ICU MANAGEMENT

THE OFFICIAL MANAGEMENT AND PRACTICE JOURNAL

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DISASTER: ARE YOU PREPARED?

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- EARLY MOBILISATION OF CRITICALLY ILL PATIENTS: SERIES - PART ONE
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EDITORIAL

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DISASTER: ARE YOU PREPARED?

DISASTER: A heading that covers a myriad of problems, reactions, plans that have failed to come to fruition, sometimes natural, uncontrollable- other times purposeful and deliberate. Whether it be a natural event- hurricane, earthquake, flood or wild fire; an accident- plane crash, bridge collapse, ferry capsizing; or an intentional act- bomb explosion, arson, mass shooting, biological warfare, the result and the manner of response should and must remain the same. Responders must act quickly, in an organised and well-planned fashion in an attempt to utilise resources and ultimately save the lives of as many as possible in what may well become a mass casualty situation.

ARE YOU PREPARED? Even carefully laid plans made by emergency departments and intensive care units or those based on national or international guidelines can sometimes fail to suffice in the heart of a mass casualty event. As recent events have shown, governments and federal agencies are not always in control of the actual implementation of these plans, and it often falls to those in the front-lines: on the scene, in the ER / trauma bay and ICU. In this issue of ICU Management, we attempt to delve into issues of planning at a hospital level and touch on a number of techniques used in emergency rooms, trauma centres and intensive care units around the world.

In this issue, paramedics Mike Clumpner and Jim Mobley discuss front-line planning for a range of disasters and remind us of recent events and lessons learned. Prof. Weiss brings his experiences from a level one trauma centre in Israel to an article on the importance of process control in mass casualty events. Professors Amir Khorram-Manesh and Martin Wahl from Sweden discuss disaster preparedness given the current ongoing challenges (economic and resource-based) in our hospitals, and management of a pandemic in our ICUs, respectively. In the management section, Prof. Örtenwall pushes further on the topic, by delving into the value of surge capacity in a cost-effective healthcare system.

Within the Matrix, you will find a number of enlightening articles - from the conclusion of Dr. Malbrain's

article on the polycompartment syndrome to Mary Kay Bader's detailed description of the positive results of utilising nurse-directed protocols in the ICU. We are also pleased to bring you the first in a three-part series on early mobilisation of critically ill patients. In this article, Radha Korupolu and her team from Johns Hopkins will discuss patient screening and safety issues.

We feature Mexico in our Country Focus this issue - a somewhat timely choice given the cover story of this issue and the country's recent management of the outbreak of the H1N1 virus. In addition to the usual overview of healthcare and intensive care in his country, Prof. Vazquez de Anda has kindly agreed to share his first hand experiences with the influenza epidemic in his country.

It has been oft said "To fail to plan is to plan to fail", and undoubtedly in these uncertain times of both global economic strife and political unease, we in the healthcare realm must assuredly make plans for events which are in most cases unpredictable and unexpected.

Jean-Louis Vincent

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Posters: Deadline for abstract submission: December 1, 2009

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WORLD

Hospital Infections In Australia Cost $1 Billion In Lost Bed Days

Infections caught in hospital are costing the Australian healthcare system more than 850,000 lost bed days, according to a new study by Queensland University of Technology.

Associate Professor Nick Graves, from QUT's Institute of Health and Biomedical Innovation, said there were 175,153 cases where patients had acquired an infection during their hospital stay.

"If rates were reduced by just one per cent, then 150,158 bed days would be released for alternative uses, allowing an estimated 38,500 additional admissions annually," he said.

The results, which have been published in the Australian journal Healthcare Infection, calculate the economic consequences of healthcare-acquired-infections arising among admissions to Australian acute care hospitals.

"Healthcare-acquired infection rates are about five per cent of all admissions at the moment and with bed days valued at 1005 AUD each, the total economic burden is close to 1 billion AUD per annum," he said. Professor Graves said the bulk of the costs were faced by the most populous states of New South Wales, Queensland and Victoria.

He said a national programme was being undertaken to encourage healthcare workers to wash their hands before and after touching every patient, which had the potential of being effective at reducing infection and cost-effective.

Queensland University of Technology (2009, September 2). Hospital Infections In Australia Cost $1 Billion In Lost Bed Days. ScienceDaily.

WORLD

New WHO Data Underscores Global Threat Of World's Leading Child Killer: Pneumonia

New World Health Organisation data published in the Lancet will shed new light on two leading causes of pneumonia, the world's leading killer of children under age 5, both globally and within specific countries. The results, which are the first ever available at the country level, are expected to serve as a clarion call to developing country governments to invest in pneumonia prevention programmes.

According to the studies, Streptococcus pneumoniae and Haemophilus influenzae type b [Hib] infections take the lives of an estimated 1.2 million children under age 5 each year. Safe and effective vaccines exist to provide protection against both diseases. However, use of Hib vaccine has only recently expanded to low-income countries and pneumococcal vaccine is not yet included in national immunisation programmes in the developing world, where children bear the highest risk for pneumonia and where most pneumonia-related child deaths occur.

For more information and country-specific estimates, visit **www.who.int/immunization_monitoring/burden/en/**.

Adapted from materials provided by GAVI's PneumoADIP, via EurekAlert!, a service of AAAS. **www.sciencedaily.com**

EUROPE

Call for Proposals for Marie Curie Initial Training Networks Launched

The European Commission's Directorate-General for Research is calling for proposals for Marie Curie Initial Training Networks (ITNs). In support of training and career development for researchers, the action addresses joint research training networks in the form of either multi- or mono-partner ITNs. Multi-partner ITNs require at least three participants from three different Member States or Associated Countries. Mono-partner ITNs, on the other hand, are composed of just one single participant in a Member State or Associated Country and a network of associated partners. The indicative budget of this call for proposals amounts to EUR 243.79 million. The deadline for submitting proposal is 22 December 2009.

Full details of the call are available at: **www.cordis.europa.eu/fp7/calls/**

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

2 FDA 510(k) clearance.

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HOSPITAL DISASTER RESPONSE: ARE YOU **REALLY** PREPARED?

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Is your hospital prepared for the next disaster? This article is designed to generate discussion into the adequacy of your hospital's current emergency response plan. Hours upon hours of work go into creating a hospital's emergency response plan that is designed to respond to a myriad of disasters. As with any large-scale plan, it may appear flawless on paper, but may fall well short during actual performance. To paraphrase a famous quote, every battle plan works perfectly until first engagement. This article is designed to review some of the basics of hospital disaster plans, and offer topics for hospital administrative personnel to discuss with their staff.

In the United States, there has been a large emphasis placed on disaster response training since 2001. Following September 11th 2001, hospitals everywhere reviewed their disaster response plans to include scenarios that seemed so unthinkable that they once would only be thought of as a plot in a Hollywood movie. Disaster plans must now address situations such as state-sponsored terrorism, weapons of mass destruction including chemical, biological radiological, nuclear and explosive agents, and cyber terrorism. In 2005, Hurricane Katrina struck the United States Gulf Coast and severely tested hospital disaster plans. Katrina proved that many hospitals could in fact handle a large-scale disaster, but only for an extremely short period of time. Most hospital disaster plans assumed that help would arrive within 12-24 hours following the incident. Katrina showed that help could be days, if not weeks away.

Disasters are not just limited to the United States. The reported frequency of mass casualty disaster incidents has increased significantly over the past 50 years. In the last ten years, over 2 billion people worldwide have been affected by disasters (Campbell 2005).

Since 2002, many hospitals have made dramatic strides towards increasing their ability to respond to disasters. However, a recent report from the Center of Biosecurity states "The nation's healthcare system still remains largely unprepared to respond to large-scale catastrophic emergencies" (Toner et al. 2009).

A research study conducted by the United States Department of Health and Human Services Agency for Healthcare Research and Quality assessed hospital training and mock responses to mass casualty incidents. Their research found several key points that were common to most all hospitals:

- Internal and external communications are the key to effective disaster response
- There must be a well-defined incident command center to reduce confusion
- Conference calls are an inefficient way to manage disaster response
- An accurate and frequently updated list of phone numbers for key personnel is essential

(Hsu et al. 2004)

All Hazards Planning

An all hazards plan is an integrated planning approach to any realistic threat to an organisation including natural disasters, terrorist attacks, and any other incidents that could threaten the operational capacity of a hospital. When an all hazards plan is produced, it needs to address the following:

- Preparedness
  - Development of plan and procedures
  - Increase response capabilities
- Incident mitigation and response
  - Sustaining critical mission operations
  - Protection of personnel

Pandemic Could Overwhelm Critical Care Beds In England, Especially Children's Units

NEWS

Experts in intensive care and anaesthesia have predicted that the current swine flu pandemic could overwhelm critical care beds and ventilators in England, with hospitals on the South East Coast, and in the South West, East of England and East Midlands, being worst hit.

The research suggests that demand for critical care beds could outstrip supply by up to 130 per cent, with up to 20 per cent excess demand for ventilators in some regions.

"Any predictions need to be based on the most accurate information available at the time and we recognise that we are in the early stages of the pandemic" says Dr. Ari Ercole, a member of the research group led by Professor David Menon from the University of Cambridge.

However, based on figures provided by the ten regional health authorities and using the FLUSURGE model developed by the Centres for Disease Control and Prevention in the USA, we can see that hospitals would face massive excess demand even if the pandemic lasted an optimistic twelve weeks.

"One of the main problems is that these beds already run at high occupancy rates and even delaying elective surgery to create additional ventilated beds would not meet demand", explains Dr. Ercole.

Dr. Jonathan Handy, a consultant intensivist and anaesthetist from the Chelsea and Westminster Hospital, London, says that the results of the study are alarming. "The best case estimates predict that capacity could be significantly increased from baseline, while the worst case could exceed current capacity by an order of magnitude" he says in an accompanying editorial.

"All acute trusts should have already developed local flu plans to include a 100% increase in critical care capacity. However, some may be more comprehensive (and optimistic) than others."

He adds that the predicted demand levels suggest that immediate action is needed to ensure that practical measures are in place, from stockpiling supplies to looking at how medical students could play an active role in patient care.

Dr. Handy argues that if the worst-case scenario fails to emerge the work carried out to expand critical care capacity will never be wasted, in a world where terrorism and environmental and man-made disasters are omnipresent.

Journal references:

Ercole A, Taylor B L, Rhodes A and Menon D K. Modelling the impact of an influenza A/H1N1 pandemic on critical care demand from early pathogenicity data: the case for sentinel reporting. Anaesthesia, July 2009

Handy et al. Critical care bed capacity during the flu pandemic: implications for anaesthetic and critical care departments. Anaesthesia, July 2009; DOI: http://dx.doi.org/10.1111/j.1365-2044.2009.06069.x"10.1111/j.1365-2044.2009.06069.x

- Recovery
  - Restoration of organisational functions

How up to date is your all hazards plan? Does it address current threats? One of the most devastating threats will arrive with very little fanfare. A cyber attack on a critical government infrastructure can absolutely cripple a community. We have become so dependent on computers that they affect almost every facet of our lives. How dependent on computers is your facility? What kind of impact would there be if you could not use a computer for an hour, a day, or a week? Does your disaster plan prepare for cyber attacks on your facility? This is a very realistic threat with a high level of operational impact that must be considered.

Communication

The Achilles' heel of disaster management has historically been communication. Hospitals need to have multiple redundancies built into their communication plan. When performing a basic critical infrastructure vulnerability analysis, communication is frequently one of the most critical vulnerabilities. Hospitals have to work in tandem with local communication providers to harden the communication infrastructure. Does your hospital all hazards plan take into account a complete and total communications failure? Imagine the potential for destruction if a terrorist organisation could eliminate all phone, Internet and intranet communication at your facility! Most hospitals have gone to a total paperless system for charting, ordering procedures, and countless other treatment modalities. Loss of communication in any infrastructure can prove to be crippling. Although most every hospital would be severely hampered by losing communication, would your facility be able to compensate? One of the greatest hurdles faced in the first 24 – 48 hours following Hurricane Katrina was the inability to communicate to any outside agency. Every hospital in essence became an island for several days. Is your hospital prepared to be completely self-sufficient for at least 48 – 72 hours? Do you maintain a stockpile of the paper forms that your hospital used to use prior to going paperless? These forms may prove absolutely invaluable if there was a total loss of computer communication.

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PROCESS CONTROL IN MULTIPLE CASUALTY EVENTS

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There are few places which could be considered immune to man-made or natural disasters, culminating in a Multiple/mass Casualty Event (MCE). Much has been written on the importance of preparedness for a MCE. However, a relatively neglected aspect in the MCE literature is that of in-hospital process control from patient admission to the trauma bay until their final admission to the ICU.

Background

A decade ago, Jerusalem was the site of recurrent MCEs related to the Israeli-Palestinian conflict. As the single level I trauma centre in greater Jerusalem, this gave us a rare opportunity to examine the effectiveness of our preparedness and process control in such events. We quickly realised the importance of process control and open communications. This was especially evident with communications between those running the emergency room / trauma bay and those responsible for the functioning of the operating rooms, imaging (specifically CT and angiography) and intensive care units. Clear communication protocols between these important areas are of key importance for the smooth processing of a multitude of severely injured patients and their successful outcomes.

Importance of Key Personnel

Our experience and subsequent analysis taught us the importance of having the most senior ICU manager present in the trauma bay/emergency room. Several reasons supported this decision.

The ICU representative can provide:

- **A direct and unbiased assessment of patient quantity and severity.** Of key importance is the direct impression on the magnitude of injury and problems faced by each patient. This is of key importance because much information may get lost in the chaotic phase of an MCE.
- **Important input in triage decisions on the placement of these patients in the ICU, intermediate unit or regular wards.** Some patients may present with only minor injuries, but their mechanism of injury and current complaint may signal only the tip of an iceberg of problems to follow within minutes, hours or days.

Importance of Information Process

The information gathered or supervised by the senior ICU manager in the trauma bay bears directly on the subsequent movement of not only the patient in question but the reorganisation of other patient's placement in the ICU.

In fact, this information impacts the discharge policy of currently admitted patients to other ICUs or regular wards. It is important to realise that some patients being first directed to the operating rooms may arrive at the ICU several hours later, providing an extended time window for patient discharge or re-organisation.

Key senior personnel can also assist in decision-making regarding necessary interventions and serve to direct patient load between different parts of the ICU or other ICU's (Cardiothoracic, Neurosurgical, Medical) based on the acuity and the level of required interventions and treatments. Equally distributing patients based on these criteria is of key importance for nursing to be able to adequately care for all patients.


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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 29 - 30 October 2009 during the European Summit at Square, Brussels' hottest new meeting centre ensuring international attention.

WHO

The event will be organised by the *European Association of Healthcare IT Managers* (HITM) and the *European Association of Hospital Managers* (EAHM), the largest interest representations of their kind in Europe.

The attendee roster will include radiologistzs, hospital CEOs, CIOs, CMIOs, hospital and healthcare IT managers, other physicians with an interest in IT, members from European and national institutions whose mandates cover healthcare IT and members from the pan-European 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 users, designers and architects, unsung heroes who have often invested their creative talents, and dedicated months and years of hard work – to create, build and implement something good, something better, all the way through to the very best. But many such efforts extend beyond job descriptions, 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

HITM and EAHM believe that peers will make the wisest decisions in respect to their own needs. As far as healthcare IT is concerned, the Associations consider it to be self-evident that senior healthcare professionals will know what is the best solution for them and the challenges they face.

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 novel voting electronic system will be used to enable attending CEOs, CMIOs, CIOs, hospital and healthcare IT managers as well as department heads to make their choices. Only they are eligible to vote.

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WHO SHOULD PARTICIPATE

Heads of ICU departments, ICU managers, cardiologists with an interest in healthcare IT, CEOs, hospital directors, CIOs, CMIOs, healthcare IT managers, professionals working in hospital and healthcare facilities, designers, users and vendors of imaginative, innovative healthcare IT solutions.

REGISTRATION FEE

- Full Members of HITM, EAHM, ESICM and attendees of ISICEM 2009	Euro 300,-
- Other CEOs, CMIOs, CIOs, hospital and healthcare IT Managers	Euro 400,-
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REGISTRATION PROCESS

For registration please visit **www.conftool.com/itawards2009/.** Please do not forget to include your membership or registration number to qualify for the special price of Euro 300,- (25 % discount).

