ICU MANAGEMENT

THE OFFICIAL MANAGEMENT AND PRACTICE JOURNAL

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MEDICAL ERRORS

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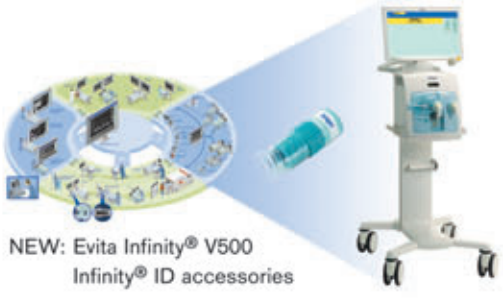

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EDITORIAL

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Much has been written about the human reality of error. The aptly named "To Err is Human" report acknowledged the fact that mistakes in the medical environment are all too common and while many safety precautions have been implemented since its' publication more than ten years ago, medical error is still a topic of significant interest and discussion in the world of emergency and critical care.

However, the initial problem that supersedes our frailty as humans occurs the moment we don our white coats. In our positions as physicians, clinical professionals and leaders of our departments we are perceived differently- apart from the "humans" we are in our personal lives, we take on a persona which is closer to that of a deity. Our patients expect it, and content with the power it may afford us, we happily oblige. Unfortunately our god-like status forgoes the ability to make mistakes, and often to admit them to our colleagues and patients when they inevitably occur.

> **"Mistakes are a fact of life. It is the response to the error that counts."**
> *Nikki Giovanni*
> *(African-American Poet, b.1943)*

In this issue we explore some of the myriad of errors and their repercussions that can occur in our departments. Dr. Newman-Toker and his team from Johns Hopkins report on diagnostic errors, where diagnoses are missed, wrong, or otherwise delayed. They discuss the most common misdiagnoses, missed diagnoses and explore the causes of these substantial but often overlooked sources of patient mortality. Timothy Cutler and Patricia Parker delve into medication errors; highlighting results from a recent study on the costs and causes of common errors, identifying high-risk patient groups and offering solution-based approaches, including the use of new technological tools which can be utilised in the administrative processes as well as monitoring of patients. As ethics are an important element of the medical errors equation, we look to Dr. Hébert, a leading author on ethics training to delve into the topic of disclosure and the regulatory and support mechanisms in place in Canada and to offer guidance on strategies to encourage a culture of disclosure in your unit.

In this issue of ICU Management we are also pleased to bring you an interesting comparison of the costs of critical care in varying countries, brought to us by Dr. Wunsch and her team from Columbia University. Her extensive research confirms what has been well documented about the high costs of care in the US, but also points to some other very interesting trends in other countries.

We feature the US in our Country Focus this issue. As a nation headed by a new administration with an outspoken penchant for healthcare change, and which is on the cusp of a national census and also in the midst of economic crisis, perhaps we would also benefit from a renewed overview of the American system in the near future; one which might shed more light on the realistic numbers of citizens, and the true picture of healthcare coverage in the country.

In this issue's Interview, ICU Management Editorial Board Member Prof. Jeffrey Lipman enlightens Managing Editor Sherry Scharff on varying topics from stress in the ICU to how the systemic problem of errors might be remedied and the benefits of the economic downturn in his hospital.

The German Coalition for Patient Safety, a non-profit association of healthcare professionals, institutions and patient organisations, recently published a brochure called "Learning from Mistakes" which describes the frequency and range of medical malpractice in Germany. In it, seventeen members of the coalition describe errors they've made on the job, ranging from late diagnoses of cancer to operations on the wrong knee.

In order to dispel the myth that in our roles in our units we are "gods in white", perhaps we must seek to follow the brave example of our German colleagues, who openly confessed their humanity in an attempt to create a culture of error prevention rather than rely on the current environment of shame and blame. As leaders in our own units and departments, we can choose perhaps not to go so far as to join coalitions, but rather to make our hospitals spaces of open communication and perpetual learning.

Jean-Louis Vincent

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Posters: Deadline for abstract submission: December 1, 2009

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SCIENCE

Swine Flu: Influenza A (H1N1) Susceptibility Linked To Common Levels Of Arsenic Exposure

www.sciencedaily.com

The ability to mount an immune response to influenza A (H1N1) infection is significantly compromised by a low level of arsenic exposure that commonly occurs through drinking contaminated well water, scientists at the Marine Biological Laboratory (MBL) and Dartmouth Medical School have found. Their findings are reported in the journal Environmental Health Perspectives.

"When a normal person or mouse is infected with the flu, they immediately develop an immune response," says Joshua Hamilton, the MBL's Chief Academic and Scientific Officer, in which immune cells rush to the lungs and produce chemicals that help fight the infection. However, in mice that had ingested 100 ppb (parts per billion) arsenic in their drinking water for five weeks, the immune response to H1N1 infection was initially feeble, and when a response finally did kick in days later, it was "too robust and too late," Hamilton says. "There was a massive infiltration of immune cells to the lungs and a massive inflammatory response, which led to bleeding and damage in the lung." Morbidity over the course of the infection was significantly higher for the arsenic-exposed animals than the normal animals.

Respiratory infections with influenza A virus are a worldwide health concern and are responsible for 36,000 deaths annually. The recent outbreak of the influenza A H1N1 substrain ("swine flu"), which is the same virus that Hamilton and his colleagues used in their arsenic study to date has killed 72 people in Mexico and 6 in the United States.

"One thing that did strike us, when we heard about the recent H1N1 outbreak, is Mexico has large areas of very high arsenic in their well water, including the areas where the flu first cropped up. We don't know that the Mexicans who got the flu were drinking high levels of arsenic, but it's an intriguing notion that this may have contributed," Hamilton says.

The U.S. Environmental Protection Agency considers 10 ppb arsenic in drinking water "safe," yet concentrations of 100 ppb and higher are commonly found in well water in regions where arsenic is geologically abundant, including upper New England (Massachusetts, New Hampshire, Maine), Florida, and large parts of the Upper Midwest, the Southwest, and the Rocky Mountains, Hamilton says.

Arsenic does not accumulate in the body over a lifetime, as do other toxic metals such as lead, cadmium, and mercury. "Arsenic goes right through us like table salt," Hamilton says. "We believe for arsenic to have health consequences, it requires exposure day after day, year after year, such as through drinking water."

Journal reference:
Kozul et al. Low Dose Arsenic Compromises the Immune Response to Influenza A Infection in vivo. Environmental Health Perspectives, Online May 20, 2009; DOI: 10.1289/ehp.0900911
Adapted from materials provided by Marine Biological Laboratory.

INDUSTRY

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DIAGNOSTIC ERRORS IN CRITICAL CARE SETTINGS

MANAGING INFORMATION OVERLOAD

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Diagnostic errors represent a substantial but often overlooked source of preventable morbidity and mortality in hospitalised patients, accounting for an estimated 40-80,000 hospital deaths annually in the US (Newman-Toker and Pronovost 2009). The intensive care unit (ICU) setting is no exception, and patients there may be at higher risk (Shojania et al. 2003). In this article we briefly review the terminology, classification, and epidemiology of diagnostic errors in critically ill patients before offering some thoughts on root causes and suggestions for systems-oriented solutions to prevent misdiagnosis in the ICU.

Diagnostic errors are diagnoses that are missed, wrong, or delayed, as detected by some subsequent definitive test or finding (Graber 2005). Some misdiagnoses result in harm. Such harm may result from unrecognised disease, unnecessary diagnostic testing, or inappropriate therapy. Misdiagnosis-related harm is preventable harm suffered from treatment provided for a condition not actually present, or the delay or failure to treat a condition actually present when the working diagnosis was wrong or unknown (Newman-Toker and Pronovost 2009). Misdiagnoses may be classified based upon their clinical relevance and potential for timely therapy to have prevented harm. Autopsy-based studies, the gold standard for detection of most diagnoses that result in death, typically employ the four-tiered Goldman classification system (Box 1) (Goldman et al. 1983). Major diagnostic errors are errors in diagnosis of the principal underlying disease or primary cause of death, and those that could have affected patient prognosis or outcome are considered class I errors.

A systematic review of higher-quality autopsy studies published from 1959-1999 found a median major error rate of 24% and a class I error rate of 9% across hospital settings (Shojania et al. 2003). Adjusting for declining autopsy rates over time, these authors estimated major errors occur in 10% of all modern hospital deaths, and 5% of all deaths are potentially-preventable class I errors. The class I error rate in US adult ICUs appears to be double the overall rate in US hospitals (odds ratio 2.12, 95% confidence interval 1.42-3.16) (Shojania et al. 2003).

Extrapolating from the larger pool of autopsy data on diagnosis not restricted to the ICU setting (Battle et al. 1987; Shojania et al. 2003; Tavora et al. 2008), factors such as patient age and sex, as well as hospital type (university versus community), size, and location (country) probably influence the likelihood of misdiagnosis in the ICU. The patient's initial clinical presentation affects misdiagnosis as well. For example, there appear to be lower rates of misdiagnosis among trauma victims (Forsythe et al. 2002) and higher rates

among transplant recipients (Nadrous et al. 2003), with the majority of misdiagnoses in this latter group being infectious. Perhaps more importantly, certain dangerous conditions represent ICU misdiagnosis "hot spots."

Initial work from a systematic review of studies reporting diagnostic errors in the ICU setting (Newman-Toker, unpublished) indicates most potentially lethal ICU misdiagnoses can be divided among vascular events (38%), infections (38%), and mechanical pathophysiologic states (15%) (Box 2). Within these groups, the top individual class I misdiagnoses detected at autopsy are:

- Pulmonary embolism (9%),
- Myocardial infarction (7%),
- Bacterial abscess (7%),
- Cardiac tamponade (5%),
- Gut perforation (5%),
- Aspergillosis (5%),
- Aortic dissection (4%),
- Gastrointestinal bleeding (4%),
- Systemic cytomegalovirus infection (3%),
- Tuberculosis (3%),
- Bowel infarction (3%), and
- Candidiasis (2%).

These 12 diseases or pathophysiologic states account for more than half of all the class I misdiagnoses reported in ICU patients.

Relatively little is known about non-lethal morbidity from misdiagnosis in the ICU setting. Although permanent non-fatal injury to vital organs such as heart, kidney, or liver may lead to chronic morbidity after ICU misdiagnosis, it seems probable that central nervous system injury accounts for much of the misdiagnosis-related chronic disability among ICU survivors. Morbidity may result from failure to recognise and treat primary neurologic illness or failure to prevent neurologic sequelae of unrecognised trauma or systemic illness. The former includes failure to adequately treat conditions such as status epilepticus (Drislane et al. 2008). The latter includes missed opportunities to prevent stroke after occult vascular injury (Baker and Wassermann 2004), cord compression after occult spine fracture (Levi et al. 2006), or Wernicke encephalopathy due to occult thiamine deficiency in malnourished, critically ill patients (Fried et al. 1990).

Even less is known about root causes for diagnostic errors in the ICU setting. Some causal factors are likely intrinsic to the complex, hurried, and stressful clinical environment of the ICU such as the high severity of illness, ubiquitous interruptions and distractions by beeping equipment, long hours, and overnight shift work (Donchin and Seagull 2002). Other factors may relate to staffing ratios or the qualifications of ICU staff physicians (Pronovost et al. 2002). While these generic factors likely play a role in diagnostic errors, their contribution is hard to quantify, since cases (i.e., those misdiagnosed) and controls (i.e., those correctly diagnosed) within an institution are typically exposed to them equally. The exception is off-hours occurrence, which can be measured, and appears to be associated with an increased risk of misdiagnosis (Kollef 1991).

Box 1: Goldman classification of discrepancies between antemortem clinical diagnoses and postmortem autopsy diagnoses *(adapted from Goldman et al. 1983)*

Major Misdiagnoses
- Class I – missed major diagnosis that would have changed patient management and might have resulted in cure or prolonged survival
- Class II – missed major diagnosis that would not have led to a change in management or not have altered survival

Minor Misdiagnoses
- Class III – missed minor diagnosis related to the terminal disease process but not directly related to death
- Class IV – other missed minor diagnosis

Although not extensively studied, cognitive and contextual factors probably play an important role in ICU misdiagnosis. We hypothesise that most missed diagnoses in critically-ill patients are causally linked to one of three difficult decision-making scenarios:

1) DISTRACTED BY A BIGGER PROBLEM — For patients to be admitted to an ICU, they must be sick with an obvious clinical problem (e.g., multiple trauma) and sufficiently unstable that they are in need of critical care (e.g., stabilisation for hypotension in the setting of haemorrhage). We are encouraged during training to seek parsimonious diagnostic explanations ("Occam's razor"), but we know that sometimes a patient may "have as many diseases as he darn well pleases" ("Hickam's dictum") (Hilliard et al. 2004). In the ICU, multiple problems or diseases are the rule rather than the exception. The classic example is the trauma patient with occult cervical fracture – spine injuries are more likely to be misdiagnosed when they occur with a greater number and severity of co-morbid injuries (Janjua et al. 1998).

2) BUSY CHASING THE USUAL SUSPECTS — As with other clinical settings, "common things are common" principles generally apply in the ICU. In a typical hypotensive patient, after ruling out cardiac failure and bleeding, one might empirically treat with broad-spectrum antibiotics for presumed bacterial sepsis. In other clinical settings, lack of response to therapy might be taken as a marker of misdiagnosis. However, in the ICU, patients are often so sick that lack of immediate response to therapy might not indicate diagnostic failure but rather overwhelming disease. This problem might be exacerbated by confounding factors, which often present in critically ill patients that limit the sensitivity of diagnostic markers (e.g., blood culture negativity blamed on cultures being obtained after initiation of antibiotics). Thus, a patient with fungemia or viremia as a cause for hypotension might go undetected until it was too late in this wrong-bug-wrong-drug scenario (Cardoso et al. 2006).

IT@ NETWORKING

The IT @ Networking Awards 2009 will select outstanding European healthcare IT solutions in hospitals and healthcare facilities and bring them to the pan-European stage.

WINNING PROJECT GETS EXTENSIVE PRESS COVERAGE AND €5,000 CASH

WHERE AND WHEN

Brussels, the centre of European decision-making, will be the location for the IT @ Networking Awards 2009 *(IT @ 2009)*. It will be held from 29 - 30 October 2009 during the European Autumn Summit, ensuring international attention.

WHO

The attendee roster will include heads of radiology and radiologists with an interest in IT, hospital CEOs, CIOs, CMIOs, hospital and healthcare IT managers, members from European and national institutions whose mandates cover healthcare IT, as well as members of the specialist healthcare and IT press.

WHY

Behind its fragmented façade, European healthcare IT includes a number of world-class jewels: cutting edge IT solutions that meet real-world challenges, efficiently and cost-effectively, and not rarely, in an elegant fashion.

Unfortunately, many such jewels remain unknown to the outside world – not just to the general public, but ironically, to the healthcare IT community as well.

So too do their designers and architects, unsung heroes who have often invested their creative talents, and dedicated months and years of hard work – to create and build something good, something better, all the way through to the very best. But many such efforts extend beyond job definitions, stretch far above the call of duty.

These pioneers need recognition! Their stories will inspire others. The lessons they have learned can help both avoid mistakes and transform healthcare IT challenges into opportunities, into "Made-in-Europe" success stories. This is the goal of *IT @ 2009*.

HOW

Several national or European awards are often decided by "experts", thus not always familiar with real-world challenges. Sometimes, they even make decisions on political grounds.

The European Association of Healthcare IT Managers believes that peers will make the wisest decisions in respect to their own needs. As far as healthcare IT is concerned, the Association considers it to be self-evident that senior healthcare professionals will know what is the best solution for them.

To use familiar terminology for IT professionals, *IT @ 2009* is built on the principles of best-of-breed and peer-to-peer networking.

An on-the-spot, one-person = one-vote electronic system will be used to enable attending radiologists, CEOs, CMIOs, CIOs and hospital and healthcare IT managers to make their choices. Only they are eligible to vote.

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G AWARDS 2009

ROLLOUT: FROM MINDBYTE TO WORKBENCH

FIRST DAY: MINDBYTE

All successful submissions for the *IT @ 2009* will be allocated 5 minutes for a short presentation (a Mindbyte) on what differentiates their solution and makes it special.

VOTING

Voting will immediately follow a synopsis of all presentations, and the finalists will be announced by the Chair of the Organising Committee.

SECOND DAY: WORKBENCH

Finalists of the *IT @ 2009* will be given 45 minutes to provide an in-depth presentation, followed by a 1/4 hour Q&A session with the audience.

FINAL VOTING

Final voting will commence immediately after the last presentation followed by the awards ceremony.

THE IT @ Networking Awards 2009 CEREMONY

Out of the finalists, the 3 top rated IT solutions will be awarded a prize.
The winning project will:
- receive the IT @ Networking Awards 2009 Trophy;
- have a detailed presentation of their solution in Europe's leading healthcare management media, and
- be awarded a cash prize of Euro 5,000.

WHO SHOULD PARTICIPATE

Developers and implementors of innovative healthcare IT solutions. Solutions can be built on both COTS as well as bespoke designs. However, all entries have to demonstrate a considerable degree of customisation and proven benefit to the healthcare facility. All entries must be already implemented and running in at least one site.

SUBMISSION DEADLINE

Submissions must be received by **25 September 2009.**

Candidates should send us a brief, 250 word synopsis of their solution – what makes it special and outstanding; what makes it a European answer to a European or global challenge. Joint presentations from radiologists, IT management together with their industry partners are stongly encouraged.

