ICU MANAGEMENT

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TECHNOLOGY

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TECHNOLOGY

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Aside from the usual highlights of the International Symposium of Intensive Care and Emergency Medicine, this 30th anniversary meeting provides us with a rare opportunity to look back and consider the evolution of the field and to take stock of what we have accomplished over the last three decades.

It is interesting, for instance to note, that while technology has asserted a dominant role in our daily workflow, there have been no "quantum leaps" in the field- no intervention or drug that we can say has been developed as a silver bullet for treatment. Although I value the use of agents such as activated Protein C, some people challenge the use of the drug based on its benefit/risk profile. Certainly, we have made some progress with research into biomarkers, but we cannot yet point to one marker or another to definitively work in treatment of specific patient groups.

While it is difficult to measure the true impact that technology has had on intensive care as a field over time, or the influence it may have for our profession and our patient's lives in the years to come, I can certainly attest to the impact it has had on the organisation of our meetings. When I started planning the first symposium, back in 1980, there were no computers or even word processing programmes. I recall taking out my typewriter and personally typing up some letters to invite a few friends to join the faculty of this new meeting. The advent of computers, the Internet and instant messaging has opened the floodgates of global communications and helped us grow as a meeting exponentially – it is nearly impossible now to imagine how it could have happened without these efficient tools!

Within our units, the presence of technology is also continuously felt and heard. Ventilators, cardiac monitors and infusion pumps are all staples of a modern intensive care unit. But outside of these life-supporting devices, increasingly, technology is also bridging the gap in terms of the administrative requirements and diagnostic decisions we intensivists make on a daily basis.

In this edition of ICU Management centred on Technology, we begin with an overview of e-health and safety, which discusses how to utilise technology to reduce risks to patients and improve efficiency in our ICUs. Next we look at a programme called the "Patient Admissions Prediction Tool" that aims to assist with the allocation of inpatient beds to alleviate overcrowding and staffing issues in the emergency department. As antimicrobial resistance and antibiotic use continue to be timely topics, we learn about an easy-to-use computer surveillance system that has reportedly improved outcomes in a Belgian ICU. To round out this cover story, we have included an article describing a successful telepresence program in Mexico that combines robotics and telecommunications.

In the Matrix, we keep to the theme with a focus on automated hand hygiene monitoring as a technology-based response to the problem of hospital-acquired infections, and we wrap up our series on early mobility with an overview of the resources required – both equipment and staff, to implement a mobility programme in your ICU.

We look further into the cost effectiveness of all of this medical technology on offer in our Management section, and we take a brief look at Switzerland in our Country Focus.

Intensive care medicine is a continuum and I am sure that we will continue to make progress. What we have seen is that is our patient populations are getting older and older- the majority were in their 40s thirty years ago, and now they are mainly in their 60s (63-64 as a mean value in Europe and in other continents as well). Additionally patients with similar severity these days have much lower mortality rates with sepsis and other diseases, so clearly progress has been made that cannot be attributed to any well-defined step-ups in our therapies. Hopefully with further advances in technology, our continued efforts perfecting interventions and treatment strategies as well as continuing pharmaceutical research and multi-centred studies, silver bullet and quantum leaps aside, we will continue to improve mortality rates and quality of care for our patients.

Jean-Louis Vincent

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30TH ISICEM: REFLECTING ON THREE DECADES OF EMERGENCY AND INTENSIVE CARE MEDICINE

It has been 30 years since the first International Symposium of Intensive Care and Emergency Medicine was held. The Founder and Chairman of the meeting, Jean-Louis Vincent sat down with ICU Management Managing Editor Sherry Scharff to reflect on the early beginnings of ISICEM and to discuss the future of the symposium and the broader field of intensive care.

S.S.-30 years, three decades… That's quite a long time! Can you believe it?