For further information on the IT @ Networking Awards 2009 please visit our website ***www.icu-management.org****, contact our General Secretariat via email* ***awards@hitm.eu*** *or call* ***+32 / 2 / 286 8501****.*

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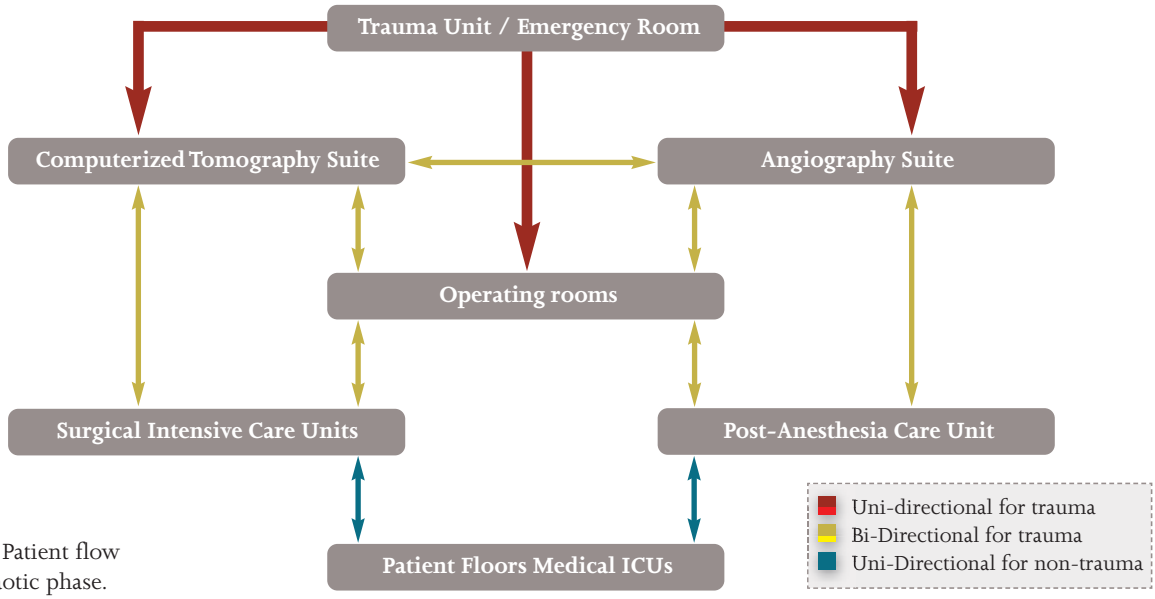

Figure 1. Patient flow in the chaotic phase.

Patient Flow

To analyse patient flow we used two terms in relationship to the patient admission stage:

- **The latent phase -** the time from the occurrence of an MCE to the admission of the first injured at the trauma bay/ER.
- **The chaotic phase -** the time from first injured admission to the final clearance of the trauma bay/ER following an MCE.

Patient flow in the hospital during the chaotic phase is of major importance. During the latent phase a quick decision, based on official sources (police, fire brigade, etc.) and the media, must be made with regards to the magnitude of the MCE. This will reflect on the policy for ER and ICU evacuation. However, as the chaotic phase starts, the flow of patients is uni-directional in restricted areas (Figure 1). Injured patients never return to the ER/trauma bay after imaging or any other procedure. It is of key importance not to clog the ER / trauma bay with patients especially when, in many cases, a second wave of transfers will arrive, soon after the first wave, from secondary ERs in the area. Hence, patient flow is directed from the ER/trauma bay to imaging and from there to the OR, ICU or ward (Figure 1).

Furthermore, it is of key importance to identify, prepare and staff a-priori an area for the management of those patients that require augmented care but do not meet criteria for ICU admission. Preferentially, this area should be controlled or co-directed by ICU specialists and be in close proximity to the ICU. A possible option is utilising the post-anaesthesia care unit (PACU), as the nursing staff is amply trained for the care of unstable critically ill patients.

Conclusions

In any MCE, there is a massive influx of trauma patients followed shortly thereafter by a second wave of patients. This influx of patients is accompanied by a plethora of information (both vital and insignificant), which requires efficient processing and prioritising. In our experiences in a level I trauma centre, we have encountered a number of these events and amassed a great deal of knowledge on best practices. Of core importance is proper process control, which is ideally managed by a senior ICU manager who can assess the priorities and smooth transfer of patients and assist when necessary. Continuous communication is also a crucial element within the departments and facilitates the efficient flow of patients from the ER / trauma bay through imaging, the OR and onto the ICU. The set-up and utilisation of an area for patients who need additional care outside of the ICU also assists in improving the uni-directional patient flow from the trauma bay. While MCEs can test the strengths of any hospitals' resources and organisational structure, the adherence to these simple process control guidelines can positively impact the outcome of the patients involved.

References

Aschkenasy-Steuer G, Shamir M, Rivkind A, Mosheiff R, Shushan Y, Rosenthal G, Mintz Y, Weissman C, Sprung CL, Weiss YG. The Israeli experience: conventional terrorism and critical care. J. "http://webspirs.ziur.co.il/webspirs/doLS.ws?ss=Crit-Care+in+SO" \t "wsr" - Crit Care 2005, 9(5): 490-499.

Shamir MY, Weiss YG, Willner D, Mintz Y, Sprung CL, Weissman C (2004). Multiple casualty terror events: the anaesthesiologist's perspective. Anaesth. Analg. 2004, 98:1746–1752.

Shamir MY, Rivkind A, Weissman C, Sprung CL, Weiss YG. Conventional terrorist bomb incidents and the intensive care unit. Curr Opin Crit Care, 2005, 11(6):580-584.

IMPACT OF HOSPITAL-RELATED DISTURBANCES ON DISASTER PREPAREDNESS

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

There is a need for adaptation and expansion of healthcare systems to mobilise its resources at the time of disasters. Therefore, every country should have or create its own regional, national, as well as, international plans to use all necessary resources to cope with qualitative and quantitative outcomes of a disaster. Such a plan should not only provide the theoretical background, but also physical facilities needed to combat a disaster. In this context the capacity and preparedness of prehospital services, emergency departments, intensive care units, radiological institutions and operation theatres are of special importance (Arnold 2002; Wenzel 2007).

In a recent publication we could show that hospital-related incidents might jeopardise the regional preparedness due to insufficient capacities within the emergency institutions (Khorram-Manesh et al. 2009). The lack of hospital beds and overcrowding of emergency departments were the major causes of such a shortcoming in this study. However, it also pointed out the shortage of hospital beds and respirators in intensive care units along with ambulance diversions as other important sources of failure. Even though the regional healthcare coverage in this study was well enough to take care of the publics' healthcare needs (around 150 primary healthcare centres and ten emergency hospitals), hospital-related incidents created such regional disturbances that resulted in a shortcoming of the ordinary healthcare system, questioning its ability to cope with an extraordinary event or disaster. Regarding intensive care units, the lack of capacity for adaptation, and expansion was obvious. Closure of an emergency department or lack of operation theatres at another hospital led to overloading of the nearest hospital, which in addition received even more patients at its emergency department. Bed shortage in intensive care units could either be due to high inflow of operated patients or high admission of critically ill patients in need of assisted ventilation. The higher rate of operated patients was directly related to higher number of planned operations and simultaneous increasing in amount of emergency cases. These numbers changed in 2008 to 35% and 65% for bed and respirators shortage, respectively. In such a situation a regional coordinating centre to assume command and control on a regional ("gold") level was inevitable (Khorram-Manesh et al. 2009).

The current economic crisis within most healthcare systems has resulted in local, regional and national plans to reduce economic deficits, mostly by increasing the healthcare systems effectiveness through reduction of hospital beds and staff numbers, minimising reserve materials, increasing inter-institutional cooperation and expansion of out-patients departments. Although these measures have proven to result in shorter length of hospital stay, higher number of out-patient treatments and temporary cost reductions, they also challenge the mode of operation at other emergency institutions by causing overcrowded emergency departments, and intensive care units, ambulance diversions, increased morbidity and mortality (Wenzel 2007; Epley et al. 2006; Lee et al. 2006; Fatovich et al 2003; Sun et al 2006).

Although these measures might be comprehended as logical steps taken to improve healthcare effectiveness and reduce costs, they also influence our disaster preparedness in a negative way. Hospitals surge capacity is influenced by three essential elements: staff; supplies/equipment; and structure (Guss et al. 1989; West et al. 1979). Structure refers to both locations for patients and the organisational infrastructure. ED (emergency department) overcrowding is associated with both space and staff shortage. Hospital beds occupancy of > 90% is correlated with a blocked access to the wards, defined as patients waiting in the ED for more than 8 hours when the decision has been made to admit them. For severely ill patients this consequently leads to initiation of extra measures e.g. multiple testing, interventions and administration of drugs during their prolonged stay in the ED (Kleine et al. 2007; Fatovitch et al. 2003; Sun et al. 2006; Khorram-Manesh et al. 2009). This even includes patients in need of beds in the in-

tensive care units. In such situations, the ED serves as a holding area for admitted patients, sometimes remaining for more than 24 hours, which may also result in establishing observation areas in the ED (Klein et al. 2007). Earlier reports show that the average waiting time for an inpatient acute or critical care bed in American EDs has nearly doubled (> 6 hr) in hospitals with consistently overcrowded EDs. Delays of > 6 hours in bringing ED patients in critical condition to intensive care units has also shown to increase hospital LOS (length of stay) and result in higher ICU and hospital mortality (Sun et al. 2006). The results, besides missed diagnoses, poor outcomes, prolonged pain and suffering, long waiting times, patient dissatisfaction, more ambulance diversions, lower physician and staff productivity and higher levels of frustration among medical staffs, are higher hospital costs and longer LOS (Wenzel 2007; Lee et al. 2006; Khorram-Manesh et al. 2009).

Disasters seldom occur, but if they do strike, a fast and effective response from healthcare services is expected. There are an increasing number of reports of incidents when emergency hospitals, for different reasons, cannot operate at their normal capacity. This is a serious matter of concern for patient safety as well as disaster response preparedness.

References

Arnold JL: Disaster medicine in the 21st Century: Future hazards, vulnerabilities, and risks. Prehosp Disast Med 2002, 17:3–11

Epley EE, Stewart RM, Love P, Jenkins D, Siegworth GM, Baskin TW, Flaherty S, Cocke R: A regional Medical operations center improves disaster response and inter-hospital trauma transfers. Am J Surg 2006, 192: 853-859

Fatovich DM, Hirsch RL: Entry overload, emergency department overcrowding, and ambulance bypass. Emerg Med J 2003, 20: 406-409

Guss DA, Meyer FT, Neuman TS, Baxt WG, Dunford JV Jr, Griffith LD, Guber SL: The impact of a regionalized trauma system on trauma care in San Diego County. Ann Emerg Med 1989, 18: 1141–5

Khorram-Manesh A, Hedelin A, Örtenwall P: Hospital-related incidents and its impact on disaster preparedness and prehospital organizations. Scand J Trauma Resusc Emerg Med 2009, 17: 26

Kleine KR, Nagel NE: Mass medical evacuation: Hurricane Katrina and nursing experiences at the New Orleans airport. Disaster Manag Response 2007, 5: 56-61

Lee VJ, Low E: Coordination and Resource Maximization during Disaster Relief Efforts. Prehosp Disast Med 2006, 21: 8-12

Sun BC, Mohanty SA, Weiss R, Tadeo R, Hasbrouck M, Koenig W, Meyer C, Asch S: Effects of Hospital Closure and Hospital Characteristics on Emergency Department Ambulance Diversion, Los Angeles County, 1988 to 2004. Ann Emerg Med 2006, 47: 309-316

Wenzel GW: Organizational aspects of disaster preparedness and response. JAVMA 2007, 230: 1634-1637

West JG, Trunkey DD, Lim RC: Systems of trauma care: a study of two counties. Arch Surg 1979, 114: 455– 460

Early Detection And Quick Response Are Key To Defense Against Anthrax Attack

NEWS

A large attack on a major metropolitan area with airborne anthrax could affect more than a million people, necessitating their treatment with powerful antibiotics. A new study finds that in order for a response to be effective, quick detection and treatment are essential, and any delay beyond three days would overwhelm hospitals with critically ill people.

"No matter how well-organised and prolonged a treatment programme is, it must be quickly implemented. In fact, our analysis shows that time-to-treatment is roughly twice as important as the duration of the distribution programme," says lead author Dr. Nathaniel Hupert, associate professor of public health and medicine at Weill Cornell Medical College.

"Crucial to rapidly implementing a treatment programme is early detection, including thorough use of advanced biosurveillance technologies and live, person-to-person communication," continues Dr. Hupert, who is also director of the new Preparedness Modeling Unit at the U.S. Centers for Disease Control and Prevention (CDC). "But most important of all are multilateral diplomatic efforts to prevent bioterrorist attacks from ever happening."

The study predicts that a campaign initiated two days after exposure would protect as many as 87 percent of exposed individuals from illness - a rate considered successful by the CDC. Each additional day needed to complete the campaign would result in an average of up to 2.9 percent more hospitalisations in the exposed population. And each extra day of delay to the start of the programme beyond two days would result in up to 6.5 percent more hospitalisations.

Anthrax attack scenarios typically involve the release of one kilogram of weaponised anthrax from a small airplane flying over a major city. The invisible powder could be inhaled by thousands or hundreds of thousands, who would start becoming sick anywhere from 24 hours to a week or more after the attack. With appropriate and timely administration of an antibiotic treatment programme, exposed individuals would be spared from developing inhalational anthrax infection.

Adapted from materials provided by **www.med.cornell.edu** New York- Presbyterian Hospital/Weill Cornell Medical Center/Weill Cornell Medical College. **www.sciencedaily.com**

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PANDEMIC IN THE ICU

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The new world, new technology and new means of transport not only make global cooperation easier, but also the distribution of new diseases. The new influenza A virus variant (H1N1)v, which has rapidly spread worldwide, offers new possibilities for cooperation and an unique opportunity to plan a mutual tactic against the pandemic.

A new influenza A virus variant (H1N1)v has spread rapidly globally since its first appearance in April 2009 (Swine influenza A, MMWR 2009). The World Health Organisation (WHO) raised the level of pandemic alert from phase five to phase 6/6 in June 2009, indicating that an influenza named "pandemic (H1N1) 2009" is under way (ProMed-mail 2009; statement WHO Director-General 2009). This is the first pandemic in 41 years and has spread more rapidly than before possibly due to international travel, which has eased the geographical spread of the new virus throughout the world (New influenza A, WHO weekly 2009; Khan et al 2009).

Today, the medical society and institutions are better prepared to tackle the impacts of a widespread pandemic than ever before owing to better knowledge about influenza epidemiology, diagnostic methods, surveillance systems, antiviral medications, antibiotics, improved influenza vaccine and vaccine production. Simultaneously, healthcare systems worldwide are struggling with higher costs and demands of becoming more cost-effective. Having a capacity for adaption and expansion is one important factor for national/regional preparedness, which in combination with planning must be crucial for the exceptional situation such as a pandemic. Without an ongoing influenza pandemic, hospital-related incidents could jeopardise such preparedness due to insufficient capacities within the emergency institutions (Khorram-Manesh et al 2009). Thus, there should be a concern how the situation will become when the pandemic strikes hard?

During a pandemic, medical care is one of the few areas of the society that definitely will experience an increased demand and work load. Such an increase in demand cannot merely be met through planning only; prioritisation will soon become the lead theme due to scarcity in many areas. The planning in the ICU setting for an extraordinary incidence, like a pandemic has in many senses the same ingredients as in the rest of the society, but also several peculiarities, which need special consideration, most of all, again: scarcity especially of:

- ICU-beds and at least in the beginning of the epidemic, beds with possibilities for isolation or later on in the pandemic, for cohort care;
- Trained staff;
- Equipment, especially for assisted ventilation;
- Pharmaceutical agents (Antibiotics, antiviral, influenza-vaccine), and
- All the above but mainly in a paediatric setting depending on how the pandemic evolves.

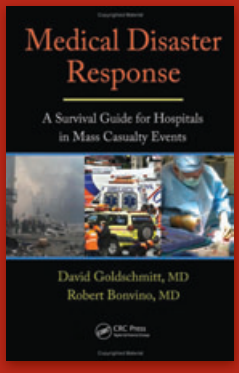
Bed shortage at intensive care units will most likely be due to high admission of critically ill patients in need of assisted ventilation. In such a situation a regional coordinating centre to assume command and control on a regional ("gold") level can be inevitable (Cowan et al. 2005, Khorram-Manesh et al. 2009). Other possible ways of increasing numbers of beds or alternative technical set-ups needs to be considered already in the pre-pandemic period. Scarcity of skilled staff, trained not only for ICU activities, but also trained and comfortable with hygienic procedures including practical skills and experience from working in personal or individual protective equipment (PPE/IPE), can be avoided through well in-advance run recruiting and training procedures. Such training has most probably to be extended far beyond the staff of the individual ICU.

Scarcity in so many aspects will eventually, whether we want it or not, lead to increased needs for making priorities among patients, possibly on grounds that we might not be used to or comfortable with. Pre-planning is thus crucial also in this con-

Medical Disaster Response: A Survival Guide for Hospitals in Mass Casualty Events (Hardcover)

BOOKS **in review**

David Goldschmitt and Robert Bonvino



While the job of a clinician in a disaster scenario is to save lives without regard for the cause or rationale for the injury, medical and emergency professionals who understand the diverse aspects of a disaster are better equipped to respond effectively. Giving emergency personnel the tools they need to perform in catastrophic situations, Medical Disaster Response: A Survival Guide for Hospitals in Mass Casualty Events addresses the critical planning and response issues surrounding a mass casualty disaster before, during, and after the event.

