increased lengths of stay (Nafiu et al. 2009). Postoperative upper airway obstruction may be caused by airway compression from excess neck tissue, hypoventilation due to decreased chest wall compliance and upward displacement of the diaphragm, and decreased airway tone after anaesthesia. Preoperative polysomnography is recommended for all obese patients to determine OSA severity, which can guide the need for intensive care monitoring postoperatively (Shine et al. 2006). If left untreated, OSA can cause pulmonary hypertension and cor pulmonale due to chronic nocturnal hypoxemia (Bower et al. 2000).

Obese children undergoing surgery have an increased risk of complications. They have significantly higher American Society of Anaesthesiology (ASA) scores, given their medical comorbidities (Nafiu et al. 2007). Vascular access can be difficult to obtain and control of the airway is more challenging. Medications, especially sedatives and narcotics, should be dosed based on ideal body weight. Postoperatively, there is increased risk of upper airway obstruction and desaturations (Veyckemans et al. 2008). Obesity is an independent risk factor for deep venous thrombosis; therefore, obese children in particular should receive DVT prophylaxis postoperatively (Wurtz et al. 1997).

As the prevalence of childhood obesity increases, there will continue to be what were formerly considered "adult" diseases manifesting in children and adolescents. It is important to be aware of these comorbidities in order to anticipate potential complications in critically ill obese children. More research is needed to better understand the effect of obesity on outcomes in the PICU and to determine strategies to improve morbidity and mortality for these patients. ■

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NETWORKING AWARDS 2009 REVIEW

On October 29-30 European healthcare IT professionals joined together at Square in Brussels for the first *IT @ Networking Awards (IT @ 2009)*, a unique event which shone a much needed spotlight on healthcare IT innovations and solutions. The stakes were high: An unrivalled cash prize of 5000 euros as well as the coveted *IT @ 2009* trophy and extensive press coverage in Europe's leading healthcare management journals for the winning project. With 78 submitted projects this event was a resounding success. The top 23 nominees were selected to present their MINDBYTE presentations on the first of this two day event.

The organisers- the European Association of Healthcare IT Managers (HITM) and the European Association of Hospital Managers (EAHM) created *IT @ 2009* on the basis that there was a lack of recognition of the innovators of healthcare IT on a pan-European level. They also believe that healthcare professionals who use IT solutions on a daily basis are best placed to judge the value of new projects.


EU Commissioner Viviane Reding

Unifying Healthcare IT Across Europe

The healthcare IT industry is not immune to the effects of rapid globalisation and emerging competition from China and India. The US is also reengaging itself in the industry despite current economic downturn. Christian Marolt, Secretary-General of HITM addressed this important issue in his opening address. He stressed the need for Europe to collaborate – to join together, not only to survive in healthcare IT for the years to follow – but to lead. Secretary-General of EAHM, Willy Heuschen stressed the core importance of healthcare IT and innovation for hospital managers.


Willy Heuschen, EAHM

EU Commissioner for Information Society and Media, Viviane Reding gave an inspiring e-address, in which she emphasised the importance of utilising IT in healthcare given the current financial crisis and issues of cross-border patient care throughout Europe. She applauded the efforts of the organisers and participants of *IT @ 2009* in furthering development and deployment of innovative e-health solutions.

Entertaining Networking Opportunities

Delegates gathered at the Grand Casino Brussels to celebrate the finalists from the first day of competition and to network with healthcare IT colleagues from across the continent. *IT @ 2009* participants, organisers and corporate sponsors were treated to drinks and canapés and a lively demonstration of black jack and roulette at the Casino's Cotton Club. The evening culminated in the draw for the order of presentations in the final WORKBENCH sessions.

Electronic Voting System

As *IT @ 2009* believes in peer to peer voting, the winning project was chosen not by the usual panel of expert judges, but by the audience of hospital CEOs, CIOs, CMIOs and hospital and healthcare IT managers. This was made possible thanks to a state-of-the-art electronic voting system. After each presentation the audience decided whether or not the presentation fulfilled the outlined criteria by pressing the relevant button on their personal keypads.

AND THE WINNERS ARE...

Winners: Kaarina Tanttu, Emile Knops, Dr. Pierre Biron and Bert Verdonck

The Winning Project

Dr. Biron from the Centre Léon Bérard in Lyon was awarded first prize. He and his team showcased the SISRA Health Information System and DPPR Shared and Distributed Patient Record, which have been implemented in the Rhône-Alpes region of France.

SISRA is a unique data capture and storage network built and reinforced with a strong identification access feature- allowing only patient and professional health ID cards clearance. Patient information is available securely and confidentially when and where needed –allowing patients to remain the gatekeepers of their own personal records.

Second Place

Digitisation of the Nationwide Breast Cancer Screening Programme in The Netherlands (presented by Bert Verdonck)

The National Institute for Public Health and the Environment (RIVM) provides a free nationwide breast cancer screening service for all women between 50 and 75 years of age. This programme is now digitised and referred to as DigiBOB. The service allows radiologists to access new and historical patient data, including multiple mammograms, in seconds. It claims to be the first digitised programme of its kind in the world.

Dr Pierre Biron receiving his prize

Third Place

From Free Text to Standardised Language – The National Development Project of Nursing Documentation in Finland" (presented by Kaarina Tanttu).

The Nursing Minimum Data Set (NMDS) is a part of the core data elements of national EHR. The national nursing documentation model and the Finnish Care Classification (FinnCC) were developed in the national nursing documentation project 2005-2008. NMDS and FinCC were integrated during 2005-2007 into 8 health recording systems in 33 healthcare organisations. As a result, the quality of nursing documentation is more uniform.

Looking Forward

Both HITM and the EAHM were overwhelmed by the positive response and look forward to an even more successful *IT @ Networking* next year. As HITM Secretary General, Christian Marolt stated, "It is clear that here in Europe, we also have outstanding healthcare IT jewels. As a non-profit body, we are doing whatever we can to get these innovations recognised globally. EU opinion leaders, politicians and policy makers also need to show their support, just like their counterparts in the US."

IT @ Networking 2010 promises to be bigger and better with more groundbreaking innovations and networking opportunities. See you in Brussels in October 2010! More details to follow.

OPTIMAL POSITIONING OF CRITICALLY ILL OBESE PATIENTS

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Intensive care of obese and morbidly obese patients is a major challenge because the patients present a wide spectrum of pre-existent pathophysiological disorders that may interfere with treatment (see p.12). Especially respiratory and cardiovascular limitations are reasons for complications and a prolonged duration of intensive care unit (ICU) stay in obese patients. Can such a simple thing as optimal positioning help to improve the wellbeing of the patient, reduce complications and, ultimatively, improve outcome?

Optimal positioning of an obese patient in intensive care has to fulfil several conditions:
1. Preventing harm to the patient;
2. Physical well-being of the patient;
3. Relief of ventilation and cardiac function;
4. Postoperative pulmonary and cardiocirculatory stabilisation, and
5. Facilitation of clinical procedures, e.g. weaning from mechanical ventilation.

Positional manoeuvres can impose extreme stress on obese patients and are often accompanied by significant changes of pulmonary and cardiocirculatory parameters. Specifically, severely obese patients tolerate relocation badly, so that any positional change has to be considered well and performed with maximal caution. Figure 1 gives an overview on the different positions used in intensive care.

This narrative review outlines the pathophysiology and specific complications associated with the positioning of obese patients. Understanding of these principles should allow safer intensive care treatment of this unique patient collective.

Supine Position

Supine positions are dangerous for patients with higher grades of obesity and should be avoided. Tsueda et al. described the "supine obesity death syndrome": A 38-year-old patient with a Body Mass Index (BMI) of 84 kg/m^2 became dyspnoeic after lying down supine for a radiological procedure. Consecutively, he developed respiratory and cardiocirculatory arrest and died after unsuccessful resuscitation.

But even in patients with lower grades of obesity, supine positioning can be harmful. Changing awake, spontaneously breathing obese patients from sitting to the supine position results in increased oxygen consumption and elevated cardiac output.

Abdominal surgery in morbidly obese patients is often followed by respiratory dysfunction (Pelosi et al. 1999). Nine patients with a BMI of 51 ± 8.2 kg/m^2 were postoperatively studied in the ICU. The patients were mechanically ventilated and lying in the supine position. Gas exchange in obese patients was worse when compared with normal-weight patients (PaO_2 110 ± 30 mmHg vs. 218 ± 47 mmHg at FiO_2 = 0.5). A PEEP of 10 mmHg cmH_20 could improve respiratory parameters of the obese patients significantly, while PEEP was not effective in the normal-weight control group.

Trendelenburg's Position

Trendelenburg's position is extremely harmful for patients with massive obesity. This position compromises the respiratory and cardiovascular system by auto-transfusion of blood to the heart and compression of the lung by abdominal fat-masses. Awake, spontaneously breathing obese patients should never be moved into Trendelenburg's position, e.g. for intensive care manoeuvres like the insertion of a central venous catheter. Hypoxaemia and cardiac decompensation may follow and threaten the patients' lives. Clinical studies in endotracheally intubated, mechanically ventilated obese patients demonstrated significant decreases in arterial oxygenation after Trendelenburg's position had been established (Meininger et al. 2006).

Head-Up Positions

Elevating the upper part of the body relieves the diaphragm from the weight of intra-abdominal contents and abdominal

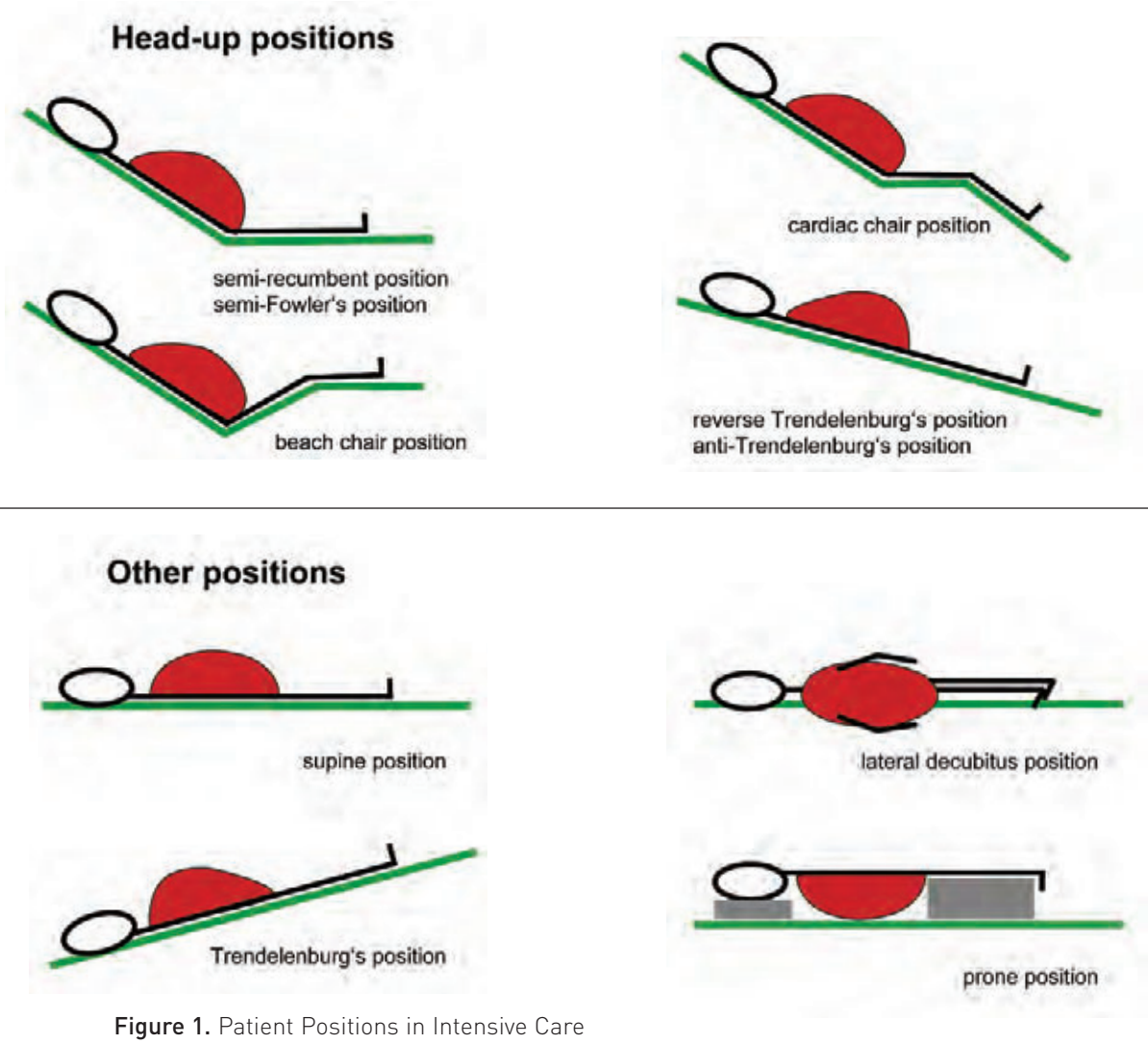


Figure 1. Patient Positions in Intensive Care

fat-masses and eases ventilation in obese patients. Suitable positions are:

1. Semi-recumbent position;
2. Reverse Trendelenburg's position;
3. Beach chair position, and
4. Cardiac chair position.

Particularly postoperatively, obese patients are at high risk for pulmonary complications and hypoxaemia. Vaughan and Wise studied 22 female patients with a mean BMI of 49 kg/m^2 and reported that during the first 48 hours after abdominal surgery gas exchange significantly improved with change from the supine to the semi-recumbent posture. For obese patients, specifically morbidly obese patients, it is recommended to establish a head-up position directly after end of anaesthesia and for endotracheal extubation. This posture should be maintained during transport from the operating room to the ICU, where it is continued for the duration of the recovery. For safe transport and intensive care of morbidly obese patients, special hospital beds to accommodate patients of > 200 kg of body weight are mandatory (Brodsky et al. 2002).

In endotracheally intubated, mechanically ventilated obese patients, head-up positions seem not to be as effective as in extubated, spontaneously breathing obese ones. Sprung et al. (2003) reported that although initial arterial oxygenation was worse in patients with massive obesity when compared with normal-weight patients, gas exchange remained almost constant regardless of mode of ventilation or body posture (supine vs. Trendelenburg's position vs. reverse Trendelenburg's position). However, the limitation of their study is the very short equilibration intervals of only five minutes.

Weaning

Weaning from mechanical ventilation benefits from head-up positioning of the obese patient. Burns et al. (1994) studied the weaning of 19 patients with large abdomens either due to obesity, abdominal distension, or ascites in different head-up positions. The 45° reverse Trendelenburg's position was identified as ideal for weaning trials because this posture lead to a significantly increased tidal volume (VT) and lower respiratory rate (RR). This form of positioning was even superior to sitting and semi-recumbent bedding.