For further information or your project submission please visit our website ***www.imagingmanagement.org****, contact the General Secretariat of HITM via email* ***awards@hitm.eu*** *or call* ***+32 / 2 / 286 8501****.*

CARDIOLOGY MANAGEMENT

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ICU MANAGEMENT

3) MASKED BY THE PATIENT'S CLINICAL STATE — Many ICU patients are intubated, sedated, and paralysed. This means they do not do things that awake patients normally do, such as walk, talk, or complain about new symptoms when they occur. Thus, it is often challenging to know when these patients lose function or develop new problems. Typical bedside methods of disease detection are often ineffective (Drislane et al. 2008). Laboratory-based diagnostic strategies may also lose potency in the ICU (e.g., D-dimer levels for pulmonary emboli (Crowther et al. 2005)), or it may not be safe to apply the full range of diagnostic tests to investigate new problems (e.g., MRI may not be safe in a ventilated patient on continuous haemodialysis). These issues present particular diagnostic challenges for patients with new neurologic illnesses or complications, but similar problems occur with other underlying conditions. Pneumothorax is misdiagnosed at greater frequency in patients who are mechanically ventilated or have altered mental state (Kollef 1991) and comorbid pneumonia decreases the likelihood of an accurate diagnosis of pulmonary embolism (Goldhaber et al. 1982). Some misdiagnoses clearly result from unavoidable limitations in current scientific understanding or available diagnostic technology, but others are potentially preventable.

In one trauma study including ICU patients, the top remediable causes of missed diagnoses were:

- Ignoring minor signs and symptoms (20%);
- Inadequate clinical assessment (18%);
- Missing findings on x-ray films (16%);
- Low index of suspicion (12%);
- Not noting the radiology report (10%), and
- Failure to obtain appropriate bedside or radiographic tests (10%) (Janjua et al. 1998).

Together these accounted for 85% of all identified causes (n=190/224) in 134 patients with missed injuries. We view these preventable causes as interrelated and suspect that the central barrier to accurate diagnostic decision-making in the ICU is probably information overload (Newman-Toker and Pronovost 2009). The level of illness is so severe and the frequency of threats and alarms so high, that detecting anything but the "loudest" threat indicators becomes a daunting task.

While some systems-oriented solutions to reduce ICU errors will likely be generic (e.g., mandatory staffing by critical care-certified ICU physicians (Pronovost et al. 2002) or adjusting shift duration (Landrigan et al. 2004)), others will be specific to particular clinical contexts or scenarios. For example, structured diagnostic protocols or algorithms such as the tertiary trauma survey should be employed to capture clinically significant missed injuries in patients with multiple traumas (Janjua et al. 1998). "Don't miss" diagnostic reminder checklists should be considered to assist in diagnosing frequently encountered clinical states in the ICU (e.g., hypotension or hypoxia); such checklists or related computer-based decision support tools

Box 2: Class I missed diagnoses identified post-mortem in ICU patients (n=188)*

Vascular events (71)

- Haemorrhage (27)
  - Vascular rupture [aneurysmal/traumatic/iatrogenic] (12)
    - Aortic dissection/ruptured aortic aneurysm (7)
    - Other (5)
  - Gastrointestinal bleed (7)
  - Other haemorrhages (8)
- Thrombosis (22)
  - Pulmonary embolus (16)
  - Cardiac valve thrombosis (4)
  - Other (2)
- Ischaemia (22)
  - Myocardial infarction (14)
  - Bowel infarction (5)
  - Ischemic cardiomyopathy (3)

Infections (71)

- Bacterial infections (32)
  - Abscesses/closed-space infection requiring drainage (14)
  - Atypical or resistant bacteria (10)
  - Unknown or unspecified bacterial infection (8)
- Fungal infections (26)
  - Aspergillosis (9)
  - Candidiasis (4)
  - Unknown or unspecified fungal infection (13)
- Viral infections (10)
  - Cytomegalovirus (6)
  - Other, unknown or unspecified viral infection (4)
- Other (3)

Mechanical (28)

- Cardiac tamponade (10)
- Perforated viscus (10)
- Hollow organ fistula (3)
- Bowel obstruction (3)
- Other (2)

Other (18)

- Malignancy (8)
- Neurologic (3)
- Other (7)

*Data derived from preliminary results of a systematic review of autopsy studies focused on ICU misdiagnosis (Newman-Toker, unpublished)

(Bavdekar and Pawar 2005) might at least be used to ensure that uncommon or atypical, yet treatable, conditions are considered. Sophisticated "intelligent" data visualisation tools should be developed to create order amidst the chaos of machine-derived data on the patient's physiologic state (Horn et al. 2001). These tools should then be coupled to robust decision support engines that integrate patient-specific data with biomedical knowledge bases to help make difficult decisions (Heldt et al. 2006).

Diagnostic errors in the ICU appear common, costly, and often lethal, yet they have received relatively limited attention from critical care researchers. Recognising ICU misdiagnosis as a problem is an important first step towards mitigating harm. In the end, robust solutions to reduce diagnostic errors will likely be multifaceted. Interventions will almost certainly need to include building new knowledge about bedside diagnosis through clinical research, advancing the sophistication and efficacy of medical education through simulation, and offering more consistent audit and feedback on diagnostic performance to clinicians without inciting fear of unjustified public disclosure or litigation (Newman-Toker and Pronovost 2009). Licensing and credentialing bodies have a responsibility to ensure diagnostic competence among physicians practicing in the ICU setting, and improved standards and testing will hopefully reduce diagnostic errors (Wachter and Holmboe 2009). While new solutions are developed, we should stay actively engaged in leveraging low-technology interventions such as evidence-based checklists and protocols to focus ICU providers on avoiding the most common and deadly diagnostic pitfalls.

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MEDICATION ERRORS IN THE INTENSIVE CARE UNIT

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Introduction

It is estimated that 1.5 million preventable adverse drug events occur annually in the United States (Institutes of Medicine 2006) and have led to 177 billion dollars in estimated costs (Ernst and Grizzle 2001). The intensive care unit (ICU) and emergency department (ED) are particularly complicated considering the level of patient acuity and frenetic work environment. As a result, it is difficult to pinpoint the problem areas and solutions necessary to avoid preventable medication errors in these settings. A recent study highlighted the risk of medication errors associated with parenteral drug administration in the intensive care unit (Valentin et al. 2009). This multinational study highlights error rates associated with the most common type of medication errors - administration at the bedside. Although medication administration accounts for most of the errors in the acute care setting, errors in prescribing, transcribing, preparing and dispensing medications also occur (Krahenbuhl-Melcher et al. 2007).

Studies highlight the consequences of medication errors in the critical care setting such as increased hospital length of stay, hospital costs, morbidity, and often mortality (Moyen et al. 2008). There is a fairly large body of literature surrounding the frequency and type of medication errors. This, however, represents only the tip of the iceberg. Many institutions struggle to capture the breadth of the problem because of their dependence on voluntary reporting through a reactive model triggered by adverse patient outcomes. Proactively identifying problem areas in the medication use process and recognising high risk patient populations can improve the safe use of medications in the ICU and ED.

Discussion

Identifying the Problem Areas: The Medication Administration Process

Critical care units are fast paced, interruption driven environments. Add to that the complexity of caring for patients with a wide range of critical illness, the presence of multiple care teams contributing to orders on a single patient, the large number of orders written per patient, and the use of high-risk medications, the atmosphere of the ICU is inherently primed for a medication error.

As described by Valentin et al, some of the patients most at risk for medication administration errors in the ICU are those with one or more organ failures, receiving multiple parenteral medications, units with increased patient to nurse ratio, and larger and mixed ICU types (Valentin et al. 2009). Interestingly, most of the errors occurred during routine care and less commonly during periods of extenuating or critical situations. Patients least at risk for errors were those where an electronic medical record was used, critical incident reporting was utilised, and routine checks at shift change occurred. It should be noted that more than 75% of the errors reported in this study were due to incorrectly timed or missed medication administration perhaps inflating the rates of medication errors reported compared to other studies.

High Risk Medications associated with Medication Errors in the Critically Ill (adapted from Thomas et al, 2008). In order of most to least frequent.

Morphine	Chloride	Midazolam
Gentamicin	Bupivacaine	Fentanyl
Insulin	Furosemide	Dopamine
Noradrenaline	Benzylpenicillin	Metronidazole
Vancomycin	Propofol	Alfentanil
Heparin	Paracetamol	
Potassium	Amiodarone	

High-risk parenteral medications are not only error prone, but are common place in the ICU (See Table 1 for a list of high risk medications). Many of these, such as vasoactive agents, are often life saving during the acute phase of critical illness requiring continuous IV administration delivery with a wide range of dosing needs based on several patient specific factors, such as clinical indication, patient size, age and organ function. Standardisation of drip concentrations and the use of smart pump technology are recognised strategies to help avoid the variability that lends itself to errors with the use of these agents. However, some studies have shown the ability of smart pumps to avoid serious medication errors may be limited (Nuckols et al. 2008 and

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Rothschild et al. 2005). It has been speculated that the effectiveness of smart pumps to reduce errors is dependent on the technology employed and the nurse training and behavioural changes necessary to integrate smart pumps into practice (Rothschild et al. 2005).

The use of bar code medication administration systems and unit dose medications can help provide additional safety measures to improve the medication administration process. A study in a neonatal intensive care unit (an area of high medication error rates) using a bar code medication administration system reduced the risk of targeted preventable ADE's by 47% and can improve patient safety during the medication administration process (Morriss et al. 2008).

Identifying the Problem: Medication Use in Transitions of Care (Medication Reconciliation)

Medication reconciliation is the process by which medication prescribing accuracy is ensured from one care setting to another or from one practitioner to another. Although not a new concept to the medical profession, there has been heightened awareness and intensified efforts in the past few years as a result of an evolving body of literature surrounding errors resulting from oversight of this process (Santell 2006).

Focus on the medication reconciliation process is often made at patient admission, transfer from level of care, and discharge from the hospital. Critically ill patients tend to transition through several levels of care while in the same ICU bed due to the dynamic nature of their critical illness. These constant changes require addressing the medication needs of both their acute and chronic conditions on a more frequent basis. Pharmacokinetic and pharmacodynamic changes that occur in the patient as a result of critical illness and medical interventions should be routinely and systematically addressed in the care assessment and plan daily.

The number of co-morbidities seen in the ICU patient population lends itself to a long list of chronic medications needed for health maintenance. During the acute phase of critical illness, practitioners commonly hold chronic medications for a variety of reasons. Many of these chronic medications become contraindicated during times of haemodynamic instability and with organ dysfunction (particularly the kidney, liver and gastrointestinal track) and clinicians appropriately and consciously discontinue their use. It has been reported that as few as 12% of chronic medications are resumed by the time the patient is transferred out of the ICU to the floor (Campbell et al. 2006). Regardless of whether these medications were consciously or inadvertently held, the lack of documentation for addressing these medications during this transition of care may itself place patients at risk for unintentional medication discontinuation for baseline health needs when they are later discharged home (Campbell et al. 2006 and Bell et al. 2006). It is imperative to ensure proper communication with regards to appropriate timing for reintroduction of therapy and current dosing needs as we hand off the care of the patient from one practitioner to another.

Strategies to Reduce Medication Errors:

- Identify Problem Areas
  - Medication Administration Process
  - Medication Reconciliation
  - Across Transitions of Care
  - Recognise High Risk Drugs (see Table 1)
  - Recognise High Risk Patients
    - Age over 65
    - Female
    - Polypharmacy
    - Organ dysfunction
- Implement a Systems Approach
  - Do not rely solely on self reporting
  - Utilise a med pass audit and trigger reports
  - Promote a "no blame" environment
  - Utilise technology
    - Electronic medical records
    - Computerised physician order entry
    - Bar code medication administration
    - Smart pump technology
    - Ensure appropriate testing and training of new technologies to ensure adoption by staff
  - Inform and educate staff on newly implemented safety practices
  - Standardise drug concentrations and implement unit dose medications where appropriate
  - Use a Multidisciplinary Team

Identifying the Problem: High Risk Patients

A review of medication related problems in acute care settings found the following populations at risk for adverse medication events: patients with polypharmacy, female sex, drugs with narrow therapeutic range, renal elimination of drugs, age greater than 65, and the use of anticoagulants and diuretics (Krahenbuhl-Melcher et al. 2007).

As previously discussed, patients in the ICU and ED have multiple pre-existing morbidities and baseline medication maintenance needs. In addition, elderly patients have declines in compensatory reserves and an increase in the variability of drug effects and are therefore at higher risk for developing adverse drug reactions (ADR's). As well, polypharmacy is common in older adults making them more at risk for adverse events related to medications, possibly leading to an ED visit or hospitalisation. Perhaps most importantly, there are many medications that are known to cause harm in older adults (Fick et al. 2003). These medications while often appropriate in a critical care setting may lead to adverse medication events in older adult populations. Specifically long acting, hepatically cleared benzodiazepines; barbiturates; meperidine; haloperidol and other medications with narrow therapeutic index and a long half-life may impair CNS functionality unnecessarily prolonging sedation. In the case of meperidine, accumulation of a toxic metabolite may lead to CNS irritation and seizures. In some cases, the effects of haloperidol and other antipsychotic drugs may accumulate and take several weeks to fully metabolise in an acutely ill older adult with organ dysfunction.

Identifying Solutions: A Systems Approach

A deliberate systematic approach that evaluates the safety of the medication process using a variety of methods may prove to be the best

solution to reducing medication errors. Proactively looking for system weaknesses utilising a multidisciplinary team through a medication pass audit approach will help in discovering system weaknesses that predispose our patients to medication misadventures before they happen. Other established strategies are the use of alert triggers, such as antidote administration, which do not rely on voluntary reporting from staff, as well as encouraging a non-punitive reporting process of 'near miss' errors through voluntary reporting. Once an error is identified through either a trigger alert or voluntary reporting, performing a root cause analysis to determine what contributing factors lead to the error is essential. It is also important to provide feedback to staff on system changes that were implemented as a result of identification of system vulnerabilities to reinforce the voluntary reporting process and encourage continued awareness. Enhanced educational efforts surrounding medication use should not be overlooked if patterns are identified in specific patient populations or medications, and should include a component of competency assessment for all levels of clinicians involved in the medication use process. Further, the use of a multidisciplinary team consisting of an intensivist, clinical pharmacist and nurse with lower patient ratios has been shown to reduce medication errors (Moyen et al. 2008 and Valentin et al. 2009).

One systems approach is the use of technology to standardise the medication ordering process. Computerised physician order entry (CPOE) is one system that has been shown to reduce prescriber errors (van Rosse et al. 2009). However, the use of CPOE does not appear to be enough to reduce all medication errors. In fact, a meta-analysis of CPOE systems on medication errors in pediatric intensive care units showed a significant reduction in prescribing errors but no effect on adverse medication events or mortality after implementation (van Rosse et al. 2009). It was also noted upon qualitative analysis that the implementation process of CPOE may be a determining factor to decide success or failure.

When adequately supported, adaptation of a CPOE system brings to the institution many improvements over handwritten clinician orders. Eliminating handwriting illegibility, abbreviation confusion and incomplete order writing, as well as providing improved formulary management, medication alerting capabilities, ability to implement standardised protocols for a specific disease state management, and improve time to administration of medication are all highly recognised benefits of CPOE systems. Facilities will quickly recognise that with the incorporation of such systems a reduction of these classically well know types of prescribing challenges will occur. However, it is important to not overlook that CPOE brings with it new types of medication errors facilitated by the use of this system that will need to be addressed (Koppel et al. 2005). A national study evaluating medication errors in emergency departments in the United States showed that up to 2.5% were caused by CPOE (Pham et al. 2008). Those most likely to occur as a result of CPOE were improper dose/quantity (28%), wrong patient (12%), and wrong dosage (8%). However, these errors were less likely to reach the patient than those not caused by CPOE.

Conclusion

Medication errors can be costly to the healthcare system and detrimental to the individual patient. Applying a systems approach that identifies and resolves institution specific risk areas leading to medication errors is an important step to improve patient safety and quality of care in the ICU and ED. Further, utilising a multidisciplinary team to identify high risk patients, and medications, are necessary measures to minimise the frequency and impact medication errors will have on patients, especially in high risk patient populations such as the critically ill.

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DISCLOSURE OF ADVERSE EVENTS IN HEALTHCARE

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The disclosure of medical harm is now the standard of care. The ICU environment challenges clinicians to recognise and disclose adverse events affecting critically ill patients. This article reviews the literature on adverse events and offers suggestions for disclosing medical harm.

Introduction

It is now well established that patients commonly suffer injuries on account of medical treatment. Studies done in Canada, Spain, Australia, the UK, and the US reveal very similar rates of adverse events. About 10% of hospitalised patients experience an adverse event, 1 in 200 die in part due to these incidents, and 40% of all such incidents are considered preventable. As task complexity is one factor associated with adverse events, not surprisingly the incidence of adverse events is higher in the ICU than in general medical wards (Forster et al. 2008).

This does not mean ICUs are less safe units. The stakes are higher in the ICU with patients being so ill and undergoing so many interventions. Were it not for such dedicated units and staff, virtually every ICU patient would die. It is much more difficult in the ICU to distinguish an adverse event due to medical care from complications due to the patient's underlying disease / injury processes. This article pertains to those instances where it is clear that harm has occurred due to medical care or the failure to provide appropriate care, such as, for example, failing to ensure a patient's O_2 is being delivered whereupon a respiratory arrest ensues.

A New Professionalism

One issue that arises is what to tell patients or their families about harmful incidents. If the harms to patients are serious and seemingly avoidable, the professional's reaction can be one of shame, guilt and embarrassment (Davidoff 2002). While in years past, clinicians might have been loath to reveal the true nature of medically related harm, there has been more recently a sea-change in attitudes towards disclosure (Witman 1996).