The book presents the fundamental components of a comprehensive medical disaster management plan that provides readers with a framework for developing individual policies to suit their particular institution. It examines natural, man-made, and terrorist disasters, and offers insight into the different strategies required for distinct scenarios, as well as the need to be prepared for the cascade effect of secondary events resulting from the original disaster.

This volume provides a powerful and unique case example through a chronology of the events of September 11th, offering a firsthand account and insight into the quintessential test case for disaster response effectiveness. It also profiles other notorious events—including Hurricane Katrina, the Madrid bombings, the SARS outbreak in 2004, and the sarin gas attack in Tokyo in 2005—as seen through the eyes of the expert contributors who witnessed and responded to these tragedies.

The book presents the lessons learned from these events by the contributing authors who acted on the front lines of the medical disaster response. It is a valuable reference manual for emergency planning, response, and healthcare professionals to confront future disasters and help prevent and mitigate destruction and unnecessary casualties.

Dr. David Goldschmitt became the director of emergency medicine at NYU Downtown Hospital in 1996. One of his first duties was to reorganise the department for disaster preparedness. At the time of 9/11, the hospital, which received 1200 casualties in three hours, had a fully operational incident command structure. Since September 11, Dr. Goldschmitt has lectured in the U.S., Canada, and Israel on disaster-management strategies.

text and must include psycho-social considerations. Risk stratification of patients with influenza related pneumonia and finding appropriate and well-communicated methods for it, is only one aspect that needs to be considered in this planning context. Risk stratification methods also need to be transferred into simple, agreed and well-communicated treatment protocols. Capabilities must of course include more than a list of staff and equipment available, but also a clear comprehension of how fast the resources can be achieved and for how long they can be sustained. Communicating all the reasons for scarcity, the necessary actions taken and priorities made, is all together probably the most intricate issue.

The medical society has never before in history been able to plan so many aspects of the upcoming and unavoidable influenza pandemic. This time we have a unique opportunity to avoid disappointing those expectations we have for our hospitals and departments in this aspect. The ultimate hope is that the old (yet valid) expression from disaster medicine "To fail to plan is to plan to fail" will not be realised.

References

Cowan R, Trzeciak S: Clinical review: Emergency department overcrowding and the potential impact on the critically ill. Critical care 2005, 9: 291-5

Influenza A (HlNl) – worldwide (86): official nomenclature. International Society for Infectious Diseases, Pro MEDmail, Archive number 20090706.2430 (Available at www.promedmail.org

Khan K, Arino J, Hu W, Raposo P, Sears J, Calderon F, Heidebrecht C, Macdonald M, Liauw J, Chan A, Gardam M. Spread of a Novel Influenza A (HlNl) Virus via Global Airline Transportation. N Engl J Med Jun 2009; [Epub ahead of print]

Khorram-Manesh A, Hedelin A, Ortenwall P. Hospital-related incidents; causes and its impact on disaster preparedness and prehospital organisations. Scand J Trauma Resusc Emerg Med. 2009; 17: 26.

New influenza A (HlNl) virus: global epidemiological situation, Jun 2009. WHO Weekly Epidemiological Record 19 June 2009, No. 25, 2009, 84, 249-260 [edited]

Statement to the press by WHO Director-General Dr Margaret Chan, 11 June 2009 (Available at: www.who.int/mediacentre/news/statements/2009/h1n1_pandemic_phase6_20090611/en/index.html>; accessed June 2009).

Swine influenza A (HlNl) infection in 2 children—Southern California. MMWR Morb Mortal Wkly Rep. 2009; 58: 400-2.

THE POLYCOMPARTMENT SYNDROME

PART TWO: FROM CARDIAC TO THORACIC – THE OTHER COMPARTMENT SYNDROMES

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In the last issue of ICU Management, we featured PART ONE of this article, which discussed Pelvic Compartment Syndrome, Abdominal Compartment Syndrome (ACS) and intra-abdominal pressure measurement. In the second part of this article, we will focus on 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.

Orbital Compartment Syndrome – OCS

Acute orbital compartment syndrome is a rare but treatable complication of increased pressure within the confined orbital space, intra-ocular pressure (IOP). The increased IOP may cause pressure-related decreased ocular perfusion pressure (OPP) similar to that caused by mass lesions or Graves disease. The condition presents with recognisable physical findings (eye pain, reduced ocular motility, pro-optosis, diplopia) and progressive visual deficit. Recognition and prompt treatment may prevent blindness. A recent study in burn patients showed that increased IOP was significantly ($p= 0.015$) associated with the amount of fluids given during the first 24 hours (37.2 ± 14.4 L vs 24.6 ± 12.3 L) and with the presence of periocular burns. Emergent orbital decompression resulted in a drop in IOP from 59.4 ± 15.9 mmHg to 28.6 ± 8.2 mmHg. Conditions that can be associated with OCS are infection, inflammation, spinal surgery, optic nerve sheath compression (tumour or meningeoma), vascular problems with ophthalmic artery or retinal vein occlusion, traumatic asphyxia syndrome, bleeding diathesis or even after orbital extravasation of X-ray contrast material.

Intracranial Compartment Syndrome – ICS

A unique feature of the brain is that the intracranial contents are confined within a rigid bony cage. Because the volume of the cranial cavity is limited by its bony casing, any change in the size of any intracranial compartment leads to a reciprocal change in the size of the remaining compartments leading to alterations in cerebral perfusion pressure (CPP) and intracranial pressure (ICP). Many studies have been published regarding the best treatment options for ICH either focusing on lowering ICP (by diuretics or evacuation) or raising CPP (by maintaining correct MAP with fluids or vasopressors). However fluid therapy used to support CPP may cause retroperitoneal and visceral oedema, ascites accumulation and increased IAP, which in turn can further increase ICP. Therefore in patients with severe traumatic brain injury, treatment decisions may result in a vicious cycle that increases pressures in various compartments.

The effects of IAP and ITP on ICP have not been extensively studied to date, and remain a challenging area for laboratory and clinical investigators. In the study by Scalea, 78 patients had an ICS and underwent a decompressive craniectomy (DC), resulting in a significant decrease in ICP from 24 to 14 mmHg. The other 24 patients had a multiple CS and underwent both a decompressive craniectomy and a decompressive laparotomy (DL). The combination of DC and DL in these 24 patients led to a decrease in ICP from around 32 to 14 mmHg after DC and from 28 to 19 mmHg after DL (the effect being different depending on whether DC or DL was performed first). After DL, the IAP decreased from 28 to around 18 mmHg and so did mean airway pressure from 37 to 27 cm H_2O. The authors concluded that increased ICP can result from primary traumatic brain injury as well as from increased IAP, which has been documented before. Patients with PolyCS received significantly more fluids during the first 7 days of ICU stay, around 63 ± 21 L vs 40 ± 13 L ($p< 0.001$). They also stayed longer in the ICU, about 25 ± 13 days vs 17 ± 12 days ($p= 0.01$) and in the hospital, 29 ± 16 days vs 21 ± 14 days ($p= 0.05$). While there was a trend towards higher mortality in these patients (42% vs. 31%), it did not reach statistical significance. PolyCS should therefore be considered in multiple injured patients with increased ICP that does not respond to therapy.

Thoracic Compartment Syndrome – TCS

Thoracic compartment syndrome has traditionally been described in adult and paediatric patients undergoing cardiac surgical procedures. In the setting of substantial myocardial oedema, acute ventricular dilatation, mediastinal haematoma or noncardiogenic pulmonary oedema, sternal closure may precipitate cardiac tamponade physiology leading to haemodynamic instability or collapse. Theoretically TCS could also occur in patients with trauma, however is rarely seen due to the limited survival of patients whose injuries were significant enough to result in massive tissue oedema after resuscitation from thoracic trauma. In the ICU, increased ITP is seen most commonly in relation to sepsis, capillary leak, fluid resuscitation, positive pressure ventilation with high PEEP or dynamic hyperinflation, pneumothorax, COPD with auto-PEEP, diminished chest wall compliance (e.g. morbid obesity or eschars), lung fibrosis and ARDS. The most important strategy to prevent TCS or decrease the ITP and to facilitate closure is the limitation of resuscitation fluid therapy through the use of hypertonic saline or colloid solutions. The rising ITP, mean or peak inspiratory pressure during thoracic wall closure may serve as an early warning that the patient is at risk for TCS. The increased ITP (normal < 5–7 mmHg) can be measured via a balloon-tipped catheter positioned in the lower third of the oesophagus will exert its effect on the lungs, the heart and the brain (by limiting venous return). Since increased ITP is most commonly related to futile fluid resuscitation, IAP and ITP go hand in hand. Some key-issues to remember are:

- Best PEEP should be set to counteract ITP and IAP whilst in the same time avoiding over-inflation of already well-aerated lung regions
  - **Best PEEP (cmH_2O) = IAP (mmHg)**
- During lung protective ventilation, the plateau pressures should be limited to transmural plateau pressures below 35cmH2O
  - **Pplattm = Pplat – ITP = Pplat – IAP/2 < 35 cm H2O**
- Increased ITP and IAP increase lung edema, within this concept monitoring of extravascular lung water index (EVLWi) seems warranted

Cardiac Compartment Syndrome – CCS

Within the thorax, the heart can develop an isolated CS also called cardiac tamponade. Cardiac tamponade occurs when there is accumulation of fluid or air in the pericardium caused by trauma, haemorrhage, infection or tumour causing impaired filling of the ventricles and decreased cardiac output (CO). As little as 250 mL of fluid can cause acute cardiac tamponade whereas under chronic conditions greater amounts of fluid can accumulate as the cardiovascular system can slowly adjust. The same effect on the heart can occur via transmission of increased ITP either directly as seen with TCS or indirectly as seen with ACS, due to the cephalad movement of the diaphragm. In case of increased ITP or IAP coronary perfusion pressure (CoPP) is lowered: CoPP = DBP – PAOP = DBP – ITP. The increase in ITP will also result in a difficult preload assessment because traditional filling pressures will be erroneously increased. When ITP or IAP rise above 10-12 mmHg CO drops due to an increase in afterload (systemic vascular resistance) and a decrease in preload and left ventricular compliance. Tachycardia may develop, mean arterial blood pressure will decrease and a pulsus paradoxus may occur. Cardiovascular dysfunction and failure (low CO, high SVR) are common in conditions of increased ITP or IAP. Finally, hepatomegaly (backward failure) may develop in chronic cases, so that cardiac tamponade may have a distant effect on other organs.

Some key-issues to remember are:

- Our understanding of traditional haemodynamic monitoring techniques and parameters, however, must be re-evaluated in conditions of increased ITP or IAP since pressure-based or "barometric" estimates of intravascular volume as pulmonary artery occlusion pressure (PAOP) and central venous pressure (CVP) are erroneously increased.
  - The clinician must be aware of the interactions between ITP, IAP, PEEP, and intracardiac filling pressures
  - Misinterpretation of the patient's minute-to-minute cardiac status may result in the institution of inappropriate and potentially detrimental therapy
  - Transmural (tm) filling pressures, calculated as the endexpiration value (ee) minus the ITP better reflect preload:
    - ***CVPtm= CVPee – ITP***
    - ***PAOPtm = PAOPee – ITP***
  - A quick estimate of transmural filling pressures can also be obtained by subtracting half of the IAP from the end-expiratory filling pressure
    - ***CVPtm = CVPee – IAP/2***
    - ***PAOPtm = PAOPee – IAP/2***
- "Volumetric" estimates of preload status such as right ventricular end diastolic volume index (RVEDVi) or global end diastolic volume index (GEDVi), are especially useful in conditions of the changing ventricular compliance due to elevated ITP.
- The cardiovascular effects are aggravated by hypovolemia and the application of PEEP, whereas hypervolemia has a temporary protective effect.

Limb or Extremity Compartment Syndrome – ECS

The ECS is a condition in which the CP within the closed muscle compartment increases to a level that reduces capillary blood perfusion below the level necessary for tissue viability. Permanent loss of function and contracture may occur. The extremity CP can be measured via a needle connected to a fluid-filled pressure transducer system. Normal CP should be below 20 mmHg and should be used to guide the need for surgical intervention.

- ***Tissue PP = capillary pressure – extremity CP***

The clinical findings are characterised by the 5 Ps: Pain, Pressure (tension on muscles), Paraesthesia, Paresis and Peripheral pulse alterations (diminished or prolonged capillary refill above 5

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TRANSPORT EQUIPMENT:
CREATING THE ULTIMATE MOBILE ICU

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The average intensive care unit (ICU) room is approximately 400 square feet. This space often seems quite small when filled with monitoring devices, beds, ventilators, and pumps necessary for proper patient care. In the transport environment, space is often a fraction of that of a hospital. Ambulances of all types must be configured to transport patients that require all of the devices that are being used in the ICU, but in a much smaller space. The limited space requires transport agencies to seek equipment that is compact, lightweight, and capable of performing the required functions that are necessary based on mission type and patient acuity.

Equipment used on board transport vehicles whether air, sea, or land, must be both durable and functional. The rigors of the transport environment necessitate that the equipment be reinforced to withstand drops, vibration, and other stressors that are not typically seen in the in hospital environment. Battery life, ease of use, and other factors also play a large role in equipment choice.

Many items are used in the transport environment. In this article we will focus specifically on ventilators and patient monitoring devices, as these are often two of the most costly purchases that must be made when outfitting a transport vehicle with medical equipment.

In recent years, the available choices of both ventilators and monitors have increased drastically. Gone are the days of one manufacturer who dominates the market. Decision makers must spend countless hours doing due diligence to ensure that purchases will allow the transport crew to be well prepared for years to come. A hasty purchase today may result in the acquisition of an outdated or obsolete system. It is common knowledge that technology changes from day to day. Today's cutting edge product can be tomorrow's antiquated dinosaur.

The transport ventilator has made great progress since its inception. Gone are the days of having a machine that just uses pressure to push air into the lungs at an oxygen concentration of 21 percent or 100 percent. Today, many ventilators allow for precise delivery of a prescribed oxygen concentration. This is of particular interest to transport providers that transport patients that have been "weaned" from 100% oxygen down to the lowest percentage of oxygen possible while maintaining haemodynamic stability. Having a ventilator that will exactly mimic the hospital's settings can mean a great deal to the patients wellbeing. In fact, placing a patient on a higher concentration of oxygen than required simply because of ventilator limitations, can result in the patient having a longer hospital stay due to the "loss of ground" that potentially occurs when oxygen settings are manipulated unnecessarily.

Oxygen concentration is not the only differentiator when evaluating possible options. Weight, oxygen consumption and battery life are also three important factors. In particular these can become a huge issue when transport distances are long or the transport vehicle has limited space. Additionally of great importance are the operating modes of the ventilator. Is the ventilator powered by gas, electricity, or both? Can it deliver positive end expiratory pressure (PEEP) and pressure support? Is it capable of delivering continuous positive airway pressure (CPAP)? Ventilators that can also do non-invasive ventilation may actually save a transport provider from buying a CPAP unit and a ventilator. Choosing an "all in one" ventilator will cover both uses with one purchase.

There are numerous ventilators to choose from in the current ECRI product comparison chart, ranging widely in price depending on the features that are included. Some are very advanced, offering many modes to choose, while others are more basic. Some of the ventilators are uniquely suited for the transport environment, touting long battery life, low oxygen consumption, and ease of use as selling points.

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TRANSPORT VENTILATORS

ECRI INSTITUTE RECOMMENDATIONS

Purchase Considerations

Included in the accompanying comparison chart are ECRI Institute's recommendations for minimum performance requirements for transport ventilators. The recommendations have been separated into two categories—basic and comprehensive. The comprehensive recommendations are for facilities that want additional features (e.g., pressure control, pressure support) so that ventilator strategies, similar to those offered by an ICU ventilator, can be provided during intra-hospital transport. Transport ventilators should offer, at a minimum, the control mode of ventilation. In the control mode, the ventilator provides mandatory breaths at preset intervals and does not allow the patient to breathe spontaneously. They may also include other modes, such as SIMV for both volume and pressure breaths. Although these modes are optional for basic units, they are preferred for intra-hospital transport applications. At minimum, both visual and audible alarms should be available for high and low pressures, low battery power level, loss of power, and loss of supply gases. Depending on sophistication, the unit may have few or numerous alarms. All alarms should be distinct and easily identified. In addition, if alarm volume is adjustable, it should not be possible to turn the volume down to an inaudible level. The alarm silence feature must reactivate automatically if the condition is not corrected. If an alarm is silenced, a visual display should clearly indicate which alarm is disabled. The delivered O_2 should be monitored with an O_2 analyser that includes an alarm for concentrations outside acceptable ranges. The analyser should either be included with the ventilator or purchased separately and should be placed in line with the breathing circuit. The controls (i.e., switches and knobs) should be visible and clearly identified, and their functions should be self-evident. The design should prevent misinterpretation of displays and control settings. Controls should be protected against accidental setting changes (e.g., due to someone brushing against the panel) and should be sealed against fluid penetration. Patient and operator safety and system performance should not be adversely affected by fluid spills.