Respiratory	Cardiocirculatory	Abdominal
Reduction of functional residual capacity	Higher prevalence of cardiovascular diseases	Increased intra-abdominal pressure
Decline in respiratory compliance	Hypertension	
Increased work of breathing	Elevated cardiac output	
	Left ventricular hypertrophy and dysfunction obesity induced cardiomyopathy	

Table 1. Major Pathophysiological Disorders in Obesity

Beach Chair Position

Positioning an obese patient in the beach chair position is a relatively new concept. Valenza et al. (2007) investigated 20 endotracheally intubated and mechanically ventilated obese patients with a BMI of 42 ± 5 kg/m^2. They moved the patients from supine to beach chair position and could demonstrate that the latter posture increased lung volumes, improved oxygenation and respiratory mechanics. The effect was in the same order of magnitude as the application of 10 cmH_2O PEEP. Studies in awake, spontaneously breathing obese patients, however, are still lacking.

Cardiac Chair Position

The cardiac chair position is often applied in obese patients suffering from cardiac insufficiency or dyspnoea. From the pathophysiological viewpoint, the lungs are relieved from abdominal pressure and the heart is disburdened from venous preload. Up to now, however, there exists no clinical study that has investigated this posture in obese patients.

Patients with obesity, especially those with higher grades of obesity, benefit from head-up positions. Regular cardiopulmonary monitoring - even in head up positions - is highly recommended.

Lateral Decubitus Position

Obese patients are often placed in the lateral decubitus position for prophylaxis of pressure ulcers. But also pulmonary parameters may benefit from the lateral posture as the abdomen is relieved from the weight of the panniculus, which probably reduces intra-abdominal pressure and enhances diaphragm motility.

A clinical study in obese subjects (BMI 44 ± 5 kg/m^2) revealed, however, that VT and RR did not change when subjects were moved from sitting to supine or lateral (Pankow et al. 1998). This is different in normal-weight subjects: Lowest VTs can be observed in the lateral position. The same study investigated the level of intrinsic PEEP (PEEPi) that must be overcome during each inspiration and is a surrogate parameter for work of breathing. PEEPi decreased in obese subjects significantly when they changed from supine to lateral position. These results support the view that lateral posture is advantageous for obese patients when compared with supine posture.

Complications

In the lateral decubitus position, lower lung volumes of the dependent lung can be observed in obese subjects. This can lead to hypoxaemia, lung oedema and atelectasis of the dependent lung. Periodical alternation of lateral posture and regular cardiopulmonary monitoring should be arranged, especially in morbid obesity.

Attention should also be paid to epidural catheters. The higher the BMI the more probable is catheter movement associated with a change in the patient's position. Dislocations of up to 4.3 cm were observed (Hamilton et al. 1997).

Prone Position

Prone positioning is used in endotracheally intubated and mechanically ventilated patients with acute lung injury (ALI) and acute respiratory distress syndrome (ARDS) to treat severe, life-threatening hypoxaemia. Increases of 52 ± 59 mmHg in PaO_2 / FiO_2 could be observed in normal-weight patients with ALI or ARDS (Protti et al. 2009).

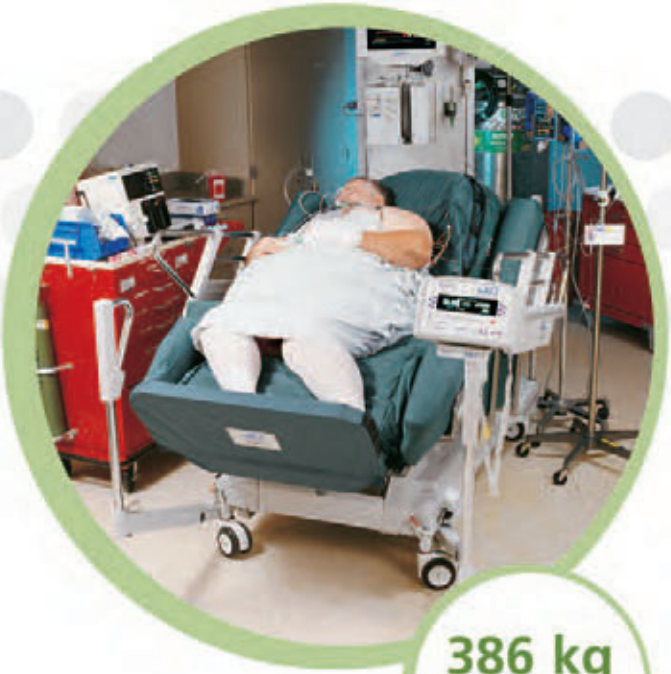
In obese patients, however, it was believed that prone positioning was harmful and should be avoided whenever possible. A study in 10 endotracheally intubated and mechanically ventilated obese patients (BMI 34.6 ± 4.8 kg/m^2) reported that prone position compared with supine posture positively affected respiratory mechanics, significantly improved oxygenation (PaO_2 of 130 ± 31 mmHg vs. 181 ± 28 mmHg at FiO_2=0.4) and enhanced functional residual capacity (FRC) (894 ± 327 ml vs. 1980 ± 856 ml) (Pelosi et al. 1996). The study demonstrates that mechanical ventilation in prone position is safe also in obese patients and improves pulmonary function. This posture could possibly be a promising option in the intensive care of obese patients with ALI or ARDS suffering from severe hypoxaemia. It is, however, important that prone position is correctly executed and free abdominal movement is guaranteed. Contraindications of prone position such as acute central nervous system injury, instable cardiocirculatory situation, and an unstable spinal column have to be kept in mind.

Rotational Bed Therapy

Positioning therapy in rotating beds is assumed to improve drainage of secretions of the airways and to counteract atelectasis and consolidation of dependent lung regions. Additionally, this form of positioning should prevent several

Continued on page 41

OFFERING PATIENT SAFETY AND MOBILITY



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* Rahoof, S. et al., Chest 1999; 115: 1658-1666
** Yarbrough, D.R. et al., OWM 2000; 46(3): 64-69

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A PHYSIOLOGICAL BASED APPROACH OF PERIOPERATIVE MANAGEMENT IN OBESE PATIENTS

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The high-risk non-cardiac surgical population represents a major global healthcare challenge. Recent estimates suggest that 234 million major surgical procedures are performed worldwide each year (Weiser et al. 2008). Complications following major surgery are a leading cause of morbidity and mortality (Head et al. 2008; Jencks et al. 2009). Previous sickness before surgery is second only to cardiovascular disease in terms of associated short-term complications and increased mortality (Head et al. 2008). Obesity is a metabolic disease continuously increasing worldwide (Weiser et al. 2008; Head et al. 2008). Many etiologic factors may be implicated in determining obesity: Genetic, environmental, socioeconomic and individual ones, such as age and sex. Since these patients are characterised by several systemic physiopathological alterations, perioperative management may present some problems, mainly related to respiratory alterations (Shenkman et al. 1993). In this brief review we will discuss:

1. The influence of body mass on respiratory function and on ventilatory management in the perioperative period; and
2. The possible role of intensive care to reduce pulmonary complications and, morbidity in the post-operative period.

How to Calculate Obesity

In clinical practice, several criteria have been proposed to exactly define obesity (Shenkman et al. 1993):
1. Height/weight indexes. The advantage of using these is that one does not have to look up ideal body weight in a table.
2. Calculation of the ratio between the actual and "ideal" weight of the patient. The "ideal" weight in kilograms is computed subtracting 100 (in men) and 105 (in women) from the patient's height in centimetres. A person weighing greater than 120 % of their "ideal" weight may be considered obese, and greater than 200 % of "ideal" weight as a pathologic obese.
3. Calculation of the Body Mass Index (BMI, or Quetelet's index). This index is computed as the ratio between weight, expressed in kilograms, and height squared, expressed in metres.

On the base of BMI, it is possible to divide the population in several classes:
a) Underweight with a BMI (kg/m^2) lower than 20;
b) Normal weight with a BMI between 20 and 25;
c) Overweight with a BMI between 25 and 30;
d) Obese with a BMI between 30 and 40; or
e) Morbid obese with a BMI greater than 40
(Weiser et al. 2008).

BMI is commonly used when dealing with obesity, because it is simple to compute and well correlated with the risk of death.

Respiratory Function in the Intra-operative Period

Body mass is an important determinant of respiratory function during anaesthesia and paralysis not only in morbidly but also in moderate obese patients. Since obese patients are starting

from a respiratory condition that is already physiologically poor, the effects on the morphological and functional variations of the respiratory system after the induction and maintenance of anaesthesia and paralysis are more pronounced than in normal subjects.

Lung volumes. The reduction in lung volumes is well associated with the increase in body mass (Shenkman et al. 1993). In morbidly obese patients, the Functional Residual Capacity (FRC) decreases after induction of anaesthesia to approximately 50% of pre-anaesthesia values (Smetana 1999; Reinius et al. 2009). It is now accepted that the main causes of the reduction in FRC during anaesthesia and paralysis can be: a) atelectasis formation and b) blood shift from abdomen to thorax. The occurrence of atelectasis can be due to changes in the shape and motion of the diaphragm, the ribcage, or both of them promoted by the loss of diaphragmatic tone induced by anaesthetics and paralysing agents. With an enhancement of body mass, an increase in intra-abdominal pressure can occur (Pelosi et al. 1998). The increased intra-abdominal pressure is mainly directed toward the most dependent lung regions with a more important cephalad displacement. This results in a decreased movement of the dependent part of the diaphragm, where atelectasis is more likely to occur. This preferential alteration of the diaphragm favours a greater development of atelectasis in the dependent lung regions more than in healthy subjects.

Respiratory mechanics. The alterations of respiratory mechanics that occur during anaesthesia and paralysis are well related to the body mass. The decrease in compliance of the respiratory system with the increase of body mass is mainly determined by the reduction in lung compliance, rather than in chest wall compliance (Pelosi et al. 1996). Also respiratory resistances are influenced by body mass (Pelosi et al. 1996). The more important factor for the decreased lung compliance and increased resistance is the reduction in FRC, since the intrinsic mechanical characteristics of lung parenchyma – "specific compliance" – and –"specific resistance" are nearly unchanged.

Gas exchange. Oxygenation decreases with the increase in body mass (Pelosi et al. 1998). In fact, the arterial hypoxaemia, that characterises awake obese patients, is worsened during anaesthesia and paralysis. As previously discussed, the lung bases are underventilated because of airway closure and atelectasis, thus producing pulmonary "shunt" and hypoxaemia. Even in obese patients without hypoventilation syndrome, the physiological dead space is increased compared to normal subjects during anaesthesia.

How to Ventilate Obese Patients

Increased intra-abdominal pressure seems to play a relevant role in the reduction of FRC, which appears to be the prevalent phenomenon, resulting in a decrease of respiratory compliance and oxygenation. This suggests the occurrence of relevant collapse and lung dependent atelectasis.

To approach the respiratory system alterations that occur in these patients, different modalities of ventilation have been proposed:

1. Use of lower inspiratory oxygen fractions to maintain physiologic oxygenation (Rothen et al. 1995);
2. Ventilation using tidal volumes lower than 13 ml/Kg ideal body weight (Bardoczky et al. 1995);
3. Inclusion of large, manually or automatically performed lung inflations (sighs) (Rothen et al. 1993); and
4. Application of a positive end-expiratory pressure (PEEP) after a recruitment manoeuvre (Reinius et al. 2009; Pelosi et al. 1999).

The superiority of one or more of these different ventilatory settings in comparative studies has never been investigated. As a consequence of respiratory modifications induced by general anaesthesia and paralysis, the main aim of mechanical ventilation in obese patients is to "keep the lungs open" during the entire respiratory cycle. This counteracts negative effects induced by the increased body mass and the high intra-abdominal pressure (airway closure, atelectasis, impaired respiratory mechanics and oxygenation), which occur in the intraoperative period but that can persist few days in the post-operative period, too. The use of low tidal volumes (and, as a consequence, low alveolar ventilation) with low PEEP levels and high inspired oxygen fraction (FiO_2) greater than 0.8 should be avoided since it has been clearly showed that this may lead to the formation of progressive reabsorption atelectasis. The use of continuously high tidal volumes (>13 ml/kg ideal body weight) seems to be ineffective to further improve oxygenation, while it can induce hypocapnia, if respiratory rate is not decreased. Moreover, the continuous use of high tidal volumes even during anaesthesia can be deleterious on the lung structure and on haemodynamics.

To ventilate a lung showing a tendency to collapse the following must be provided:

1. Inspiratory pressure to open the collapsed lung regions (recruitment pressure);
2. A positive end-expiratory pressure (PEEP) high enough to keep the lung open at end-expiration associated with low tidal volumes; and
3. FiO_2 lower than 0.8.

Adequate opening pressure can be obtained applying periodic large, manually performed lung inflations (recruitment manoeuvres) (Reinius et al. 2009). To achieve a transpulmonary pressure enough to reopen collapsed alveoli, airway pressures up to 60 cmH_2O are necessary. On the other hand, an application for a relatively short period of time (six seconds) is recommended to avoid possible negative effects on haemodynamics. The recruitment manoeuvre should be performed always only when volemic and haemodynamic stabilisation is reached after induction of anaesthesia and should be repeated every half an hour in absence of PEEP. The role of PEEP in anaesthesia is still controversial. This is likely due to the opposite effects induced by PEEP on oxygenation in different patients. PEEP can resolve atelectasis, if present, and prevent small airways collapse, improving ventilation-perfusion matching and oxygenation. However, increasing PEEP

may lead to negative effects on ventilation-perfusion ratio and pulmonary shunt, if alveolar overstretching and cardiac output reduction or redistribution becomes the prevalent phenomena. The final effect on oxygenation of PEEP application depends on the balance between the positive and negative effects in any given patient. We found that applying 10 cmH_2O of PEEP during anaesthesia and paralysis induces an oxygenation improvement in morbidly obese patients, but not in average subjects (Pelosi et al. 1999). Moreover, we found that the partitioned Pressure-Volume curves measured at PEEP 0 and 10 cmH_2O roughly follow the same pattern in normal subjects, while in obese patients the Pressure-Volume curves at 10 cmH_2O PEEP are shifted upward and on the left, suggesting the occurrence of alveolar recruitment. The amount of alveolar recruitment was also related to the improvement of oxygenation.

Thus we believe that morbidly obese patients during general anaesthesia should be ventilated with physiologic tidal volumes (6-10 ml/Kg Ideal Body weight) and a respiratory rate to maintain normocapnia. In addition, an application of 10 cmH_2O PEEP after a recruitment manoeuvre associated with a FiO_2 between 0.4 and 0.8 are recommended (Reinius et al. 2009). This suggested ventilator setting has been proven to be effective also during bariatric laparoscopic surgery (Valenza et al. 2007; Delay et al. 2008). Further studies are needed to define the optimal levels of PEEP and tidal volume during general anaesthesia in obese patients, for opening up and keeping the lung open, as well as improving oxygenation and respiratory mechanics.