For example, the 'new professionalism' initiative launched in 2002 by the American Board of Internal Medicine (ABIM), American College of Physicians-American Society of Internal Medicine (ACP-ASIM), and the European Federation of Internal Medicine (EFIM) promulgated the 'Medical Professionalism in the New Millennium: A Physician Charter'. According to the charter, physician obligations include the commitment to:

- Professional competence;
- Honesty with patients;
- Improving quality of care, and
- Maintaining trust in healthcare.

When Should a Clinician Disclose Error?

- The greater the impact or harm an adverse event has or may have upon a patient, the greater is the obligation to disclose the event to the patient and/or the family.
- By corollary, 'non-significant events' do not require disclosure. However, just what "significant" means may depend on individual or subjective factors that need to be taken into account by clinicians when deciding whether they ought to disclose an unanticipated outcome to the patient.

Consistent with these commitments, current professional opinion calls for open and timely disclosure of harmful medical incidents to patients (and / or, where appropriate, to the patient's family or substitute decision-maker) (Robertson 2009). The question, then, is not whether but how and when to disclose information regarding such events. Despite this, evidence from the literature suggests such disclosure does not always take place and, when it does transpire, may not go well (Gallagher 2009). This may be for a variety of reasons including uncertainty as to who should do the disclosing, what should be disclosed, and to whom should the disclosure be made.

Doing Right: A Practical Guide to Ethics for Physicians and Medical Trainees

BOOKS in review

Philip C Hébert MD PhD - 2nd Edition OUP. Toronto, 2009

Although it has a Canadian focus, the material covered in Doing Right should be relevant to all healthcare practitioners and trainees, as the focus of the book is on articulating a 'professional ethics' for healthcare generally. Cases are examined in a thoughtful way and readers are encouraged to consider the application of local or national circumstances that might affect the resolution of ethical dilemmas. Avoiding an over-reliance on technical jargon, it covers core curricular topics in bioethics – from consent and disclosure to resource allocation and end-of-life care -- using a multitude of cases. These cases illustrate the formative principles and precedents, legal and ethical, of modern medical care. The first chapter provides a procedure for analysing ethical dilemmas. Subsequent chapters focus on principles such as autonomy, beneficence and justice, and then examine related topics such as truth telling, professionalism, mental capacity, modern reproductive technology, physician-assisted death, and medical error.

The final chapter provides suggestions for supplementary reading; however, this book can serve as a stand-alone comprehensive introduction to medical ethics. 'Doing Right' is representative of a new trend in modern ethics: rather than focussing on discord, it emphasises what we have learned and achieved in medical ethics. What we have achieved is a surprising level of professional agreement on many issues and cases that face clinicians everyday. 'Doing Right' is a useful reminder as to how substantial and sustained these achievements are.

A New Regulatory Environment

The failure of healthcare professionals to meet expectations regarding the disclosure of adverse events has led to new Canadian regulations and laws compelling such disclosure. For example, several provinces have laws requiring disclosure of harmful incidents – albeit to health authorities and not to patients. Professional and regulatory medical authorities mandate openness with patients concerning adverse events (Forman 2008). Even professional insurers, typically resistant to openness for fear of self-incrimination, recognise that honesty about adverse events is the best medico-legal course. Hospital accreditation standards also will require that all hospitals have a system in place to ensure disclosure of 'critical incidents' to patients. New national guidelines encourage hospitals to devise disclosure policies. The focus is on the disclosure of harm, not of error or mistakes per se. The threshold for disclosure is any harm or significant threats to patient welfare. Where a harmful incident has occurred or has a significant likelihood of causing harm, this ought to be disclosed.

Disclosing Error

- Empathise with/normalise the patient's feelings. Use reflective listening: "I know this must be hard for you / your family…"
- Once rapport has been established, provide information and offer, "Would it be helpful for me to explain what I think happened…?"
- Avoid defensiveness.
- Stick to a narrative account.
- It is not helpful to lay blame on others or yourself.
- Don't speculate: if you don't know, find out. "Here's what I know now…"
- Apologise for the event and be accountable for your part in its occurrence, its satisfactory management and prevention.

Help From Above

In my hospital, senior administrators act as the consultant-on-call for hospital staff and physicians who may wonder whether and how to disclose an incident. Any time a critical incident occurs, 24/7, physicians are directed to contact their Department Chief for guidance and support. If unavailable, physicians are directed to contact the Medical Director on call. Similarly, when it comes to harmful incidents, other staff may access the Risk Manager / Shift Manager for guidance and support. The role of such administrators is to facilitate the staff or physician's discussion about and investigations concerning the incident as well as to help plan the disclosure conversation with the patient and/or the authorised or substitute decision-maker.

As a general rule, acknowledgement and discussion of the unexpected event should be overseen or undertaken by the most responsible physician. Others who have a significant role in the patient's care, such as the primary nurse or resident, should also be involved. Disclosure of complex incidents ought to be inter-professional (Shannon et al. 2009). Educating clinicians in advance about the 'how-to's' of disclosure can make the real-world practice much easier (Gallagher et al. 2007).

The Disclosure Process

Establishing rapport with the patient is the first step in disclosure. Disclosure should take place as soon as possible after an incident has been identified and when the patient is stable and able to understand and appreciate the information. (In circumstances of severe patient injury or death, a meeting with the patient's substitute decision-maker ought not to be delayed.) At the out-

set, empathetic expressions, such as "I am sorry to see how things have turned out", can set an appropriate tone of acknowledgement of the harm. The focus of the disclosure should be on a narrative account of what transpired (a truthful account of what is known to have happened) rather than obfuscations or hasty conclusions as to 'who did it'. Uncertainty concerning the incident should not delay initial meetings but rather call for future meetings. Any questions the patient or family may have should be solicited and answers sought in an expeditious manner. It is important for patients also to be told what is being done to prevent the event's recurrence.

Apologies

No matter how innocuous or how serious the adverse event might be, the offer of genuine apologies by those caring for the patient is critical whether or not they were 'responsible' for the incident. Expressions of regret and acceptance of responsibility are morally proper, interpersonally appropriate, and should not be legally contentious. Studies do not bear out the worry that admitting to harm or error is likely to increase one's medico-legal liability, although, admittedly, the evidence is limited (Levinson and Gallagher 2007). In 2009, Ontario, like many other provinces, passed a 'uniform apology act' that immunises from liability clinicians who make apologies, whether they are expressions of empathy or acceptance of responsibility for adverse medical events (Getz 2007).

These new expectations accord with what we know concerning patient attitudes. A need for explanation and accountability and a concern for the standards of care underlie many medico-legal actions (Vincent et al. 1994). One study revealed that over 90% of patients want to be informed about even minor errors, (Witman et al. 1996) probably an impossible task. Another study in 2004 suggested 'full disclosure' of an adverse event reduces a clinician's malpractice relative risk by about 1/3rd (absolute risk reduction, 8%) (Mazor et al. 2004).

While disclosure does not confer immunity against lawsuits and complaints, such honesty has been shown to reduce the punitive 'sting' that sometimes accompanies proceedings against clinicians and hospitals (Kraman and Hamm 1999). In a recent US study, in adverse events with a severe outcome, an honest, empathic, and accountable approach to the error decreased by 59% the probability of participants' support for strong sanctions against the physician involved (Schwappach and Koeck 2004).

Conclusion

Medical-induced harms are common in healthcare. ICUs are a locus for such events given task complexity and the burden of illnesses in patients. The setting makes it challenging but perhaps not impossible, to offer patients and their families 'open disclosure' of adverse medical incidents.

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Witman AB, et al. How do patients want physicians to handle medical mistakes? A survey of internal medicine patients in an academic setting. Arch Intern Med 1996; 156:2565-69.

THE POLYCOMPARTMENT SYNDROME

PART ONE: PATHOPHSIOLOGY AND PRESSURE MEASUREMENT OF PELVIC AND ABDOMINAL COMPARTMENT SYNDROMES

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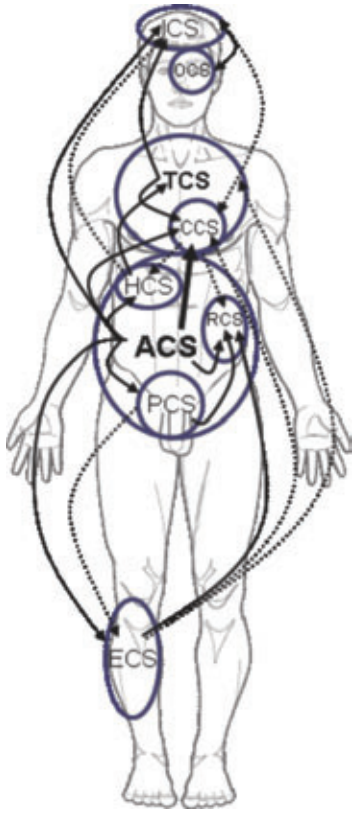
Introduction

A Compartment Syndrome (CS) exists when the increased pressure in a closed anatomic space threatens the viability of surrounding tissue. Within the body there are 4 compartments, the head, the chest, the abdomen and the extremities. Within each compartment; an individual organ or a region with multiple organs can develop a CS. A CS is not a disease, as such it can have many causes and it can develop within many disease processes.

Scalea et al. was the first to allude to the term Multiple Compartment Syndrome (MCS) in a study of 102 patients with increased intra-abdominal (IAP), intrathoracic, and intracranial pressure (ICP) after severe brain injury. Since the term multi or multiple CS is mostly often used in relation to multiple limb trauma with CS requiring fasciotomy, the term Polycompartment Syndrome was finally coined in order to avoid confusion. Part one of this article will focus on Pelvic Compartment Syndrome, Abdominal Compartment Syndrome (ACS) and intra-abdominal pressure measurement as well as briefly outlining the recently published consensus definitions for intra-abdominal hypertension (IAH) and ACS.

Pathophysiology

The increased compartment pressure (CP) will exert a direct force on the original compartment and its contents by increasing venous resistance and decreasing perfusion pressure, as well as on distant compartments (Figure 1). The impact on end-organ function and viability within and outside the original cavity can be devastating.



ACS: abdominal compartment syndrome
CCS: cardiac compartment syndrome
ECS: extremity compartment syndrome
HCS: hepatic compartment syndrome
ICS: intracranial compartment syndrome
RCS: renal compartment syndrome
OCS: orbital compartment syndrome
PCS: pelvic compartment syndrome
TCS: thoracic compartment syndrome

Figure 1. Interactions between different compartments.
The arrows indicate possible interactions between different compartments. Solid lines show direct effects by mechanical pressure forces. Dotted lines show indirect distant effects between compartments.

Table 1. Consensus definitions

Definition 1	IAP is the steady-state pressure concealed within the abdominal cavity.
Definition 2	APP = MAP – IAP
Definition 3	FG = GFP – PTP = MAP – 2 * IAP
Definition 4	IAP should be expressed in mmHg and measured at end-expiration in the complete supine position after ensuring that abdominal muscle contractions are absent and with the transducer zeroed at the level of the mid-axillary line.
Definition 5	The reference standard for intermittent IAP measurement is via the bladder with a maximal instillation volume of 25 mL of sterile saline.
Definition 6	Normal IAP is approximately 5-7 mmHg in critically ill adults.
Definition 7	IAH is defined by a sustained or repeated pathologic elevation of IAP > 12 mmHg.
Definition 8	IAH is graded as follows: • Grade I: IAP 12-15 mmHg • Grade II: IAP 16-20 mmHg • Grade III: IAP 21-25 mmHg • Grade IV: IAP > 25 mmHg
Definition 9	ACS is defined as a sustained IAP > 20 mmHg (with or without an APP < 60 mmHg) that is associated with new organ dysfunction / failure.
Definition 10	Primary ACS is a condition associated with injury or disease in the abdomino-pelvic region that frequently requires early surgical or interventional radiological intervention.
Definition 11	Secondary ACS refers to conditions that do not originate from the abdomino-pelvic region.
Definition 12	Recurrent ACS refers to the condition in which ACS redevelops following previous surgical or medical treatment of primary or secondary ACS.

Table legend:
ACS – abdominal compartment syndrome,
APP – abdominal perfusion pressure,
FG – filtration gradient,
GFP – glomerular filtration pressure,
IAH – intra-abdominal hypertension,
IAP – intra-abdominal pressure,
MAP – mean arterial pressure,
PTP – proximal tubular pressure

Pelvic Compartment Syndrome – PCS

In the pelvic region three major compartments (gluteus mediusminimus compartment, gluteus maximus compartment, and iliopsoas compartment) can be distinguished from the smaller compartment of the tensor fasciae latae muscle. Pelvic compartment syndromes are rare and a clear history of trauma is often lacking. The PCS is often associated with drug and alcohol abuse, infections (necrotising fasciitis) and the use of anticoagulant therapy. Increased pelvic CP may eventually increase IAP and affect kidney function due to bilateral ureteral obstruction and renal failure caused by a massive intrapelvic haematoma with increased retroperitoneal pressure. Decompressive fasciotomy of the gluteal compartment is the treatment of choice.

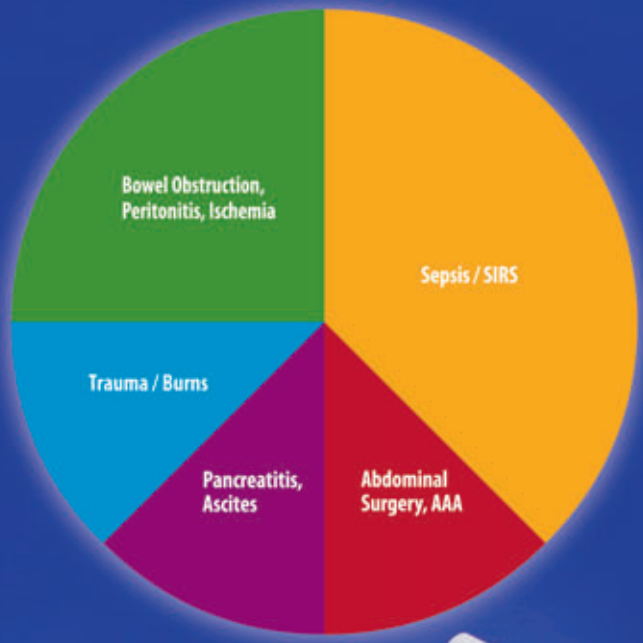
Abdominal Compartment Syndrome

In many ways the abdomen could be compared to the head with its' partially rigid sides (spine and pelvis), not unlike the skull, an anchorage above (costal arch) and partially flexible sides (abdominal wall and diaphragm). Both are filled with organs: small and large intestine, liver, kidneys, spleen in the abdomen and like the head contains the brain which is surrounded by a third space filled with peritoneal fluid like the cerebrospinal fluid (CSF) and perfused by the mesenteric arteries with a mesenteric and venous capacitance blood volume. However, the abdomen is further complicated by the movable diaphragm, the shifting costal arch, the contractions of the abdominal wall, and the intestines that may be empty or filled with air, liquid or fecal mass.

The term ACS was first used by Fietsam et al. in the late 1980's to describe the pathophysiologic alterations resulting from IAH secondary to aortic aneurysm surgery: "In four patients that received more than 25 litres of fluid resuscitation increased IAP developed after aneurysm repair. It was manifested by increased ventilatory pressure, increased central venous pressure, and decreased urinary output. This set of findings constitutes an abdominal compartment syndrome caused by massive interstitial and retroperitoneal swelling… Opening the abdominal incision was associated with dramatic improvements…"

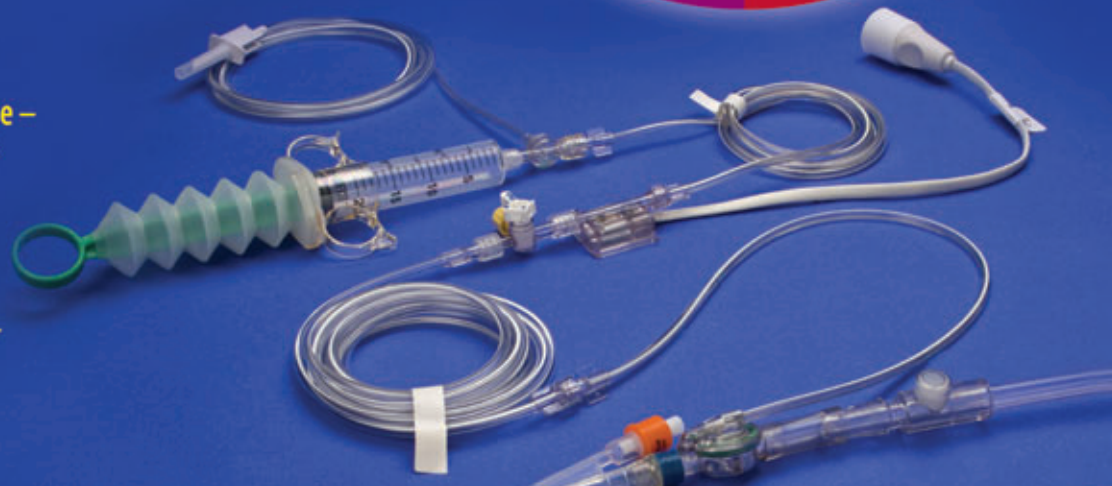
The World Society on Abdominal Compartment Syndrome (WSACS – www.wsacs.org) was founded in 2004 to serve as a peer-reviewed forum and educational resource for all healthcare providers as well as industry with an interest in intra-abdominal hypertension (IAH) and ACS. Recently the first consensus definitions have been published. Table 1 summarises these consensus definitions: a sustained increase in IAP equal to or above 12 mmHg defines IAH where ACS is defined by a sustained IAP above 20 mmHg with new onset organ failure. While Table 2 lists some possible risk factors for the development of IAH.