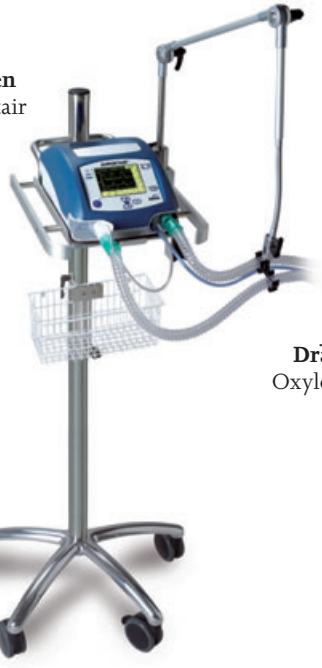
Other Considerations

When a purchase decision is being made, the ease with which the ventilator can be carried or transported must be considered. The ventilator should be small and lightweight, resistant to tipping over, and easily mounted in different orientations. These features are especially useful because users may need to maneuver the ventilator to gain access to the controls or to accommodate space constraints. Another important consideration is the length of time the unit can operate on internal battery power.

Users should select ventilators that are easy to operate, which is especially important in emergencies. The primary controls should

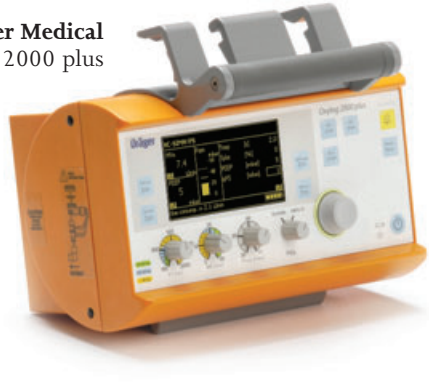
Dräger Medical
Oxylog 3000 plus

Covidien
Supportair



GE Healthcare
iVent 201

Dräger Medical
Oxylog 2000 plus



be located on one side and should be protected against accidental setting changes. Labels and displays should be clear and visible—even in subdued lighting and from different angles—and resistant to damage from liquid disinfectants and normal wear. For ventilators that offer additional modes, such as SIMV, visual indicators are desirable to identify when the ventilator senses a breathing effort and what type of breath (spontaneous or mechanical) the patient receives. Alarms should allow quick assessment and correction of the signaled condition. The priority of the alarm should be indicated by different audible tones and visual indicators. The disabling of visual indicators should not be possible. Additional monitors can be used to augment the integral airway-pressure monitor; desirable supplemental monitors include exhaled-volume monitors, O2 monitors, and pulse oximeters. Ventilators should be able to operate in a variety of adverse conditions and should be unaffected by electromagnetic interference and electrostatic discharge. Power-surge protectors are recommended, especially if the ventilator is used in an area that experiences frequent power surges or thunderstorms. Servicing by a skilled technician should be easy, and the operator manual should provide adequate information for clinicians, users, and caregivers. Some suppliers offer transport ventilators that are constructed of materials compatible with magnetic resonance imaging (MRI) scanners. If the ventilator will be used to transport patients to the MRI suite, MRI compatibility is a necessary feature.

Stage of Development

Transport ventilators are essential in the emergency and non-emergency transport of mechanically ventilated patients. Small, lightweight, microprocessor-controlled ventilators are now available. These ventilators do not require a separate air source (e.g., a small turbine drive unit) and have monitors as well as more modes and alarms.

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

Contact

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Tel. +44 (0)1707 871511
Fax. +44 (0)1707 393138
info@ecri.org.uk www.ecri.org.uk

	ECRI INSTITUTE'S RECOMMENDED SPECIFICATIONS [1]	COVIDIEN positive results for life
MODEL	Basic Transport Ventilators	SUPPORTAIR
WHERE MARKETED		Europe - MEA
FDA CLEARANCE		
CE MARK (MDD)		Yes
PATIENT TYPE	Adult	Paediatric / Adult
CONTROLS		
Pressure level, cm H2O	Optional	5 - 60
Pressure ramp	Optional	4 slopes
Tidal volume, mL	100-1,000	50-2000
Breath rate, breaths/min	0-60	5 - 60
Inspiratory time, sec	0-2	0,1 - 3
PEEP, cm H2O	0-20	0-20
Pressure support	Optional	8 - 60
FiO2, %	21-100	21-100
IE	1:1 to 1:3	1:1 to 1:3
Trigger mechanism	Flow or pressure	Flow & Pressure (1 Pedia - 5)
Panel lock	Yes	Yes
Others		Complies with EN794-1 not for Emergency transport
OPERATING MODES		
Assist/control		
Volume breaths	Yes	Yes
Pressure breaths	Optional	Yes
SIMV		
Volume breaths	Optional	Yes
Pressure breaths	Optional	
Pressure support	Optional	Yes
Spontaneous/CPAP	Optional	Yes
Pressure support	Optional	Yes
Apnea-backup vent	Yes	Yes
Others		Pressure Breaths with Target Vt
MONITORED PARAMETERS		
Pressure		
PIP	Yes	Yes
MAP	Yes	Yes
PEEP	Yes	Yes
Volume		
Tidal	Optional	Yes Vti / Vte
Minute	Optional	
Others		I/T - Leaks - Pressure waveform - Flow waveform
PATIENT ALARMS		
FiO2	Optional	Yes
Low/high minute volume	Optional	
Low inspiratory pressure	Yes	Yes
High pressure	Yes	Yes
Loss of PEEP	Optional	Yes
Apnea	Optional	Yes
Inverse IE	Optional	
High continuous pressure/occlusion	Yes	Yes
High respiratory rate	Optional	Yes
Others		
MRI COMPATIBILITY	Preferred	No
SUITABLE FOR AIRCRAFT USE		No
Approved by	Not specified	
INTERNAL BATTERY		
Type	Any common type	Li-Ion
Voltage		25.2 V -4.4 Ah
Operation time, hr	1	10hrs
Rechargeable		Yes
Recharging time, hr		8 hrs
H x W x D, cm (in)		15,4 x 23,5 x 33,5 (6 x 9 x 13)
WEIGHT, kg (lb)		4,9 Kg (10 lbs)
OTHER SPECIFICATIONS		Complies with IEC 60601-1 - EN794-1
UMDNS CODE(S)	18098	
LAST UPDATED		Sep-09
Supplier Footnotes	[1] These recommendations are the opinions of ECRI Institute's technology experts. ECRI Institute assumes no liability for decisions made based on this data.	
Model Footnotes		
Data Footnotes		

MODEL	CareFusion LTV 1000	CareFusion LTV 1200	GE Healthcare iVent 201 IC-AB
WHERE MARKETED	Worldwide	Worldwide	Worldwide
FDA CLEARANCE	Yes	Yes	Yes
CE MARK (MDD)	Yes	Yes	Yes
PATIENT TYPE	Adult, pediatric	Adult, pediatric, infant. All patients greater than 5 kg.	Adult, pediatric
CONTROLS			
Pressure level, cm H2O	1 to 99	1 to 99	5- 80
Pressure ramp	Rise time 1-9	Rise time 1-9	Adjustable rise/auto rise
Tidal volume, mL	50-2,000	50-2000	50-2,000
Breath rate, breaths/min	0-80	0-80	1 - 80
Inspiratory time, sec	0.3-9.9	0.3-9.9	0.2-3, adaptive time
PEEP, cm H2O	0-20	0-20	0-40
Pressure support	Off, 1-60 cm H2O	Off, 1-60 cm H2O	0-60 cm H2O
FiO2, %	21-100	21-100	21-100
IE	1:4 to 4:1	1:4 to 4:1	Adjustable
Trigger mechanism	Flow	Flow	Pressure, flow, dual
Panel lock	Yes	Yes	Confirm required for all changes
Others	Pressure control, sensitivity, inspiratory/expiratory hold	Pressure control, sensitivity, inspiratory/expiratory hold	Adaptive flow, adaptive I-time, easy exhale, Esens, Phigh, Plow
OPERATING MODES			
Assist/control		Yes	
Volume breaths	Yes	Yes	Yes
Pressure breaths	Yes	Yes	Yes
SIMV		Yes	
Volume breaths	Yes	Yes	Yes
Pressure breaths	Yes	Yes	Yes
Pressure support	Yes	Yes	Yes
Spontaneous/CPAP	Yes	Yes	Yes
Pressure support	Yes	Yes	Yes
Apnea-backup vent	Yes	Yes	Yes
Others	NPPV	NPPV	Adaptive bilevel (NIV)
MONITORED PARAMETERS			
Pressure		Yes	
PIP	Yes	Yes	Yes
MAP	Yes	Yes	Yes
PEEP	Yes	Yes	Yes
Volume		Yes	
Tidal	Yes	Yes	Yes
Minute	Yes	Yes	Yes
Others	Static compliance, autoPEEP, calculated peak flow, patient effort	Static compliance, autoPEEP, calculated peak flow, patient effort, SBT f/Vt, SBT f	Plateau pressure, autoPEEP, time constant, compliance, resistance, Rt/Vt, trending (14 parameters for 72 hr), pressure and flow over time curves, event log, optional SpO2
PATIENT ALARMS			
FiO2	Yes	No	Adjustable
Low/high minute volume	Yes	Yes	Adjustable
Low inspiratory pressure	Yes	Yes	Adjustable
High pressure	Yes	Yes	Adjustable
Loss of PEEP	Not specified	Yes	Yes
Apnea	Yes	Yes	Adjustable
Inverse IE	No	No	Yes
High continuous pressure/occlusion	No	No	Yes
High respiratory rate	Yes	Yes	Adjustable
Others	None specified	Low PEEP, SBT high f/Vt, SBT low f/Vt, SBT high f, SBT low f	Leak, low tidal volume delivered
MRI COMPATIBILITY	No	MR Conditional System available.	Yes, conditional
SUITABLE FOR AIRCRAFT USE	Yes	Yes	Yes
Approved by	Air Force (C-17, C-21A, C-130EH, C-130J, KC-10, KC-135 & WC-130J), Army (H-60 medevac H-60 helicopter)	Army (H-60 medevac H-60 helicopter)	Not specified
INTERNAL BATTERY	Yes	Yes	Yes
Type	Sealed lead-acid	Sealed lead-acid	Sealed lead-acid
Voltage	Not specified	Not specified	12, 7.8 A-hr
Operation time, hr	1	1	Up to 2, depending on settings; optional up to 4
Rechargeable	Yes	Yes	Yes
Recharging time, hr	Not specified	8 hours	~Twice battery duration
H x W x D, cm (in)	8 x 25 x 30 (3.1 x 9.8 x 11.8)	8 x 25 x 30 (3.1 x 9.8 x 11.8)	33 x 24 x 26 (13 x 9.4 x 10.2)
WEIGHT, kg (lb)	6.5 (14.5)	6.5 (14.5)	10.9 (24)
OTHER SPECIFICATIONS	O2 cylinder calculation feature, variable rise time, variable termination criteria for pressure support and pressure-controlled breaths. Meets requirements of cETL, IEC 60601-2-12, and ISO 13485.	Patient presets, spontaneous breathing trial (SBT), O2 flush, O2 cylinder duration, variable rise time, and variable termination criteria for pressure support and pressure-controlled breaths. Meets requirements of cETL, IEC 60601-2-12, and ISO 13485.	Rotational control knob interface; VGA output for secondary screen option; integral O2 sensor; battery backup; software upgrades via PC; optional integral pulse oximetry with pleth waveform. Meets requirements of CSA, IEC 60601, and UL.
UMDNS CODE(S)	18098	18098	18098
LAST UPDATED	Sep-09	Sep-09	Sep-09

Dräger medical A Dräger and Siemens Company	Dräger medical A Dräger and Siemens Company	Dräger medical A Dräger and Siemens Company	MAQUET
Oxylog 2000 plus	**Oxylog 3000**	**Oxylog 3000 plus**	**Servo-i (Adult : Infant : Universal Basic : Universal Extended)**
Worldwide	Worldwide	Worldwide	Worldwide
Yes	Yes	Pending	Yes
Yes	Yes	Yes	Yes
Adult	Adult & Pediatric	Adult & Pediatric	Adult, pediatric, neonatal
			0-120
0 - 35	3 - 55	3 - 55	Rise time
3 levels	3 levels	3 levels	100-2,000 : 2-350 : 2-4,000 : 2-4,000
100-2000	50-2000	50-2000	0-150
2 - 60	2 - 60	2 - 60	0.1-5 (infant)
0.2 - 10	0.2 - 10	0.2 - 10	0-50
0 - 20	0 - 20	0 - 20	Yes
0 - 35 mbar	0 - 35 mbar	0 - 35 mbar	21-100
40% or 100%	40% - 100%	40% - 100%	1:10 to 4:1
1:4 to 3:1	1:4 to 3:1	1:100 to 50:1	Pressure, flow, neural
Flow	Flow	Flow	Yes
No	No	No	Inspiratory cycle off
Central rotary knob, EL display	Central rotary knob, EL display	Central rotary knob, EL display	
			Yes
Yes	Yes	Yes, AutoFlow®	Yes
No	Yes	Yes	
			Yes
Yes	Yes	Yes, AutoFlow®	Yes
Yes (Pressure Support)	Yes (BIPAP & Pressure Support)	Yes (BIPAP & Pressure Support)	Yes
Yes	Yes	Yes	Yes
			Yes
Yes	Yes	Yes	Yes
Yes	Yes	Yes	PRVC, Volume Support, NIV, NCPAP, automode, BiVent, Heliox, NAVA[1]
Non-Invasive ventilation	Non-Invasive ventilation	AutoFlow®, Non-Invasive ventilation	
Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes
Yes	Yes	Yes Vti / Vte	Yes
Yes	Yes		Yes
RRspon., Pplat, MVspon., Actual O2 consumption,. Paw bar graph	RRspon., Pplat, MVspon., Actual O2 consumption, Paw & Flow curves	etCO2, RRspon., Pplat, MVspon., Actual O2 consumption, Paw & Flow & CO2 curves	Ti/Ttot, Tc, WOB, RSBI, Edi, ETCO2, R, C, P0.1
No	No	No	Yes
Yes/Yes	Yes/Yes	Yes/Yes	Yes
Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes
No	No	No	Yes
Yes	Yes	Yes	Yes
No	No	No	Yes
Yes	Yes	Yes	Yes
Yes	Yes	Yes	Yes
		Low & High etCO2	Low Resp rate, High/Low EtCO2, Technical alarms
No	No	No	Yes
Yes	Yes	Yes	Yes
			FRM, Linköping, Sweden
Yes	Yes	Yes	Yes
Lithium ion	Lithium ion	Lithium ion	Ni-MH
11,1 Volt	11,1 Volt	11,1 Volt	12
4 hrs	4 hrs	4 hrs	1-3 (based on 2-6 battery modules, at least 30 min/module)
Yes	Yes	Yes	Yes
4-5 hrs	4-5 hrs	4-5 hrs	3 per battery
184 x 285 x 175	184 x 285 x 175	184 x 290 x 175	41.5 x 30 x 20.5 (16.3 x 11.8 x 8.1) patient unit
5,4 Kg (11,9 lb) incl. Battery	5,4 Kg (11,9 lb) incl. Battery	5,8 Kg (12,8 lb) incl. Battery	15 (33) patient unit
Supplier Footnotes: Options: Pressure Support & NIV		Complies with IEC 60601-1 - EN794-8 **Supplier Footnotes:** Oxylog 3000 plus replaces the Oxylog 3000. Options: AutoFlow®, Capnography, Real-time-Data Export, Remote Servicing.	Can be used for treatment with Heliox (80-20, 79-21, 78-22 mixtures can be used), both invasively and noninvasively and in any mode of ventilation offered. Meets requirements of IEC 60601-1 and ISO 10651-1. **Supplier Footnotes:** [1] NAVA stands for Neurally Adjusted Ventilatory Assist.
			18098
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SERIES ON EARLY MOBILISATION OF CRITICALLY ILL PATIENTS

PART ONE: SCREENING AND SAFETY ISSUES

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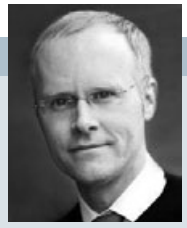

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Introduction

Patients in the intensive care unit (ICU) often receive heavy sedation and bed rest, particularly while mechanically ventilated (Needham et al. 2007; Weinert & Calvin 2007; Winkelman et al. 2005). This immobility may contribute to ICU-acquired neuromuscular weakness, which can be severe and long lasting in some ICU survivors. (De Jonghe et al. 2002; Fletcher et al. 2003; Herridge et al. 2003). To improve this complication of critical illness, there is growing interest in early mobilisation of patients in the ICU setting (Herridge 2008; Korupolu et al. 2009; Needham 2008; Perme and Chandrashekar 2009). Existing studies indicate that early mobilisation is safe and associated with improved physical function, shortened length of stay, and improved weaning from mechanical ventilation. In this article, we discuss issues related to the safety and screening of critically ill patients for early mobilisation.

Early Mobilisation in the ICU

Early mobilisation aims to reduce the deleterious effects of bed rest and post-ICU impairments in muscle strength, range of motion and physical functioning. In many ICUs, physical therapy (PT) and occupational therapy (OT) begin only once a patient appears ready for weaning from mechanical ventilation and sedation is reduced, or once patients are extubated (Morris et al. 2008; Schweickert et al. 2009). This delay in rehabilitation therapy is associated with physical impairment after ICU discharge (Korupolu et al. 2009; Schweickert et al 2009).