Respiratory Function in the Post-operative Period

Respiratory function is deeply altered in the post-operative period (Pelosi et al. 1997). Both upper abdominal and thoracic surgery can result in a post-operative pulmonary restrictive syndrome. This restriction of pulmonary function may persist for several days, leading to a high incidence of post-operative pulmonary complications such as sputum retention, atelectasis, and bronchopulmonary infection, even in the absence of a previously demonstrable intrinsic lung disease. These complications produce further worsening of pulmonary function and cause secondary hypoxaemia. To reduce post-operative pulmonary complications, different techniques and treatments have been proposed, such as chest physiotherapy, incentive spirometry, and intermittent positive pressure breathing (Fagevik et al. 1997). Some authors have proposed the use of continuous positive airway pressure (CPAP) (Fagevik et al. 2002) or bi-level positive airway pressure (Bi-PAP) administered by non-invasive techniques in the first 24 hours during the post-operative period (Joris et al. 1997).

We believe that CPAP is the easiest method of respiratory assistance compared to ventilation, especially if performed in the ward or in the surgical department. CPAP should be always administered in the postoperative period when the PaO_2 / FiO_2 ratio falls below 300, and maintained for a prolonged period of time during the day. The use of the helmet instead of the mask can improve the efficacy of the treatment and the comfort of the patient (Morer et al. 2009). The aim is to give ventilatory support in order to more rapidly restore lung volumes to the pre-operative values, improving oxygenation and reducing work of breathing. Moreover, for several days after surgery, patients should remain in semi-recumbent position (30°-45°), to reduce the abdominal pressure on the diaphragm. These data suggest that a more physiological approach to respiratory treatment in the postoperative period could be useful in improving respiratory outcome. The role of a preventive admission of morbidly obese patients undergoing abdominal surgery in intermediate or general intensive care units (ICUs) during the post-operative period is not yet defined. Some advantages of ICUs admission are a gentler weaning from the ventilator, to easily perform chest physiotherapy and non-invasive ventilatory treatment, an optimised fluid treatment, a more careful pain control. On the other hand, there are increased costs and more difficulties related to organising the time schedule of operations.

Conclusion

The important alterations in the respiratory function of morbidly obese patients in the perioperative period may play a significant role in determining pulmonary complications in the intra and post-operative period. In morbidly obese patients, adequate ventilatory settings aimed at keep the lungs open during surgery and in the postoperative period (associated with ICU admission) may help to reduce the incidence of postoperative pulmonary complications. ■

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EARLY MOBILISATION OF CRITICALLY ILL OBESE PATIENTS

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Obesity is increasing at an alarming rate across many countries throughout the world. As a consequence, we are more frequently challenged with the management of obese patients in our Intensive Care Units (ICUs) *(Akinnusi et al. 2008; Hogue, Jr. et al. 2009; Oliveros and Villamor 2008).* **Obese patients have an increased risk for thromboembolic disease, pressure ulcers, prolonged mechanical ventilation, deconditioning, and poor physical function** *(Charlebois and Wilmoth 2004).* **Due in part to such complications, obesity is associated with an increased length of stay** *(Akinnusi et al. 2008; El-Solh et al. 2001; Hogue, Jr. et al. 2009).* **Bed rest and immobilisation, which are common in mechanically ventilated patients, may further contribute to these complications of ICU care.**

Early Mobilisation of Obese Patients in the ICU

Early mobilisation of obese patients in the ICU aims to preserve physical function and prevent complications associated with bed rest and obesity. Compared to other ICU patients, critically ill obese patients may require additional resources for support and balance during rehabilitation activities; however, mobilisation is still feasible with an interdisciplinary team approach and appropriate planning and coordination.

Physiotherapy treatments aimed at mobilising obese patients must be coordinated with other healthcare professionals, including respiratory therapy and nursing staff. It is important to maintain patient confidence, motivation and safety awareness during mobilisation. Obese patients may feel discouraged or reluctant to participate in mobilisation activities. Such patients may benefit from positive support and education on the importance of daily physical activity, particularly in the ICU setting. The patient should be involved in setting daily goals for mobilisation therapy in order to advance their mobility from previous sessions. The entire healthcare team should provide positive reinforcement for participation in mobilisation activities. ICU clinicians can assist with mobilisation through minimising deep sedation and ensuring appropriate mechanical ventilator settings to support respiratory effort and maintain patient comfort during mobilisation (Korupolu, Gifford, and Needham 2009; Needham 2008).

Mobilisation of obese patients often requires consideration of appropriate staffing and specialised bariatric equipment. Two or three staff members may be required to assist a physiotherapist in transferring an obese patient from laying to sitting, from sitting to standing and during ambulation. However, such staffing may be reduced with appropriate equipment. For example, transfer boards can assist the patient and therapist in safely performing lateral transfers. In addition, a bariatric patient lift, bariatric chair and walker can assist with graduated mobility activities in obese patients. Such equipment may be important in reducing work-related injuries among ICU and rehabilitation staff and decrease the risk of related patient injuries (Charney and Hudson 2004).

Conclusion

Recent studies have demonstrated that early mobilisation is safe, feasible and beneficial in ICU patients (Bailey et al. 2007; Morris et al. 2008; Schweickert et al. 2009). However, early mobilisation has not been specifically evaluated in critically ill obese patients. In our experience, early mobilisation of critically ill obese patients is feasible with interdisciplinary teamwork and patient education. Specialised bariatric equipment may improve the feasibility and safety of mobilisation activities. Future studies are needed to more fully understand the benefits of early mobilisation in obese patients in the ICU setting and to develop specific evidence-based guidelines. ■

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RISK ASSESSMENT OF PATIENTS WITH SEVERE COMMUNITY-ACQUIRED PNEUMONIA

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Severe Community-Acquired Pneumonia is the main single cause of mortality from infectious diseases in developed countries. Risk stratification is essential for patients presenting to the emergency department to allow a precise definition of need of intensive care and the initiation of adjuvant therapies. Numerous scoring systems have been developed to predict mortality. The pneumonia severity index and the CURB-65 are validated worldwide and often employed in clinical practice. However, these tools may not be sufficient. Recently, new scoring systems and biomarkers have been proposed to help the decision making process and to assess the severity of illness. New scoring systems as the SMART-COP and CAP-PIRO represent major advances in predicting the need of intensive care support and healthcare resource utilisation. Among biomarkers, C-reactive protein and procalcitonin may be incorporated to clinical practice supporting the assessment of severity of illness and response to treatment.

Introduction

Community-acquired pneumonia (CAP) is a major cause of morbidity and mortality associated with increased healthcare costs (Rodriguez et al. 2009; Singanayagam et al. 2009). Routine clinical judgment is considered a poor predictor of outcome. Severity scores are useful to assist physicians in the decision making process, especially to decide whether patients should be admitted to the hospital or to the intensive care unit (ICU) (Singanayagam et al. 2009). Scores are key elements for the stratification of patients in clinical care and research (Niederman 2009). In addition, biomarkers are proposed to assess the response to therapy and augment the predictive capacity of scores (Marshall et al. 2009).

Scoring Systems in Clinical Practice

The Pneumonia Severity Index (PSI) was introduced to help to identify patients with CAP and a low risk of death (Fine et al. 1997). The PSI is based on 20 clinical variables segregating patients into five classes associated with 30-day mortality. Although it performs well as a predictor of mortality, it is time consuming and requires multiple clinical and laboratory parameters. Moreover, the PSI was developed to identify low risk patients and may underestimate the severity of illness (Rello and Rodriguez 2007). The CURB-65 features are new-onset mental confusion, urea >7mmol/l, respiratory rate ≥30 breaths/min, systolic blood pressure <90mmHg or diastolic blood pressure ≤60mmHg and age ≥65 years (Lim et al. 2003). It is a 5-point score with three risk categories: low risk (0-1 points), intermediate risk (2 points) and high risk (>3 points). It is a straightforward and accurate tool for the prediction of 30-day mortality. A simplified version of the CURB-65 obviating the need of urea measurement was tested showing a comparable performance (Niederman 2009).

Besides mortality, scoring systems may predict the need of ICU admission (see page 28). The 2007 ATS definition includes the need for invasive mechanical ventilation (MV) or vasopressors as indicators for direct admission to an ICU (Mandell et al. 2007). For patients who do not meet either of these major criteria, minor criteria have been proposed. A recent validation of these criteria in a large population confirmed its good discriminative ability (Brown et al. 2009). Another recent advance was achieved by the SMART-COP (Charles et al. 2008). It aimed to identify variables associated with the need of intensive, respiratory or vasopressors support (IRVS). This was converted into a score that was subsequently validated in five external databases (n=7464). SMART-COP denotes: Systolic blood pressure (<90mmHg), Multilobar chest radiography involvement, Albumin (<3,5g/dl), Respiratory rate ≥25 ipm (<50 years) or ≥30 ipm (>50 years), Tachycardia (>125 bpm), Confusion, Oxygenation <70mmHg (≤ 50 years) or <60mmHg (>50

Scoring System	CURB-65	SMART-COP	REA-ICU	CAP-PIRO
Meaning	New-onset mental Confusion, Urea >7mmol/l, Tespiratory rate ≥30 Breaths/min, Systolic blood pressure <90mmHg or Diastolic blood pressure ≤60mmHg and Age ≥65 years	Systolic blood pressure (<90mmHg), Multilobar chest radiography involvement, Albumin (<3,5g/dl), Respiratory rate ≥25 ipm (<50 years) or ≥30 ipm (>50 years), Tachycardia (>125 bpm), Confusion, Oxygenation <70mmHg (≤ 50 years) or <60mmHg (>50 years) and arterial pH<7,35	Risk of Early Admission to ICU	CAP for patients with severe CAP, P for "Predisposition", I for "Infection"; R for "Response", characterised by the inflammatory and innate immune response and, finally, O for "Organ dysfunction
Usage	To predict 30-day mortality	To identify variables associated with the need of intensive, respiratory or vasopressors support (IRVS)	To be used within three days of hospital stay for patients initially presenting without respiratory failure or shock (includes 11 variables associated with ICU admission)	To stratify patients into risk categories for sepsis to facilitate benchmarking and randomisation of patients for clinical trials
Key Points	5-point score with three risk categories: Low risk (0-1 points), Intermediate risk (2 points) and High risk (>3 points)	SMART-COP score ≥ 3 points was superior in the identification of patients who received IRVS as compared to PSI and CURB-65	The REA-ICU performed significantly better than usually employed scores (PSI, CURB-65) for the prediction of ICU admission (AUC-REA-ICU=0,81,95%CI 0,78-0,83)	CAP-PIRO scores were superior to APACHE II and the 2007 ATS/IDSA criteria and associated with increased mortality, longer ICU length of stay and duration of MV

Table 1. Major Overview of Scoring Systems

years) and arterial pH<7,35. A SMART-COP score ≥ 3 points was superior in the identification of patients who received IRVS as compared to PSI and CURB-65.

Recently the "Risk of Early Admission to ICU" multicentre study enrolled 6560 adults with pneumonia not requiring immediate ICU admission to identify factors associated with ICU admission within three days of hospital stay for patients initially presenting without respiratory failure or shock (Renaud et al. 2009). The Risk REA-ICU index includes 11 variables associated with ICU admission. Interestingly, the REA-ICU performed significantly better than usually employed scores (PSI, CURB-65) for the prediction of ICU admission (AUC-REA-ICU=0,81,95%CI 0,78-0,83).

Taking an innovative perspective, Rello et al. developed the CAP-PIRO score aiming to stratify patients into risk categories to facilitate benchmarking and randomisation of patients for clinical trials (Rello et al. 2009). The PIRO concept was first introduced as a staging system for sepsis (Levy et al. 2003) to allow stratification of patients on the basis of four domains. P for "Predisposition", I for "Infection"; R for "Response", characterised by the inflammatory and innate immune response and, finally, O for "organ dysfunction". A CAP-PIRO model was developed for patients with severe CAP using a historical cohort with 529 patients from the CAPUCI study (Bodi et al. 2005). The main objective was to compare the performance of the CAP-PIRO with the APACHE II and the 2007 ATS/IDSA criteria. The CAP-PIRO scores was superior to usual scores and associated with increased mortality, longer ICU length of stay and duration of MV.

Should Biomarkers be Included in the Assessment of CAP?

Biomarkers are valuable tools for the assessment of disease severity, the prediction of response to treatment and mortality in severe infections (Marshall et al. 2009). As a biomarker

Continued on page 28

ECRI Institute

INTENSIVE CARE VENTILATORS

ECRI INSTITUTE RECOMMENDATIONS

Purchase Considerations

Included in the accompanying comparison chart are ECRI Institute's recommendations for minimum performance requirements for intensive care ventilators. The requirements are separated into two categories—basic and mid/high complexity. The differences between these two categories are based on performance criteria for operating modes, controls, monitored parameters, and alarm functionality.

The ventilator should offer assist/control and SIMV modes. For volume- and pressure-controlled breaths, it should also provide CPAP/PEEP and pressure support. The unit should monitor airway pressure, respiratory rate, I:E ratio, and minute volume; controls should be available for pressure level, tidal volume, breath rate, inspiratory time, FiO_2, PEEP/CPAP, I:E ratio, pressure support, and sensitivity.

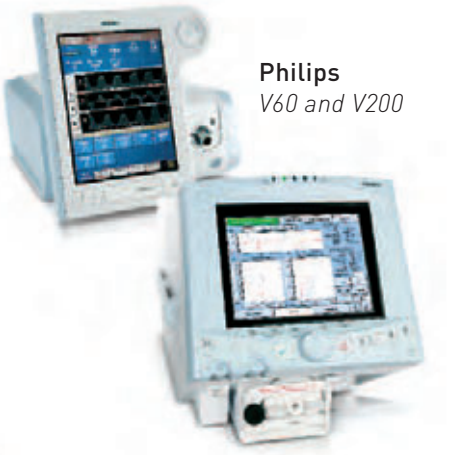
ECRI Institute recommends that these units have patient-responsive features and patient-responsive modes or combination modes. For higher-end ventilators, graphical displays should include waveforms and loops. Loops should be saved for comparisons and trending of monitored variables. The higher-end units should also offer some respiratory manoeuvres.

Alarms, both visual and auditory, should be available for inspiratory pressure (low and high), low CPAP/PEEP, minute volume (low or low/high), respiratory rate (low and high), gas supply loss, and power failure. All alarms should be distinct and easy to identify. Also, if alarm volume is adjustable, it should not be possible to turn the volume down so low that the alarm is inaudible. The alarm silence feature must reactivate automatically within two minutes if the condition is not corrected. If an alarm is silenced, a visual display should clearly indicate which alarm is disabled. The delivered O_2 or O_2/air mixture should be monitored with an O_2 analyser that includes an alarm for concentrations outside acceptable ranges. The analyser should be included with the ventilator. The controls (i.e., switches, knobs) should be visible and clearly identified, and their functions should be self-evident. The design should prevent misinterpretation of displays and control settings. Controls should be protected against accidental setting changes (e.g., due to someone brushing against the panel) and be sealed against fluid penetration. Patient and operator safety and system performance should not be adversely affected by fluid spills.