Who is at risk for Intra-Abdominal Hypertension?[1-4]



AbViser® AutoValve® – IAP Monitoring Device is the first and only closed IAP monitoring system with proven accuracy, reproducibility and safety.[5]

- **Simplifies ICU Nursing Tasks –** Easy set-up and use[5]
- **Standardized Data –** Proven accuracy, reproducibility and safety.[5]
- **Automatic Valve with Time Release –** Eliminates clamping and turning of stopcocks
- **White Stripe Tubing (designates IAP) –** Reduces misconnection errors
- **Closed System w/Syringe Sleeve –** Helps reduce nosocomial infection risk[6]
- **Operating Theatre Compatible –** Data assists surgeon in closing laparotomy
- **Early IAH Recognition –** Consistent monitoring improves outcomes[2,7-9]



Protocol driven intra-abdominal pressure monitoring and intervention reduce resource utilization while improving patient outcomes.[7-9]

Come See Us in **Stand # 7** at the World Congress of Abdominal Compartment Syndrome in Dublin.

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Table 2. Risk factors for the development of IAH and ACS

A. Related to diminished abdominal wall compliance
- Mechanical ventilation, especially fighting with the ventilator and the use of accessory muscles
- Use of positive end expiratory pressure (PEEP) or the presence of auto-PEEP
- Basal pleuroneumonia
- High body mass index
- Pneumoperitoneum
- Abdominal (vascular) surgery, especially with tight abdominal closures
- Pneumatic anti-shock garments
- Prone and other body positioning
- Abdominal wall bleeding or rectus sheath hematomas
- Correction of large hernias, gastroschisis or omphalocoele
- Burns with abdominal eschars

B. Related to increased intra-abdominal contents
- Gastroparesis
- Gastric distention
- Ileus
- Volvulus
- Colonic pseudo-obstruction
- Abdominal tumour
- Retroperitoneal/ abdominal wall hematoma
- Enteral feeding
- Intra-abdominal or retroperitoneal tumour
- Damage control laparotomy

C. Related to abdominal collections of fluid, air or blood
- Liver dysfunction with ascites
- Abdominal infection (pancreatitis, peritonitis, abscess,…)
- Haemoperitoneum
- Pneumoperitoneum
- Laparoscopy with excessive inflation pressures
- Major trauma
- Peritoneal dialysis

D. Related to capillary leak and fluid resuscitation
- Acidosis* (pH below 7.2)
- Hypothermia* (core temperature below 33°C)
- Coagulopathy* (platelet count below 50000/mm3 OR an activated partial thromboplastin time (APTT) more than 2 times normal OR a prothrombin time (PTT) below 50% OR an international standardised ratio (INR) more than 1.5)
- Polytransfusion / trauma (> 10 units of packed red cells / 24 hours)
- Sepsis (as defined by the American – European Consensus Conference definitions)
- Severe sepsis or bacteraemia
- Septic shock
- Massive fluid resuscitation (> 5 liters of colloid or > 10L of crystalloid / 24 hours with capillary leak and positive fluid balance)
- Major burns

**The combination of acidosis, hypothermia and coagulopathy has been forwarded in the literature as the deadly triad (129, 130).*

Table 3. Treatment options for compartment syndrome

1. Improvement of compartment wall compliance
- Sedation
- Pain relief (not fentanyl!)
- Neuromuscular blockade
- Body positioning
- Negative fluid balance
- Skin pressure decreasing interfaces
- Weight loss
- Percutaneous abdominal wall component separation
- Escharotomies

2. Evacuation of intra-compartmental contents
- Gastric tube and suctioning
- CSF, ascites, pleural or pericardial drainage
- Rectal tube and enemas
- Chest tube and suctioning
- Endoscopic decompression of large bowel
- Colostomy or ileostomy
- CT- or US-guided aspiration of abscess
- CT- or US-guided aspiration of hematoma
- Pericardectomy

3. Correction of capillary leak and positive fluid balance
- Albumin in combination with diuretics (furosemide)
- Correction of capillary leak (antibiotics, source control,…)
- Colloids (Hypertonic-Voluven® instead of cristalloids)
- Dobutamine (not dopamine!)
- Dialysis or CVVH with ultrafiltration
- Ascorbinic acid in burn patients

4. Specific therapeutic interventions
- Continuous negative external pressure (VAC®)
- Targeted compartment perfusion pressure

5. Rescue therapy
- ICS: decompressive craniectomy
- ACS: decompressive laparotomy
- TCS: decompressive sternotomy
- ECS: decompressive fasciotomy
- PCS: decompressive gluteal fasciotomyy
- RCS: renal decapsulation
- HCS: hepatic decapsulation
- CCS: decompressive pericardiotomy
- OCS: orbital decompression

Monitoring of Intra-abdominal Pressure

Since the abdomen and its contents can be considered as relatively non-compressive and primarily fluid in character, behaving in accordance to Pascal's law, the IAP measured at one point may be assumed to represent the IAP throughout the abdomen. IAP increases with inspiration (diaphragmatic contraction) and decreases with expiration (diaphragmatic relaxation). In the

Continued on page 38

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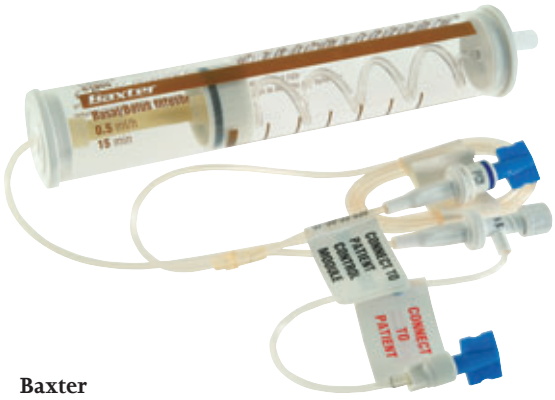
PCA INFUSION PUMPS

ECRI INSTITUTE RECOMMENDATIONS

Purchase Considerations

In the accompanying comparison chart are ECRI Institute's recommendations for minimum requirements for PCA infusion pumps.



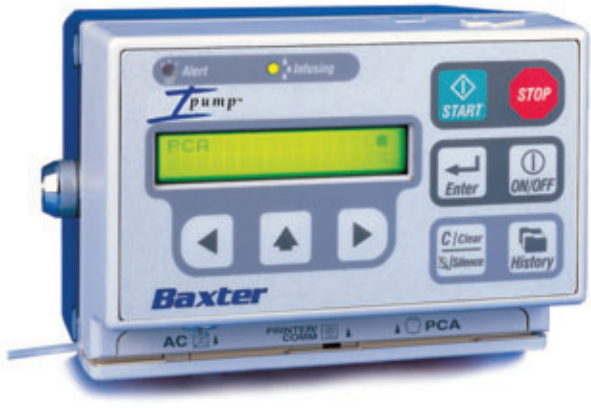
Baxter

The design of the PCA pump should allow clinicians to limit access to the reservoir and controls with a lockbox, combination box, and/or access code. Additionally, PCA pumps should detect and prevent most dose-related infusion and programming errors through the use of advanced safety features such as a DERS and an integrated bar-code scanner. Facilities should look for a pump with a DERS and only consider those models that have a drug library stored on the pump. Software should also be provided to allow users to analyse and make decisions from data in the DERS logs. Some pumps with a DERS offer wireless connectivity between pumps and a server. This capability allows transfer of event and DERS logs from the pumps to the server in near real-time and transfer of new drug libraries from the server to pumps. This capability enhances the use of a DERS by allowing for regular review of logs and for library revision (e.g., to ensure that effective drug limits have been set). Libraries can be updated without removing pumps from use and physically connecting them to a computer. Manufacturers should provide facility-based support with the implementation of advanced safety features. This support includes assisting with coordination of appropriate decision-making staff, developing a protocol/drug library consistent with the facility's ordering and delivery practices, developing dose limits for each protocol/drug, developing protocol-/drug-specific parameters, and training clinicians in the effective use of the pump and its advanced safety features.

Other Considerations

Although the free-flow goal was removed from the Joint Commission's 2006 National Patient Safety Goals, the Joint Commission still requires (under Environment of Care standard EC.6.20) that PCA pumps and/or their sets have mechanisms to prevent overinfusion due to gravity free-flow, which could result from use of broken or defective drug reservoirs or from improper set removal. Free-flow protection for most models of PCA pumps depends on the use of tubing with an integral pressure-activated valve to connect the pump reservoir (e.g., vial, collapsible bag) to the patient catheter. Such a valve, often referred to as an antisiphon valve, should allow fluid to flow to the patient only when enough positive pressure is generated by the pump to open the valve (i.e., when the pump is infusing).

The key issue in assessment for free-flow protection should be to determine whether a tubing set is protected rather than whether a particular PCA pump model is acceptable. Hospitals must also ensure that extension sets without a pressure-activated valve are not stocked in clinical locations where PCA pumps are used. Pumps that allow the use of larger reservoirs may require less-frequent reservoir changes. In addition, some manufacturers offer prefilled reservoirs. While they are typically more expensive than reservoirs filled by the pharmacy, prefilled reservoirs may be useful if your pharmacy is small and has limited staff. In addition, prefilled reservoirs may help avoid human errors and the resulting accidents associated with filling and labeling reservoirs.



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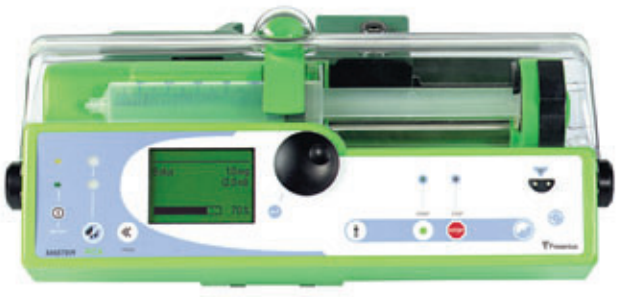
Because DERS vary greatly in their features and functionality, evaluating these systems is a critical part of the pump selection process. Refer to the ECRI Institute DERS Checklist (cited in the bibliography) for a comprehensive list of specifications and features for DERS pumps, and compare them your facility's needs.

PCA infusion pumps vary in the types of medication reservoirs they use; a few accommodate standard or prefilled syringes, but most require proprietary disposables. Some devices are compatible with third-party disposables; this can reduce the overall cost of operating those devices by allowing negotiation with a number of suppliers to obtain the lowest price for sets. Note, however, that some third-party administration sets may not offer anti-free-flow protection. A life-cycle cost (LCC) analysis should take into account the costs of disposables (which can exceed the cost of the pump over its lifetime), maintenance (which can be difficult to predict unless a service contract is contemplated), and training of patients in pump use. Many suppliers offer various programmes for rental, lease, or purchase of infusion pumps, including volume discounts. Because infusion pumps 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 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 infusion pumps from one supplier). An LCC analysis can be used to compare high-cost alternatives and/or to determine the positive or negative economic value of a single alternative. For example, hospitals can use LCC analysis techniques to examine the cost-effectiveness of leasing or renting equipment versus purchasing the equipment outright. Because it examines the cash-flow impact of initial acquisition and operating costs over a period of time, LCC analysis is most useful for comparing alternatives



Fresenius Kabi

with different cash flows and for revealing the total costs of equipment ownership. One LCC technique—present value (PV) analysis—is especially useful because it accounts for inflation and for the time value of money (i.e., money received today is worth more than money received at a later date). Conducting a PV/LCC analysis often demonstrates that the cost of ownership includes more than just the initial acquisition cost and that a small increase in initial acquisition cost may produce significant savings in long-term operating costs. The PV is calculated using the annual cash outflow, the dollar discount factor (the cost of capital), and the lifetime of the equipment (in years) in a mathematical equation.

Hospira

Stage of Development

Increasing awareness of adverse events related to medication administration errors has prompted some PCA pump manufacturers to develop software and hardware systems that build safety into the medication administration process. Three examples of advanced safety technologies for PCA pumps are integrated bar-code readers, computer-based programming applications, and DERSs. Currently, these safety features employ one of two strategies: automated pump programming or guided manual programming. Bar-code readers and computer-based programming systems employ automated programming, in which information is entered into the pump by electronic means. A DERS utilises guided manual programming, which will alert users if they have entered inappropriate settings. Integrated bar-code readers allow a user to populate a pump's settings without manually entering the information into the pump. When a clinician scans a drug vial's bar code, pump settings such as drug name and concentration are entered automatically (and without the risk of human error) from the bar code. Some systems can also automatically populate the pump with patient-specific or drug-vial-specific dosing protocols and dosing limits. More pump manufacturers are expected to provide these and additional safety features in the future.

PCA INFUSION PUMPS

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ECRI Institute is a totally independent nonprofit research agency designated as a Collaborating Center of the World Health Organisation (WHO). Such organisations are appointed to contribute to WHO's public health mission by providing specialised knowledge, expertise, and support in the health field to the WHO and its member nations. ECRI Institute is widely recognised as one of the world's leading independent organisations committed to advancing the quality of healthcare with over 240 employees globally.

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

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

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	ECRI INSTITUTE'S RECOMMENDED SPECIFICATIONS [1]	FRESENIUS KABI caring for life
SUPPLIER		
MODEL	PCA Infusion Pumps	Master PCA Pack
WHERE MARKETED		Worldwide, except North America
FDA CLEARANCE		No
CE MARK (MDD)		Yes
CONFIGURATION		Locks to IV pole, tabletop
PCA DOSE BUTTON LOCATION	Bolus cord or pump	Handset
RESERVOIR		
Type (volume, mL)	Any (≥30)	Syringe (20, 50/60)
Configuration		Syringe
Access	Key, lockbox	Key
SYRINGE-SIZE DETECTION	Preferred	Yes
DISPLAY, TYPE	LCD or LED	Graphic LCD
Data displayed	Dose, concentration, lockout interval, rate, patient requests, alarms	Comprehensive messages and trends
CONTROLS		
Type	Keypad preferred	Rotary knob, keypad
Access	Key or security code	Electronic key, security code
PUMPING MECHANISM		Stepper motor, lead screw
ACCURACY, %	±5	2, drive accuracy
CONTINUOUS FLOW		0.1-800 mL/hr, 0.001-99.9 mg/hr
Increments, mg/hr or mL/hr	0.1 mL/hr or equivalent mg or µg	0.1 mL/hr, 0.5 µg/hr
LOADING DOSE	Yes	0.001-99.9 mg
BOLUS DOSE	Yes	0.001-99.9 mg
Increments	0.1-25 mL	0.5 µg, 1 µg, 1 mg
DOSE PROGRAMMED	Yes	Yes
Concentrations	0.1-100 mg/mL	0.0001-99.9 mg/mL
LOCKOUT INTERVAL RANGE, min	≤5-100	1-720
ACCUMULATED DOSE LIMIT	Yes	0.01-9,999 mg over 1-12 hr
ALARMS/INDICATORS		Yes For times
Up/down occlusion	Yes	Not specified
Low battery	Yes	Not specified
Infusion near end	Yes	Not specified
Empty reservoir	Yes	Not specified
Other	Air-in-line, depleted battery, on line or battery power	Audible alarm, LED and LCD graphics and messages, bolus ready, <1 bolus dose or <15 min continuous infusion, remaining volume, infusion end, bolus/patient-demand trends, infusion pressure, pusher not engaged, incorrect syringe insertion, unauthorized entry attempt
SAFETY FEATURES	Lockbox, locking keypad, memory protection, tamper evident	12 hr limit, program-access electronic key, lockable cover, limit dose, occlusion and line-disconnection alarms
FREE-FLOW PROTECTION	Required	Yes
BAR-CODE READER	Preferred	No
DOSE ERROR REDUCTION SYSTEM (smart technology)	Preferred	No
Pump defaults to DERS on startup	Yes	N/A
Library size		N/A
No. of care areas	≥10	N/A
No. of drug entities/care area	≥10	N/A
Log-analysis software	Yes	N/A
EVENT LOG	Yes	Yes
Display	Yes	Yes
Printout	Yes	Yes
Number of events	≥200	1,500
Time retained	1 year	Indefinitely
Events stored	Event history, drug infused, settings, alarms	Parameters and changes, time demand, doses, demand attempts
OTHER SPECIFICATIONS		Programmable in mg or µg; printer/PC download; titration mode; 5 PCA modes; PCA/PCEA protocol library; includes standard infusion pump; antisiphon valve on extension set.
LAST UPDATED		Dec-2008

Footnotes used in pages 25 to 28

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

[2] *This product not currently available for sale in North American pending regulatory approval.*