J.L.V- No, no, no- I can hardly believe that this child – that is the way I think about it, like another child, is thirty! I remember those early days like they were yesterday… I did the completion of my training in critical care medicine in the U.S. under Dr. Weil in Los Angeles (from 1977-1979). Dr. Weil already had quite a successful symposium set up to update all aspects of critical care medicine and when I came back, I recognised that there was nothing similar in Europe, so I thought I should start the same thing here. So without any budget, without anything- I decided that I would plan it for March, and in 1981 I held the first International Symposium of Intensive Care and Emergency Medicine. At that time, it was possible to get some sponsorship from companies, and so I could invite 5 or 6 friends from abroad to join the faculty.

The first symposium was at the Erasme hospital and we used the 200-seat auditorium. In the end it was too small, so we organised a video transmission for another 20-30 people. I believe we were altogether around 250. In the second year, we moved to the University of Brussels, where they have two auditoriums, and we started simultaneous sessions with about 300, 400, 500 people. After a few years we moved to the congress centre in the middle of Brussels, and we continued to grow there until that place also became too small- so we moved the Exhibition Centre just outside the centre of the city.

S.S.-Were you surprised by the success of the initial years?

J.L.V- No, to be honest, I wasn't really surprised because I knew that there was really a need for this. Intensive Care was a new specialty, rapidly growing and ISICEM started at the right time so there was a supply and demand scenario at play. People wanted information and networking and it was available at the right time. It was, in fact, a kind of snowball effect, as the participants grew, so too did industry interest. Every year we had more people, and more industry support, which allows for a better faculty from varying areas, among other things.

S.S.-What sets ISICEM apart from all of the other congresses and meetings?

J.L.V- The key to our success is clearly the high quality of the programme, the low registration fees, the good organisation of the meeting as a whole and specifically of the programme, so that participants have a variety of interesting sessions to choose from at all times. In addition, the talks are relatively short- we went from 25 minutes to 20 minutes, to now- on average, 15 minute talks, so speakers must focus on their best material, condense their introduction and background and presentation as a whole and that improves the quality and makes the material more "crispy" if you will.

S.S.-This 30th Anniversary ISICEM has returned to the centre of your favourite city…

J.L.V- I am very pleased that the old congress centre could reopen under the name of 'Square' in the centre of the city and is larger than before. Of course it is still too small for us and we need to utilise additional sites as well, but with more than 5000 participants, there really are few congress centres that can accommodate so many people. As intensive care as a speciality continues to grow, so too does our meeting which focuses on this field specifically.

S.S.-How has industry involvement changed over the years and where do you see it going in the years ahead?

J.L.V- Industry support has continued to grow substantially and steadily over the years. In recent years there is an interesting process that has taken place and that is that support and attendance by companies at larger meetings like ours has either been stable, or in our case, actually increased- in fact we have more industry support for this one than last year. But for smaller meetings the support has really dissipated. What happens is, as you can imagine, when these companies establish their budgets for the next year, they start from the top down with regards to which meetings they will attend and support. Often the smallest, although they are specialised and interesting, just don't make the cut and they are suffering during this period of financial crisis as a result.

I'm not sure how this will follow in the coming years, as I am still continuously surprised at the desire of companies to exhibit in big spaces given the era of Internet and the fact that people can easily find the information on their computers. So perhaps in the years to come the exhibition may shrink somewhat but for this 30th Anniversary meeting, we do not have enough space available for all the companies that wanted to exhibit.

S.S.-Could you reflect a bit on the biggest changes in the field of critical care in general over the past 30 years, and how this has impacted on the topics featured in sessions at the meetings since 1981?

J.L.V- Well, interestingly enough, our specialty has evolved considerably over the years, but in terms of topics- I must say that the challenges in critical care and as a result, the topics featured at our meetings have more or less stayed the same. From the very beginning, intensive care as a field has covered a very broad range of topics- from respiratory failure to diabetes via cardiopulmonary resuscitation and neurological aspects… IV fluids, of course have been our bread and butter since the very beginning in addition to topics like shock and its treatment. You may think that topics to do with management, such as cost benefits or budget issues would have expanded over the years, but in fact that is not the case- these topics, while important and increasingly so, have never been very popular. In terms of an international meeting, I think this may have much to do with the fact that it is difficult to generalise when it comes to these topics, because of local rules and the like- what may work in Belgium may not be pertinent or effective in the UK or in Spain. It is notable, though, that while the ethical issues have remained popular throughout the years, they have become less so recently. We can continue to teach about these things, of course, but there is little left with regards to progress in this specific area of ethical aspects.