Cost Containment

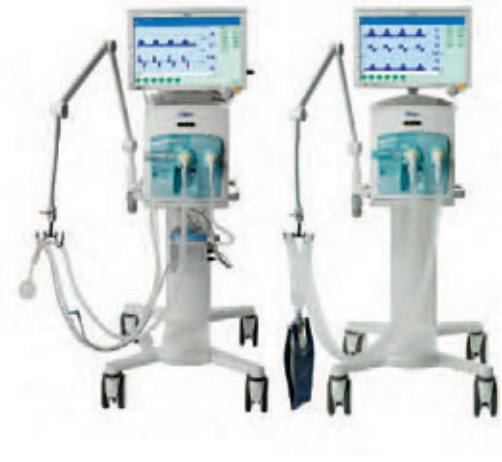
Because intensive care ventilators entail ongoing maintenance and operational costs, the initial acquisition cost does not accurately reflect the total cost of ownership. Therefore, a purchase decision should be based on issues such as life-cycle cost (LCC), local service support, discount rates and non-price-related benefits offered by the supplier, and standardisation with existing equipment in the department or hospital (i.e., purchasing all ventilators from one supplier).

Hospitals should evaluate how they plan to use the ventilator; in particular, the decision to use disposable or reusable breathing circuits will affect the cost of operation. Hospitals can purchase service contracts or service on a time-and-mate-

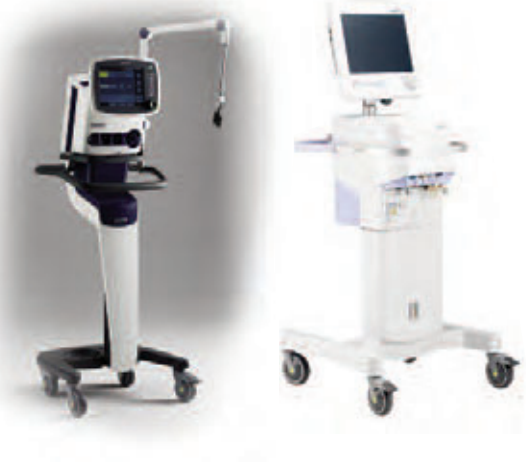


Philips
V60 and V200

Dräger
Babylog VN500 and Evita Infinity V500



Hamilton
C2 and G5



GE Healthcare
iVent 201

rials basis from the supplier. Service may also be available from a third-party organisation. The decision to purchase a service contract should be carefully considered. Purchasing a service contract ensures that preventive maintenance will be performed at regular intervals, thereby eliminating the possibility of unexpected maintenance costs. Also, many suppliers do not extend system performance and uptime guarantees beyond the length of the warranty unless the system is covered by a service contract. ECRI Institute recommends that, to maximize bargaining leverage, hospitals negotiate pricing for service contracts before the system is purchased. Additional service contract discounts may be negotiable for multiple-year agreements or for service contracts that are bundled with contracts on other similar equipment in the department or hospital.

Stage of Development

The mid-1980s witnessed the introduction of microprocessor-based ventilators that could be easily upgraded to perform additional operations by a simple software change. However, the use of microprocessors has given the operator a vast and sometimes confusing number of options to choose from. In the near future, monitors for gas exchange and haemodynamics may be merged with the ventilator's existing data collection system. This combined system may alert the clinician to necessary control changes. Recently, the concept of tracheal triggering was introduced. Tracheal pressure triggering has substantially reduced the work of breathing in lung models simulating spontaneous breathing with CPAP. This reduction occurs because a small level of pressure support is produced at the proximal endotracheal tube. Tracheal triggering may also be beneficial when small endotracheal tubes are used.

For more information, visit **www.ecri.org**

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Footnotes on page 43

	ECRI Insitute's Recommended Specifications	CareFusion
MODEL	**Basic IC Ventilators**	**LTV 1200**
WHERE MARKETED		Worldwide
FDA CLEARANCE		Yes
CE MARK (MDD)		Yes
PATIENT TYPE		Adult, pediatric
CONTROLS		
Tidal volume, mL	50-800	50-2,000
Inspiratory flow, L/min	3-180	>160
Inspiratory pressure, cm H2O	0-80	1 to 60
Respiratory rate, bpm	6-120	0-80
Inspiratory time, sec	0-3 pause	0.3-9.9
Expiratory time, sec	1-Aug	346 msec minimum
IE ratio	1:4 to 4:1	1:4 to 4:1
Inspiratory hold/plateau	0-3 sec	6 sec maximum
Expiratory hold	0-3 sec	6 sec maximum
FiO2, %	30-90	21-100
Manual breath	Yes	1 x current settings
PEEP/CPAP, cm H2O	0-45	0-20
Pressure support, cm H2O	0-45	Off, 1-60
Nebulizer	Optional	Not specified
Pressure slope/ramp adjustment	Yes/yes	Yes/yes
Sigh	Optional	No
100% O2		Yes
OPERATING MODES		
Assist/control		Yes
Volume breaths	Yes	Yes
Pressure breaths	Yes	Yes
SIMV		Yes
Volume breaths	Yes	Yes
SIMV Pressure breaths	Optional	Yes
Pressure support	Yes	Yes
Spontaneous/CPAP		Yes
Pressure support	Yes	Yes
Apnea-backup vent	Yes	Yes
Responsive valve		Not specified
Bilevel/APRV		Not specified
MONITORED PARAMETERS		
Pressure		Yes
PIP	Yes	Yes
MAP	Yes	Yes
PEEP	Yes	Yes
Volume		Yes
Tidal	Yes	Yes
Minute	Yes	Yes
Spontaneous minute	Optional	Yes
FiO2	Yes	Set
Respiratory rate	Yes	Yes
Inspiratory time	Yes	No
Expiratory time	Yes	No
IE	Yes	Yes
PATIENT ALARMS		
Breathing circuit disconnect		Yes
DISPLAY TYPES	User preference	LED, optional LCD
DATA DISPLAYED	User customizable	Numbers
MRI COMPATIBILITY		Yes
LINE POWER, VAC	Standard	90-240
INTERNAL BATTERY	Required	Yes
PURCHASE INFORMATION		
Warranty		1 year
OTHER SPECIFICATIONS		Patient presets, spontaneous breathing trial (SBT), O2 flush, O2 cylinder duration, variable rise time; variable termination criteria for pressure-support and pressure-control breaths, Oxygen Conserve. Meets requirements of cETL, IEC 60601-1, and ISO 13485.
LAST UPDATED		Nov-09
Footnotes		

SUPPLIER	CareFusion	CareFusion	CareFusion	PHILIPS	
MODEL	**Vela Comprehensive**	**EnVe**	**AVEA**	**V60**	
WHERE MARKETED	Worldwide	US only at time of print	Worldwide	Worldwide	
FDA CLEARANCE	Yes	Yes	Yes	YES	
CE MARK (MDD)	Yes	Not at time of print	Yes	YES	
PATIENT TYPE	Adult, pediatric	Adult, Pediatric	Adult, pediatric, neonatal	ADULTS AND PEDS (>20kg)	
CONTROLS					
Tidal volume, mL	50-2,000	50-2,000	2-2,500	200-2000 (AVAPS target volume)	
Inspiratory flow, L/min	10-140/180 spontaneous maximum	0-120/180 LPM Spontaneous	0.4-150, 180 spontaneous maximum	N/A	
Inspiratory pressure, cm H2O	1-100	1-99	0-90 for Ped & Adult, 0-80 for neo	4 to 40	
Respiratory rate, bpm	2 - 80	1-80 BPM	1 - 150 bpm neonatal 1 - 120 bpm adult	4 to 60	
Inspiratory time, sec	0.3-10	0.3-9.9	0.15-5	0.3 to 3.0	
Expiratory time, sec	Depends on rate	Depends on rate	Depends on rate	N/A	
IE ratio	4:1 maximum inverse	4:1 maximum inverse	4:1 maximum inverse	N/A	
Inspiratory hold/plateau	6 sec maximum; off, 0.1-2 sec	0-6 sec	0-3 sec	N/A	
Expiratory hold	6 sec maximum	0-6 sec	3 sec for neo, 20 sec for adult	N/A	
FiO2, %	LPS, 21-100	LPS, 21-100	21-100	21 to 100	
Manual breath	Yes	Yes	Yes	N/A	
PEEP/CPAP, cm H2O	0-35	0-30	0-50	4 to 25	
Pressure support, cm H2O	Off, 1-60	Off, 1-60 cmH2O	0-90 adult & Ped, 0-80 neo	0 to 36	
Nebulizer	Off, 1 to 60 min	Off, Continuous/Insp. Synchronized	20 min	N/A	
Pressure slope/ramp adjustment	No/no	Yes	0-9 relative scale	YES	
Sigh	Yes	No	Yes	N/A	
100% O2	Yes	Yes	Yes, adjustable % increase	N/A	
OPERATING MODES					
Assist/control	Yes	Yes	Yes		
Volume breaths	Yes	Yes	Yes	NO	
Pressure breaths	Yes	Yes	Yes	YES, (ST mode)	
SIMV			Yes		
Volume breaths	Yes	Yes	Yes	NO	
SIMV Pressure breaths	Yes	Yes	Yes	NO	
Pressure support	Yes	Yes	Yes	NO	
Spontaneous/CPAP			Yes		
Pressure support	Yes	Yes	Yes	YES (S/T mode)	
Apnea-backup vent	Yes	Yes	Yes	NO	
Responsive valve	Yes	Yes	Yes	Open circuit plus rapid flow response	
Bilevel/APRV	Yes	No	Yes	NO	
MONITORED PARAMETERS					
Pressure	Yes	Yes	Yes		
PIP	Yes	Yes	Yes	YES, IPAP	
MAP	Yes	Yes	Yes	NO	
PEEP	Yes	Yes	Yes	YES, EPAP	
Volume	Yes	Yes	Yes		
Tidal	Yes	Yes	Yes	YES	
Minute	Yes	Yes	Yes	YES	
Spontaneous minute	Yes	Yes	Yes	Only in CPAP mode	
FiO2	Yes	Yes	Yes	NO	
Respiratory rate	Yes	Yes	Yes	YES	
Inspiratory time	Yes	No	Yes	NO	
Expiratory time	Yes	No	Yes	NO	
IE	Yes	Yes	Yes	YES, Ti/Ttot	
PATIENT ALARMS					
Breathing circuit disconnect	Circuit fault	Circuit Fault	Yes	YES	
DISPLAY TYPES	Graphics SVGA color LCD	Color LCD on Vent or PTM Graphics Display	Graphics SVGA color LCD	Color touch screen	
DATA DISPLAYED	User configurable	User Configurable	Waveform and loops on monitor with trends		
MRI COMPATIBILITY	No	No	No	NO	
LINE POWER, VAC	85-264, 47-65 Hz	100 -240, 50 - 60 Hz	100/120/230/240		
INTERNAL BATTERY	Yes	Yes, 2 types	Yes	No	
PURCHASE INFORMATION					
Warranty	2 years; 5 years or 40,000 hr on turbine	2 years	2 years	1 year standard, extendable	
OTHER SPECIFICATIONS	Low pressure (flowmeter); O2 inlet connection; synchronous nebulizer drive; touchscreen controls; onboard barometric pressure sensor; optional transport cart with cylinder holders; optional capnography.	Spontaneous breathing trial (SBT), O2 flush, O2 cylinder duration, variable rise time; variable termination criteria for pressure-support and pressure-control breaths. Hot Swappable batter, Auto Set Alarms. Meets requirements of cETL, IEC 60601-1, and ISO 13485.	Tank holder; esophageal balloon/tracheal catheter monitoring for adult/pediatrics on comprehensive units; proximal hotwire flow sensing on deluxe units; proximal variable orifice flow sensing on comprehensive units; onboard barometric pressure sensor; optional compressor and heliox on standard model; optional external battery on deluxe stand; optional volumetric capnography.		
LAST UPDATED	October 2009	Nov-09	October 2007		
Footnotes					

PHILIPS	COVIDIEN	COVIDIEN	COVIDIEN	COVIDIEN
V200	**Supportair**	**840**	**760**	**740**
Worldwide	Worldwide (exept USA)	EMEA	Worldwide	Worldwide
YES	No	Yes	Yes	Yes
YES	Yes	Yes	Yes	Yes
ADULTS, PEDS and NEO	Pediatric to Adult	Adult to neonatal	Adult, pediatric	Adult, pediatric
50-2500	5-2,000	5-2,500	40-2,000	40-2,000
3-140 (controlled) 0-200 (Spontaneous)	NA	3-150	3-150	3-150
5-100	5-60	5-90	5-80	No PCV
1-80 (ped/adult) 1-150 (neo)	5-60	1-150	1-70	1-70
0.1-9.9 seconds	0.1-3	0.2-8	0.2-8	No PCV
Depends on rate and I time	≥0.2	≥0.2	>0.2	>0.2
1:10 to 4:1	1:1 to 1:3	1:299 to 4:1	1:99 to 4:1	1:99 to 4:1
0-2 sec	NA	0-2 sec	0-2 sec	0-2 sec
Manual	NA	0.5-3 sec automatic pause		Not specified
21-100%	21-100	21-100	21-100	21-100
Yes	NA	Yes	Yes	Yes
0-35	0-20	0-45	0-35	0-35
0-100	8-60	0-70	Yes (0-70)	0-70
External	Works with external nebulizers	Works with external nebulizers, Aerogen Pro/Solo	Yes	Yes
Yes	4 slopes	Yes/yes 1 to 100%	Yes/yes	No/no
No	Yes	No	No	No
Yes	No	Yes; 2 min	21-100	21-100
Yes	Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes	No
Yes	Yes	Yes		
Yes	Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes	No
Yes	Yes	Yes	Yes (0-70)	Yes (0-70)
Yes	Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes (0-70)	Yes (0-70)
Yes	Yes	Yes	Yes	Yes
Yes	Yes	Yes, active exhalation valve	Not specified	Not specified
	Yes/No	Yes/Yes	Not specified	Not specified
Yes				
Yes	Yes	Yes	Yes	Yes
Yes	No	Yes	Yes	Yes
Yes	Yes	Yes	Yes	Yes
Yes				
Yes	Yes	Yes	Yes	Yes
Yes		Yes	Yes	Yes
Yes		Yes	Yes	Yes
Yes	Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes	Yes
Color Touch Screen	5 inch (12 cm)	15 inch (41 cm) Color LCD, touchscreen	LCD	LCD
	Box 1 (see page 43)	**Box 2** (see page 43)	Numbers, optional graphics	Numbers, optional graphics
No	No	No	Not specified	Not specified
	100-240	100-240	100-240	100-240
Internal to roll stand	Yes	Yes	Yes	Yes
1 year - extendable	2 years	2 years	2 years	2 years
	Box 3 (see page 43)	Upgradable and modular design; Invasive to Noninvasive ventilation with automatic Leak compensation up to 65LPM;Adult pediatric and neonatal (with Neomode (optional)) ventilation; Unique Proportional Assist Ventilation Plus modality with automatic assessment of E, R, WOBpatient, WOBtotal Integral Heated Exhalation filtering system for protection of patients, caregivers and environnement from infection Meets requirements of CISPR 11, CSA, IEC 60601-1, IEC 60601-2, IEC 60601-2-12, and UL.	Exhalation sensitivity; rise-time percentage; integral O2 sensor; 2-5 hr battery backup; optional 7 hr external battery backup. Meets requirements of CISPR 11, CSA, IEC 60601-1, IEC 60601-2, IEC 60601-2-12, and UL.	Integral O2 sensor; 2-5 hr battery backup; optional 7 hr external battery backup. Meets requirements of CISPR 11, CSA, IEC 60601-1, IEC 60601-2, IEC 60601-2-12, IEC 60601-2-12, and UL.
	Jul-08	October 2009	Oct-07	October 2007