	Baxter	Baxter	Baxter
SUPPLIER			
MODEL	**Ipump**	**PCA Infusor with Patient Control Module**	**Syndeo PCA Syringe Pump**
WHERE MARKETED	Worldwide	Worldwide	North America (currently on sales hold)[2]
FDA CLEARANCE	Yes	Yes	Yes
CE MARK (MDD)	Yes	Yes	No
CONFIGURATION	Ambulatory (carrying bag), locks to IV pole	Patient worn	IV-pole mounted
PCA DOSE BUTTON LOCATION	PCA cord, pump keypad (if configured)	Patient control module	Bolus cord
RESERVOIR			
Type (volume, mL)	Locking bag cover (100/250/250E/500)	Baxter (60)	Monoject (60), BD (60)
Configuration	Fluid bag	Inflatable balloon	Syringe
Access	Key	Back-check valve	Key
SYRINGE-SIZE DETECTION	N/A	N/A	Yes
DISPLAY, TYPE	Backlit LCD	None	Color touchscreen
Data displayed	Programming steps, alarm status, Rx and patient history, power/therapy status, others	N/A	Battery level, date, time, icon driven, alarms/alerts with diagnostic instruction, value/range limits and prescription order
CONTROLS			
Type	Keypad prompts, security code, integral locking bag reservoir, and locking pole clamp; pump detects when lockbox is unlocked and records the event in history	Push button	Push button, touchscreen
Access	Lockbox	N/A	Key, security code, lockbox
PUMPING MECHANISM	Linear peristaltic	Elastomeric balloon	Covered lead screw/stepper motor
ACCURACY, %	8	10	5 %(nominal) (1% linear accuracy)
CONTINUOUS FLOW	0.1-90 mL/hr	No	0.1-99.9 mL/hr
Increments, mg/hr or mL/hr	0.1 mL/hr	N/A	0-99.9 mL/hr in 0.1 mL/hr increments
LOADING DOSE	No	No	Yes
BOLUS DOSE	0-49.9 mL	Yes	0.1-9.9 mL
Increments	0.1 mL	0.5 mL/dose (fixed)	0.1 mL
DOSE PROGRAMMED	Yes	No	Yes
Concentrations	mg/mL, µg/mL	N/A	mg/mL, µg/mL
LOCKOUT INTERVAL RANGE, min	1-60/1 hr, 1-240/4 hr	6, 15, 60	3-240
ACCUMULATED DOSE LIMIT	90 mL/hr total	0.5, 2, or 5 mL/hr	1 and 4 hr
ALARMS/INDICATORS			
Up/down occlusion	Yes	Not specified	No/yes
Low battery	Yes	Not specified	Yes
Infusion near end	Not specified	Not specified	Not specified
Empty reservoir	Yes	Not specified	Yes
Other	Air in line, low volume, PCA button missing, system malfunction, bag cover unlocked, depleted battery, AC adapter, stuck PCA button/key, check tubing placement, left in programming mode, 1 or 4 hr limit reached	Bolus-ready indicator tabs on wristwatch, volume indicator	Reservoir low, door unlocked, syringe misloaded, syringe empty, depleted battery
SAFETY FEATURES	Configurable limits (units, infusion modes, max PCA dose, max basal rate, max bolus dose), 3 configurable safety modes, visual and audible alarms; Locking cover; 3-digit programmable security code	None specified	Locking syringe cover with key, locking IV-pole clamp, security code with key, antisiphon valve, plunger retainers/pusher block, syringe-misload detection
FREE-FLOW PROTECTION	Set-based, antisiphon valve	Not specified	Yes
BAR-CODE READER	No	No	No
DOSE ERROR REDUCTION SYSTEM (smart technology)	No	No	No
Pump defaults to DERS on startup	N/A	N/A	N/A
Library size	N/A	N/A	N/A
No. of care areas	N/A	N/A	N/A
No. of drug entities/care area	N/A	N/A	N/A
Log-analysis software	N/A	N/A	N/A
EVENT LOG	Yes	No	Yes
Display	Yes	N/A	Yes
Printout	Yes	N/A	Yes
Number of events	400	N/A	1,000
Time retained	Rolling 400 events with 3-year internal-battery backup	N/A	Until cleared
Events stored	Cover unlocked, start/stop, bolus start/infused, dose limit reached, end, alarms, Rx changes	N/A	Prescription order, PCA events, alarms, user actions
OTHER SPECIFICATIONS	Configuration can be transferred from 1 pump to multiple additional pumps; choice of security types and infusion modes; patient history can be printed for records; security codes can be changed; realarms if not attended in 2 min. UL listed.	Optional IV pole and/or bedpost mount; entire system is disposable.	Impact-resistant; shock-protected screen and electronics; enclosed syringe drive; upgradable; postocclusion bolus reduction; standby function; start-up compliance to remove slack; wireless download history to PDA/printer; auto restart after bolus.
LAST UPDATED	Apr-2009	Nov-2004	Apr-2009

CARDINAL HEALTH	CARDINAL HEALTH	CURLIN MEDICAL
IVAC PCAM Syringe Pump	**Alaris PCA Module**	**6000 CMS**
Worldwide, except USA	Canada, USA	Worldwide
No	Yes	Yes
Yes	Yes	Yes
IV-pole mounted	IV-pole mounted, modular device used with Alaris system	Lockbox; patient worn or IV-pole mounted
Handset	Bolus cord	Bolus cord and button on pump
Syringe (20-100)	Syringe (20-60)	Lockbox (100, 250, 500)/syringe
Syringe	Syringe	IV bag, syringe
Lockbox	Lockbox key, bar-code scanner for clinician ID, security-code keys	Lockbox with key
Yes	Yes	No
Backlit LCD	LED (backlit LCD on Alaris PC point-of-care unit)	Large graphic LCD
Protocols, history, start/stop, time, amount/drug infused, pattern of use, events	Current infusion program, VTBI, patient history, detailed patient history, rate, channel message, drug-event history on Alaris PC point-of-care unit	Line pressure, user prompts, help screens, battery life, delivery mode, amount delivered, rates, bolus given/attempts, amount and time remaining
Touch-control keys	Touch-control keys	Touch-control keys, point-and-click with PDA
Self-prompting	Self-prompting	Self-prompting with pump
DC motor, lead screw	DC motor, lead screw	Proprietary curvilinear peristaltic
2	2	5
0-90 µg/hr, 0-99.9 mg/hr, 0-20 mL/hr (varies with syringe size)	0.1-999 mL/hr (varies with syringe size)	0.1-50 mL/hr PCA, 0.1-25 mL/hr epidural
mg/hr, µg/hr, mL/hr	mg/hr, µg/hr, mL/hr	0.002 mL/hr or equivalent mg or µg
0-999 µg, 0-99.9 mg, 0-99.9 mL	0.1-99 mg, µg, or mL	Yes
Yes	Yes	Yes
0.1 µg-99.9 mg in 0.1-1 µg/mg steps	Configured according to hospital best-practice guidelines	0.1-50 mL IV, 0.1-25 mL epidural
Yes	Yes	Yes
mg/mL, µg/mL	mg, µg, mL	0.1-999 mg/mL, 0.1-999 µg/mL
0-180	1-99 in 1 min increments	1-60
1 µg-99.9 mg or 0.1 mL-999 mL over 8 hr in 999 mL/hr 1-8 hr in 1 µg/0.1 mg/0.1 mL increments	999 mL/hr	0.1 mL
Yes	Yes	Yes (400 or 900 mm Hg)
Yes	Not specified	Yes
Yes	Yes	Not specified
Yes	Yes	Yes
Syringe almost empty, cover open, battery depleted, patient handset removed, power failure (optional), max dose, internal malfunction, drive disengaged, nurse attention	Bolus complete, infusion complete, load complete, max limit reached, panel locked, panel unlocked, PCA complete, syringe not recognized, attach dose-request cord, check syringe, lock door, indicators for infusing (green), standby (yellow), and alarm (red)	Infusion complete, air in line (off, 0.1, 0.5, and 2 mL), high upstream pressure, door open, set not installed, unattended pump, replace set, system malfunction, battery gauge, depleted battery, audible/visual indicators with temporary alarm silence
Lockbox	Lockbox with key or code access, optional pole clamp cover, module location enforcement, bar-code scanner for clinician ID	MedLIMITS (with hard and soft lock default settings) to set upper and lower limits and increments on rates and boluses, maintains bolus schedule on repeat infusion, QC electronic programming through PDA and/or PC, integral set-based flow stop, pump-based free-flow protection, volume delivery limits in PCA modes, max of 0.1 mL accumulated and released at downstream occlusion
Not specified	Set-based, integral antisiphon valve	Active, integral set-based
No	Yes, with Alaris Auto-ID module	Yes
No	Yes, Guardrails Suite MX software	Yes, Protocol Library Safety System
N/A	Yes, basic infusion must be manually selected	Yes
N/A	1,500	100
N/A	15	15
N/A	1,500 total	100 total, can be any combination of drug protocols/care area
N/A	Yes, CQI Reporter	Yes
Yes	Yes	Yes
Yes	Yes	Pump, PDA, PC
Yes	Via Alaris System Maintenance	Yes
2,000	10,000 keystrokes, 2,000 events (will vary slightly based on text saved with each entry)	6,000
First in, first out	3 to 6 months of data, lithium battery for memory lasts ~5 years	Until cleared or overwritten
Time, event, total drug infused, settings	Time, event, total drug infused, settings, key presses, alarms	Line pressure, volume over time, power type and usage, state of administration set, bolus attempted, bolus given, start/stop bolus, alarms, system errors, start/stop pump, start/stop infusion, pump serial number, manufacturing date, user access code, next maintenance date
None specified.	None specified.	Information on Demand (IOD) feature provides one-touch viewing of key infusion parameters during "Run" mode. All data is date and time stamped; "quick repeat" feature; auto distal occlusion restart; adjustable distal press setting; delay start; program and infusion status not lost with power interruption; real-time clock; works with CMS software; protocols and prescriptions can be uploaded via Palm PDA or PC to reduce operator error; data transferred to spreadsheet for analysis.
Dec-2008	Dec-2008	Dec-2008

SUPPLIER	Hospira	Hospira	Hospira
MODEL	GemStar	GemStar-SP	LIFECARE PCA with Hospira MedNetSoftware
WHERE MARKETED	Worldwide	Worldwide	Worldwide
FDA CLEARANCE	Yes	Yes	Yes
CE MARK (MDD)	Yes	Yes	Yes
CONFIGURATION	Lockbox; patient worn, IV-pole mounted, or tabletop	Lockbox; patient worn, IV-pole mounted, or tabletop	IV- Pole mounted
PCA DOSE BUTTON LOCATION	Bolus cord or pump	Bolus cord or pump	Bolus cord
RESERVOIR			
Type (volume, mL)	Universal lockbox, Hospira prefilled vial, 100 mL bottle, or 100, 250, 500 mL bag	Universal lockbox, Hospira prefilled vial, 100 mL bottle, or 100, 250, 500 mL bag	Hospira 30 mL prefilled vials or sterile empty vials that have pharmacy-generated bar codes
Configuration	IV bag, syringe, bottle, vials	IV bag, syringe, bottle, vials	Glass vial
Access	Lockbox with key	Lockbox with key	Key
SYRINGE-SIZE DETECTION	N/A	N/A	30 mL vial
DISPLAY, TYPE	LCD	LCD	Backlit LCD
Data displayed	Infusion amount, bolus demand and deliveries, alarms, event history, program and shift totals, time/date, therapy mode (PCA, epidural)	Infusion amount, bolus demand and deliveries, alarms, event history, program and shift totals, time/date, therapy mode (PCA, epidural)	Settings, clinical care areas, drug type and concentration, drug delivered, alarm and operating conditions, delivery mode
CONTROLS			
Type	Keypad	Keypad	Keypad
Access	Self-prompting	Self-prompting	Self-prompting
PUMPING MECHANISM	Piston driver, volumetric	Piston driver, volumetric	Lead screw
ACCURACY, %	±5	±5	±5
CONTINUOUS FLOW	0.1-25 mL/hr	0.1-100 mL/hr to hundredths of mL	Variable from 0.1-20x concentration (mg/hr or µg/hr)
Increments, mg/hr or mL/hr	0.1 mL/hr or equivalent mg or µg	0.1 mL/hr or equivalent mg or µg	0.1 mg/mL or 1 µg/hr
LOADING DOSE	Yes	Yes	Yes
BOLUS DOSE	Yes	Yes	Yes
Increments	0.1-25 mL or equivalent mg or µg	0.1-100 mL or equivalent mg or µg	0.1-5x concentration or 0.1 mL
DOSE PROGRAMMED	Yes	Yes	Yes
Concentrations	0.1-100 mg/mL or 0.1-1,000 µg/mL	0.1-100 mg/mL or 0.1-1,000 µg/mL	0.1-50 mg/mL or 1-500 µg/mL
LOCKOUT INTERVAL RANGE, min	1-999	1-999	5-120
ACCUMULATED DOSE LIMIT	1 or 4 hr, number of boluses/hr or no limit	1 or 4 hr, number of boluses/hr or no limit	0.1-80x concentration
ALARMS/INDICATORS			
Up/down occlusion	Yes	Yes	Yes
Low battery	Yes	Yes	Yes
Infusion near end	Yes	Yes	Yes
Empty reservoir	Yes	Yes	Yes
Other	Air in line, almost empty, call-back alert, change batteries, on batteries, on external batteries, check cassette, error; audible and visual KVO,programme incomplete,call back	Air in line, almost empty, call-back alert, change batteries, on batteries, on external batteries, check cassette, error; audible and visual KVO,programme incomplete,call back,hard limit	Audible and visual; soft-limit alert; hard-limit attempt; pendant fault; bar code not read; dose end; check vial, syringe, and injector settings; infuser in reset; malfunction; door open or locked; patient lockout; 1 or 4 hr limit reached (flashing message)
SAFETY FEATURES	Lockbox, self-test, 1 or 4 hr limit, audible alarms, program/memory protection, shock resistant, bumper guards, configuration mode	Lockbox, key pad lock (4 levels), self-test, 1 or 4 hr limit, audible alarms, program/memory protection, shock resistant, bumper guards, configuration mode, Safety Suite-25 standardized protocols	Lockbox; self-test; 1, 4, 6, or 12 hr limit; audible alarms; program/memory protection; bar-code reader (drug name and concentration)
FREE-FLOW PROTECTION	Set-based integral flow stop and integral pressure-activated antisiphon valve	Set-based integral flow stop and integral pressure-activated antisiphon valve	Integral antisiphon valve
BAR-CODE READER	N/A	N/A	Yes
DOSE ERROR REDUCTION SYSTEM (smart technology)	N/A	GemStar SP Safety Suite-25 safety protocols	Yes, MedNet
Pump defaults to DERS on startup	Yes	Yes	Yes
Library size	N/A	25	720
No. of care areas	N/A	1 per pump	18
No. of drug entities/care area	9	25	40 with 5 protocols per CCA
Log-analysis software	Yes	Yes	Yes
EVENT LOG	Yes	Yes	Yes
Display	2-line, 16-character, 16 font	2-line, 16-character, 16 font	128 x 64 pixels
Printout	Yes	Yes	Yes
Number of events	400	925	20,000, 400 viewable on pump
Time retained	1 year	1 year	1 year
Events stored	Event history, speed protocols, diagnostic history, 48 hr bolus history	Event history, speed protocols, diagnostic history, 48 hr bolus history, Safety Suite, hard-limit log	Requests, number delivered, opening/closing of security door, start/stop
OTHER SPECIFICATIONS	Self-prompting program; PC download; user-configurable; custom lock mode; integrated automated operations test; 4 lock levels; 9 speed protocols.	Self-prompting program; PC download; user-configurable; custom lock mode; integrated automated operations test; 4 lock levels;r 25 safety protocols.	Bar-code reader reads and automatically programs drug name and concentration for prefilled vials and pharmacy-generated bar codes; 24 hr event log of injection attempts. Meets requirements of CSA.
LAST UPDATED	Dec - 2008	Dec - 2008	Dec - 2008

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EMEA-GS-EN-1
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EMEA 08/011

FROM AMBULANCE TO ICU

COMMUNITY DEVELOPMENT OF A THERAPEUTIC HYPOTHERMIA PROTOCOL

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The continuum of care is best divided into five distinct areas in order to identify all of the key roles. These areas include: pre-hospital care, emergency department care, specialty care (i.e. cardiac catheterisation lab, critical care transport teams), general inpatient care areas, and intensive care. We have also identified eleven possible points for patients to enter the hospital protocol (Figure 1).

Pre-hospital Care

Pre-hospital care providers include the first responders (fire departments, rescue squads, police, etc.), as well as emergency medical technicians, paramedics, air medical personnel, and EMS medical directors (physicians). It is important to not just consider the personnel in the ambulance, but to include everyone who may be involved in the pre-hospital care. In Charlotte, North Carolina (US) the ambulance service recently adopted a therapeutic hypothermia protocol. As part of the implementation stage, all 1100 members of the first response fire department (trained at the basic emergency medical technician level) were taught about the new protocol, and ways to assist paramedics with protocol implementation.

Emergency Department Care

It is important to incorporate the emergency department staff (including nurses, physicians and administrative staff) into the care plan progression, because they will be a focal triage point of care. The emergency department staff may initiate care, continue care in the emergency department, or facilitate immediate transfer – bypassing the emergency department and going directly to the cardiac catheterisation lab, or intensive care unit. Emergency departments at smaller hospitals may view the care in the emergency department as the terminal end point of care, and prepare the patient for transport to larger hospitals that have more extensive cardiac care services.

Specialty Care

Specialty care includes two major services, cardiac catheterisation and/or critical care transport to a larger hospital. Over half of all post-arrest patients will need to go the cardiac catheterisation lab for intervention. It is important to remember that therapeutic hypothermia will not stop an evolving myocardial infarction. Only cardiac catheterisation or administration of thrombolytics will stop an evolving infarct. However, implementation of therapeutic hypothermia is not contraindicated in the patient who requires thrombolysis or cardiac catheterisation intervention. From experience, we have found that a large number of cardiologists at our hospital would prefer to perform a diagnostic cardiac catheterisation in the stable post-arrest patient despite the absence of indicators that point to an ongoing infarct (ST segment elevation, elevated cardiac markers). This is often a point of debate between the cardiologist and the intensivists. Intensivists would rather admit and observe the post-arrest patient in the ICU. Their rationale is that by postponing the catheterisation, the risk of causing any further aggravation to the post-arrest myocardium is minimised. In contrast, the cardiologists often want to perform a diagnostic catheterisation to locate any blockages.