In contrast to this traditional approach to ICU care, an "early mobilisation" programme starts from patients' initial physiologic stabilisation and continues throughout the entire ICU stay (Bailey et al. 2007). This approach minimises heavy sedation and introduces physical medicine and rehabilitation therapies even while patients are receiving life support therapies, such as mechanical ventilation and vasopressor infusions. Such programmes frequently start within 48 hours of initiation of mechanical ventilation (Morris et al. 2008; Schweickert et al. 2009).

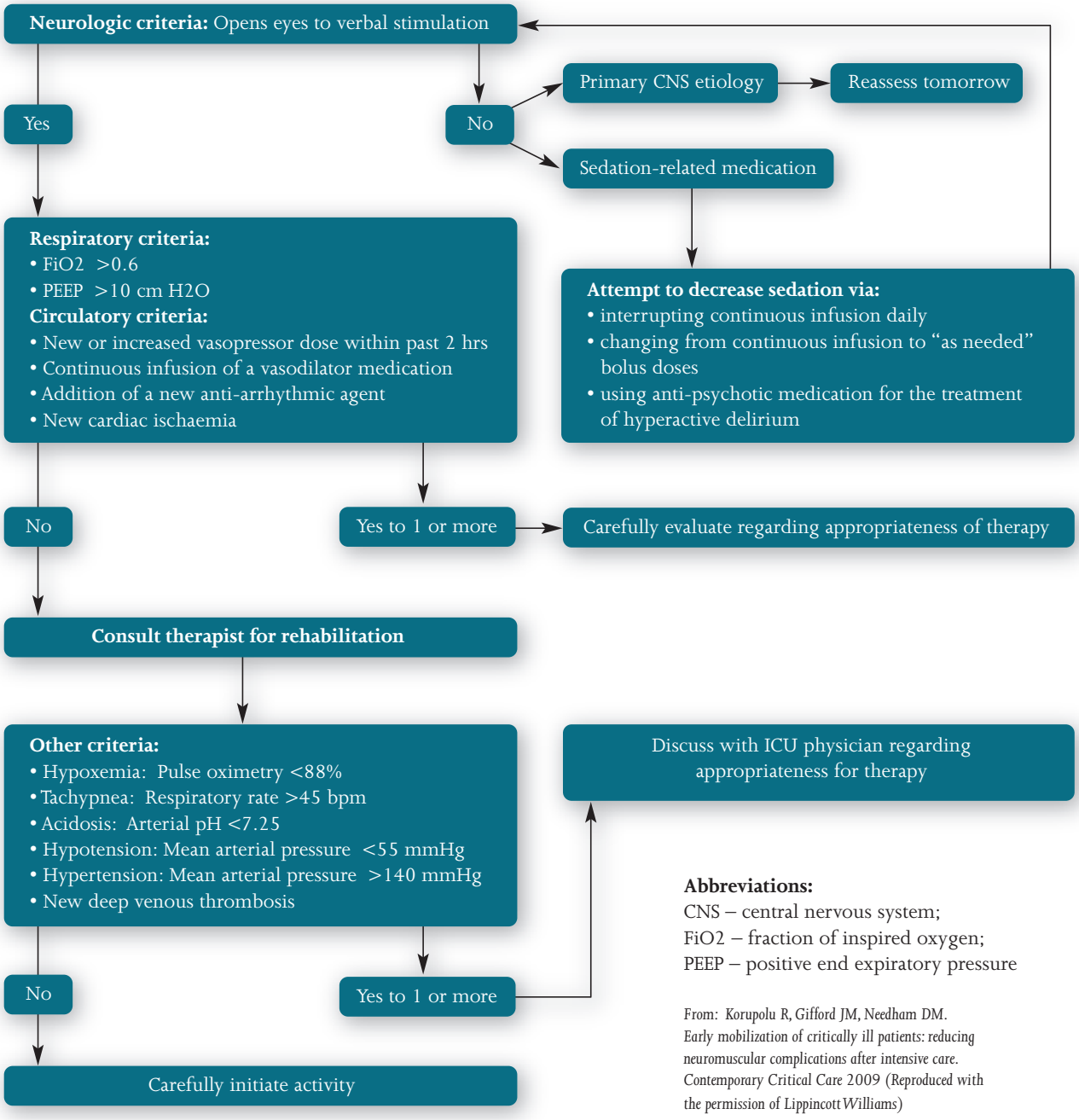
Screening and Safety Issues

Early mobilisation of ICU patients presents challenges, including poor cardiopulmonary reserve, changes in mental status (e.g., sedation and delirium), and the need for medical devices and equipment (e.g., lines, tubes, mechanical ventilator and monitors). These challenges necessitate careful screening to ensure patient safety during mobility activities. We discuss four important publications which demonstrate screening and safety issues related to early mobilisation in ICU patients (Bailey et al. 2007; Morris et al. 2008; Schweickert et al. 2009; Stiller et al. 2004).

The first study specifically evaluated the effect of mobilisation on the haemodynamic and respiratory status on acutely ill ICU patients (Stiller et al. 2004). In this study, after a comprehensive screening process, 69 mobilisation activities were performed on 31 patients. The most frequently reported activities were sitting on the edge of the bed and standing. A total of 3 (4%) sessions resulted in desaturation that responded to a temporary increase in the inspired fraction of oxygen.

The second study involved mechanically ventilated medical, surgical and trauma patients in a respiratory ICU. A total of 1,449 activity events were performed on 103 patients including sitting on the edge of the bed, sitting in a chair, and ambulation (Bailey et al. 2007). Of these activities, 41% were performed on intubated patients. Criteria for initiation of mobility therapy included patient response to verbal stimulation (neurologic criteria), FiO2 ≤0.6 and positive end-expiratory pressure (PEEP) ≤10 cm H2O (respiratory criteria), and the absence of orthostatic hypotension and catecholamine drips (circulatory criteria). Adverse events were prospectively defined as: (1) fall to knees, (2) feeding tube removal, (3) systolic blood pressure >200 or <90 mmHg, (4) oxygen saturation <80%, and (5) extubation. Such events occurred in <1% of all patient activities with no extubation events recorded. All adverse events were immediately corrected with no need for additional therapy, cost, or length of stay.

Figure 1. A screening algorithm to evaluate patient appropriateness for rehabilitation therapy



Abbreviations:
CNS – central nervous system;
FiO2 – fraction of inspired oxygen;
PEEP – positive end expiratory pressure

From: Korupolu R, Gifford JM, Needham DM. Early mobilization of critically ill patients: reducing neuromuscular complications after intensive care. Contemporary Critical Care 2009 (Reproduced with the permission of Lippincott Williams)

The third study is a non-randomised, controlled trial of medical ICU patients with acute respiratory failure (Morris et al. 2008). In this study, an early mobility protocol was started within 48 hrs of mechanical ventilation. In the early mobility group, 106 patients received graduated PT activities, including turning, active resistance, sitting on the edge of the bed, and active transfer from bed to chair. The criteria to limit or withhold mobilisation activities included hypoxia with frequent desaturations below 88%, hypotension (mean arterial pressure <65 mmHg), administration of a new vasopressor agent, new documented myocardial infarction, dysrhythmia requiring the addition of a new antiarrhythmic agent, an increase in the PEEP or a change to assist-control mode of ventilation once in a weaning mode. No events of death, near death, cardiopulmonary resuscitation or removal of a medical device were reported during physical therapy in these patients.

"YES, YOU CAN"

A CHANGE OF PARADIGM IN EARLY MOBILISATION AND VERTICALISATION OF CRITICAL CARE PATIENTS?

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Phone (+49 211) 16450-0

Early verticalisation and mobilisation of Intensive Care patients are actually in focus when looking for appropriate measures to prevent complications and neuromuscular deconditioning. Various publications in the recent past have examined the topic of early mobility, sitting upright, stand-up trials and walking within ICU patients. Numerous studies report significant advantages in a standardised approach to those measures in order to prevent complications and accelerate therapeutic outcomes. This opens the door for one of the most desired outcomes in managing ICU patients: A reduction of ICU and hospital length of stay[1].

Even patients on life support are being mobilised, including weight bearing- and walking exercises. Corresponding publications report about only few adverse events in a range of a very low single digit percentage of all conducted sessions. Additionally, none of these adverse events had impact on patient outcome or cost[1].

Why is this change of paradigm so important?

Experimental Studies show a 4-5% loss of muscle strength per week of bed rest in healthy and well-nourished subjects[2]. Other studies have shown a neuromuscular weakness occurring in 25% of patient who where mechanically ventilated for more than seven days[2]. It is well known that even high intensity exercises done in bed do not counteract the adverse effects of bed rest[3]. Moreover, latest publications raise the demand that monitoring and life support equipment, including ventilators, should not limit mobility exercises[3].

"What if the patients could actually sit up in their beds or in a chair or even walk, despite their life-support lines and tubes?" This is the question raised by Intensivists in a New York Times article on January 12th, 2009. We developed a therapy support system,

Perfect synergy: *Safe verticalisation out of Hill-Rom's TotalCare is trained at the Liko Training and Competence centre: Weight bearing exercises to prevent and counteract neuromuscular deconditioning.*

which exactly fulfills the requirements to drive these early mobility strategies. It allows verticalising patients with the touch of a button, and with maximum comfort and minimum disruption. Thus it is possible to achieve a complete chair-like position, as well an optimum bed egress position for early stand-up trials. In combination with some innovative products from our new Hill-Rom member Liko, we can offer tailored solutions, which will allow you to answer to the above quoted question with a definite "Yes, you can".

So, is mobilisation and verticalisation of critically ill patients safe and easy? It is – and will remain – a challenging task. However, it is the right combination of people, process and technology, which you need to make it happen. You got the right people, and we provide the right technology. Together we can establish the processes you need to successfully break the paradigm of bed rest for your ICU patients. Let's talk about it.

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

References: [1]Morris PE, Goad A, Thompson C, et al. Early intensive care unit mobility therapy in the treatment of acute respiratory failure. Crit Care Med 2008;36(8):2238-2243. [2]Needham D, Johns Hopkins University School of Medicine; JAMA 10/2008. [3]Perme, C, Early Mobility and Walking Program for Patients in Intensive Care Units: Creating a Standard of Care, AJCC 2009

Finally in a recently published randomised controlled trial of acute reparatory failure patients, 498 therapy sessions were performed on 104 patients in a medical ICU (Schweickert et al. 2009). Only one adverse event (desaturation <80%) was reported in this study. Activity events included range of motion exercises, bed mobility, sit to stand, transfer from bed to chair, and walking. The criteria to withhold therapy included MAP <65 or >110 mmHg, systolic blood pressure >200 mmHg, heart rate <40 or >130 beats per minute, respiratory rate <5 or >40 breaths per minute, and oxygen saturation <88%.

"All adverse events were immediately corrected with no need for additional therapy, cost, or length of stay."

Based on the above studies and experience with the Critical Care Physical Medicine and Rehabilitation programme in our medical ICU at Johns Hopkins Hospital, we have proposed a screening algorithm (Figure 1) for initiation of early mobility therapy (Korupolu et al. 2009). In general, active mobilisation activities are deferred in patients who are deeply sedated or comatose, and who have unstable blood pressure or require at least moderate doses of infusions of vasoactive medications.

To maximise safety, it is important that mobilisation activities be tailored to each patient's individual circumstances. Clinical judgment is always required on the part of all ICU clinicians and rehabilitation therapists involved in patient care since not all circumstances can be anticipated. Moreover, providing a graduated level of activity and carefully evaluating patients' prior and current clinical response to each activity are vital for the safety of early mobility therapy. Consequently, even patients who do not fully meet circulatory and respiratory criteria may be able to safely participate in mobilisation activities with close monitoring (Bailey et al. 2007).

Conclusion

Early mobilisation and rehabilitation therapy may reduce the deleterious effects of bed rest in the ICU. Existing studies and our clinical experience indicate that screening for patients' level of consciousness, haemodynamic and respiratory stability, and other relevant factors is key for safe delivery of mobilisation activities in critically ill patients. Further research is required to study the physiological effects and outcomes of mobilising critically ill patients to continue the evolution of evidence-based guidelines (Gosselink et al. 2008; Tan et al. 2009).

References

Bailey, P., Thomsen, G. E., Spuhler, V. J., Blair, R., Jewkes, J., Bezdjian, L., Veale, K., Rodriquez, L., & Hopkins, R. O. 2007, "Early activity is feasible and safe in respiratory failure patients", Crit Care Med, vol. 35, no. 1, pp. 139-145.

De Jonghe, B., Sharshar, T., Lefaucheur, J. P., Authier, F. J., Durand-Zaleski, I., Boussarsar, M., Cerf, C., Renaud, E., Mesrati, F., Carlet, J., Raphael, J. C., Outin, H., & Bastuji-Garin, S. 2002, "Paresis acquired in the intensive care unit: a prospective multicenter study", JAMA, vol. 288, no. 22, pp. 2859-2867.

Fletcher, S. N., Kennedy, D. D., Ghosh, I. R., Misra, V. P., Kiff, K., Coakley, J. H., & Hinds, C. J. 2003, "Persistent neuromuscular and neurophysiologic abnormalities in long-term survivors of prolonged critical illness", Crit Care Med, vol. 31, no. 4, pp. 1012-1016.

Gosselink, R., Bott, J., Johnson, M., Dean, E., Nava, S., Norrenberg, M., Schonhofer, B., Stiller, K., van de, L. H., & Vincent, J. L. 2008, "Physiotherapy for adult patients with critical illness: recommendations of the European Respiratory Society and European Society of Intensive Care Medicine Task Force on Physiotherapy for Critically Ill Patients", Intensive Care Med, vol. 34, no. 7, pp. 1188-1199.

Herridge, M. S. 2008, "Mobile, awake and critically ill", CMAJ., vol. 178, no. 6, pp. 725-726.

Herridge, M. S., Cheung, A. M., Tansey, C. M., Matte-Martyn, A., az-Granados, N., Al-Saidi, F., Cooper, A. B., Guest, C. B., Mazer, C. D., Mehta, S., Stewart, T. E., Barr, A., Cook, D., & Slutsky, A. S. 2003, "One-year outcomes in survivors of the acute respiratory distress syndrome", N.Engl.J.Med, vol. 348, no. 8, pp. 683-693.

Korupolu, R., Gifford, J. M., & Needham, D. M. 2009, "Early mobilization of critically ill patients: reducing neuromuscular complications after intensive care", Contemporary Critical Care, vol. 6, no. 9, pp. 1-12.

Morris, P. E., Goad, A., Thompson, C., Taylor, K., Harry, B., Passmore, L., Ross, A., Anderson, L., Baker, S., Sanchez, M., Penley, L., Howard, A., Dixon, L., Leach, S., Small, R., Hite, R. D., & Haponik, E. 2008, "Early intensive care unit mobility therapy in the treatment of acute respiratory failure", Crit Care Med, vol. 36, no. 8, pp. 2238-2243.

Needham, D. M. 2008, "Mobilizing patients in the intensive care unit: improving neuromuscular weakness and physical function", JAMA, vol. 300, no. 14, pp. 1685-1690.

Needham, D. M., Wang, W., Desai, S. V., Mendez-Tellez, P. A., Dennison, C. R., Sevransky, J., Shanholtz, C., Ciesla, N., Spillman, K., & Pronovost, P. J. 2007, "Intensive care unit exposures for long-term outcomes research: development and description of exposures for 150 patients with acute lung injury", J.Crit Care, vol. 22, no. 4, pp. 275-284.

Perme C & Chandrashekar R 2009, "Early mobility and walking program for patients in intensive care units: creating a standard of care", Am J Crit Care.

Schweickert, W. D., Pohlman, M. C., Pohlman, A. S., Nigos, C., Pawlik, A. J., Esbrook, C. L., Spears, L., Miller, M., Franczyk, M., Deprizio, D., Schmidt, G. A., Bowman, A., Barr, R., McCallister, K. E., Hall, J. B., & Kress, J. P. 2009, "Early physical and occupational therapy in mechanically ventilated, critically ill patients: a randomised controlled trial", Lancet, vol. 373, no. 9678, pp. 1874-1882.

Stiller, K., Phillips, A., & Lambert, P. 2004, "The safety of mobilisation and its effects on haemodynamics and respiratory status of intensive care patients.", Physiother.Theory.Pract., vol. 20, pp. 175-185.

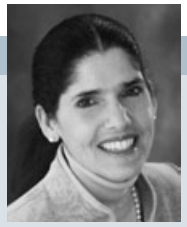
Tan, T., Brett, S. J., & Stokes, T. 2009, "Rehabilitation after critical illness: summary of NICE guidance", BMJ, vol. 338, p. b822.

Weinert, C. R. & Calvin, A. D. 2007, "Epidemiology of sedation and sedation adequacy for mechanically ventilated patients in a medical and surgical intensive care unit", Crit Care Med., vol. 35, no. 2, pp. 393-401.