SUPPLIER	GE Healthcare	GE Healthcare	HAMILTON MEDICAL	HAMILTON MEDICAL	HAMILTON MEDICAL	
MODEL	**Engström Carestation**	**iVent201**	**G5**	**GALILEO GOLD**	**HAMILTON-C2**	
WHERE MARKETED	Worldwide	Worldwide	Worldwide	Worldwide	Worldwide	
FDA CLEARANCE	Yes	Yes	Yes	Yes	Yes	
CE MARK (MDD)	Yes	Yes	Yes	Yes	Yes	
PATIENT TYPE	Adult to pediatric, optional neonatal	Adult to Pediatric	Adult, pediatric, neonatal	Adult, pediatric, neonatal	Adult, pediatric	
CONTROLS						
Tidal volume, mL	20-2,000 (2 - 350 ml with Neo option)	50ml to 2.0 liters	2-2,000	10-2,000	20-2000	
Inspiratory flow, L/min	2-160 (0.2 to 30 l/min with Neo option), 200 maximum peak flow	3-120 mandatory breaths, up to 180 lpm for spontaneous breaths	1-180	1-180	0-240	
Inspiratory pressure, cm H2O	1-98 cmH2O	0-80	0-100	0-100	0-60	
Respiratory rate, bpm	3-120 for control modes (3-150 with Neo option), 1-60 for support modes	6-120	1-150	1-120	1.0-80.0	
Inspiratory time, sec	0.25-15 (0.1 - 10 sec with Neo option)	0.2-3, adaptive time	0.1-10	0.1-10	0.3-9.9	
Expiratory time, sec	0.25-59.75	Esens, easy exhale algorithm	0.2-59.9	0.2-30	0.2-59.7	
IE ratio	1:9 to 4:1; 1:72 to 60:1 in BiLevel (1:180 to 40:1 in BiLevel with Neo option)	Not specified	1:9 to 4:1	1:9 to 4:1	1:9 to 4:1	
Inspiratory hold/plateau	Yes , adjustable 2-15 sec	0-3 sec	0-70% cycle time	0-8 sec (0-70% cycle time)	0-15 sec	
Expiratory hold	Yes, adjustable 2-20 sec	0-3 sec	10 sec maximum	10 sec maximum	Not specified	
FiO2, %	21-100	Room air to 100%/ low flow bleed in if high pressure oxygen unavailable	21-100	21-100	21-100 sec	
Manual breath	Yes	Not specified	Yes	Yes	Yes	
PEEP/CPAP, cm H2O	Off, 1-50	0-40	0-50	0-50	0-35	
Pressure support, cm H2O	0-60 above PEEP/CPAP	0-60	0-100	0-100	0-60	
Nebulizer	Built-in Aeroneb Pro nebulizer system	Pneumatic	Yes	Yes	Yes	
Pressure slope/ ramp adjustment	Rise-time adjustment for pressure, flow, and pressure support 0-500 ms	Adjustable rise/auto rise	25-200 msec	25-200 msec	0-200 ms	
Sigh	No	Yes	Yes	Yes	Yes	
100% O2	Yes, suction maneuver	Yes	Yes	Yes	Yes	
OPERATING MODES						
Assist/control	Yes	Yes				
Volume breaths	Yes	Yes	Yes	Yes	Yes	
Pressure breaths	Yes	Yes	Yes	Yes	Yes	
SIMV	Yes	Yes				
Volume breaths	Yes	Yes	Yes	Yes	Yes	
SIMV Pressure breaths	Yes	Yes	Yes	Yes	Yes	
Pressure support	Yes	Yes	Yes	Yes	Yes	
Spontaneous/CPAP	Yes	Yes				
Pressure support	Yes	Yes	Yes	Yes	Yes	
Apnea-backup vent	Yes	Yes	Yes	Yes	Yes	
Responsive valve	Yes, active exhalation valve	Yes	Yes	Yes	Yes	
Bilevel/APRV	Yes	Adaptive Bi-Level for NIV	Yes	Yes	Yes	
MONITORED PARAMETERS						
Pressure		Yes				
PIP	Yes	Yes	Yes	Yes		
MAP	Yes	Yes	Yes	Yes		
PEEP	Yes	Yes	Yes	Yes	Yes	
Volume		Yes				
Tidal	Yes	Yes	Yes	Yes	Yes	
Minute	Yes	Yes	Yes	Yes	Yes	
Spontaneous minute	Yes	Yes	Yes	Yes	Yes	
FiO2	Yes	Yes	Yes	Yes	Yes	
Respiratory rate	Yes	Yes	Yes	Yes	Yes	
Inspiratory time	Yes	Yes	Yes	Yes	Yes	
Expiratory time	Yes	Yes	Yes	Yes	Yes	
IE	Yes	Yes	Yes	Yes	Yes	
PATIENT ALARMS						
Breathing circuit disconnect	Yes	Yes	Yes	Yes	Yes	
DISPLAY TYPES	Color LCD 30.5 cm (12")	User preference	Detachable color touchscreen 15"	Color screen, LCD, TFT	Color touchscreen	
DATA DISPLAYED	Real-time graphics, numbers, 3 waveforms, 4 loops, trends, minitrends, take snapshot, split screens ; Simplified screen with big size number	Volume, flow and pressure over time waveforms, flow-volume, pressure-volume loops and waveform history browse feature	Dynamic lung, vent status, real-time graphics, numerics, waveforms, loops, trends, volumetric capnogram, user configurable graphics layout (incl. Default graphics)	Real-time graphics, numerics, waveforms, loops, trends	Dynamic lung, vent status, real-time graphics, numerics, waveforms	
MRI COMPATIBILITY	Not specified	Yes, Mri conditional	Not specified	Not specified	Not specified	
LINE POWER, VAC	85-132, 187-264; 47/63 Hz	Standard	100-240	100-240	100-240 12-24 VDC	
INTERNAL BATTERY	Yes	Yes	Yes	Yes	Yes	
PURCHASE INFORMATION						
Warranty	1 year, parts and labor	1 year parts and labor	2 year, parts and labor	2 year, parts and labor	2 year, parts and labor	
OTHER SPECIFICATIONS	Spontaneous Breathing Trial (SBT); nondepleting paramagnetic O2 sensor; user-customizable default settings; escalating high-priority alarm; NIV option; automatic patient detection; takes snapshot; airway resistance compensation; programmable mode families; optional module bay provides enhanced respiratory monitoring. Visualization of patient tirgger on the pressure and flow waveforms		Heliox ventilation, CO2 measurement (etCO2 and volumetric capnography), smart apnea backup; proximal airway monitoring; TRC automatic tube compensation; PV tool; automated compliance curve with both inspiratory and expiratory limbs; PV tool; fully control	O2 analyzer; smart apnea backup; proximal airway monitoring; TRC automatic tube compensation; PV tool; automated compliance curve with both inspiratory and expiratory limbs; ventilation analyzer window. Meets requirements of ANSI Z79.10-1979/ Z797-1976, CSA, DIN 13254, GLEM, IEC 60601 and 62D/60601, ISO 121/5359/5369/7767, JMMI, NFC 74-350, SEV, SETI, ORKI, VTT, and TUV.	Proximal airway monitoring. Meets requirements of ISO13485, EN ISO 9001, 93/42/EEC, IEC 60601-1, IEC 60601-1-2, IEC 60601-2-12, CAN/CSA-C22.2 No. 601.1, UL 60601-1	
LAST UPDATED	Jun-08	Jun-08	July 2008	July 2008	Nov-09	
Footnotes						

	Evita Infinity V500*	Babylog VN500**	Evita XL	Evita 4 edition	Savina
	N. a.	N. a.	Worldwide	Worldwide	Worldwide
	510k pending	510k pending	Yes	Yes	Yes
	No	No	Yes	Yes	Yes
	Adult, pediatric, neonatal	Pediatric, neonatal	Adult, pediatric, neonatal	Adult, pediatric, neonatal	Adult, pediatric
	2-3,000	2-300	3-2,000 with NeoFlow	3-2,000 with NeoFlow	50-2,000
	2-120	2-30	6-120	6-120	0-180
	1-95	1-80	0-95	0-80	0-99
	0,5-150	0,5-150	0-150	0-150	2-80
	0,1-10; 0,1-30 (APRV)	0,1-3; 0,1-30	0.1 - 10, 0.1 - 30 (APRV)	0.1 - 10, 0.1 - 30 (APRV)	0.2-10
	0,05-30 (APRV)	0,05-30 (APRV)	0.1 - 10 , 0.1 - 30 (APRV)	0.1 - 10 , 0.1 - 30 (APRV)	No
	1:300; 600:1	1:300; 600:1	1:300 to 300:1	1:300 to 300:1	1:150 to 150:1
	Yes	Yes	Yes	Yes	Yes
	Yes	No	Yes	Yes	No
	21-100	21-100	21-100	21-100	21-100
	Yes	Yes	Yes	Yes	Yes
	0-50	0-35	0-50	0-35	0-35
	0-95	0-80	0-95	0-80	0-35
	Yes	Yes	Yes	Yes	Yes
	Yes/yes	Yes/yes	Yes/yes	Yes/yes	Yes/yes
	Yes	Yes	Yes	Yes	Yes
	Yes	Yes	Yes	Yes	Yes
	Yes	Yes			
	Yes	Yes (Volume Guarantee)	Yes, AutoFlow	Yes, AutoFlow	Yes, AutoFlow
	Yes	Yes	Yes	Yes	Yes
	Yes	Yes	Yes	Yes	Yes
	Yes	Yes (Volume Guarantee)	Yes	Yes	Yes
	Yes	Yes	Yes	Yes	Yes
	Yes	Yes	Yes	Yes	Yes
	Yes	Yes	Yes	Yes	Yes
	Yes	Yes	Yes	Yes	Yes
	Yes	Yes	Yes	Yes	Yes
	Yes	Yes	Yes	Yes	Yes
	Yes	Yes	Yes	Yes	Yes (with BIPAP)
	Yes	Yes			
	Yes	Yes	Yes	Yes	Yes
	Yes	Yes	Yes	Yes	Yes
	Yes	Yes	Yes	Yes	Yes
	Yes	Yes			
	Yes	Yes	Yes	Yes	Yes
	Yes	Yes	Yes	Yes	Yes
	Yes	Yes	Yes	Yes	Yes
	Yes	Yes	Yes	Yes	Yes
	Yes	Yes	Yes	Yes	Yes
	Yes	Yes	No	No	Yes
	Yes	Yes	No	No	No
	Yes	Yes	No	No	Yes
	Yes	Yes	Yes	Yes	Yes
	TFT LCD 17˝wide color touchscreen	TFT LCD 17˝wide color touchscreen	TFT color touchscreen	TFT color touchscreen	TFT colour screen
	Values, waveforms, loops, trends, short trends , Smart Pulmonary View	Values, waveforms, loops, trends, short trends , Smart Pulmonary View	Numbers, waveforms, loops, trends, short trends	Numbers, waveforms, loops, trends	Measured data, waveforms, bar graph
	No	No	No	No	No
	100V-240V	100V-240V	100-127/220-240	100-127/220-240	100-240
	Yes	Yes	Yes	Optional	Standard
	1 year	1 year	1 year	1 year	1 year
	Part of the Infinity Acute Care System • Configurable screen with extended graphical capabilities such as short loops, waveforms,Smart Pulmonary View • Extended online help function • lung proctectiv ventilation with Smart low flow PV -Loop • QuickSet and PressureLink for easy adjustment of ventilation settings • SmartCare/PS 2.0 • USB port for an easy information transfer and configuration export • mounting possibilites for architectual systems • RFID technology for mismatch control, exchange control etc. • Transfer of Ventilation Settings (TVS)	Part of the Infinity Acute Care System • Configurable screen with extended graphical capabilities such as short loops, waveforms,Smart Pulmonary View • Extended online help function • QuickSet and PressureLink for easy adjustment of ventilation settings • USB port for an easy information transfer and configuration export • mounting possibilites for architectual systems • RFID technology for mismatch control, exchange control etc.	Evita 4 platform plus screen customization (vent check sheet, waveforms, displayed values), multiple graphic capabilities (short trends, up to 6 loops, combined cursor for simultaneous loop and wave analysis); online information for modes and alarms; lung protection package includes slow flow inflection maneuver; lung recruitment trending and direct link for pressure changes in pressure control. Knowledge based weaning system Smart Care.	Evita 2 platform plus touchscreen, ideal-body-weight setting, and cursor in displayed graphics.	All gas measurements under BTPS conditions; single-rotary-knob parameter adjustment; options and upgrades via software and/or hardware; open breathing system in all modes and patient ranges; low-pressure O2 (LPO) inlet. Meets requirements of IEC 60601. Robust, rugged design. Meets requirements of RTC/DO-160D. Option graphic screen provides extended graphic capabilities including three waveforms, loops, trends and logbook.
	End 2009	End 2009	July 2008	July 2008	July 2008
	* IACS Workstation Critical Care	** IACS Workstation Neonatal Care			

Continued from page 21

Severity score	30-day mortality (AUROC)	Need for mechanical ventilation and/or vasopressors (AUROC)
PSI	0.74–0.83	0.69–0.79
CURB65	0.73–0.83	0.59–0.77
Modified ATS	0.63–0.67	NA
SMART-COP	NA	0.87

Table 2. Accuracy of Values of Scoring Systems: 30-day Mortality and Need for Mechanical Ventilation and/or Vasopressors

level changes with the inflammatory response, accordingly, adequate treatment and clinical improvement should be accompanied by decreases of its concentrations. Conversely, when the response to therapy is inadequate, biomarker levels should remain elevated, raising the suspicion of clinical failure (Bozza et al. 2005; Póvoa 2008; Salluh and Bozza 2008). Although there is still insufficient data supporting the clinical use of most biomarkers of sepsis, C-reactive protein (CRP) and procalcitonin (PCT) have been extensively evaluated and may assist clinicians at bedside in the management of severe CAP (Table 3).

As an acute phase-protein, CRP production is stimulated by inflammatory insults, being the bacterial infection the most powerful one (Coelho et al. 2007). Additionally, CRP is an easily available, fast and inexpensive laboratory assay. However, initial CRP levels do not show good correlation with severity of illness in patients with CAP and sepsis (Salluh et al. 2008; Silvestre et al. 2009). In contrast, CRP has a fine performance for monitoring the response to treatment in patients with severe CAP (Salluh and Bozza 2008; Salluh et al. 2009). Coelho et al. prospectively studied 53 patients with CAP demonstrating that variations were able to discriminate patients with a poor outcome as early as at day three of treatment. In non-survivors CRP levels remained elevated or presented slight reductions, while survivors had significant decreases of >0.3 of previous level (sensitivity 0.75; specificity 0.85; $p<0.001$) (Coelho et al. 2007). Moreover, when CRP is coupled with PSI and CURB-65 it shows a good ability to predict mortality (AUC=0.88) (Menendez et al. 2009). Also, CRP may be helpful when monitoring treatment in patients with renal impairment, as it does not influence the clearance of this biomarker (Dahaba et al. 2003). Therefore, recent evidence points towards the use of CRP for monitoring response to treatment of patients with CAP.