Another important point of focus with regards to specialty care is the use of critical care transport teams. In hospitals without the benefit of comprehensive cardiology care, the patient will most likely be transported either by ground critical care units, or air medical units to the larger receiving hospital. The ground and air critical care units are usually staffed with a nurse/paramedic team, and some may include physicians such as those seen with the European model. These teams are well trained in critical care treatment, and will be able to continue therapeutic hypothermia as well as any concurrent treatment modalities such as pressor therapies, ventilator care, and thrombolytic administration. In smaller hospitals, it is important to account for the transfer of patients when developing the protocol.

General Inpatient Care Areas

Another sometimes overlooked area of inpatient care in hospitals are those of patients that do not meet criteria for admission to the intensive care unit, or in some cases, there are no intensive care beds available. With a lack of critical care beds in many facilities, patients that have historically been admitted to the intensive care unit are now being placed in step-down units. Whether the patient's illness warrants admission to this type of care area, or they are being held until a critical care bed is available, these patients are often at risk for suffering a cardiac arrest. When this occurs, staff must be alert to recognise the post-arrest patients that can benefit from therapeutic hypothermia. This requires training of the staff regarding the benefits of the therapy as well the steps to take to ensure that the patient is immediately evaluated and the treatment is started as soon as possible.

Intensive Care Units

The fifth and final area of care for the patient in therapeutic hypothermia protocol is admission into the intensive care unit. Patients who are being cared for using the therapeutic hypothermia protocol usually require a 1:1 or even 2:1 nurse to patient ratio. The level of care and acuity of such patients necessitates that they be cared for in the most advanced cardiovascular care units in the hospital. Patients who are expedited through the admission process in the hospital and arrive in the intensive care unit in a timely fashion will stand to receive the best care. When therapeutic hypothermia is initiated, the goal is to reach target temperature as quickly and as safely as possible. Multiple studies have shown that patients who arrive in the intensive care unit quickly will reach target temperatures faster. The rationale is quite simple. Patients who receive care in the emergency department are subject to nurse care ratios that are four to five times that of the ratios seen in the intensive care units. Although emergency department nurses are very skilled, the time required to manage the patients receiving therapeutic hypothermia is often more than the typical emergency department nurse can offer. This is attributed directly to staffing levels as well as the number of patients being cared for in emergency department. Also, patients seen in the emergency departments are subject to the availability of emergency physicians who may be tasked with caring for multiple critically ill or injured patients. The same reason that we have worked to expedite our myocardial infarctions through the emergency department and to the cardiac catheterisation lab also holds true for these patients. It has been proven time and time again that by expediting patient arrival to the intensive care setting, target temperature can be reached quickly, offering patients the best chance for survival possible.

Options

There is much debate as to the optimal strategy to facilitate a patient receiving therapeutic hypothermia from the ambulance through the emergency department and on to the intensive care unit. Although it is important to get the patients either into the cardiac catheterisation lab, or intensive care unit quickly, the patient must be adequately evaluated to determine which of these is most appropriate. Some hospitals have chosen to have all patients evaluated initially in the emergency department. This option has much merit, as long as the patient can be quickly evaluated and expedited through the process. However, experience has shown in many hospitals despite the best intentions of the emergency department staff, treatment of these patients will be delayed when they have to be first evaluated in the emergency department.

Many physicians will want to assess the patient as soon as they enter the hospital to determine if any life saving interventions need to be immediately employed. Erlanger Medical Center in Chattanooga, Tennessee (US) has adopted a very innovative process to expedite the process of moving critically ill patients to the appropriate area of the hospital. The hospital assigns a highly trained nurse to critically ill patients to ensure that the prescribed treatment regimen is being followed. This nurse has no other responsibility other than ensuring that the patient is cared for during the acute period of his/her illness. These nurses are identified by colour coded shirts and function as a great advocate for the patient. This advocacy results in better outcomes.

Our hospital (Spartanburg Regional Medical Center) in Spartanburg, South Carolina (US) has adopted an innovative approach to caring for our pre-hospital patients who come to the hospital in protocol. Spartanburg Regional Medical Center is a 588-bed teaching hospital that serves over 100,000 patients a year. The hospital has 36 intensive care beds, is an accredited Level I Trauma Center and Primary Stroke Center, and has a Level III Neonatal Intensive Care Unit.

In our hospital, post-ROSC patients who are in therapeutic hypothermia protocol are brought directly from the field to the intensive care unit. The patient is allowed to bypass the often busy and overcrowded emergency departments (ours has 72-beds) and go right to definitive care. Once in the intensive care unit, an intensivist and cardiologist both evaluate the patient, and determine the best treatment modality for the patient prior to the patient being moved from the ambulance stretcher. Although this method has worked well for our facility, its success has been largely attributed to the collaboration of all members of the healthcare team. Establishing trust between hospital and pre-hospital staff is a must. Physicians and nurses working in these units do not typically receive patients directly from the field. Because of this atypical method of receiving the patient (bypassing the emergency department), relationships built upon training, familiarisation, and trust are of paramount importance.

Conclusions

Deciding which option is best for your hospital will depend on several factors. One of the underlying factors is the hospital's comfort level in the care provided by the pre-hospital providers. If the hospital is unsure of the quality of pre-hospital care, the patient is often best evaluated immediately in the emergency de-

Entry into Protocol at Primary Hospital:

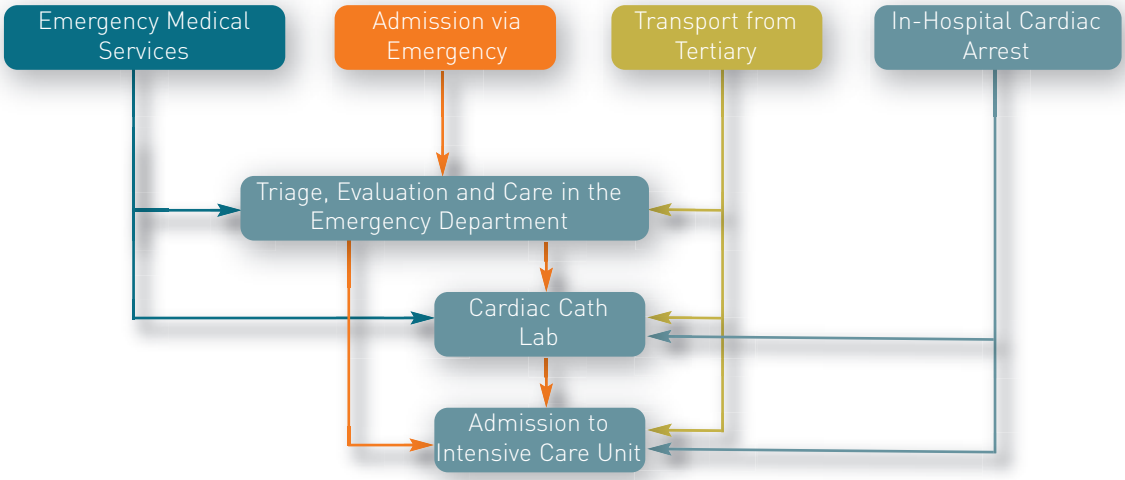

Figure 1. There are 11 different potential entry points into the protocol, and the protocol must be developed to seamlessly accept a patient regardless of the entry point.

partment. If the care provided is clinically competent by the pre-hospital personnel, the patient may benefit most by being taken directly to the intensive care unit or cardiac catheterisation (cath) lab. Some hospitals will base their decision on the report called in by the pre-hospital personnel. Depending on the patient's status and presentation, the receiving hospital physicians may decide where the patient will go. This decision is often easily made when the patient is coming from another hospital, and not when the patient is coming from the field simply because more information is available regarding the patient.

A second factor when determining the best option is the availability of the intensivists and cardiologists in the unit. Some hospitals may want the patient to be evaluated by physicians in the emergency department before consulting with the cardiologists and intensivists. Having the emergency physicians evaluate the patient first, may result in needless activation of specialty services such as the cath lab.

The protocol itself needs to be developed such that patients can easily transition between the different phases of care. By doing so, each of the key players will know and anticipate the care that the patient should have received in the prior stage. An example is found in our protocol. We found that the cardiac catheterisation lab wanted the patient to have pacer/defibrillator pads placed prior to the patient being brought into the catheterisation lab. This was a simple request, and a revision was made to our protocol so that all therapeutic hypothermia patients will have pacer/defibrillator pads placed in anticipation of going to the catheterisation lab. Other treatment modalities that have been addressed in a unified protocol are the use of sedatives and/or paralytics, glucose monitoring and control, and temperature monitoring. An added benefit of involving various staff in the continuum of care during development of the protocol is the discovery of equipment incongruities between pre-hospital and hospital, and even within units at the hospital.

Establishing shared ownership of the therapeutic hypothermia process by all members of the continuum is imperative. By allowing every person in the spectrum of care to participate in developing the protocol, key players in each stage will learn and recognise the priorities of the other stages.

Therapeutic hypothermia treatment has shown a great deal of promise in the care of post cardiac arrest patients. With further advances in temperature management and other treatment modalities, the number of patients that recover from cardiac arrest with a favourable neurological outcome will surely rise. Clinicians that collaborate with other members of the team, whether it is a cardiologist meeting with pre-hospital personnel, or an ICU nurse that meets with a critical care transport team, will set the stage for cooperation that results in better care and better outcomes. This therapy must know no boundary and be availed to as many patients as possible.

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VARIATION IN ICU RESOURCES ACROSS COUNTRIES

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Intensive care resources vary greatly across countries and impact delivery of care. Better understanding of these differences is needed to improve quality of care while minimising costs.

The delivery of healthcare occurs at the local level, yet the economics of healthcare and the resources for a given society are often shaped at a national level. While variation in healthcare resources and spending exists within regions and countries, there are also clearly defined differences in the delivery of care that occur among countries due to cultural and economic disparities (Wunsch et al. 2006). The most obvious, and quantifiable example of this is the variation in healthcare spending in different countries. For example, healthcare spending per capita is 6,014 dollars in the United States (US), almost three times that spent in the United Kingdom (UK) (2,509 dollars, in 2008, calculated using purchasing power parity) (http://stats.oecd.org/WBOS/index.aspx).

Intensive care is one of the most expensive aspects of healthcare, accounting for 0.5-1% of the Gross Domestic Product in the US (Halpern et al. 2004), and up to a third of hospital costs (Cooper & Linde-Zwirble 2004). The true impact of economic differences on intensive care may be impossible to isolate and quantify. However, a knowledge of baseline differences in resources, such as intensive care unit (ICU) bed numbers, may allow us to gain a better handle on how economics and resources confound our examination of other aspects of intensive care, such as patient selection, organisation of ICUs, and ultimately outcomes (Angus et al. 1997).

Definition of Intensive Care

The first question to ask is what constitutes intensive care? In a recent study of ICU beds in North America and Western Europe, data on beds came from eight different sources with seven different definitions (Wunsch et al. 2008). The challenge of comparing resources is to identify the true capacity to care for critically ill patients. For example, if patients after major surgery are cared for in either an ICU or in a recovery room, depending on availability of beds, should all the recovery room beds in that hospital be counted as ICU beds? Should coronary care unit beds be counted as ICU beds if they have the capacity to care for ventilated patients? And is a patient in a "stepdown" bed or a "high-dependency" bed receiving intensive care? These questions, combined with the lack of an international definition, make all comparisons challenging (Fan and Ferguson 2008).

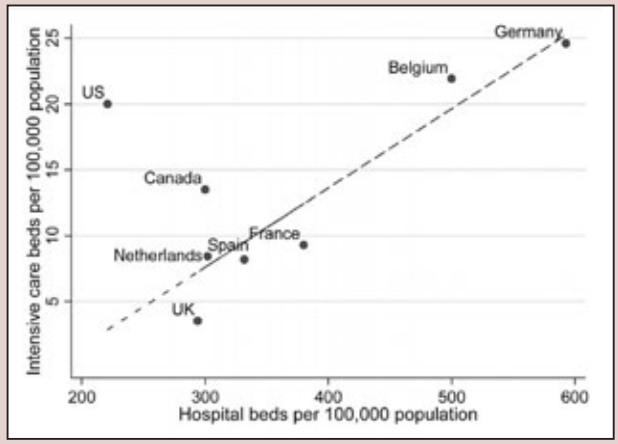

Figure 1. Correlation between reported beds: acute care hospital beds vs. intensive care unit beds per 100,000 population in eight countries (Wunsch et al. 2008).

ICU Resources

While the problem of definition may mean that we can never provide absolute numbers for any given region or country, the reality is that the differences are so stark that even rough estimates provide an important picture of differences in resources. The UK for example, is estimated to have only about one fifth of the available ICU beds of Germany (Wunsch et al. 2008). Among eight countries in North America and Western Europe, there are enormous variations in both the availability of hospital beds and ICU beds (Figure 1). However, excluding the US, there is a strong relationship between the number of acute hospital beds and ICU beds. This suggests that even though much of healthcare may occur at the local level, there is an innate balance between hospital beds and ICU beds for a given population that is used (even without national planning) by many developed countries (Wunsch et al. 2008).

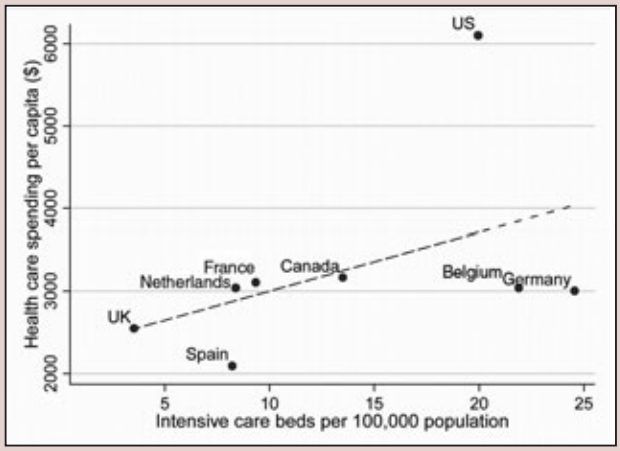

Figure 2. Correlation between intensive care unit beds per 100,000 population and healthcare spending per capita in eight countries (equivalent spending in dollars, using 2004 data from Organisation for Economic Co-operation and Development) (Wunsch et al. 2008).

Relationship with Case Mix and Outcomes

Data from the SOAP study by Vincent et al. demonstrated large variation by country with regard to the percentage of patients admitted to the ICU with sepsis (18-73%), and a strong correlation between this incidence and hospital mortality (Vincent et al. 2006). It makes intuitive sense that having fewer ICU beds would mean that the overall severity of illness of patients in the ICU should be higher, as well as subsequent hospital mortality. In fact, there is a strong correlation between the availability of ICU beds and both the incidence of sepsis and outcome, as well as a strong correlation with outcome for all ICU patients in a given country (Wunsch et al. 2008). Many questions remain, such as the impact of different availability of intermediate care beds, the ratio of ICU beds to hospital beds in a given hospital, and the potential optimal number of beds per ICU. The little data we have suggest that our ability to understand information on diseases and outcomes in intensive care must account for all this variation in order for us to fully understand findings and to move forward to improve delivery of care in any country.

Economics

In the hospital setting, costs are made up of fixed and variable components. The majority of hospital costs are fixed, usually estimated at over 80% in the US (Kahn 2006). Given the high fixed costs of intensive care beds and the enormous portion of healthcare that intensive care represents, one would expect a strong relationship between ICU resources and per capita healthcare spending. Yet, analysis of ICU beds per capita versus health care spending per capita shows only a moderate association (R=0.48, Figure 3) (Wunsch et al. 2008). This association is unaffected by the inclusion or exclusion of the US, which is a large outlier in spending.

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INTERVIEW WITH JEFFREY LIPMAN: HOW AN ICU COMPARES TO A SQUASH COURT

Jeffrey Lipman is Director of the Department of Intensive Care Medicine, Royal Brisbane and Womens' Hospital, Professor and Head of Anaesthesiology and Critical Care, University of Queensland. Sherry Scharff asked this ICU Management Editorial Board Member to share his thoughts on management challenges, the effects of economic downturn in his part of the world and the future of intensive care medicine.

Can you briefly describe your department (number of staff, beds, mortality rate, etc.)?

The current Royal Brisbane and Women's Hospital is a 942 bed general, and is a tertiary referral hospital encompassing a number of specialties including vascular, facio-maxillary, plastics, ENT urology and neurosurgery, and is the only Queensland centre for burns and bone marrow transplantation. The Department of Intensive Care Medicine (DICM) runs a 30-bed ICU. Like all other Australian ICUs we run the Unit as a "Closed" ICU working collaboratively (closely) with the referring specialties. The case-mix is adult surgical/medical excluding cardiothoracic. The unit also provides care for gynaecological and obstetric emergencies from the Women's section of the Hospital, and ICU back up for the major haematology / bone marrow transplantation service on campus.

Training is recognised by the Joint Faculty of Intensive Care. Teaching of undergraduates and postgraduates is an integral component of DICM's programme, with formal teaching sessions for all grades of staff.

Our Unit has a strong academic focus linking into a newly formed University "Burn Trauma and Critical Care Research Centre" (www.som.uq.edu.au/research/burns/default.asp). There is a very active clinical and laboratory research programme with a national and emerging international profile. Current research interests include aspects of head injuries, sepsis with an emphasis on antibiotic pharmacokinetics (including microdialysis) in critical illness and improved prevention and diagnosis of pulmonary infection in ventilated patients.

Senior medical staff consists of eleven full-time Intensivists. There are eleven ICU advanced trainees and nineteen junior registrars who participate in an independent junior medical roster. The registrars are trainees drawn from the Anaesthesia, Physician, Surgical and Emergency Medicine streams and working along side Intensive Care registrar posts.