What has become a bigger topic of late is the use of computerised systems. As intensivists who are working in a highly technical environment, we are naturally interested in how to integrate these systems into our units.

If you want to look at the field over time, 30 years ago people were focused on what can I do, such as I can intubate the trachea, I can resuscitate, I can do this, I can do that… Over time, the word "can" started to be replaced by the word "should". Now it is more should I intubate? Should I resuscitate? And of course there are some ethical issues associated with that, but it is also related to the process of care, and how to improve the management of patients.

I think the overall feeling is that we know and understand what to do, but it has become more about how to treat patients in the most effective ways, while avoiding errors and improving communication. Communication wasn't really discussed years ago, now we have pinpointed the importance of these types of things- whether it be how to communicate with the team or families; these issues have become much more important because we recognise that these things improve the quality of care.

Quality of care was not really in the forefront 30 years ago because the core of our field centred on the basic belief that it was natural to do what is necessary to save a life. Resuscitate? Of course! Save a life, no question- it is a good thing. Whereas now, we do sometimes question it, we ask: Did we do the right thing? For example, if we resuscitated a patient, but now the patient remains comatose… Have we made the best choice? What could we have done differently?

Another aspect, which is somewhat related in the evolution of our field over the years is that we tend to do less and less in many aspects. In the beginning, we were quite aggressive with our mechanical ventilators now we try to ventilate gently; we also used to push nutrition on our patients, thinking they need a lot of calories – now we have realised that regardless of the number of calories we give,

patients will lose weight and now we refrain from overfeeding them…

It is no longer trendy to do endless procedures either- following the idea that blood is good and serves to bring oxygen to the cells, we used to transfuse patients- now we are much more likely to stand back rather than transfuse. With regards to sedation, in the past, the belief was that it was better to keep patients totally asleep in the ICU because of all of the machines and the noise- and this has gone by the wayside in favour sedating minimally; keeping the patients awake so that you can improve the process of care – by communicating directly with the patients. When you sedate, there is a period when patients must wake up from this state, and recover somewhat before they are able to leave the ICU- and this can be a very difficult period, so it is better to avoid this altogether and to try to mobilise the patient and support rapid healing.

With nearly everything, the current thinking is try to do less. This is quite an interesting phenomenon, as in general you would anticipate that people would want to do more and more over the years, but in fact we have found that indeed less is often more. In fact reflecting on the whole field of intensive care, it is challenging to think of any one thing that we do more now than 30 years ago. For all the procedures and treatments we have done, we have rather decreased the intensity of our interventions.

S.S.-Has this been a cultural shift across the field?

J.L.V-Yes, but this is a cultural change based on good science. The studies have shown that often we were harming our patients by over aggressively treating them, and consequently we do less harm by doing less. I am not suggesting, of course, that we withhold needed interventions, I am not saying that we should not feed or transfuse if it is necessary- and certainly we must utilise our ventilators when they are required, but I urge gentle usage and restraint.

S.S.-So after 30 years, it begs the question- Will the ISICEM continue indefinitely with you at the helm?

J.L.V-Well, it will continue definitely for the next 100 years, and then I will retire! (laughs) No, I hope that the symposium will continue forever, and despite all of the new developments with regards to information in our modern lives, I think it we will continue to need this kind of meeting, because there is nothing that can replace a face-to-face meeting and dialogue. At the symposium, as we recognise, it is not only in the rooms that networking and dialogue happens, it's also in the corridors or at the bar or restaurant and these informal discussions can bring a lot as well. This is part of why we mix different types of sessions- informal roundtables and meet the expert sessions or pro/con debates with the standard presentations.