Procalcitonin is a "hormokine" mediator that is elevated in bacterial infections. As a diagnostic marker, PCT guidance can safely reduce antibiotic prescription for patients with uncomplicated CAP (Christ-Crain et al. 2004). Furthermore, in a multicentre study that evaluated 1,651 patients admitted to the emergency department (ED) with CAP, PCT was an accurate predictor of mortality (Huang et al. 2008). Christ-Crain et al. evaluated 302 patients with CAP randomised to receive antibiotics according to usual practice or guided by PCT levels (Christ-Crain et al. 2006). Sequential evaluation of PCT markedly reduced antibiotic exposure in patients with CAP as compared to usual care (5 vs 12 days, $p<0,001$). Outcomes were similar in both groups, with an overall success rate of 83%. Recently, a confirmatory randomised multicentre trial enrolled 1359 patients (Schuetz et al. 2009). Again, PCT guidance was associated with a shorter period of antibiotics and less adverse events. Overall, these findings may have major public health implications as PCT guidance leads to more judicious antibiotic use.

Plasma cortisol levels increase as a response to stress and to counterbalance excessive inflammation. Christ-Crain et al. evaluated 278 patients with CAP at the ED and observed that increased cortisol levels were correlated with PSI classes and mortality (Christ-Crain et al. 2007). Our group investigated 72 patients with CAP admitted to ICU, showing that higher baseline cortisol levels were associated with increased mortality (Salluh et al. 2008). Cortisol was a better outcome predictor as compared to APACHE II, SOFA and CURB-65 and other laboratory tests (CRP, leukocyte count and d-dimer). Although multicentre validation is required, cortisol levels are accurate, biologically plausible and easy to use biomarkers for patients with CAP.

Among novel biomarkers, proadrenomedullin is a promising one (Huang et al. 2009; Christ-Crain et al. 2006). Huang et al. recently investigated the correlation of proadrenomedullin with PCT, PSI, CURB-65 and its impact on 30-day mortality (Huang et al. 2009). This prospective multicentre study involving 1,653 patients in 28 centres demonstrated a close correlation between proadrenomedulin levels, severity scores and mortality. Future studies should evaluate the performance of this biomarker in monitoring response to treatment of severe CAP.

Conclusions

CAP is a potentially life-threatening disease. The routine use of scoring systems and biomarkers such as CRP and PCT are helpful to assist physicians at the bedside. New and promising biomarkers should be investigated as they may help identify patients who require additional supportive care and adjuvant therapies. ■

Biomarker	Diagnosis of Infection	Stratification of Disease Severity/Mortality Risk	Monitoring Response to Treatment
C-Reactive Protein	+	+	+++
Procalcitonin	+++	+++	+++
Cortisol	-	+++	Not Available
Proadrenomedullin	Not Available	+++	Not Available

Table 3. Biomarkers for Severe Community-Acquired Pneumonia

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In an acute and critical-care setting, patient security—physical well-being as well as peace-of-mind—is paramount. Caregivers must rely on solutions that effectively reduce patient injury and maintain quality of access and care. Unassisted bed exit remains a leading cause of patient in-hospital injury. Sometimes the injury is fatal. However, efforts to restrain a patient are met with controversy. And monitoring a patient with one-to-one sitters is both costly and subject to human error. An enclosed bed helps to reduce patient injury from in-hospital falls without full restraint, while maintaining full access to the patient.

The Posey StaySafe Bed for Europe Aids in Reducing Patient In-Hospital Injury

The Posey Company, a leader in the design and manufacture of innovative and reliable patient safety solutions, now offers a complete, enclosed-bed solution for European hospital markets. Posey officially debuted the bed—The Posey StaySafe Bed Model 8080—in November 2009 at MEDICA in Germany. The bed initially has been designed for sale in Holland, France, and Germany; sales to additional European countries are to follow. The StaySafe Bed delivers improved safety, while allowing patient freedom of movement and caregiver freedom of access, and has been used in hundreds of hospitals across the U.S. since 2000.

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Of growing importance around the globe is the development of protocols and programs created to better manage in-hospital patient safety. For patients who are disoriented or debilitated, the Posey StaySafe Bed offers a secure, reliable, and managed environment for both the patient and the caregiver. A much less restrictive option for patients at risk of injury due to a fall or unassisted bed exit, the complete system includes an electric bed, frame, mattress, and canopy that zips around the area, yet does not inhibit patient in-bed movement or caregiver access. Increasingly, the Posey StaySafe Bed is a vital component of fall management efforts around the world.

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Posey offerings create care advantages for a wide variety of patients from brain injury, to stroke, post-surgical, even dementia patients. To meet demand in Europe, Posey engages partners capable of serving the hospital community with the same quality. Concerning the Posey StaySafe Bed, Benedikt Hüpkes of KREWI Medical Products, a Posey partner in Germany, said, "The Posey StaySafe Bed delivers peace-of-mind to both the patient and the caregiver. The combined ability to access a patient easily, allow a patient relative freedom of movement, and yet also better assure patient safety from injury, makes the StaySafe Bed an industry-leading offering and we are proud to announce its availability in Europe." Ernie Posey, CEO and President of Posey Company, said "Posey products effectively integrate patient care with flexibility. The company was founded on the premise that simple, comprehensive solutions such as the Posey StaySafe Bed can work to help reverse negative patient injury trends around the world—and they do." For more information, visit www.posey.com.

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EARLY MOBILISATION OF CRITICALLY ILL PATIENTS: FEASIBILITY AND BENEFITS

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In our previous article, we discussed the rationale for early mobilisation and described general screening guidelines and safety issues when considering this therapy (Korupolu et al. 2009). In this second of three articles, we focus on the feasibility and benefits of early mobility, describing how ICUs use available personnel and equipment to facilitate early rehabilitation.

Is Early Mobilisation Feasible in ICU Patients?

Feasibility of early mobilisation is dependent on a supportive culture and interdisciplinary collaboration in the ICU. It may be possible to incorporate early mobility into routine clinical care without increasing staffing (Bailey et al. 2007), while using routine physical therapy and ICU equipment. However, successful delivery of early mobility requires team effort, which frequently includes a physical therapist, nurse, respiratory therapist and technician or assistant to safely manage the patient and ICU equipment (Hopkins and Spuhler, 2009).

Benchmarks of successful early mobilisation include receipt of rehabilitation therapy in the ICU initiated immediately after physiological stability and objective measures of the patient's physical activity. For example, 73% (106/145) of all patients assigned to a dedicated mobility team (using a mobility protocol), received physical therapy in the ICU compared to only 6% (8/135) of patients receiving "usual" care ($p<0.001$) (Morris et al. 2008). In another study of 104 acute respiratory failure patients requiring mechanical ventilation for >4 days, the odds of ambulation in the ICU increased 2.5 times (95% confidence interval (CI) 1.9-3.4) following transfer from a traditional ICU to a respiratory ICU with an emphasis on early mobilisation (Thomsen et al. 2008).

During mobilisation activities, patients may receive mechanical ventilation, vasopressors and other ICU therapies. For example, in a cohort of 103 patients receiving early mobility, 41% (593/1,449) of activity events occurred in patients with endotracheal tubes, with ambulation occurring in 42% of these events (Bailey et al. 2007). Moreover, 9% of the 103 patients received catecholamine infusions during their ICU activities.

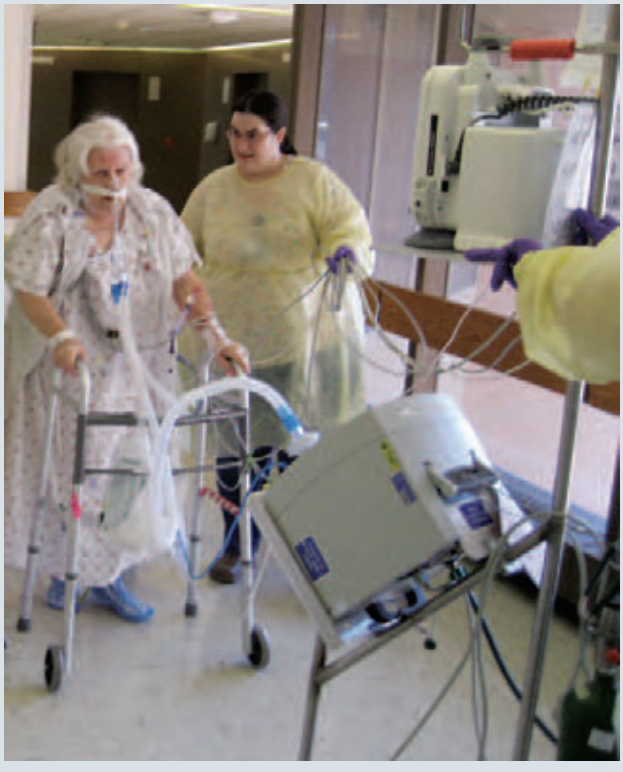

Figure 1. Example of the feasibility of early mobility in a 75-year-old woman. The photo was taken on day 14 of her stay at the Johns Hopkins Hospital Medical ICU. The patient is orally intubated, mechanically ventilated, and has both a left radial arterial line and right internal jugular central line in situ during her ambulation.

The feasibility of early ambulation is illustrated (Figure 1) by a 75-year old patient admitted for pneumonia and septic shock who is ambulating during her stay in the Johns Hopkins Medical ICU (Needham, 2008). This patient is mechanically ventilated using assist control mode via an oral endotracheal tube and has a left radial arterial line, peripheral intravenous access, a right internal jugular central line, and a urinary catheter. During three physical activity sessions occurring on day 14 of her MICU stay, she walked a total distance of 150 feet, and sat up in a chair for 90 minutes post-therapy. Key success factors for this patient's early ambulation include coordination and communication among the ambulation team (physical therapy, respiratory therapy and ICU technician) and the patient's ICU nurse and physicians. The team used standard physiotherapy equipment (e.g. two-wheeled walker) available in any hospital in addition to a portable mechanical ventilator and a mobility device for the ICU equipment (Needham, 2009).

What are the Benefits of Early Mobilisation?

Studies conducted in patients with chronic disease (e.g. chronic obstructive pulmonary disease) and long-term mechanical ventilation demonstrate the benefits of rehabilitation therapy. In these patients, rehabilitation therapy is associated with improved strength, physical function, weaning from mechanical ventilation and ICU length of stay, with some evidence of a dose-response effect (i.e. more therapy results in greater benefit) (Nava, 1998).

Reports from single-centre uncontrolled studies of early mobilisation suggest potential improvements in both patient health and hospital resource utilisation. Patient benefits over a six-year review of an early mobilisation programme in a respiratory ICU included a 24% absolute reduction in tracheotomy rate (29% to 5%) and a 9% reduction in mechanical ventilation weaning failure (12% to 3%) (Hopkins et al. 2007). Furthermore, ICU length-of-stay decreased by three days (13 to 10 days) during this period. Successes from this hospital's early mobilisation programme, which provides twice-daily treatment, seven-days per week, are encouraging. For example, in 103 patients ventilated for >4 days, 69% ambulated >100 feet by ICU discharge (Bailey et al. 2007). In a subsequent cohort of 104 ventilated patients, 88% ambulated a median distance of 200 feet (interquartile range 0-800) by ICU discharge with this ICU's early mobilisation programme (Thomsen et al. 2008).

A second hospital centre noted improvements in physical activity and resource utilisation in patients with acute respiratory failure admitted to a medical ICU (Morris et al. 2008). A controlled trial of 330 patients compared patients assigned to an early mobility team and protocol within 48 hours of ICU admission versus usual care. Patients in the early mobility group got out of bed 8.3 days earlier than those in usual care (5.0 vs. 11.3 days, $p<0.001$), had a 1.4 day decrease in risk-adjusted ICU length of stay (5.5 vs. 6.9 days, $p=0.025$), and a 2.3 day decrease in risk-adjusted hospital length of stay (11.2 vs. 14.5 days, $p=0.006$).

More recently, the first randomised controlled trial of early mobilisation was published (Schweickert et al. 2009). This study occurred in medical ICUs at two hospitals and included 104 mechanically ventilated patients. Researchers randomised patients to early mobility during daily interruption of sedation versus daily sedation interruption with "usual care" for rehabilitation therapy. Early mobilisation resulted in more patients returning to independent physical functioning at hospital discharge (59% vs. 35%, $p=0.02$), a shorter duration of ICU-associated delirium (2 vs. 4 days, $p=0.02$), and a shorter duration of mechanical ventilation (3.4 vs. 6.1 days, $p=0.02$).

Conclusion

Recent data support the feasibility and short-term benefits of early mobilisation in mechanically ventilated ICU patients. Successful implementation of an early mobility programme requires a supportive culture and interdisciplinary teamwork. Future studies of early mobility in the ICU aim to evaluate the longer-term benefits to patients and provide formal economic analyses of the benefit to the healthcare system. ■

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ABOUT WIDTH AND WEIGHT

MULTIPLIED CHALLENGES: EARLY MOBILITY OF BARIATRICS PATIENTS IN ICU

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Even though there are studies which raise some doubts about a direct correlation between high BMI and impaired ICU outcome, there is no doubt that bariatric Patients mean a specific challenge in Healthcare, especially when it comes to early mobility in ICU. A known correlation which has been observed in normal weight patients is the one between extended ventilation or ICU immobility and neuro-muscular deconditioning, resulting in significant consequences for rehabilitation[1,2]. Leaving all other obesity related complications aside, it seems obvious that any kind of muscular deconditioning must have exponential impact on the weight bearing abilities of bariatric patients.

A case for two: Using appropriate tools allows safe mobilisation of bariatric patients (Foto: Hill-Rom TotalCare Bariatric Plus in Chair Egress-Position)

How heavy will tomorrow's patients be?

Despite all spectacular media reports about patients with 300 kg and more, those numbers are – although real – the exception. Even at a height of 180cm, a patient reaches the WHO classification "Super Obesity" (BMI > 50) without exceeding a weight of 170 kgs. In 2004, the proportion of patients with a weight of more than 230 kg was published to be at 0,1%[3]. Although the increasing trend towards patients getting heavier can not be denied, it is important to look at the real limiting factors before entering the race for higher and higher weight capacities.

Width vs. Weight – or the essence of what's required

Talking to our customers, we learned that it is mostly the width of bed which is the limiting factor for bariatric patient care. Secondly, they need more than a high safe working load of a bed when it comes to early mobility. Coming back to early mobility in ICU, the basic need is to have the right process improvement tools which deliver the functionality to prevent immobility related complications such as VAP, pressure ulcers and neuro-muscular deconditioning. On top of that, the product's ability to ease Progressive Mobility™ is key to ensure efficiency at the point of care – even more so than it is for normal weight patients.