The nursing staff component is over 200. We have about 2500 admissions/pa with merely 6% mortality. Australia and New Zealand have a central repository that gets de-identified data of all admissions from almost all ICUs within the two countries (ANZICS CORE – Australia and New Zealand Intensive Care Society's Centre for Outcome and Resource Allocation). They produce various reports, one of which is often used as a Key Performance Indicator for ICUs. It presents the individual ICU's "hospital outcome data" comparing it to APACHE II database, APACHE III (J), SAPS 2 etc. It also compares each Unit to its comparators across the two countries (i.e. we compare ourselves to other tertiary referral Units). Our APACHE II SMRs for 2008 were 50.8%.

What would you say is the most challenging part of your job?

Working in ICU reminds me a little of my competitive squash days. The closed, stressful, claustrophobic environment of the squash court during a tense competitive game often brings out the "worst" of one's behaviour, temper tantrums, throwing rackets, swearing etc. The stressful environment of ICU can be the place where all one's personal issues can come to the fore.

I find one of the most challenging parts of my job is to keep the ICU as stress free as possible for all those that work within. The interpersonal relationships of various staff members, both with the "outside" consultant staff and alleviating stressful interactions between ICU staff themselves, is demanding. We work

hard at keeping stress levels as low as possible, giving members of the unit a feeling of ownership, of feeling part of the team. We try and distribute workloads evenly or certainly appropriately, not allowing inexperienced staff to be left alone with tasks or workloads they cannot manage.

Can you describe a recent success (department/professionally)?

We have recently started a formal telemedicine consultation service with a small peripheral hospital ICU upstate. Queensland has the tyranny of distance with a large coastline and small scatterings of populations all along that coastline. In keeping with the worldwide move to the big cities, it is difficult to staff small ICUs along the coast. We believe telemedicine can solve some of the problems of small isolated ICUs. It provides "tertiary level intensivist" consultation service, provides some collegiate support for the practitioners in that area and we believe earlier and more appropriate tertiary transfer of patients centrally.

There are obvious and less obvious hurdles in setting up such a service. One of the latter is potential medico-legal problems that need formal attention. Firstly all patients or surrogates give formal consent before any consultation. We have set up a system that tapes all conversations, we have a secretary that sits in the consultation with the intensivist at our end, at the end of the hour's consultation every day, a summary of the discussion is dictated by the intensivist, transcribed by the secretary and a copy with both parties' signatures is placed in patient's base file and a file created for the patient with us.

What does your department excel at?

We believe our mortality rates are as good if not better than most places. This is in fact best shown by our Burns patients. We have recently published a study on 10 year mortality rates of our Burns patients (Dulhunty J, Boots RJ, Rudd MJ, Muller MJ, Lipman J. Increased fluid resuscitation can lead to adverse outcomes in major-burn injured patients, but low mortality is achievable. Burns 2008;34: 1090-1097).

What poses the greatest threat to patients in ICU's (infections, staff ratios, lack of equipment, medical errors)?

I am convinced that the answer to this question is nursing staff shortages.

There is no doubt in my mind that the best monitor is a good bedside nurse. For theatre work, most places will not allow the anaesthetist to leave the operating suite whilst the patient is still anaesthetised. For this, not only is there peer-recognition but there is also commensurate financial reward. I believe there will never be ideal financial recognition for the good ICU nurse who has to deal with not dissimilar anesthetised patients while the attending physician often is doing other things or seeing other patients.

Are there particular issues you deal with in Australia that are unique (from others around the world)?

Not really. Whilst the medical system is really good here with an excellent public health system, and we treat octogenarians in ICU, there are still resource allocation issues. The only difference is the "bar" is set much higher.

Has the current economic downturn affected healthcare in your country? In your hospital? Do you think there are effects to come?

Absolutely. Nursing staff are returning for a definite, reliable income. Not only their own income was in jeopardy wherever they were working, but often that of their partners' too, hence coming back into a "reliable" income has become one of our unforeseen benefits of the economic downturn. Talking to other senior staff in the hospital, I have found the same thing is happening with other job advertisements, particularly in relation to administrative staff, but also allied health staff advertisements which would normally attract one or two applicants, now attract double or triple that number.

Whilst all sounds good in the government healthcare sector with the above, I suppose it could be a worry when the economy turns the other way. Will there be a reversal and an exodus to the private sector again?

What are the most important skills for a manager of an ICU?

"People" skills! This is not taught well at Medical School or during Specialty Training.

Have you some parting wisdom on the state of the critical care field?

Medical science and technological advances are allowing us to keep more patients alive for longer. Unfortunately sometimes we just delay death. This is distressing for both the family and the ICU staff. The parameters of these two situations are often blurred. It is my hope that somehow without limiting progress, we will develop better methods of delineating the two issues, thus helping both our patients and our hard working, dedicated colleagues.

Jeffrey Lipman received his medical degree from the University of Witwatersrand, South Africa and moved to Australia in 1997. An internationally recognised expert in antibiotic usage in acute situations, Professor Lipman's research interests include all aspects of infection management in intensive care with a special interest in the pharmacokinetics of antibiotic dosage.

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strictest sense, normal IAP ranges from zero to 5 mmHg. Certain physiologic conditions, however, such as morbid obesity, ovarian tumours, cirrhosis or pregnancy, may be associated with chronic IAP elevations of 10-15 mmHg to which the patient has adapted with an absence of significant pathophysiology. In contrast, children commonly demonstrate low IAP values. The clinical importance of any IAP must be assessed in view of the baseline steady-state IAP for the individual patient. The gold standard IAP measurement method is via the bladder with a FoleyManometer (Holtech Medical, Copenhagen, Denmark) or an AbViser valve (Wolfe-Tory, Utah, USA), while continuous IAP measurement can be performed via a balloon-tipped catheter in the stomach (Spiegelberg, Hamburg, Germany or CiMON, Pulsion Medical Systems, Munich, Germany).

Abdominal Perfusion Pressure (APP) Measurement

Analogous to the widely accepted and clinically utilised concept of cerebral perfusion pressure, calculated as mean arterial pressure (MAP) minus intracranial pressure (ICP), abdominal perfusion pressure (APP), calculated as MAP minus IAP, has been proposed as a more accurate predictor of visceral perfusion and a potential endpoint for resuscitation by considering both arterial inflow (MAP) and restrictions to venous outflow (IAP).

- APP = MAP – IAP

Clinical Management

The management of patients with polycompartment syndrome is based on 3 principles:

- Specific medical and surgical procedures to reduce the compartment pressure (Table 3)
  - Improvement of compartment wall compliance
  - Evacuation of intra-compartment contents
  - Correction of capillary leak and positive fluid balance
  - Specific treatments
  - Rescue treatments
- General and organ support (intensive care) of the critically ill patient
- Optimisation and prevention of specific adverse events after surgical decompression (ischaemia/reperfusion)

Conclusion

First suggested in 1863 by Marey, ACS is the end-stage of the physiologic sequellae of increased IAP, termed IAH. Recent observations suggest an increasing frequency of this complication in all types of patients. Even chronic elevations of IAP seem to affect the various organ systems in the body. The presence of IAH and ACS are significant causes of organ failure, increased resource utilisation, decreased economic productivity, and increased mortality among a wide variety of patient populations. Despite its obvious clinical implications, too little attention is paid to IAP, IAH and ACS. Although there is much research interest in the subject, there are still too many unanswered questions, which cloud our understanding of the pathophysiology of this syndrome.

In the second part of this article, in the Autumn Issue of ICU Management, we will discuss the remaining compartment syndromes –Orbital (OCS), Intracranial (ICS), Thoracic (TCS), Cardiac (CCS), Limb or extremity (ECS), Hepatic (HCS), and Renal RCS as well as their interactions.

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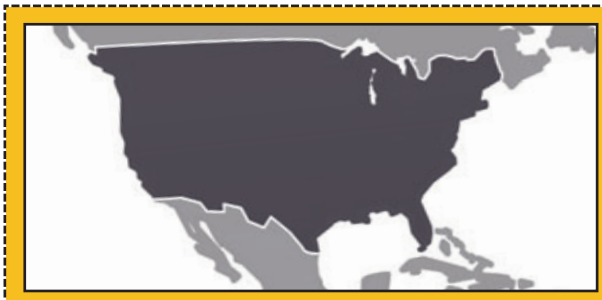
US HEALTHCARE OVERVIEW

Organisation of the Health System

The United States' health system is actually a cluster of health systems of diverse complexity. Federal, state, and local governments have defined, often in concert with one another, their roles in protecting the public's health. State public health departments are not under the jurisdiction of federal health agencies and administrations, and, in many states, city and county local public health departments are not under the jurisdiction of state public health departments. As a rule, direct healthcare services are provided by the private sector. Many of these governmental and nongovernmental services share public funds, technical advice, regulatory standards, and health research provided by federal, state, and local governments.



The United States of America: Facts and Figures

Total population:	302,841,000
Gross national income per capita (PPP international $):	44,070
Life expectancy at birth m/f (years):	75/80
Healthy life expectancy at birth m/f (years, 2003):	67/71
Probability of dying under five (per 1 000 live births):	8
Probability of dying between 15 and 60 years m/f (per 1 000 population):	137/80
Total expenditure on health per capita (Intl $, 2006):	6,714
Total expenditure on health as % of GDP (2006):	15.3

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

The federal government manages various programmes; oversees research; and provides technical advice and direction, training, funding, and other public health resources, mainly through the Department of Health and Human Services. The Department often works through state and local government programmes and with other partners. Responsibility for individual healthcare issues is much more decentralised. The government provides health insurance to highly vulnerable groups, such as some families in poverty, the disabled, and the elderly. Most persons, however, acquire private health insurance coverage through their employers or on their own. Direct healthcare services, including primary, secondary, and tertiary care, are provided primarily by thousands of private sector hospitals and clinics throughout the country. The federal government directly funds additional hospitals and clinics that care for military personnel and veterans and for American Indians and Alaskan Natives.

Healthcare Investment

In 2005, the U.S. Department of Health and Human Services spent more than 30 billion US dollars on research, demonstration, and evaluation, including investments for medical research, public health, and food and drug safety. The National Institutes of Health invests more than US$ 27 billion annually in medical research, 80% of which is awarded through almost 50,000 competitive grants to more than 212,000 researchers at more than 2,800 universities, medical schools, and other research institutions in every state and around the world. Another 10% of the Institutes' budget supports projects conducted in its own laboratories by nearly 6,000 scientists.

Within the Department of Health and Human Services, the Centers for Disease Control and Prevention (CDC) spends more than 650 million US dollars on research to meet health and safety challenges, including public health research on emerging infectious diseases, environmental threats, the aging population, and lifestyle choices. Another Department component, the Food and Drug Administration (FDA), conducts research and carries out regulatory activities to ensure the safety of food, drugs, devices, and cosmetics. FDA spends over 140 million US dollars on research.

Other major areas of research within the Department of Health and Human Services include healthcare quality, aging, and mental health services.

Human Resources

In 2004, there were more than 17 million jobs in the health sector or in health occupations outside the health sector, accounting for nearly 12% of the total U.S. workforce. Among these were approximately 2.4 million registered nurses, 1.45 million nursing aides, 1.3 million personal care or home health aides, 567,000 physicians, 230,000 pharmacists, and 150,000 dentists.

Noting that healthcare is the fastest growing employment sector in the country, the U.S. Bureau of Labour Statistics projected that between 2004 and 2014, the healthcare sector will grow by more than 27%, compared to a growth under 12% for all other employment sectors. Within healthcare, jobs in home healthcare and offices of health practitioners, particularly physician offices, are projected to grow

the fastest. The health occupations projected to add the most new jobs over the 10-year period are registered nurses (703,000 new jobs), home health aides (350,000 new jobs), and nursing aides (325,000 new jobs). More than 200,000 physicians and 100,000 new pharmacists will also be needed to fill new jobs as well as replace those who leave existing positions.

Most sources acknowledge a serious nursing shortage, which may become more severe as the population continues to age. Reimbursement issues, working conditions, and regulatory requirements are cited as contributing factors.

This information has been adapted from data obtained from the World Health Organisation (WHO), and its' regional office - the Pan American Health Organisation (PAHO): HEALTH IN THE AMERICAS, 2007. Volume II-COUNTRIES

IS THE US READY FOR OBAMA HEALTHCARE REFORM?

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It has been described as the beginning of a new era in the US; one of change with a push towards equality and balance among citizens. Critics of the new President and his proposed platform have even gone so far as to call it a "socialist agenda" (Daily Herald – Utah; November 1, 2008). Given this pretence, are we to expect the birth of universal healthcare on American soil within the new administration's first term in office? In the current economic climate, all clues should point to no, but the rhetoric that is coming from the White House and the new Health Secretary Kathleen Sebelius seems to be on message with the President's campaign platform – healthcare reform is a priority and it must start sooner rather than later.

The current healthcare system has been called a "system in crisis" by critics inside the country and dire from those outside (The Sunday Times –UK; March 29, 2009). One out of three Americans under 65 went without health insurance at some point during 2007 and 2008, according to a report recently released by the consumer advocacy group Families USA. An estimated 46 million Americans currently lack health insurance. For those who are covered, their employer-sponsored health insurance premiums have doubled in the last 9 years, a rate 6 times faster than cumulative wage increases. The average cost of family healthcare coverage more than doubled from 1999 to 2008, from $1,543 to $3,354, according to a report by the Institute on Medicine release.

"The cost of healthcare now causes a bankruptcy in America every 30 seconds. By the end of the year, it could cause 1.5 million Americans to lose their homes," *Obama said.*

The United States spent approximately $2.2 trillion on healthcare in 2007, or $7,421 per person – nearly twice the average of other developed nations. Americans spend more on healthcare than on housing or food. Obama made healthcare reform a central theme of his presidential campaign and promised not only to achieve universal healthcare in his first term, but also to cut the average family's healthcare costs by $2,500.

Since his inauguration at the end of January, the White House has noted the first key steps in the President Obama's healthcare reform:

- The Children's Health Insurance Reauthorisation Act (signed on February 4, 2009), provides quality healthcare to 11 million kids – 4 million who were previously uninsured.
- The American Recovery and Reinvestment Act (Signed into law on February 17): Helps 7 million unemployed Americans keep their COBRA coverage for an additional nine months with a 65 percent subsidy;
- The Recovery Act also invests $19 billion in computerised medical records that will help to reduce costs and improve quality while ensuring patients' privacy;
- The Recovery Act also provides: $1 billion for prevention and wellness to improve America's health and help to reduce healthcare costs; $1.1 billion for comparative effectiveness research that will give doctors objective information about which treatments work and which do not; and $500 million for health workforce to help train the next generation of doctors and nurses.

Among other things, Obama is seeking to set aside $634 billion in a healthcare reserve fund over the next 10 years to help move the country closer to the goal of universal coverage. He also would require senior citizens making more than $170,000 annually to pay a greater share of their prescription drug costs under Medicare.

Public support seems, for the most part to be with President Obama and his planned initiatives. In fact, upwards of seventy-two percent of Americans favour an increase in government influence over the healthcare system to help lower costs and expand coverage, according to a February CNN/Opinion Research Corp. poll.

A visit to the government's health website leaves little doubt that "Reform"- as the site is so titled, is in the cards. The information available highlights recent studies, which

show that certain populations are suffering under the current system and links to media articles on healthcare issues. Whether wide scale changes are indeed made or initiated in his first year in The White House still remains to be seen, but the "foundations" of change (a key phrase used extensively by President Obama in recent weeks) are certainly being set.

Adapted from information available on **www.HealthReform.gov**

"I suffer no illusions that this will be an easy process. It will be hard. But I also know that nearly a century after Teddy Roosevelt first called for reform, the cost of our healthcare has weighed down our economy and the conscience of our nation long enough. So let there be no doubt: healthcare reform cannot wait, it must not wait, and it will not wait another year."

- President Barack Obama, February 24, 2009

MEDICAL ERRORS: A NURSES ROLE

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Nurses have a genuine impact on patient safety. Studies have found a link between patient safety and RN staffing and an increase rate of error when the hospital nursing staff with a smaller proportion of RNs (Ramsey 2005). Other studies have shown that increasing the nurse to patient ratio by 1 can significantly impact the 30-day mortality in surgical patients (Aiken et al. 2002). Errors have also been linked to long work hours for nurses. In 2003 the Institute of Medicine (IOM) claimed that nurses' long working hours posed one of the most serious threats to patient safety, as fatigue slows reaction time, saps energy and diminishes attention to detail (IOM report "Keeping Patients Safe: Transforming the Work Environment for Nurses").

While the provision of care involves multidisciplinary teams, there are clear examples where error is clearly associated with nurses. Medication errors are one example where more often than not directly involve a nurse interacting with the patient. These errors have been studied by many researchers and generally are preventable errors such as inappropriate dosage, errors of omission, the wrong medication, or the wrong route of administration. Such errors are felt to stem from a confluence of factors including environmental distractions, miscommunications, drug labelling errors, and deviations from policy and procedures.

The relationship between quality nursing care and patient outcomes has been recognised. On the list of Hospital Acquired Conditions (HAC) are several that nursing has a direct impact on, including the development of pressure ulcers; hospital acquired injuries including fractures related to falls; and catheter associated urinary tract infections. Nurse staff-to-patient ratios and staffing mix does have a potential to impact these complications directly. In an American Nurses Association (ANA) study, five adverse outcome measures including hospital-acquired pneumonia, postoperative infections and decubiti (pressure ulcers), significantly decreased with higher levels of RN involvement in the care.