Winkelman, C., Higgins, P. A., & Chen, Y. J. 2005, "Activity in the chronically critically ill", Dimens.Crit Care Nurs., vol. 24, no. 6, pp. 281-290.

TRANSFORMING CARE IN THE INTENSIVE CARE UNIT

THE USE OF NURSE DRIVEN PROTOCOLS



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Practitioners in intensive care units (ICU) are challenged to deliver care to critically ill patients presenting with a wide variety of diagnoses and co-morbidities. Care in ICUs should be based on the best evidence-based literature (EBL) available and delivered by a collaborative team of practitioners working from the same 'framework'. This implies a unified, consistent approach to patient management embedded in a work environment that promotes interdisciplinary respect and collaboration amongst all practitioners. ICU nurses are consistently present at the bedside of critically ill patients and are vital members of this interdisciplinary team. Their skills, clinical insight, and critical decision-making transform the evidence based protocols and physician orders from paper to practice.

Optimising the ICU nurse's presence at the bedside with physician ordered nurse-driven protocols enhance the power of the interdisciplinary team to achieve coordinated, collaborative patient care leading to improved patient outcomes. In 1997, Mission Hospital's (Mission Viejo, California) Trauma/Neuro Surgical ICU team acknowledged the need to change the practice environment. Outcomes for patients with severe traumatic brain injury (TBI) were less than optimal with a high mortality and morbidity in this population (Palmer et al. 2001). Upon analysis of practice patterns, there was great disparity amongst physician providers in delivering care and a lack of team guidelines based on the scientific literature. ICU nurses identified diverse practices for managing increased intracranial pressure (ICP) due to individual physician preferences. This led to confusion amongst team members and an inconsistent approach to a multitude of patient management issues. With the hiring of a Neuro/ICU advance practice nurse (APN), meetings were held to discuss changing the environment of care. The team focussed on creating a collaborative practice team by unifying management strategies, translating evidence-based guidelines into hospital-based protocols, integrating standardised physician order sets, and developing nurse driven protocols with critical thinking algorithms.

Transformation of Care

Following a retrospective review of 3 ½ years of severe TBI patients and identification of a high mortality and morbidity, a group of physicians, nurses, pharmacists, and respiratory therapists met to review the Brain Trauma Foundation (BTF) "Guidelines for managing severe TBI" (Bullock et al. 1995). Consensus was obtained amongst the practitioners to translate the BTF guidelines to practice and standardise care amongst all practitioners. Neurosurgeons, trauma surgeons and intensivists agreed on the major treatment goals for severe TBI. New technology was introduced including monitoring oxygen levels in the brain. Pre-printed physician order sets were created. Education of all team members occurred with 24/7 support provided by the Neuro/Critical Care APN. A TBI nurse competency was developed by the nursing leadership team and nurses were selected based on the skill, ability to critically think and problem solve. Physician ordered nurse-driven protocols were implemented. Critical thinking algorithms were developed, tested and implemented to enhance decision-making at the bedside. These algorithms are continually revised as new knowledge, technology, or changes in the EBL occur. Consultation with the Neuro/Critical Care APN facilitated decision making by the bedside nurse. Prospective data collection began in June of 1997 and is ongoing today. Results of this approach led to a statistically significant improvement in patient outcomes with a reduction in mortality (43% to 14%) and severe disability (30% to 14%) and an increase in good outcome/moderate disability (27% to 72%) (Palmer et al. 2001; Bader et al. 2008).

The use of nurse driven protocols was expanded to other facets of care in the neurosurgical population. The TBI protocol mandated the maintenance of normothermia, core body temperature of

37 degrees Celsius, for the first seven days of the patient's ICU stay. Temperature control was difficult due to technology shortcomings as well as shivering. With the introduction of a pad based wrap system to maintain temperature at a constant rate and adoption of a protocol from Columbia Hospital (New York, USA) (Badjatia et al. 2008; Mayer et al. 2004; Badjatia et al. 2007; Mayer 2008), the nursing staff has been consistently successful in maintaining normothermia. The translation of the Columbia's protocol to Mission Hospital's physician ordered nurse-driven shivering protocol involved holding a consensus meeting with neurosurgeons, trauma surgeons, intensivists and nurses to agree upon a step-by-step approach (see Figure 1) to physical and medication interventions to counter shivering and maintain normothermia in the critically ill neuro patient population.

Figure 1. Nurse-Driven Normothermia/Shivering Protocol

I. Maintain patient's temperature 37 degrees during first seven days of hospitalisation
II. Assess patient using the Bedside Shivering Assessment Scale (BSAS) every hour.
A. BSAS: (Badjatia et al. Stroke 2008) GOAL is BSAS < 1.
Palpate masseter, pectoralis, deltoids and quadriceps muscles
0 = No shivering
1 = Mild shivering localised to neck and/or chest
2 = Shivering involving neck and/or chest and arms
3 = Intermittent generalised shivering involving all 4 extremities
II. Temperature > 37.5 Celsius during first 7days of admit
A. Institute cooling measures
(Medications: *Physician orders obtained per protocol)
1. Remove excess blankets
2. Maintain external environment cool
3. Administer Acetamenophen 650 mg per rectum/ feeding tube every 4 hours*
4. Start Buspirone 20 mg per feeding tube every 8 hours*
B. If shivering present
1. Apply Counterwarming (BAIR Hugger at 43 degrees C)
2. *Physician orders obtained for shivering protocol
a. Non Sedating: Magnesium sulfate 0.5 – 1gram/hour IV (goal 3-4 mg/dL)
b. Sedating: Choose one of the following
1) Meperidine 25 mg every 1 hour prn
2) Dexmedetomidine 0.2-1.5 mcg/kg/hour IV
3) Fentanyl 50-200 mcg/hour IV
c. Refractory shivering (must be mechnically ventilated)
1) Propofol 20-100 mcg/kg/min IV titrated to reduce shivering
2) Neuromuscular Blockade: Assure sedation/ analgesia medications in place prior to starting

In the aneurysmal subarachnoid haemorrhage (SAH) population, a protocol was developed outlining major care issues and monitoring priorities. One of the most frequent potential complications associated with aneurysmal SAH leading to increase morbidity and mortality is vasospasm (Bederson et al. 2009). The complex management of these patients requires the interdisciplinary team to assess, monitor, intervene, and evaluate for vasospasm. Using the clinical exam in awake patients and invasive technology such as transcranial dopplers, ICP monitors, brain tissue oxygen monitors, and cerebral blood flow monitors in patients with a decrease level of consciousness requiring intubation for airway support, the team outlined important components of an aneurysmal SAH protocol. In order to assist with the translation to the bedside, critical thinking physician-ordered, nurse-driven algorithms were developed and implemented. This approach has led to consistency in care and trouble shooting of clinical scenarios.

Discussion

The use of nurse-driven protocols in critical care has been explored in the literature. In 2003, researchers explored the use of a nurse-driven protocol that allowed the nurse to select and start age-appropriate interventions to control procedural pain in paediatric patients in the emergency department (Meunier-Sham and Ryan 2003). The researchers used a computerised pre-established order set, which was initiated by a physician ordering "PainFree Measures per Protocol". By providing the nurses with the protocol and orders for PainFree Paediatric agents, the team was able to avoid delays in procedure start times by facilitating the achievement of a pain free intervention (Meunier-Sham and Ryan 2003). McKendry et al. 2004 studied whether using a nurse delivered protocol to optimise postoperative circulatory status in the early hours following cardiac surgery compared to standard perioperative care where the nurses would call for individual orders decreased ICU/hospital length of stay. The study results showed a trend towards fewer complications and lower ICU length of stay in the nurse delivered protocol group (McKendry et al. 2004).

In the mechanically ventilated patient population, there are several published studies on strategies using a nurse/therapist driven protocol for weaning patients from mechanical ventilation (Ely et al. 2001; Marelich et al. 2000; Dries et al. 2004; Tonnelier et al. 2005). These studies have found nurse-driven protocols safe, reduced mechanical ventilation days and ICU days, reduced ventilator associated pneumonia, and decreased complications.

Studies exploring the use of a nurse-directed protocol with regards to controlling hyperglycemia in critical care resulted in good control of elevated serum glucose with few hypoglycemic episodes. Strategies included physician pre-printed orders with ranges for treatment of elevated serum glucose with insulin as well as computerised protocols with set ranges for treatment (Meynaar et al. 2007; Osburne et al. 2006).

These studies provided validation to the use of a well-constructed hospital based protocol that provides physician directed, nurse-driven interventions used in the ICU. Mission Hospital's experiences with the implementation of these strategies have led to improved outcomes and increased nurse satisfaction.

Conclusion

Properly constructed, evidence based hospital protocols that provide ICU nurses with physician-ordered, nurse-driven interventions enhance the ability of the critical care team to deliver optimal care to the ICU patient population. The interdisciplinary team of practitioners possesses the ability to transform care in the ICU through collaboration and the translation of the scientific literature to practice.

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SURGE CAPACITY IN A COST-EFFECTIVE HEALTHCARE SYSTEM

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Increasing cost within the healthcare systems has enforced dramatic changes to prevent a disastrous outcome and to make it more efficient. Financial constraints are obvious in the generic planning phase for a real disaster. Economical restrictions have a huge impact on disaster planning. It is now the time to decide which disasters we will see in the future.

Worldwide, healthcare systems have been struggling with higher costs and demands of becoming more cost-effective. Despite our efforts diseases cannot be exterminated and treatments of curable diseases result in manifestation of new ones. For instance decreasing neonatal mortality has been replaced with diseases among aging population e.g. cancers, raising the need for new areas of competency, treatment alternatives and technologies (Khorram-Manesh et al. 2004). The latter is considered to be the highest cost increase for today's and future healthcare – a desirable improvement of the healthcare quality, but at a cost, which has not been included in our economical calculations (Culter 2001; Okunade 2002; Baker 2005; Di Matteo 2005; Bodenheimer 2005).

The Swedish healthcare system has seen dramatic changes during the last two decades. An increasing elderly population combined with improvements in medical technology and treatment facilities has led to a situation with an ever-increasing demand of healthcare. In a healthcare system that is almost 100% funded by taxpayers, and since Sweden has some of the highest income taxes in the world, increasing taxation rates has not been a viable political option. Instead these challenges have been met by several different measures:

- A more "efficient" hospital system has been created, often using large manufacturing industries as a "blueprint";
- The length of stay (LOS) has been reduced dramatically for all patient groups and more diseases and conditions are treated on an outpatient basis or in day-care surgery;
- Stockpiling of supplies has been replaced by systems of "same day delivery" (Carlsson 2007; OECD Health data 2008); and
- In the last 20 years, the number of hospital beds in Sweden has been reduced from around 100,000 to 26,000. Several emergency hospitals have closed or been converted to facilities dealing only with elective cases (OECD Health data 2008; Khorram-Manesh et al. 2009).

These changes have obvious implications for the hospital surge capacity in cases of major incidents or disasters – a fact that is rarely openly discussed (Khorram-Manesh et al. 2009). In disaster/armed conflict planning in the 1980's, it was assumed that 1/3 of all in-hospital patients in Sweden could be immediately discharged should there be an influx of trauma patients. Such an assumption would be completely unrealistic today! A major task for many consultants on call in Swedish emergency hospitals is to prioritise which patients must be discharged in order to make hospital beds accessible for newly admitted patients, a task sometimes referred to as "reverse triage". Overcrowding of hospitals is a common problem in many countries and often affects the ICUs.

From an economic point of view, the most efficient way of utilising given resources is a 100% occupancy at all given times. This can possibly be achieved in an ideal purely elective setting with much standardised care provided that none untoward events occur. In emergency care such a perfect balance between given resources and demand is much more difficult to achieve and maintain. In reality, certain key resources, e.g. ICU beds, are often over-utilised. However to have a preparedness that can deal with a sudden increase in demand for emergency care there must be a certain "reserve capacity" built into the system. This is what all emergency hospitals use on an everyday basis dealing with trauma alerts, myocardial infarctions or other potentially life-threatening conditions. Thus, medical preparedness - even for everyday emergencies - carries a cost and has to compete with other priorities within the healthcare system (Kohn 2000; Läkaresällskapet 2001; Prioriteringar i hälso- och sjukvården 2007). Preparedness to increase the capability of a hospital or a hospital system beyond

the everyday influx of emergencies in order to deal with a major incident/disaster ("surge capacity") will also draw resources. Perhaps there is positive aspect to the recent global terrorist actions and the on-going pandemic of influenza (A/H1N1) in that the resulting media coverage has highlighted the need for every hospital management to review their disaster plans.

The key question in attempting to increase the surge capacity is which costs can be justified in a sector that is under constant financial constraint? Decisions must be made based on estimates of realistic predictions on which disasters we will see in the future (risk assessment). Climate changes and global warming are additional hazards that might completely change both risks of incidents as well as vulnerabilities within our societies. The complexity of these issues merits a multi-disciplinary approach, in which relevant hospital and pre-hospital preparedness must be assessed by experts on disaster medicine. Financial constraints are obvious in the generic planning phase for a disaster, but often seem to evaporate in the aftermath of an actual event. The result is often costly actions with little or even counter-productive effects on the stricken society and population. It is time to realise that money spent on scientifically based generic plans on how to increase healthcare surge capacity is the way forward. It is time to get rid of the old myths regarding disasters!

References

Baker L, Birnbaum H, Geppert J, Mishol D and Moneur E. "The Relationship Between Technology Availability And Health Care Spending," Health Affairs, Web Exclusive 2005; 5: W3-537-W3-551

Bodenheimer T. High and Rising Health care Costs. Technologic Innovation. Ann Intern Med 2005; 142: 932-937

Cutler DM and McClellan M. "Is Technological Change In Medicine Worth It?" Health Affairs 2001; 20: 11-29

Di Matteo L. "The Macro Determinants of Health Expenditure in the United State and Canada: Assessing the Impact of Income, Age Distribution and Time," Health Policy 2005; 71: 23-42

Khorram-Manesh A, Ahlman H, Nilsson O, Odén A, Jansson S. Mortality associated with pheochromocytoma in a large Swedish cohort. Eur J Surg Oncol 2004; 30:556-559

Khorram-Manesh A, Hedelin A, Örtenwall P. Hospital-related incidents; causes and its impact on disaster preparedness and prehospital organisations. Scand J Trauma Resusc Emerg Med. 2009; 17: 26.

Kohn LT. Organizing and managing care in a changing health system. Health Serv Res. 2000; 35: 37-52

Läkaresällskapet. Prioriteringar – vad krävs för underlag för att göra bra horisontella prioriteringar 2001. "www.svls.se/cs-media-old /SvLSPublikat30/xyz/000152109.pdf

OECD Health Data (2008). www.oecd.org

Okunade AA and Murthy VNR. "Technology as a "Major Driver" of Health Care Costs: a Co-integration Analysis of the Newhouse Conjecture," J Health Econ 2002; 21: 147-159

Prioriteringar i hälso- och sjukvården. Socialstyrelsen analys och slutsatser utifrån rapporten "Vårdens alltför svåra val?" Artikelnr . 2007-103-4, www.socialstyrelse.se

Continued from page 20

As previously mentioned, ventilators and monitors are two of the most costly pieces of equipment to consider when outfitting any type of transport vehicle. Monitors are unique, due in large part to their wide variance in capabilities. As with any purchase, the mission profile of the agency must be evaluated prior to purchasing a monitor. Many monitors can be configured in an "a la carte" manner. This means that the external portion of the monitor may look the same, but the internal part of the machine may not be fully capable of performing all of the monitoring capabilities seen in a "fully loaded" or maximally configured device.

Some transport agencies have a mission profile that requires basic monitoring. Electrocardiogram (ECG) and non-invasive blood pressure monitoring (NIBP) are two pieces of data required by most agencies. This allows for monitoring of patient status by most any member of the transport team, from first responder to physician.

Specialty care transport agencies may require a monitoring device that is far more advanced. In addition to pulse oximetry, ECG and NIBP monitoring, the ability to monitor invasive pressures such as central venous pressure (CVP), intra-cranial pressure (ICP), intra-arterial pressure (IA), and even pulmonary artery pressures (PA) may be necessary. In addition to these pressure readings, temperature, and the ability to acquire and transmit a 12 lead electrocardiogram may be options that are required for patient care.

Manufacturers of both ventilators and monitors are constantly researching and evaluating ways to improve their ability to assist in the care of patients. As we look at devices, it is imperative that we not only look at what we need in a device today, but that we also look at our needs in the future. With due diligence in the evaluation and research stages, we can ensure that we make a well informed decision resulting in our patients receiving the best possible care regardless of the environment.

THE MEXICAN HEALTHCARE SYSTEM: THE PRACTICE OF CRITICAL CARE MEDICINE

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The United Mexican States, better known as Mexico, is conformed by 32 states and the capital city is Mexico City. Mexico has a total population of 103 million people (www.inegi.gob.mx). Every Mexican has the right to receive health protection stated in the 4th article of the "Constitución Politica de los Estados Unidos Mexicanos". Despite this constitutional right, the Mexican Healthcare System is complex and unequally distributed. According to the Organisation for Economic Co-operation and Development (www.oecd.org), Mexico is placed on the tail of countries with lowest investment in health from the Gross National Income (GNI) with 6.4%. Medical attention is mainly offered according to social level, 46.9 % of Mexicans have social security insurance, but nearly 50% of the population don't have any kind of insurance to cover medical expenses and these expenses must be paid directly from the consumers' pocket.