What about a wider bed with unique Progressive Mobility™ functions, premium transfer and lifting solutions (no matter if mobile or ceiling bound), adjunctive products for out-of-bed procedures – in other words: a concept to enhance outcomes for bariatric patients and their caregivers? And we don't stop on the product level: we deliver training and education how to safely mobilise bariatric patients in ICU. Let's talk about it.

Education: The popular Loko Lift Licence™ "Bariatric Patients" provides knowledge for safe transfers and early mobility of bariatric patients.

The reference of publications and studies in this presentation is for the purpose of medical-scientific background information only. Hill-Rom does not claim that any of the authors expresses a direct or indirect recommendation to use Hill-Rom products.

References: [1]Needham D, Johns Hopkins University School of Medicine; JAMA 10/2008; [2] Schweickert WD, Hall J. ICU acquired weakness; Chest 2007; [3]International Obesity Task Force (IOTF), May 2004

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PRIORITISING: IS IT THE WAY TO COUNTER TODAY'S ECONOMIC CRISIS WITHIN THE HEALTHCARE SYSTEM?

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In response to the current economic constraints within healthcare systems, different action plans and reforms, including tax increases, have been deployed to decrease these and to increase healthcare's effectiveness. It is, however, the time to realise that these measures are not enough and prioritisation might be the only way to cure this chronic condition.

Worldwide, healthcare systems have been struggling with higher costs and demands of becoming more cost-effective. The discrepancies between increased costs and an economic retrenchment can be handled in five different ways:
1) Increase resources financed by either the state or different individuals;
2) Supervision of either demands or access to healthcare (through dividing costs);
3) Elimination of ineffective activities or replacing them with cheaper alternatives;
4) Increase the effectiveness of the service provision; and
5) Create possibilities to prioritise.

Experiences from England and Germany show that none of the four first alternatives have proven to be sufficient or possible to carry out, but prioritising (rationing) (Abel-Smith et al. 1995; Smith 1993).

Priorities are about choosing how to use our public and private resources best. It is a process by which different operators on political, administrative or clinical level make well-aware or unconscious decisions about order of precedence between different activities or group of patients. The decision, in turn, leads to certain consequences for the resource distribution and the activity's performance and thereby the healthcare's direction and contents (Hope et al. 1996; Kohn 2000; Cho et al. 2005). Priority within healthcare services is either economic or non-economic. In the former, the healthcare budget is considered to be insufficient during longer time ahead. Thus, the production costs (e.g. technology, personnel) within the healthcare are, and remain costly. The non-economic priority is a process that happens irrespective of the economic access and is influenced by other factors e.g. medical factors (Harrison et al. 1997; New and the Rationing Agenda Group 1996). In such a setting the ethical stand and the guidelines for priorities are considered to constitute the ground for open and conscious priorities and should be available for everyone (Statens offentliga utredningar 2001). The priority can also be horizontal or vertical. The horizontal priority is mainly a political responsibility and deals with the resource distribution among different activities e.g. primary- vs. hospital-healthcare. The vertical priority is a medical affair and has long expressed itself through waiting lists and exclusion, where the patients are ranked due to their medical problems and other medical-related factors such as their general conditions. In such a system, exclusion deals with cases that cannot obtain a treatment due to the lack of resources as a result of horizontal priority. There are thus many contact points between these modalities when priorities are practically made (Carlsson et al. 2007; Statens offentliga utredningar 2001; Redwood 2000; Prioriteringar i hälso- och sjukvården 2007). The priority should therefore be carried out in a dialogue between politicians and medical professions.

There are some factors, that influence the priority-setting:
1) Patients' demand on type and quality of treatments are important today, but are socially conditioned and subjective and should not influence the way healthcare resources are distributed (Cho et al. 2005; Harrison et al. 1997; New and the Rationing Agenda Group). However, since the political priority-making aim for the benefit of the people it can be influenced by trends and extraneous requirement from the public (Läkaresällskapet 2001).
2) Politicians' quest for control of the healthcare system through priority may simply be clarified as New Public Management. These are control and management policies from early 1900, often renewals of what has been examined within other activities and unknown for large groups of managements

and employees in the healthcare services (Statens offentliga utredningar 2001; Olson et al. 1998).

3) Although prioritising is actually nothing new or difficult for healthcare professionals, the ability of choosing between medical and economical benefits is; knowledge that should be offered by policy-makers.

4) Finally, there is too much territory-mindedness within the medical profession resulting in not taking command in the crucial medical questions, losing its credibility and making cooperation impossible (New and the Rationing Agenda Group 1996; Redwood 2000).

> *"In a desirable situation, there is a balance between demands and access based on evidence-based medicine, research, and economy in line with a healthy ethical standpoint."*

All these issues emphasise the need for an understanding and mutual leadership (Carlsson et al. 2005; Sandberg et al. 1998; Sahlin-Andersson 1999; Lind et al. 2007). In a desirable situation, there is a balance between demands and access based on evidence-based medicine, research, and economy in line with a healthy ethical standpoint. But, in reality that does not exist and political frustration has led to repeated catastrophic reorganisations and increasing mistrust between healthcare and political professionals.

Conclusions

Let us agree that certain changes in our welfare and healthcare system are necessary to finance the costly and demanding healthcare system. Prioritising and or increasing effectiveness are two alternative solutions that are not necessarily cheaper, but linked together (Socialstyrelsen 2007; Reeleder et al. 2005). Therefore these measures should be part of healthcare's future planning. It should, however, not be the responsibility of a single group. Politicians should not single-handedly take difficult priority decisions on ethical and medical grounds and the medical profession should not be left alone to choose between money and patients. Making such difficult decisions should not be based on political trends and historical materials. The healthcare professionals should be engaged earlier to practice their responsibilities and to contribute with their knowledge, but also to become aware of the economical consequences of their decisions. Making priorities should be based on sound ethical grounds, national will and a political unity, complemented by higher influence of professionals and better engagement of those who eventually benefits all these efforts – the patients (Östergren et al. 1998; Daniels et al 1997). ■

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BELGIAN HEALTHCARE:
OVERVIEW OF THE HEALTH SYSTEM AND FINANCING

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Introduction

Total healthcare expenditures, both public and private, are increasing every year in most western industrialised countries with extended social security systems, and comprise approximately one-tenth of the Gross Domestic Product (GDP) (van den Oever and Volckaert 2008). The underlying determinants of this continuous growth in the costs of healthcare are well-known and similar around the world. Most noted are:

- An aging population;
- Development of new medical technologies;
- Increased influence of mass media and the internet (responsible for creating high expectations among patients in relation to modern medicine and its' ability to care for and cure complex life-threatening conditions); and
- Increasing personnel costs (healthcare is a costly and labour-intensive sector) (Annemans 2007)

As demands on healthcare increase in general, so too does the demand for care within hospitals' emergency rooms and Intensive Care Units (ICUs). With the increased numbers of aging patients and the strain of global pandemics, a substantial portion of patients will need 24-hour monitoring, causing the ICU to play a central role. As such, the ICU consumes a significant fraction of hospital resources, and consequently of the total healthcare budget (estimated around 1% of the GDP) (Fein 1993; Vandijck et al. 2007).

In 2009, the Belgian population reached 10.5 million, and with its 341 inhabitants per square kilometre, it is one of the most densely populated countries in Europe. Average life expectancy at birth is 80.4 years, and main causes of death are cardiovascular diseases, cancer, traffic accidents and suicides (**www.statbel.fgov.be, www.iph.fgov.be/epidemio/epinl/inegalnl/index.htm**).

Belgian Context: Organisation and Financing of the Health System

The Belgian healthcare system is mainly organised on two levels: The federal and regional levels. Responsibility for healthcare policy is shared between the federal government, the Federal Public Service Social Security, the National Institute for Sickness and Disability Insurance (INAMI), and the Dutch-, French-, and German-speaking community Ministries of Health. The federal government is responsible for regulating and financing the compulsory health insurance, determining accreditation criteria, financing hospitals and so-called 'heavy' medical care units, as well as legislation covering different professional qualifications, and registration of pharmaceuticals and their price control. The regional governments are responsible for health promotion, maternity and child health services, some aspects of elderly care, implementation of hospital accreditation standards, and financing of hospital investment.

Nowadays, healthcare expenditure as a percentage of GDP in Belgium is about 10%, and expressed in USD purchasing power parity per capita is about 3000, which is the fifth highest healthcare expenditure among all 27 European Union countries (**www.oecd.org**), and a further 4.5% increase is expected over the following years (OECD, 2003). The Belgian health system is primarily funded through social security contributions and taxation. Public sector funding as a percentage of total expenditure on healthcare fluctuates around 70%.

The Belgian health system is based on the principles of equal access and freedom of choice, with a Bismarckian-type of compulsory national health insurance, which covers the whole population and has a very broad benefits package. Compulsory health insurance is combined with a private system of healthcare delivery, based on inde-

Total population	10,430,000
Gross national income per capita (PPP international $)	33,860
Life expectancy at birth m/f (years)	77/82
Healthy life expectancy at birth m/f (years, 2003)	69/73
Probability of dying under five (per 1 000 live births)	5
Probability of dying between 15 and 60 years m/f (per 1 000 population)	111/61
Total expenditure on health per capita (Intl $, 2006)	3,183
Total expenditure on health as % of GDP (2006)	9.5

Figures are for 2006 unless indicated. Source: World Health Statistics 2008

pendent medical practice, free choice of service provider and predominantly fee-for-service payment (van den Oever and Volckaert 2008). All individuals entitled to health insurance must join or register with a sickness fund. Belgian sickness funds receive a prospective budget from the INAMI to finance the healthcare costs of their members (**www.riziv.fgov.be**). They are held financially accountable for a proportion of any discrepancy between their actual spending and their so-called normative, that is, risk-adjusted, healthcare expenditures. The reimbursement of services provided depends on the employment situation of the patient, the type of service provided, the statute of the person who is socially insured, as well as the accumulated amount of user charges already paid (Nonneman and van Doorslaer 1994).

Patients in Belgium participate in healthcare financing via co-payments, for which the patient pays a certain fixed amount of the cost of a service, with the third-party-payer covering the balance of the amount, (i.e. the practice of an insurer (third party) paying providers (second party) directly for services rendered instead of the patient); and via co-insurance for which the patient pays a certain fixed proportion of the cost of a service and the third-party-payer covers the remaining proportion. There are, respectively, two systems of payment:

1) A reimbursement system for which the patient pays the full costs of services and then obtains a refund for part of the expense from the sickness fund, which covers ambulatory care; and

2) A third-party-payer system for which the sickness fund directly pays the provider while the patient only pays the co-insurance or co-payment, which covers inpatient care and pharmaceuticals.

In Belgium, in 2005, there were 215 hospitals, of which 146 were general and 69 psychiatric. The general hospital sector consists of acute (116), specialised (23) and geriatric (7) hospitals (Gemmel and Vandijck, 2005). The basic feature of Belgian hospital financing is its dual remuneration structure according to the type of services provided: Accommodation, emergency admission, and nursing activities in the surgical department are financed via a fixed prospective budget system based on diagnosis-related groups; while medical and medicotechnical services such as consultations, laboratories, medical imaging, technical procedures, and paramedical services are remunerated via a fee-for-service system to the service provider.

Although the Belgian healthcare system has not undergone major structural reforms for several decades, various measures have been taken mainly to improve its performance (Corens 2007). Reform policy in recent years has included:

- Hospital financing reform;
- Strengthening primary care;
- Restriction of the supply of physician;
- Promotion of generic substitution of pharmaceuticals;
- Increase of accountability of healthcare providers and sickness funds;
- Tariff cuts; and
- Supplementary emphasis on: Quality of care, equity, evidence-based medicine, healthcare technology, benchmarking with financial consequences and health economic evaluations.

Future Changes

Future health reforms are likely to build on recent reforms and achievements. Changes in provider payment methods (i.e. diagnosis related groups) may improve providers' accountability and increase efficiency. Primary care could be strengthened by the general application of the Global Medical File and the introduction of financial incentives to enable general practitioners to play a more central role in the health system and to promote other forms of primary healthcare, such as home care. Physicians could be rewarded for improved prescribing. One area could include prescribing targets for generics, which is an example of not only cost savings, but also quality improvements in prescribing practices. Finally, an increased and sustained focus on quality is likely to be a significant element in healthcare policy-making. ■

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INFECTION CONTROL IN THE ICU: THE NURSE PERSPECTIVE

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Infection prevention and control is of utmost importance. Nurses play a major role in the successful implementation of infection prevention strategies in the intensive care unit.

Healthcare-Associated Infections (HAIs) constitute a major health problem in the intensive care unit (ICU). They concern 5% to 10% of hospitalised patients in European and American acute care hospitals (Vrijens et al. 2008; Yokoe et al. 2008), and can lead to additional complications in up to 33% of those admitted to the ICU (Eggimann and Pittet 2001). Recently, the significant physical, social, psychological and economic burdens they cause have increased both government and public awareness of the importance of their prevention (Vandijck et al. 2007a, Vandijck et al. 2007b). This increasing alertness is reflected by the current trend towards holding each hospital employee accountable for his or her personal responsibilities regarding infection control, and by the tendency to consider HAIs avoidable medical errors (Jarvis 2007, Yokoe and Classen 2008). Also, in the United States, performance measures of HAI prevention have been integrated into regulatory and reimbursement systems, thereby illustrating the growing consensus that many HAIs are preventable, and that their prevention is a new healthcare imperative (Harbarth et al. 2003; Yokoe and Classen 2008).

Many principles of infection control are based on simple concepts, and the application of preventive strategies often consists of basic measures that are easy to implement (Eggimann and Pittet 2001; Vandijck et al. 2009). As managers of the daily care processes, nurses undeniably are key to the implementation of these measures at bedside, and play an important part in determining the success or failure of initiatives aimed at the prevention and control of infection in the ICU.

In mechanically ventilated patients, maintaining the pressure of high volume-low pressure endotracheal tube cuffs above the critical value of 20 cmH_2O is such a simple, but crucial nursing concern to prevent silent aspiration of oropharyngeal contents, and thereby ventilator-associated pneumonia (VAP) (Rello et al. 1996; Rello et al. 1999). Accurate monitoring by means of a well-calibrated manometer – continuously or regularly, and upon indication – is of pivotal importance for safeguarding cuff pressure within the 20 cmH_2O - 30 cmH_2O range. Regretfully, however, substantial practice variation and improper cuff management among ICU nurses have been reported (Labeau et al. 2009; Rose and Redl 2008).