Some time ago, people were thinking that with the development of new technologies we could stay in our countries and communicate and interact with telecommunications but this has not been the case, because people continue to travel, even in the era of the Internet and I think this need to explore and move outside our daily lives will continue and I am quite confident that the recent past proves this with regards to the high number of participants at the symposium. ■

INDUSTRY NEWS

Study Finds TaperGuard™ Line of Endotracheal Tubes Reduces Microaspiration

New tapered cuff may decrease common and costly pulmonary complications

Boulder, CO —*February*, 2010 – Covidien announced results from a recent study[1] suggesting that its Mallinckrodt™ TaperGuard™ line of endotracheal tubes reduces microaspiration by providing a more effective tracheal seal compared to other conventional endotracheal tubes. Microaspiration refers to aspiration of fluid, secretions and other materials that have leaked past the endotracheal tube cuff and into the lungs that may lead to pulmonary complications.

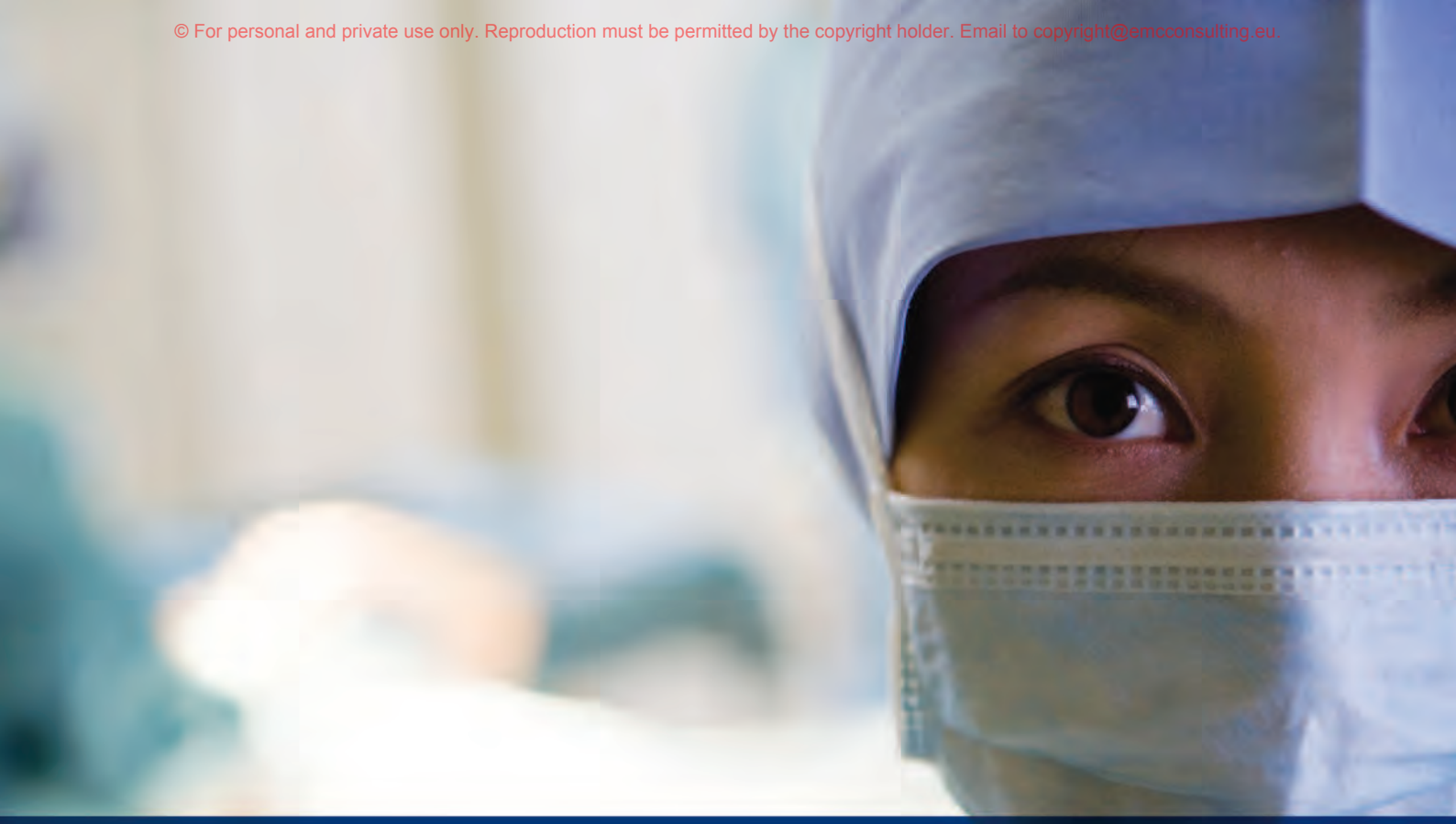
The study by Jan-Paul Mulier, M.D., Ph.D investigated the outcomes of patients intubated with either a TaperGuard tube or conventional high-volume, low-pressure cuff during laparoscopic gastric bypass surgery. In the study, not one patient intubated with a TaperGuard tube (n = 11) had microaspiration secondary to leakage of fluid past the inflated cuff. In contrast, more than 40 percent of patients intubated with a conventional high-volume, low-pressure cuff (n = 9) exhibited clear evidence of microaspiration.