Intensive Care Units (ICUs) in Mexico

Although critical care medicine has been practiced for nearly 40 years in Mexico (www.ammcti.org.mx) there are not clear rules about its' practice within either the public (Social Security) or private system. There is a norm utilised in the basic design of an ICU, but it does not include specifications for equipment and supplies or specify who should lead the unit (intensivist or any other physician). Critical care practice is traditionally divided into critical care medicine for adults, children, and neonates, with the latter two attended by paediatricians and neonatologists. Mainly cardiologists attend specific cardiac ICUs or those with coronary units. Recently, the Health Secretary integrated a multitask force to develop the official Mexican norm in ICUs.

Social Security is available for the Labour class (~66.6% of population), the Federation workers (~14.0% of population), the Armed Forces, and employees of parastatal companies like the Mexican oil company PEMEX (~2.2% of population), and other governmental workers from the Mexican states (~6.1%). Recently a new programme called "Seguro Popular" was introduced and is managed by the Health Secretary (www.salud.gob.mx). This broader programme covers an additional ~11.1% of Mexico's population.

Public hospitals are classified according to the level of attention that is given. First Level includes primary care; Second Level hospitals mainly include hospitals with four specialties: Surgery, Internal Medicine, Paediatrics and Gynaecology/Obstetrics and Third Level Hospitals include most other subspecialties and are mainly referred to as "Medical Units of High Care". There is close interaction between first and second levels, as well as second and third levels. Intensive Care Units are placed in second and third level hospitals.

In the public system, ICUs are mainly closed, while in contrast, units in the private system are mainly open. Unfortunately, there is a shortage of intensivists in Mexico and as a result, ICUs are mainly attended by specialists from other fields like internal medicine, surgery, anaesthesiology and nephrology among others. There are highly specialised ICUs like trauma, gynaecology and obstetrics, neurointensive care mainly in the public system from important cities (Mexico City and capitals of each state). Three suburban hospitals (60 beds each) have recently started working with telepresence in their ICUs. Using robots (RP7i) is being increasingly accepted as a new and practical way of solving the shortage of intensivists in hospitals where there are not specialists available 24/7.

The State of Mexico is leading this new practice in Mexico offering high care specialists to ICUs localised in distant cities. This "robotic programme" is focussed on protecting and serving those people without social security or "Seguro Popular" who are situated in suburban cities.

Specialisation in Critical Care Medicine in Mexico

Several universities around Mexico offer a specialisation in Critical Care Medicine, which is taken

at third level or high care affiliated hospitals. The critical care medicine programme for adults involves a minimum of four years of training. The physicians should have at least two years of a basic specialty (internal medicine, anaesthesiology, surgery, gynaecology and obstetrics) and complete another two for Critical Care. However, it is preferred and physicians are encouraged to have already completed a first specialty before entering critical care medicine.

After training, physicians receive a diploma from the affiliate hospital and the university where he or she finished the specialisation course. Thereafter, specialists must take an examination given by the Mexican Council of Critical Care Medicine in order to receive approval to practice in critical care and be certified by the National Academy of Medicine of Mexico. Today there are 1039 certified specialists in critical care medicine in Mexico and nearly 40% are located in Mexico City (www.conacem.anmm.org.mx). Finally, doctors have to receive a registered license of specialist, which is given by the Public Education Secretary; this is the most important document to the practice of critical care medicine.

Job Opportunities

In Mexico, after finishing their training, intensivists can work either in the public system (which is the most important employer of specialists), in the private system, at universities or within all three. Salaries are fixed ~$ 25 000 US dollars per year, which compared with incomes in other countries in North America, Asia or Europe is relatively low. This is seen as one of the major flaws in the system as it forces intensivists to seek a second or even third job in addition to their primary full time position.

There are other options available within the private system: One possibility is to work along with a multidisciplinary team; another is to work directly for a hospital and be on the payroll (although the salary is more or less the same as in public hospitals) and a third option is to practice on their own as specialist (internal medicine, surgery, anaesthesiology). Universities often offer jobs to intensivists who are interested in following an academic career in teaching and/or research.

Continual Education for Intensivists

The AMMCTI (Asociación Mexicana De Medicina Critica y Terapia Intensiva), founded in 1972, is the most important association for intensivists in Mexico and is the organisation, which looks after continual education. Every year a national congress is held in a major city in Mexico, where more than a thousand doctors and nurses unite and discuss important topics in critical care along with highly recognised speakers from around the world. Also, there are monthly nation-wide sessions transmitted by internet (www.ammcti.org.mx). AMMCTI has nineteen branches located in cities all around Mexico and it is divided into three regions: Central, North and South. Additionally, AMMCTI has a peer-reviewed journal in Spanish, indexed to Latin American indices, with printed and web versions. There are representative chairs in critical care medicine at the most important Academies in Mexico, the National Academy of Medicine of Mexico (www.anmm.org.mx), Mexican Academy of Sciences (www.amc.unam.mx) and the Mexican Academy of Surgery (www.amc.org.mx).

Research

Research in critical care in Mexico is still undeveloped. This is due to the federal government investing more in social care and medical assistance than in research, only 0.33% of the GNI (www.amc.unam.mx). Despite that, there are several groups that publish their experiences in Spanish publications and contribute to local journals. Additionally, groups of intensivists have participated in international multicentre trials (i.e. the EPIC II study, and others sponsored by the pharmaceutical industry).

The ICU Team

It is worth mentioning that there could not be a viable ICU team without critical care nurses and respiratory care technicians- who are important caregivers for the critically ill patient. The ratio of care nurses to patients is 1 to 2 in most public and private ICUs. In Mexico, nursing is a professional career that requires five years of university. To obtain a

Mexico: Facts and Figures

Total population:	105,342,000
Gross national income per capita (PPP international $):	11,990
Life expectancy at birth m/f (years):	72/77
Healthy life expectancy at birth m/f (years, 2003):	63/68
Probability of dying under five (per 1 000 live births):	35
Probability of dying between 15 and 60 years m/f (per 1 000 population):	155/89
Total expenditure on health per capita (Intl $, 2006):	756
Total expenditure on health as % of GDP (2006):	6.2

Figures are for 2006 unless indicated. Source: **www.who.int/whosis/en/index.html**
World Health Statistics 2008

ICU MANAGEMENT

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specialisation in intensive care, nurses have to take another year of training. With a professional career, nurses can work towards a master's degree and/or doctorate in the same manner as physicians. Also, they should have a registered license from the Public Education Secretary (www.sep.gob.mx). In Mexico, nurses have their Mexican Nurses Association in Intensive Care Medicine (AMMENCTI, from their meaning in Spanish) and hold their annual congress along with the AMMCTI at the same days and places. The respiratory care technicians have a three years course recognised by the Public Education Secretary and a registered license for practicing respiratory care (www.conalep.edu.mx).

The Future

New opportunities are emerging for intensivists to practice: echocardiography, telepresence with robots in remote ICUs, sub specialisations in obstetrics, neurological critical care and recently, the practice of rapid response teams, as well as pursuit of further master's degrees and doctorates. There are opportunities for improvement in quality of care and safety in the future in ICUs in Mexico, and there are figures excluded from our system, which point to the inclusion of a pharmacist and a specialist in rehabilitation within the ICU. Every day we work to promote our specialty as well as to increase the standard of safety and care to international levels.

EXPERIENCE FROM THE INFLUENZA OUTBREAK IN MEXICO

Gilberto Felipe Vazquez de Anda, MD, PhD

Background: Natural Disasters

Mexico has suffered from more than its' fair share of disasters. In 1985, an earthquake struck Mexico City killing more than 10 000 inhabitants and destroying or disabling the most important high care hospitals. Following the earthquake, Mexican society showed a deep sense of humanity, solidarity and awareness about the importance of being prepared for disasters. New laws and rules were created with regards to the design of hospitals and skyscrapers in high risk zones, the Civil Protection Secretary was created and special education, "disaster teams" for first aid were introduced, evacuation routes for every building and simulations were planned to protect the population in case of a new treat of earthquake, fire or flood. A sonar system was installed at the pacific shore as to send an alarm 40 seconds before an earthquake would hit Mexico City. In 1988, another natural disaster occurred – hurricane Gilberto struck Mexico twice, first in the Yucatan peninsula in the city of Cancun and then at the other site of the Gulf of Mexico in the northern city of Monterrey, leaving hundreds of deaths and economic losses of millions of dollars in its wake. However, despite these recent natural disasters, and the preparation that resulted, we were not prepared for an epidemical or biological disaster.

Outbreak

The Influenza outbreak observed from March to May 2009 in several cities of Mexico mainly affected the fragile intensive care system and the health system in general, showing deep flaws and a general lack of knowledge of how to act and react in case of an epidemical event. It took nearly a month to fit all the pieces together and to see that we were facing an outbreak with a serious threat for the population at large and given our lack of experience in this type of case, we did not know what to do. Additionally, there were concerns with regards to the health workers, they were highly exposed to the virus due to their inexperience and insufficient protection equipment and supplies. Mexican health authorities sent an epidemiological alert about the known cases of influenza on April 16th, 2009. The same day, the Mexican Association of Critical Care Medicine (AMMCTI) held its monthly session, at which an important subject was discussed: The increasing number of cases of severe pneumonia in younger people. These cases were invading intensive care units (ICUs) across the country and were associated with high acute respiratory failure, multi organ failure and high mortality. A common pattern was observed: All patients in these cases were below 65 years, obese, with severe hypoxemia and there were difficulties to ventilate them. Also, it was apparent that health workers were becoming infected by patients despite taking the usual precautions. Of course, the highest numbers of cases of infected health workers were observed in the first days of the outbreak, in March and April. Those professionals who participated in this session were very concerned and motivated to rectify the issues and change our current course. A major concern was in our minds – we were facing an outbreak of influenza, which we were not prepared for, and had no plan at all to deal with a biological disaster like the one that was facing us. Our highly demanded ICUs, which most of the time are full of patients, might be under further demand from patients suffering from the epidemic- our primary concern at that time was the knowledge that there were not enough ventilators available for all patients who would require ventilatory support. Additionally, ICUs were not designed with negative pressure rooms, doctors and nurses were not trained to attend patients with highly transmissible infections, and there was not proper safety equipment to protect them during patient care in the ICU. There was a high probability, given these problems, of this epidemic causing the total failure of the healthcare system.

Organisation and Planning

Members of the AMMCTI agreed to start organising ourselves to make an action

plan for an eventful outbreak of influenza. Colleagues from Mexico City and from all over Mexico were informed about the epidemic, and advised on how to treat patients and how to protect doctors, nurses and other health workers, as well as prepare for the number of patients which were admitted in their units with severe pneumonia. We were acutely aware that the impact of the outbreak would be on ICUs.

By April 21, we sent a call for help to some colleagues, mainly those who had previous experience with SARS, in an attempt to get specific recommendations on appropriate measures of protection, and the supplies and equipment that we would require. Members of the AMMCTI became involved in committees organised by the federal Health Secretary and the more localised health system from the states. We were just three days ahead of the official announcement of the new virus causing the infection in Mexico when we received the first responses to our call for help. The responders, Randy Wax from University of Toronto and Edgar Jimenez from University of Florida, took immediate action and scheduled a series of web talks about protection from the spread of infection in cases of biological disasters. Also the AMMCTI designed a specific web page with information about influenza, primary care and information about how to avoid transmission.

International Response

Exactly one week after our meeting, the President of Mexico announced that México was facing an outbreak of a new type of virus of influenza, the swine origin flu AH1N1, and for that reason schools, universities and public buildings had to be closed the very next day in order to cut down the transmission of the virus in a city of nearly 20 million people. For the three weeks that followed, Mexico was immersed in what several called the first pandemic of the new era. People started wearing facemasks in public settings, rapidly depleting stocks of these products even in hardware stores. In hospitals, especially within ICUs and ERs there were insufficient supplies to attend to the demand of patients with flu, and there was a lack of diagnostic tests and antiviral treatments. Mexican health authorities took drastic measures to efficiently control the epidemic; and a special budget was authorised to buy supplies, equipment, diagnostic tests and treatment with antivirals. However, in the first days of the outbreak, there was an overwhelming feeling of fear and hopeless when patients crowded the ER and there were mass transfers into ICUs. The web talks that were given by Dr. Edgar Jimenez and Dr. Randy Wax were well attended by doctors, nurses, and administrators from several hospitals in Mexico City and in other cities. The Critical Care Society web page provided information about influenza, and there were numerous other examples of solidarity, like the letters to members of the AMMCTI sent by the president of the SCCM and colleagues from all over the world (Canada, USA, China, Spain, and Germany, among others).

Mexico deserves global gratitude for its forceful, costly, courageous and timely response to the flu. The national shutdown in Mexico, which caused Cuba and Argentina to cancel flights to the country, helped slow the initial spread of the virus.

"Mexico gave the world an early warning, and it also gave the world a model of rapid and transparent reporting, aggressive control measures, and generous sharing of data and samples,"

said World Health Organisation Director-General Dr. Margaret Chan.

The health secretary, the federal government and the government of states involved in the outbreak gave supplies for protection, diagnosis and treatment. Members of the AMMCTI designed a decision making chart for treatment of acute respiratory failure secondary to severe pneumonia, and were involved in most of the committees during the outbreak.

Despite the fact that influenza virus AH1N1 was virulent, the associated mortality was relatively low, but the economic impact was quite high. The epidemic has spread rapidly all over the world and has reached the level of pandemic according to WHO. Now we are preparing the second strike for this coming winter and schools, universities, public buildings, federal and local governments are working intensively to prepare people for the potential reoccurrance of the outbreak.

What we learned from the epidemic was that we have to have a plan for biological disasters, that mother nature can strike at any moment and most of the time is not so benevolent. For that reason the Secretary of Health together with a multidisciplinary team is working to map out directives on the minimal equipment and supplies needed for ICUs to guarantee medical attention for severely ill patients under these extreme circumstances. Also, there is a nationwide campaign underway to show the population how to act in case of an epidemic, and how to prevent transmission. In the State of Mexico there is a telepresence programme which utilises robots and the internet to treat patients in distant cities.

Since the outbreak, we have returned somewhat to what we call normality, but we are mindful of the immediate need to prepare for the potential reappearance of influenza this coming winter. The health system is preparing the population with information about how to prevent influenza, primary care measures to avoid transmission of the virus, a daily count of new cases, mortality, statistics, improvement of equipment and supplies, symposiums, etc.

Conclusion

With the initial phase of this epidemic nearing completion in our area, we are able to finally reflect on our state of preparedness for disasters. It has become clear that it is a priority to plan for the possibility of all types of disaster, not just the predictable events such as hurricanes or earthquakes, in every ICU of Mexico. Of crucial importance with regards specifically to biological threats is the improvement of efficient medical attention for critically ill patients, the protection of health workers from highly virulent viruses and/or bacteria and the decrease of mortality by careful monitoring of vulnerable patient populations during outbreaks. At this point, we feel relatively confident of our position should we face an outbreak in the future, however we must challenge ourselves to act in an even more organised and rapid way to save more lives than we did in our recent showdown with AH1N1.

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seconds). A crush injury can be caused by the patient's own weight in case of unconsciousness related to poisoning, drug overdose, strenuous exercise or during prolonged anaesthesia, especially if the patient has a high body mass index (BMI). External causes of increased extremity CP are mainly related to trauma with fractures (especially of the tibia) and tight plaster casts, muscle contusions, bleeding disorders, burns (with eschars), venous obstruction, arterial occlusion with post ischaemic swelling, all causing muscle compression and further crush injury. This will result in muscle compression and rhabdomyolysis, which may cause hypovolemia, acute kidney injury and failure, coagulopathy, acute lung injury (ALI) and shock. Hence the increased extremity CP may have a distant effect on other organs. Besides aggressive fluid resuscitation, the only definitive treatment if CP rises above 30 mmHg is decompressive fasciotomy with muscle debridement in case of necrosis. Increased IAP related to ACS or Pelvic CS can have an effect on extremity CP due to the diminished venous return from the extremities to the central circulation causing further limb swelling.

Hepatic Compartment Syndrome – HCS

Within the capsule of the liver itself, local haematoma formation caused by trauma or bleeding diathesis (e.g. oral anticoagulants, liver cirrhosis,…) may have an adverse affect on tissue perfusion causing a local hepatic compartment syndrome. The liver appears to be particularly susceptible to injury in the presence of elevated surrounding pressures, thus especially in case of IAH or ACS. Animal and human studies have shown impairment of hepatic cell function and liver perfusion even with only moderately elevated IAP of 10 mmHg. Furthermore, acute liver failure, decompensated chronic liver disease and liver transplantation are frequently complicated by IAH and ACS. Close monitoring and early recognition of IAH, followed by aggressive treatment may confer an outcome benefit in patients with liver disease. In the management of these patients it might be useful to monitor the plasma disappearance rate (PDR) for indocyaninegreen (ICG) as this correlates not only with liver function and perfusion but also with IAP. Since cytochrome P450 function may be altered in case of IAH/ACS, medication doses should be adapted accordingly. With increasing IAP, there is decreased hepatic arterial flow, decreased venous portal flow and an increase in the portacollateral circulation, which all exerts physiological effects with decreased lactate clearance, altered glucose metabolism and altered mitochondrial function.