It is clear that there is a need to enhance patient safety through improving nursing care. There is a need for a firm and shared commitment on the part of the multidisciplinary team. Working side by side to care for the critically ill and injured, critical care staff understand that teamwork is necessary to prevent error and harm. To this end, the adoption of protocols and checklists has become a part of the work in many critical care units. Standardisation of care to reduce the reliance on human memory is an important characteristic of a well functioning critical care team. The use of checklists for insertion of a central line is a key example to the role of the nurse in preventing harm. The nurse gets to "call a time out" if the checklist is not followed by the physician inserting the line. The procedure will stop until all safety aspects are followed. This is a powerful way to protect the patients from a central line infection.

Daily rounding by the team and incorporation of nurses, therapists and the medical staff on the team with daily goal setting can facilitate patient care and help to move the patient out of the critical care unit in a more timely way. The team not only plans the care for the day but monitors through the bedside nurse that the goals have been achieved.

Conclusion

The environments in which nurses work are complex systems that are prone to error. The team approach to care is important to error prevention. Recognition of the interdependence of the team members is key to optimising care – everyone brings something to the care team. This comes from the lesson learned from aviation where team training is required to foster trust and mutual commitment.

As errors are underreported in healthcare, it is important to encourage efforts that promote the recognition and reporting of errors. Creating the environment that is blame free but with accountability for care is the most important step to having staff report error. This is where the learning environment can be so helpful. It will also help to support the development of systems to prevent error.

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Why is there such a weak correlation? First, hospital (and ICU care) represents only a part of healthcare costs. Within the ICU, there are different choices with regard to nurse-to-patient ratios, number and type of ancillary healthcare staff, and availability of expensive care options such as dialysis machines for each bed, that will vary even fixed costs. ICU costs also vary by the day in the ICU, with the first day usually the most expensive (Dasta et al. 2005). Intensity in the use of diagnostic procedures, such as echocardiography, will also impact the cost of care. A recent study in a single US ICU demonstrated substantial variation in per patient spending depending on the physician caring for the patient, with no differences in either adjusted ICU length of stay or mortality (Garland et al. 2006). Finally, willingness to withhold or withdraw care, and overall cultural attitudes towards intensity of care at the end of life may affect the costs (Barnato et al. 2004; Barnato et al. 2007).

The US as Outlier

It is clear from the data presented that the US represents an outlier compared with other developed countries when it comes to many aspects of the delivery of intensive care, from the ratio of ICU beds to hospital beds per capita, to overall healthcare spending per capita. The most obvious over-arching reason may be the large amount of private healthcare in the US compared with many other countries, which may drive care in different directions. For example, the different ratio of ICU to hospital beds may be due in part to the pressure from private health insurers to minimise hospital lengths of stay. This has led to a decrease in hospital beds, at the same time that there has been an increase in intensive care beds (Halpern et al. 2006). During this same time period there has been a trend towards high reliance on the use of other types of facilities, such as skilled nursing facilities after hospital discharge that may, in effect, substitute for acute care hospital beds (Barnato et al. 2004; Sirio et al. 1999). Such differences can profoundly affect both the patterns of care and perceived mortality for patients (Kahn et al. 2007).

Conclusions

Intensive care resources vary greatly across countries. We are only just beginning to understand the relationships between spending, resources, delivery of care and outcomes in critical care medicine. There are clear patterns in care that are truly international, and large differences that make the delivery of critical care unique in each country. We must continue to look across these artificial boundaries to identify the systems and practices that will allow us to maximise high quality care while minimising costs.

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29TH INTERNATIONAL SYMPOSIUM ON INTENSIVE CARE AND EMERGENCY MEDICINE (ISICEM)

ISICEM 2009 welcomed more than 5000 participants from over 78 countries around the world to a buffet of controversial topics and debate. Here is just a taste of some of the topics covered at this years ground-breaking meeting:

Tight Glucose Control: Yes or No?
The debate about tight glucose control continues. Hyperglycaemia is associated with increased mortality but does achieving normoglycemia influence outcomes? In the opening session of this ISICEM, Dr. Finfer presented results from the much-awaited NICE-SUGAR study, showing an increased 90-day mortality in patients managed according to a tight glucose control protocol. Later, he further discussed the results of this trial and speculated on some of the reasons for the differences among the different studies, and how to incorporate these results into the current body of evidence. Dr. Van den Berghe presented findings from a recent single-centre randomised controlled study of tight glucose control in the paediatric population which included 700 children and infants. There were considerably more episodes of hypoglycaemia in the tight control group but the primary endpoint of ICU length of stay was reduced, as were secondary endpoints of organ dysfunction and mortality. Drs. Jean-Charles Preiser and Duncan Young presented data on the harmful effects of glucose variability and Dr. Taylor Thompson highlighted the important place computerised algorithms could have in the protocolised management of blood glucose levels.

Massive Blood Loss: Does rFVIIa Help?
Trauma is frequently associated with massive bleeding and one third of trauma deaths are due to infractory haemorrhage. Dr. Bertil Bouillon presented the results of a recent prospective, randomised, double-blinded, multi-centre, placebo-controlled trial of rFVIIa (the CONTROL study) in patients with active haemorrhage due to trauma, who had already received 4-8 units of RBCs. The trial was stopped for likely futility at interim analysis after inclusion of 573 patients and 30- and 90-day mortality and morbidity rates were indeed similar in treatment and placebo groups. However, rFVIIa-treated patients did have significantly lower transfusion requirements than placebo-treated patients both after blunt trauma and penetrating trauma. The placebo mortality rate was lower than expected (11% for blunt trauma and 13% for penetrating trauma) and Dr. Bouillon suggested that the lack of a beneficial effect on survival or multiple organ failure outcomes may have been related to this fact and that further studies are needed to better determine which patients could best benefit from the blood-sparing properties of this agent.

Coagulation and Inflammation in Sepsis: Proposed Therapies

Realisation of the link between coagulation and inflammation led to the development of activated protein C, a drug that has been shown to reduce mortality rates in patients with severe sepsis and septic shock and is licensed for use in such patients. But activated protein C is expensive and the original study design and results have been criticised. After several talks discussing the links between coagulation and inflammation, Dr. Laurent Mosnier presented some insights into the possible mode of action of activated protein C, other than its known anti-coagulant properties. Other speakers then focussed on the ongoing debate regarding the use of activated protein C and presented the rationale and design of two ongoing trials. Drs. Steven Opal, Pierre-François Laterre and Richard Wunderink then presented the methodology and somewhat disappointing results from a study of tissue factor pathway inhibitor in 2138 patients with severe community-acquired pneumonia, showing that it had no effect on outcomes in these patients. Finally, the present status of antithrombin in patients with sepsis was discussed.

IV fluids: What's your Favourite?
No one would disagree that intravenous fluids are an essential part of resuscitation in the shocked ICU patient, whatever the cause. However, there is considerable disagreement about which fluid and how much fluid to use. Dr. Peter Kruger opened with a concise discussion of the basics of fluid distribution and particularly how these may differ in critically ill patients compared to the normal population. Dr. Lewis Kaplan then highlighted the potentially detrimental effects of saline resuscitation, including the risks associated with hyperchloremic acidosis. Different speakers then presented the potential benefits of and indications for hypertonic solutions, albumin, and gelatins. Dr. Martin Westphal addressed the idea that hydroxyethyl starch solutions are not nephrotoxic, while Dr. Gernot Marx argued that they could damage renal function. More modern hydroxyethyl starch solutions may have a better profile.

Be sure to join us for the 30th Anniversary of the International Symposium on Intensive Care and Emergency Medicine from March 9 to 12, 2010. This meeting will move back to the centre of Brussels, (Square – Brussels Meeting Centre) and promises another outstanding scientific programme in addition to many other anniversary "celebratory" surprises!

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THE 22ND ANNUAL CONGRESS OF THE EUROPEAN SOCIETY OF INTENSIVE CARE MEDICINE

OCTOBER 11-14; VIENNA, AUSTRIA

As one of the biggest and most successful annual critical care meetings in the world, this ESICM will surely once again not disappoint its' participants. Held over three days, the congress will feature ten parallel sessions with over 800 lectures, presentations, debates, round table discussions, tutorials and interactive educational sessions. A faculty of more than 220 internationally recognised experts from all around the world has been invited to lecture and animate a scientific programme that makes the congress an event that should not be missed.

Presentation of cutting-edge original research is one of the priorities of this congress and we are pleased that over 1350 abstracts have been submitted to the meeting. Many of these will be presented in either oral or poster format to congress registrants. This year, we are pleased to announce novel features that will enable each congress attendee to fully enjoy this exciting scientific programme. With the introduction of our electronic posters, poster corners or replay theatres, congress participants will have unprecedented opportunities to optimise their selection of thematic sessions or debates of new data in a user-friendly and interactive fashion.

More than ever, this congress aims to update clinicians, nursing staff, allied health professional and industry partners on the most recent and relevant advances that pertain to critical care and emergency medicine. Before the official opening of the congress, we will propose a programme of courses to update participants on a wide variety of relevant subjects. The Congress Committee has worked closely with the Division of Professional Development to design a refresher course that will suit anyone thinking of taking the European Diploma in Intensive Care or other parties wanting to refresh their knowledge on a broad number of topics. We will also be hosting postgraduate courses on sepsis, acute kidney failure and renal replacement therapy, acute respiratory failure and mechanical ventilation, in addition to echocardiography and communication skills.

As we not only focus on patient management decisions but also on organisational and management topics that are important in intensive care, we will also host prior to the start of the congress two important events that are expected to shape the future of our discipline. First, the ESICM has taken the initiative to invite world-reknown experts to represent most of the international scientific societies in a « Roundtable on Echocardiography and Ultrasound for the ICU Physician ». The aims of this closed meeting are to define the ideal curriculum and process to train and certify intensivists that express the urgent need to acquire new competencies that prove so important in today's practice. Last but not least, as patient's rights and patient safety are becoming an increasing concern of EU institutions, the ESICM has invited leaders of national and international scientific societies to participate in a Roundtable on Patient Safety in the ICU together with EU and WHO officials, political leaders, as well as industrial partners. This conference is expected to result in the signature of an important declaration in which all stakeholders pledge to coordinate efforts to improve patient safety at every level in intensive care medicine. Reports from these two important events will undoubtedly figure among the highlights of an exciting Opening Ceremony that will bring its own mixture of science, information and surprises.

Situated on the banks of the Danube, Vienna is a metropolis with unique charm, vibrancy and flair. Also described as Europe's cultural capital, it has all the inspiration that you could wish for in order to discover this wonderful part of Europe. Sightseeing opportunities are to be found in abundance, and Vienna is a dream city for anyone with a romantic streak or an interest in history, culture or music. Vienna has always produced and nurtured outstanding artists. Home to Mozart, Beethoven and Schubert, the city has been synonymous with music and art for centuries, and this outstanding musical heritage has been preserved right to the present day. The collecting passion of art-loving rulers and monarchs has led Vienna to host one of the world's largest and most distinguished art collection. Wandering along narrow, medieval alleyways or across imperial squares, or visiting one of Vienna's famous coffee houses or traditional wine taverns will prepare your mind for a unique learning experience during the 22nd Annual Congress of the ESICM. We look forward to you attending our congress in Vienna where we will offer both an enjoyable and exciting scientific programme together with an entertaining social and cultural spectacle.

EUROPEAN SOCIETY OF INTENSIVE CARE MEDICINE

22nd annual congress

European Society of Intensive Care Medicine

Vienna, Austria
11-14 October 2009

ESICM VIENNA 2009

For physicians, nurses and other allied healthcare professionals

For more information, contact
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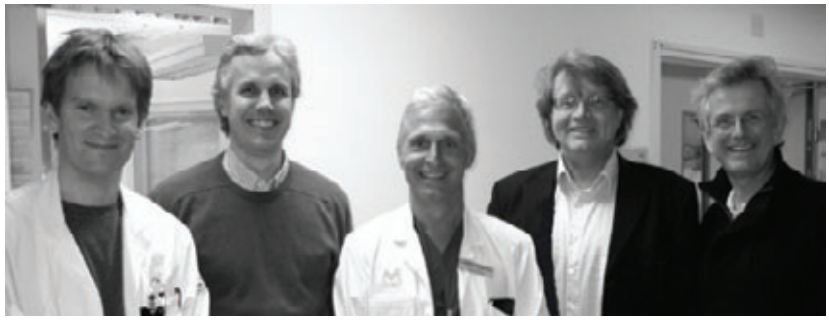
THERAPEUTIC HYPOTHERMIA TO PROTECT THE BRAIN AND THE HEART



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< **PHOTO:** Organising Committee – Tobias Cronberg, David Erlinge, Hans Friberg, Bertil Romner, and Tadeusz Wieloch.

The clinical use of therapeutic hypothermia and temperature management to prevent or reduce neurological injury is gaining interest and is increasingly used throughout the world. In the experimental setting, the protective effect of hypothermia after tissue injury seems to be applicable to many different tissues. In the clinical setting, however, it has been difficult to prove a beneficial effect of therapeutic hypothermia in other organs than the brain. There is an ongoing NIH-sponsored study, investigating the protective effect of therapeutic hypothermia for myocardial infarction and yet another study for myocardial infarction complicated with shock (www.clinicaltrials.gov). Other hot topics are the beneficial effect of hypothermia on cardiac function and whether hypothermia during cardiopulmonary resuscitation actually improves the rate of return of spontaneous circulation (ROSC) as stipulated by some; this is currently investigated in clinical trials.

The use of therapeutic hypothermia after cardiac arrest is considered standard care in many countries and the implementation rate is especially high and close to 100% in the Nordic countries and in the Netherlands. In large clinical centres, such as Pittsburgh (PA, USA), implementation rate has increased from a few percent in 2004 to over 80% of eligible patients in 2009 (P. Kochanek, personal communication).

Hypoxic ischaemic encephalopathy (HIE) in neonates is the other indication where randomised trials have shown solid evidence that therapeutic hypothermia is protective. Furthermore, there are ongoing and planned clinical trials that address the use of therapeutic hypothermia in traumatic brain injury (TBI), in spite of earlier equivocal reports. Regarding treatment of stroke with therapeutic hypothermia, randomised trials will reveal whether this treatment is effective in clinical practice. All these topics and more will be addressed at The 3rd International Hypothermia Symposium, to be held in Lund, Sweden from September 2-5, 2009.

The faculty consists of more than 40 renowned clinicians and researchers, covering all areas of molecular and experimental hypothermia research and clinical trials for hypothermic protection in the heart and the brain. The conference participants will be provided with the most recent data from the world's leading experts in the field of therapeutic hypothermia. Mechanisms of hypothermic tissue protection will be discussed and current concepts will be challenged. The results from clinical trials will be presented. New technology and novel cooling methods will be discussed. There will be ample time for poster presentations and discussions. A pre-conference workshop (Sept 1) will address the increasingly difficult topic of how to prognosticate after cardiac arrest.

The topics of the conference are:

- The Physiology of Hypothermia: How does hypothermia affect body homeostasis?
- Molecular Mechanisms of Hypothermic Tissue Protection.
- Cardiac Ischaemia and Resuscitation: Mechanical compressions and hypothermia during CPR and the effect of hypothermia on post cardiac arrest myocardial function.
- Cardiac Arrest: How and when should we cool, results from a RCT. A report from the 2000-patient database "The International Cardiac Arrest Registry" (INTCAR).
- Hypoxic Ischaemic Encephalopathy (HIE) in Neonates: A Clinical Update. Xenon-induced hypothermia in long term surviving newborn models.
- Prognostication after Cardiac Arrest: Preliminary results from the PROPAC II study. Continuos aEEG and multimodal strategies for prediction of outcome.
- Traumatic Brain and Spinal Cord Injury: Recent Clinical Trials in TBI. Results from experimental studies and planned clinical trials in spinal cord injury.
- Stroke and Neurointensive Care: The ICTuS-L trial. The EuroCools trial.
- New Devices and Chemical Hypothermia.

Visit our website **www.hypo2009.com** for the latest programme and join us in Lund, Sweden, in September! Deadline for abstract submission is June 10.

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AGENDA

AUGUST/SEPTEMBER 2009

28-01 10th Congress of the World Federation of Societies of Intensive and Critical Care Medicine and 63° Italian National Congress of SIAARTI
Florence, Italy
www.wfsiccm-florence2009.it

2-5 3rd International Hypothermia Symposium
Lund, Sweden
http://hypo2009.com

9-12 Weimar Sepsis Update 2009: Sepsis Goes Public
Weimar, Germany
www.sepsis-2009.de

OCTOBER 2009

11-14 22nd Annual Congress European Society of Intensive Care Medicine
Vienna, Austria
http://www.esicm.org

29-30 IT @ Networking Awards 2009
Brussels, Belgium
www.hitm.eu

NOVEMBER 2009

11-13 The Critical Care Canada Forum 2009
Toronto, Canada
http://www.criticalcarecanda.com

17-19 Echocardiography Course
Brussels, Belgium
www.intensive.org

DECEMBER 2009

1-3 15th Postgraduate Refresher Course
Brussels, Belgium
www.intensive.org

13-16 Update on Haemodynamic Monitoring
Rome, Italy
www.intensive.org

FEBRUARY 2010

5-6 15th International Symposium on Infections in the Critically Ill Patient
Barcelona, Spain
http://www.infections-online.com

MARCH 2010

9-12 30th ISICEM
Brussels, Belgium (Back to Brussels Congress Center: THE SQUARE)
www.intensive.org

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Also plan to attend the Post-Congress event in Key West, Florida, USA, for more vital information to help you take your practice of critical care to the next level.

Registration for the 39th Critical Care Congress and the Post-Congress session will open in June 2009. Please watch www.sccm.org for further details.

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More information on the IT @ Networking Awards 2009 on page 8 and 9.