Another marked example of a simple preventive strategy that is pre-eminently managed by the ICU nurse is elevation of the head of the patient's bed to prevent VAP. In mechanically ventilated patients, semirecumbent position is associated with lower levels of aspiration of upper airway secretions into the lower airways (Ibáñez et al. 1992; Orozco-Levi et al. 1995; Torres et al. 1992) and a lower VAP incidence than the supine position (Drakulovic et al. 1999; Fernández-Crehuet et al. 1997; Kollef 1993). Particularly in patients receiving enteral nutrition, elevation of the head of the bed to 30° - 45° is effective in reducing the risk of VAP (Drakulovic et al. 1999). The feasibility of this strategy in daily practice was investigated by van Nieuwenhoven et al. who randomised 221 patients to a backrest of 45° or to a backrest of 10° (van Nieuwenhoven et al. 2006). Remarkably, in the 45° group the targeted position was not achieved, the

average positional angle being 28°. No clear explanation for this finding could be given. It was suggested that clinician-related factors such as motivation and commitment to adhering to scientific protocols might have been involved.

It is well known indeed that clinician's adherence to protocols and guidelines is often limited (Castella et al. 2006; Grover et al. 2007; Rello et al. 2007; Rello et al. 2002; Ricart et al. 2003; Rickard et al. 2004; Rubinson et al. 2005; Sinuff et al. 2007; Vandijck et al. 2007). Among nurses, examples of non-compliance with evidence-based recommendations for infection prevention and infection control abound, as do self-reported barriers to adherence (Rello et al. 2007; Ricart et al. 2003; Rickard et al. 2004). Optimisation of guideline uptake and compliance is a complex process that requires insight in theories of behaviour change, and in the local potential facilitators and barriers related to adherence. Recently, a European study investigating ICU nurses' knowledge of evidence-based guidelines for preventing VAP, central venous catheter-related infection and surgical site infection found the overall mean scores to be as low as 45.1%, 44.4% and 29.0% respectively, suggesting poor guideline knowledge to be a potential barrier to guideline adherence (Blot et al. 2007; Labeau et al. 2008; Labeau et al. 2009a; Labeau et al. 2009b). Although guideline knowledge does not guarantee adherence, logically, one cannot adhere to guidelines of which he/she does not know the contents. As such, interactive educational initiatives may be considered as first and crucial elements of multifaceted programmes that target the implementation of interventions for infection prevention and infection control in the ICU.

Implementation of change is known to be challenging. Especially when a permanent change in nurses' well-established routine care is intended, sustained efforts and a multidisciplinary collaboration are basic prerequisites to success. Until today, it is not fully understood which implementation strategies are more likely to be successful, but there is a general consensus that multifaceted programmes targeting different barriers to change are more effective than single interventions (Grimshaw et al. 2001). Still, little information is available to guide the choice, or optimise the components of such complex programmes in practice (Prior et al. 2008).

Berenholtz et al. have clearly demonstrated that the use of a well-defined set of multimodal, bundled implementation approaches, in which ICU nurses were cast in a major role succeeded in dramatically reducing central venous catheter-related bloodstream infections (CVC-RBSI) (Berenholtz et al. 2004). In their study, a quality improvement team introduced the following five interventions in a surgical ICU over a four-year period:

1) Education of the local staff;
2) Creation of a catheter insertion cart;
3) Daily assessment of the need for the catheter to remain in situ;
4) Implementation of a checklist to ensure adherence to evidence-based prevention guidelines; and
5) Empowerment of the nurses to stop catheter insertion if breaches in the procedure were detected.

Over the implementation period, a decrease in the rate of CVC-RBSI from 11.3 to zero per 1,000 catheter days was registered. The authors estimated that 43 cases of CVC-RBSI, eight deaths, and about 2 million USD in additional costs per year may have been prevented. As such, these hopeful study results have clearly exemplified that the implementation of preventive strategies can actually be effective over prolonged periods of time if they can be successfully integrated into the behaviour of all those who are involved in patient care (Berenholtz et al. 2004; Eggimann and Pittet 2001).

Finally, infection prevention and control is a dynamic process, requiring a continuous surveillance programme to monitor, guide and evaluate the implemented preventive strategies and to allow for benchmarking and quality improvement. The clinical expertise and accurate input from dedicated nurses who are committed to meticulously observing and reporting infection are essential to reduce the risk of HAI in the ICU.

In conclusion, despite the increase in awareness, there is still some considerable way to go to reduce HAI in the ICU. As nurses play a major role in warranting patient safety, taking up a leading part in the implementation of infection prevention programmes is an outstanding opportunity to promote themselves as dedicated and responsible professionals, and key players within the multidisciplinary team. ■

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hazards of immobility, such as pressure ulcers, deep vein thrombosis, constipation, muscle atrophy, etc.

A meta-analysis of 16 prospective randomised studies on rotational therapy was performed and indicated that the incidence of pneumonia was lower when the patients were positioned in rotational beds compared with manual turning of patients by nurses every two hours. However, no effect on duration of mechanical ventilation, number of ICU days or hospital mortality could be observed (Goldhill et al. 2007). Little evidence is available regarding the most effective rotation parameters as degree of rotation and time intervals, which may vary with the underlying disease and the weight of the patient. From pathophysiologic considerations, patients with higher BMI may benefit more than others because this patient collective is more likely to develop respiratory complications. Obese patients may also profit from rotational beds because they possibly receive more turning intervals as by manual turning which requires sufficient manpower and the coordination of many people. However, studies in obese patients are lacking.

Summary

Positioning considerations are extremely important for the treatment of obese patients in the ICU. These patients can experience serious physiologic impairment if improperly positioned. Trendelenburg's position and supine position put the obese patients at risk for developing severe respiratory insufficiency and cardiocirculatory complications and should be avoided whenever possible. Knowledge on optimal positioning of critically ill obese patients is essential as the incidence of obese and morbidly obese patients in our ICUs is rising. ■

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AUTHOR GUIDELINES

ICU MANAGEMENT

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Thank you,
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Footnotes from PCC *(p23 -27)*

Box 1

Alarm and Monitoring:Each mode presents specific monitoring and alarm parameters providing: • Display of patient's values monitored during breath delivery allows optimal control of patient related settings. • Additional monitoring and alarm message displays provide enhanced monitoring of patient and ventilator • Alarm memory feedback helps keep you updated about past events and as well as the patient progress. • Integrated SpO2 monitoring for continuous patient monitoring and safety.• Apnea Time • Leak Flow (L/min)

Box 2

Screen is divided in logical areas customizable and without overlapping of critical information as real-time monitored data and alarms. Real time monitored data with breath type indicator (Controlled, Assisted, spont colored coded); Curves, loops, additional monitored data area with Pressure-time curve, flow-time curve, volume-time curve, pressure-volume loop; Flow-volume loop, additional monitored data, trending; Control Area for ventilation, alarm and respiratory maneuvers settings; The PB840 includes Proportional Assist Ventilation(tm) Plus (PAV+) advanced spontaneous mode, Advanced Respiratory Mechanics and Trending Package, Tube Compensation, Bilevel, Volume ventilation plus. The PB840 is optionnally ugradable to neanatal invasive and non invasive nasal CPAP ventilation with NeomodeData displayed: • Fi02 • End expiratory pressure (PEEP)• End inspiratory pressure (PI END) • Exhaled minute volume (VE TOT) • Exhaled tidal volume (VTE) • Inspired tidal volume (VTI) (with NIV only) • Mandatory inspired tidal volume (VT MAND) (with VC+ only) • I:E ratio • Maximum circuit pressure (PPEAK) • Mean circuit pressure (PMEAN) • Spontaneous minute volume (VE SPONT) •Total respiratory rate (fTOT) • Rapid shallow breathing index (f/VT) • Spontaneous inspiratory time (TI SPONT) • TI/TTOT ratio • Leak (at peep) Exhalation leak • Leak% • Vleak Inspiratory Leak Volume • Typical compliance (CPAV) (with PAV+ only) • Inverse of compliance in cm/l (EPAV) (with PAV+ only) • Dynamic display of intrisic PEEP (PEEPI) (with PAV+ only) • Patient resistance (Total-Airway) (RPAV) (with PAV+ only) • Patient + artificial airway (RTOT) (with PAV+ only) • Inspired spont tidal volume (VTI SPONT) (with PAV+ only) • Normalized f/VT to IBW (f/VT/kg) (with PAV+ only) • Work of breathing by patient (Joules/l) (WOBPT) (with PAV+ only) •Total work of breathing (WOBToT) (with PAV+ only) • Negative Inspiratory Force (NIF) • P0.1 or Occlusion Pressure (P100) • Vital Capacity (VC) • Dynamic Compliance (CDYN) • Dynamic resistance (RDYN) • Peak Expiratory Flow (PEF) • End Expiratory Flow (EEF) • Peak spontaneous (PSF); Trending Function: • 53 parameters monitored over a 72 hr period • 7 Clinical Scenario Presets • 15 Manual event markers • Automatic event markers • 3 graph display, 360 rows of tabular data • Fast cursor to allow fine analysis • Integral waveforms function includes

Box 3

Ventilator dedicated to NIV with Invasive ventilation capabilities, intra-hospital transport and Homecare ventilation titration.The Supportair ventilator accompanies your patient from exacerbation to stability.Non Invasive ventilation in low and high acute hospital settings:• High performance turbine-based pneumatics for high flow ventilation modes (PSV)• Outstanding leak compensation assures safety and continuum of ventilation.• Smart trigger performance for better patientcomfort and synchrony reducing Work of Breathing (WOB)• Non invasive and invasive ventilation functionality offers the versatility to care for patients throughoutmultiple disease states. Mobility: • Small size and light weight facilitate the uncomplicated and safe use inside the hospital.• Independent from external power source for up to 10 hours* reduces concerns for power during transport.• Variety of ventilation modes allows wide range of ventilation even during transportation.• Optional single or dual limb breathing circuits facilitate use on a wide variety of patient types and enhances patient comfort.• Preference set-up screen to customize operation and screens• Service Screen

THE UNITED STATES HEALTHCARE SYSTEM: THE MOST IS NOT NECESSARILY THE BEST

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The United States (US) healthcare agenda is the major domestic debate of President Obama's presidency. He had made revamping of the US' pluralistic medical delivery system a cornerstone of his campaign and at his inauguration he prompted both the House of Representatives and the Senate to design legislation to fix it by focusing simultaneously on its deficiencies in access, its high cost and its less than optimal quality.

And well he should. By consensus it is a mess. Celebrated for its innovations with respect to the adoption of technology and the high standards it meets with regard to the training of health professionals, American healthcare is a mosaic of initiatives and regulations tied predominantly to private practitioners and non-governmental reimbursers (save for Medicare for the aged and Medicaid for the poor). It excludes nearly one sixth of the population who lack insurance or are not eligible for public assistance. Moreover, it consumes one sixth of the economy and nearly every year its share of all expenditures rises faster than the rate of inflation.

Expense Versus Results

It is by far the most expensive system in the world, about 50% higher in percentage of GNP than in most other developed countries. And by nearly every quality index, American healthcare lags behind the current experience of other nations comparable in wealth. The US has a lower life expectancy for both men and women than Japan and most of Western Europe, and a higher infant mortality rate, too. Much of the added costs go to meet the anticipated rewards sought by stockholders of private insurance companies and to meet the expectations of procedurally-oriented medical specialists whose compensation depends on the volume of work they recommend and generate. Incidentally, on average, the incomes of American orthopedists, gastroenterologists, cardiologists and radiologists are higher than their counterparts in most other nations and the rate of increase in earnings of these physicians is advancing faster still than the annual growth in healthcare expenditures.

At this juncture, a comprehensive health bill is still under debate. A plan to offer a public health insurance option to compete with private insurance in order to enroll those presently uninsured was initially a minor component of a sweeping array of proposals. But it has galvanised opinion not only among legislators but also in the populace itself, engendering sometimes ugly demonstrations mixing fact and fantasy about the implications of the "public option". This issue goes to the heart of the ongoing tension about what and how a country with a legacy of self-reliance and rugged individualism (which served it well as it developed a largely virginal continent) now has to come to terms with the post-industrial obligations of a state committed to equality not only of opportunity but also of obligation which is a hallmark of a mature polity.

Picture 1. Vice President Joe Biden speaks to seniors during a healthcare town hall meeting at Leisure World in Silver Springs, Maryland, Wednesday, September 23, 2009. Also in attendance were Secretary of Health and Human Services Kathleen Sebelius, and Director of the White House Office of Health Reform Nancy Ann De Parle.
(Official White House Photo by David Lienemann)

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Picture 2. President Barack Obama delivers a healthcare address to a joint session of Congress at the US Capitol in Washington, D.C., September 9, 2009. *(Official White House Photo by Pete Souza)*

Political Battle Lines are Drawn

So the Democrats favour enhancing access while the Republicans by and large object to any innovation that limits choice and adds cost. Any compromise legislation that accommodates itself to a resolution of these competing claims might represent a victory for Obama's desire to make social change. Yet it will fail, nonetheless, because the matter of quality will not be addressed in a meaningful way. That is because the various legislative initiatives fail to relate to the fact that utilisation is controlled by doctors. Their impetus to do more outflanks the insurance companies objective to reimburse less.

The incorporation into practice of truly outstanding advances in techniques, procedures and pharmaceuticals is enticing and is an attraction in itself. And it is made more compelling as a generator of activity by the specter of malpractice risk. These two factors operate in concert. Technologic improvements have caused a sea change in medical education. Now the older techniques of the art of medicine including history and physical exam have been bypassed in favour of the objective measures afforded by imaging tests among other innovations. And the notion that failing to obtain such tests constitutes a susceptibility to an eventual malpractice suit has established defensive medicine as a protective sensibility. It is perceived as a means of insulating the doctor from the threat of an assertion of incompetence using tort action to besmirch a reputation, increase cost and heighten anxiety. The looming presence of malpractice considerations and the behaviour of physicians it promotes have aligned patients and doctors together against the political allies of plaintiff lawyers. Many of whom are prominent Democrats, who fret about changing a system which would lessen the contributions to their re-election campaigns from their plaintiff lawyer benefactors.

Defensive Medicine Hikes up Costs

It is reckoned that the costs of care engendered by defensive medicine may approach a trillion dollars. But the costs to physicians of defensive medicine no way counterbalance the benefits they receive because they are paid by the "piece work" they do. The cost of all judgments per annum of settlements both out of court and court verdicts nationally per annum for all physicians is only four billion dollars and the total cost of their collective malpractice premium is less than 50 billion dollars each year.

Convenient misconceptions about malpractice serve to legitimate defensive medicine. Yet they are not borne out by the facts. Among all physicians less than one third will ever be sued. And less than one third when sued will eventually lose the case. Among radiologists many, many more will be sued for a complication or a misdiagnosis of a test or procedure that was not indicated clinically than for not doing a test that was indicated. And the leading cause of malpractice suits for all specialists, not just radiologists, is a failure to diagnose breast cancer in a woman under fifty years of age, a group for which the limitations of mammography are well known among physicians but not generally appreciated by patients.

Conclusions

Thus healthcare in the US will continue to be expensive and wasteful, remaining as an aberrant manifestation of a social policy of misdirected aims and assumptions until quality incentives are redesigned in a meaningful way to serve common rather than selective interests. That will require uncoupling physician incentives from utilisation at the very least. However, if doctors and the public continue to operate according to the "pathophysiology of malpractice", do not expect any fundamental improvement in cost and quality until the first term of the next president and even then one should not be too optimistic. ■

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