Renal Compartment Syndrome – RCS

Intra-abdominal hypertension (IAH) has been associated with renal impairment for over 150 years. It is only recently however that a clinically recognised relationship has been found. Elevated IAP significantly decreases renal artery blood flow and compresses the renal vein leading to renal dysfunction and failure. Oliguria develops at an IAP of 15 mmHg and anuria at 25 mmHg in the presence of normovolemia and at lower levels of IAP in the patient with hypovolemia or sepsis. Renal perfusion pressure (RPP) and renal filtration gradient (FG) have been proposed as key factors in the development of IAP-induced renal failure.

- $RPP = MAP - RVP$
  - Where RVP = renal vein pressure
- $FG = GFP - PTP = RPP - PTP =$
  $(MAP - RVP) - RVP = MAP - 2*RVP$
  - Where GFP = glomerular filtration pressure
  - And PTP = proximal tubular pressure

In conditions of increased IAP, the RVP may be substituted by IAP, or thus:

- $RPP = MAP - IAP$
- $FG = MAP - 2*IAP$
  - Thus, changes in IAP have a greater impact upon renal function and urine production than will changes in MAP. It should not be surprising, therefore, that decreased renal function, as evidenced by development of oliguria, is one of the first visible signs of IAH. An increasing number of large clinical studies have identified that IAH (³15mmHg) is independently associated with renal impairment and increased mortality. The etiology of these changes is not entirely well established, however it may be multifactorial: Reduced renal perfusion, reduced cardiac output and increased systemic vascular resistance and alterations in humeral and neurogenic factors. Within the capsule of the kidney itself, local haematoma formation (caused by trauma or bleeding diathesis) may have an adverse affect on tissue perfusion causing a local renal compartment syndrome.

Conclusions

First suggested in 2007, the polycompartment syndrome is a constellation of the physiologic sequelae of increased compartment pressures, be it ICP, ITP or IAP. Recent observations suggest an increasing frequency of this complication in all types of patients and increased compartment pressures are independently associated with morbidity and mortality. Even chronic elevations of CP seem to affect the various organ systems in the body. In spite of this, the syndrome is still in its infant stage and remains poorly recognised and thus poorly treated in some cases. The diagnosis relies largely on CP measurement. Within the polycompartment syndrome the abdomen plays a central role and the effect of IAH on different organ systems has been described, along with recommendations to compensate for these effects. The ultimate goal of treatment is not only to decrease the CP, but also to improve organ function and to decrease mortality. Decompressive craniectomy, sternotomy, fasciotomy and laparotomy are the only treatment options that have been shown to reach most of these goals today. However, some less invasive techniques and some medical treatment strategies have shown promise in achieving CP reduction as well as organ function improvement. The bottom line is that futile crystalloid over-resuscitation may cause (iatrogenic) secondary ACS, while the cautious administration of colloids not only seems to decrease the incidence of ACS in burn and trauma patients but also the ACS associated complications and mortality as well as the complications related to increased pressures in other compartments.

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Security

Security is a vital link in disaster response. If your emergency department has four shooting victims arrive from a gang shooting, do you automatically "lock down" the emergency department? How difficult is it just to secure your emergency department? Does your facility have the ability to completely secure every entrance? How big is your security force? Historical data has shown that the majority of patients from a large-scale event will self-transport to the closest hospital. (Figure 1, below) Along with the concern of a large influx of patients, the United States Center for Disease Control has found several problems for hospitals that are common when patients self transport from a mass casualty scene. (Figure 2, page 44)

Figure 1. Recent Mass Casualty Incidents with Patient Self-Transport

Virginia Tech Shooting
04/16/09
The first student who was shot walked onto a city bus and took it to the local hospital. This patient arrived and immediately created a security nightmare in the small emergency department.

New York City Terrorist Attack
09/11/01
911 patients were received at the two closest hospitals, with 85% self-transporting.

Tokyo Subway Sarin Gas Attack
March 20, 1995
5500 injuries, with 85% self-transporting. All patients required chemical decontamination upon arrival at the hospital.

If a major event happened blocks from your hospital, would you be able to completely lock down your hospital and prepare for the onslaught of patients? If there were an incident at an elementary school which numerous injured children, could your hospital handle the influx of worried parents? How many security officers would it take to secure every entrance at your facility? If you gave the orders right now to lock down your hospital, how long would it take? Could you secure your facility within five minutes? Odds are, in a real event, you will have less than five minutes after notification to prepare for the onslaught of patients.

Security is vital in protecting the facility from the rush of injured patients and the "worried well", but could your hospital actually be a target of terrorist activity? The attacks by the Al-Qaeda trained Chechens in Georgia have shown that hospitals are often considered as targets by terrorists. Chechen rebels have attacked hospitals both as primary and secondary targets. What better way to completely decimate a community then to injure people and destroy the place where they would be treated?

One of the biggest threats is also one of the hardest to protect against. The use of car bombs has proven an effective weapon that is difficult to prevent. Most hospitals are designed to allow for vehicles to pull up close to the building to facilitate loading and unloading passengers. How easy would it be for a car bomb to pull into your emergency department? Odds are, they would be able to park within 20 feet of the entrance to your facility. More and more high-threat buildings being built are having counter-measures designed and installed to deter car bombs. Unfortunately, convenience is the price that is paid for increased security to minimise this threat.

Decontamination

When was the last time that your staff unpacked all of the patient decontamination equipment and practiced with it? We have had the opportunity to teach disaster decontamination at several hospitals. It is always disheartening to see staff open up equipment that is several years old and still in the original package. Our history has shown us that over half of the participants in these disaster preparation classes have never seen their hospital's decontamination equipment prior to the class. However, each of the participants in the class was already assigned an active role in their hospital's disaster response plan.

All personnel who have an active role in the disaster plan that is outside of their normal daily duties should have routine training. The complexity of their role should dictate the frequency of their training. Personnel who have a complex role (i.e. patient decontamination) should train at least quarterly on their duties. At Spartanburg Regional Medical Center in Spartanburg, South Carolina (United States), the hospital emergency response team (HERT) is comprised of personnel from all disciplines. These personnel train often and are ready to respond at a moment's notice to threats to the facility of any level.

Surge Capacity

Surge capacity is the hospital's ability to rapidly expand services in order to accommodate an unanticipated influx of patients in the event of a large-scale event. Hospitals throughout the world are faced with daily staffing shortages. In many places, hospital personnel are already providing care at suboptimal patient care ratios. Hospitals are staffed based on daily, anticipated capacity, not for the unusual. A study of hospitals in the Los Angeles, California (United States) area found that out of 45 area hospitals, almost all operated all constant full capacity with very little ability to handle surge capacity.

To stress this point, the problem of "patient parking" has become more common in the United States. Patient parking occurs when an emergency department is too full to accept a patient, and does not allow the ambulance to offload the patient, but instead requires the crew to wait with the patient until a bed is available. Patient parking has often times result-

ed in an ambulance waiting hours with patients for a bed to become free. This obviously has a massive negative impact on the abilities and efficiency of the ambulance service.

What is your daily surge capacity at your facility? Do you share information each day with other local hospitals to see the availability of beds in the event of a large disaster? If you do not want to share this information with competing hospitals, do you send the information to a neutral third party such as the emergency services provider? The person(s) in the community with the responsibility to manage disaster must have bed capacity information provided to them daily.

Figure 2. Evidence-Based Problems with Patient Self-Transport in WMD Events

- Arrival of patients to the hospital with no prior notice;
- Patients will converge on either the closest hospital, or the locally most renowned hospital;
- Arrival of patients to the hospital who have not been previously triaged;
- Arrival of patients without prior decontamination;
- Patients are placed in hospital rooms without staff being aware that they are contaminated;
- The least injured patients will arrive first, tying up valuable resources;
- Secondary decontamination of hospital staff, and
- A significant delay in the hospital learning what chemical(s) are involved in the attack.

Evidence-based disaster medicine shows that for every patient who arrives to the hospital with physical injuries, five more will arrive with psychological injuries (Hankins 2009). Most patients will self-present at the hospital within one hour of the incident.

The optimal method for predicting and preparing for hospital surge capacity is not yet known. However, hospitals should strive to prepare for a myriad of incidents that can occur in their community that would produce multiple patients. It is also hard to predict the disaster that may exhaust specific resources such as surgical suites, ventilators, or burn beds. Literature from previous mass casualty disasters shows that the majority of patients will be discharged from the hospital within 24 – 72 hours following admission (Einav-Bromiker and Schecter 2009).

Reliability on External Resources

When we have provided disaster training, we have had the opportunity to review multiple hospitals' disaster plans. An all hazard plan that relies on outside agencies or resources to mitigate a disaster is a set up for failure. Many hospitals are under the false impression that the local emergency services agency will be able to assist with patient decontamination in the event of a large incident. If there is a large hazardous materials incident, the emergency service's primary obligation is to mitigate the incident. Fire department and ambulance resources cannot be dedicated to assisting hospitals with decontamination. If resources are available, emergency service agencies would be more than willing to assist, but they cannot be counted on in the disaster plan. Hospitals must be as self-sufficient as possible, and designed to operate for at least seven days before receiving outside help.

Relationships

When a hospital or community suffers from a disaster, it is imperative that in addition to being self-sufficient, they must also have a working relationship with other facilities in the area. These relationships may be with direct competitors and facilities that are not typically encountered on a daily basis. By developing relationships in advance of a disaster, the call for assistance made by your hospital in the event of disaster will not be made to a stranger. It has been proven time and time again that relationships forged in advance of a disaster can pay dividends in the event an actual disaster.

Disaster Drills

The Joint Commission on Accreditation of Healthcare Organisations (JCAHO) requires all hospitals in the United States to test their emergency plan twice a year, including one community-wide drill. The authors recently were involved as instructors in a large community disaster drill. Every hospital in the community was asked to participate in the drill. It was rather disheartening to hear several of the hospitals decline to participate in the drill with each offering the same excuse: "We are under-staffed. We can't afford to send anyone to the drill, nor can any of the mock patients come to our facility." What better way to test your ability to respond to a disaster then when you are already short staffed! Disaster drills should be realistic as possible, and under-staffed hospitals are a very realistic issue!

Conclusion

In closing, disaster planning should encompass all legitimate threats. Hospitals must consider the possibility of being a primary target in terrorist operations. In order to limit the impact of a large-scale disaster, hospitals must have multiple systems of redundancy to back up their critical infrastructures. Hospitals must also limit their reliance on outside agencies to provide support during disasters. Ideally, hospitals should be completely self-sufficient for a minimum of seven days. Hospitals must routinely train and drill participants on their roles and responsibilities in a disaster. By emphasising these core components of disaster management, hospitals minimise the impact to their operational abilities during a large-scale disaster.

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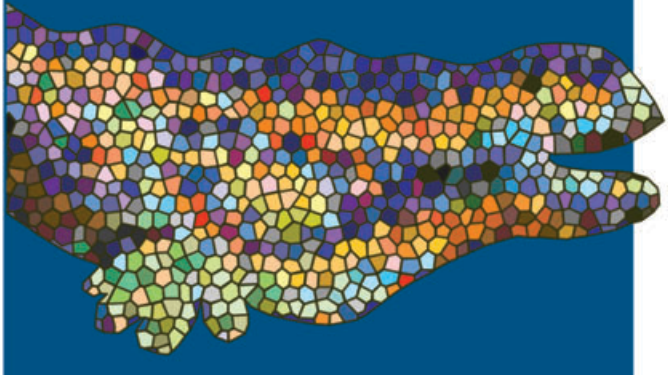

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EUROANAESTHESIA 2009

Euroanaesthesia 2009, the annual scientific meeting of the European Society of Anaesthesiology, took place at the beginning of June in the Milano Convention Centre, the largest convention centre in Italy.

Over its four days, around 5,500 delegates attended. Most participants pre-registered, but around 15% registered on the day. Euroanaesthesia has a similar format to most major medical conferences, in that there is a large industrial exhibition, with almost 100 industrial stands and scientific and educational content comprised of refresher course lectures, scientific updates, hands-on workshops, interactive sessions and abstract presentations.

Euroanaesthesia is a general conference, which aims to provide a broad range and depth of content, with something for everyone from novice to expert. The scientific programme is planned by a series of subcommittees covering fields as diverse as paediatrics, respiration, intensive care and ethics. A new subcommittee this year now covers peri-operative management of the elderly – an increasingly important cohort of patients.

The Milano Convention Centre provided an excellent, spacious venue for the congress. As delegates have come to expect, the standard of speakers was high. The ESA deliberately seeks new speakers, rather than relying on purely the well known. The result is a mix of speakers, some are undoubtedly world experts, and others are likely to become world experts in a few years time.

Many of the delegates are able to come to Euroanaesthesia by virtue of the reduced rates available to abstract presenters. Close to 800 abstracts were presented in poster format; around 67% of submitted abstracts are accepted. The standard of poster presentations is generally high and reported studies include full-scale trials, basic science and cohort studies. With presenters from all around the world, there was the occasional language problem, but with good humour and patience these were usually overcome. The best 6 abstracts were presented orally, with prizes for the top three. The winner this year was Malin Jonsson Fagerlund (Sweden) with a paper entitled: "The functional affinity for propofol is dramatically decreased in human $\alpha 1\beta 2(N290M)\gamma 2$ and $\alpha 2\beta 3$-$(N290M)\gamma 2$ mutant GABAA receptors".

Aside from the scientific presentations, delegates spent time browsing the industrial exhibition. Despite the economic downturn, around 100 companies came to the congress, again covering the whole of anaesthesia and intensive care related pharmacology and technology. One of the interesting aspects of returning to the same congress is observing the subtle, or not so subtle, ways in which industry changes the way products are marketed. Non-invasive monitoring of cardiac output was one of the rising stars this year, with established and new products vying for delegates' attention.

As well as the science and industrial exhibitions, Euroanaesthesia includes a prize giving ceremony. Every year, successful candidates of the European Diploma of Anaesthesiology and Intensive Care are awarded their diploma. This year was a special year: it is 25 years since the Diploma was founded, and the ESA was pleased to be able to honour this achievement. The EDA is actually believed to be the oldest surviving European medical diploma.

The Dräger company have sponsored a prize for the last few years for the best paper published by a European group in the field of intensive care. This year there was strong competition. Following a very rigorous approval process, the Dräger prize was awarded to Peter Radermacher and the Universitätsklinik für Anästhesiologie, Ulm, Germany for their paper: Effects of ventilation with 100% oxygen during early hyperdynamic porcine fecal peritonitis. Barth E, Bassi G, Maybauer DM et al. Critical Care Medicine; 2008;36:495-503.

Outside of the congress, delegates had the opportunity to explore the renaissance wonders and fashion of Milan. Eating out was a pleasure, with fine food and drink available in a multitude of restaurants and bars. The networking evening was a Renaissance themed event in the grounds of at the beautiful main state university of Milan "Università degli Studi di Milano". Delicious Italian specialities were served from the generous buffet tables with entertainment provided by renaissance singers, dancers and jugglers.

Overall the congress was judged a success, both by delegates and by the ESA. The ESA looks forward to welcoming people to its 2010 congress in Helsinki.

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AGENDA

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11-13 The Critical Care Canada Forum 2009
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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
www.infections-online.com

JANUARY 2010

9-13 Society of Critical Care Medicine's (SCCM) 39th Critical Care Congress
Miami Beach, Florida, USA
www.sccm.org

MARCH 2010

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

JUNE 2010

8-11 19th International Vicenza Course on Critical Care Nephrology
Vicenza, Italy
www.nefrologiavicenza.it

12-15 Euroanaesthesia 2010
Helsinki, Finland
www.euroanaesthesia.org

OCTOBER 2010

1-2 World Conference on Portable, Wearable and Miniaturized Dialysis Systems
Vicenza, Italy
www.nefrologiavicenza.it

10-13 23rd Annual Congress ESICM
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www.esicm.org

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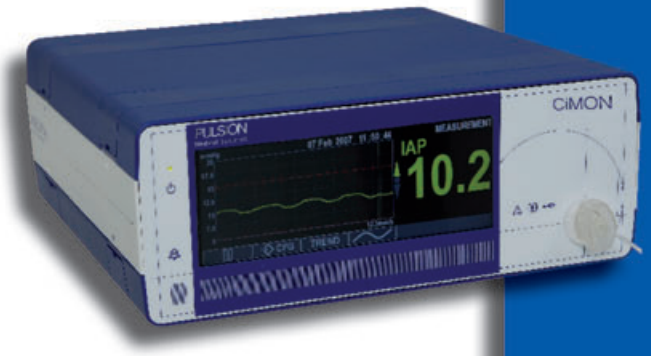

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