"*The difference in leakage prevention rates is likely a result of the innovative shape of TaperGuard product's cuff,*" Dr. Mulier said. "*The newly designed tapered cuff may improve the sealing rate over conventional barrel-shaped cuffs found on the most widely used endotracheal tubes, the Mallinckrodt™ Hi-Lo endotracheal tubes.*"

[1] Tracheal Cuff Leak in Morbid Obese Patients Intubated with a TaperGuard, a Hi-Lo Cuffed or a Hi-Lo Cuffed and Lubricated Tracheal Tube, **www.nyssa-pga.org.**

Covidien provided certain supplies and loaned equipment for use in the above study.

www.respiratorysolutions.covidien.com



We all know endotracheal tubes leak.

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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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PATIENT SAFETY AND E-HEALTH

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Since the publication in 1999 of arguably the most important call to action for patient safety, the Institute of Medicine's report 'To Err is Human', we have learnt a lot about how to reduce risk in healthcare and how to improve patient safety. Technology clearly has an important role to play but we know that it can also bring increased risks, which every hospital worker should be aware of.

Research has shown that the context in which we work affects our behaviour and our chance of making mistakes. For example, long hours and tiredness increases our chances of slips and lapses; insufficient staff or poorly designed equipment increases the likelihood of us taking short cuts and committing violations; a lack of communication and teamwork amongst colleagues and poor training increases the likelihood of knowledge based errors. Many of these latent, error producing conditions are organisational factors, often the result of management decisions taken to satisfy other priorities and needs, such as meeting externally imposed targets or balancing the finances.

Using Technology to Reduce Risks in Healthcare

Computerised Decision Support Systems (CDSS) have grown in use in the last ten years, driven by clinicians suffering from information overload whilst being pressurised to make accurate, cost effective, evidence based clinical decisions. These systems provide access to a wealth of accessible information removing over reliance on memory; they use the power of the technology to analyse tests and compare the results to millions of stored images and evidence; and they accurately perform complex calculations taking into consideration multiple patient factors.

Once a clinical decision is made, CDSS's can help with ongoing treatment. For example electronic prescribing systems take the vagaries of the pen out of prescribing. They can ensure that blood tests are ordered when required for certain high-risk drugs. Alerts are built in to laboratory systems highlighting abnormal values of test results. Reminders can pop up to prompt a review, for example a re-assessment of patients' risk factors for venous thrombo-embolism (VTE).

Electronic patient records enable fast access to important information at the point of clinical decisions being made, wherever the patient is.

Technology, People and Patient Safety

When considering e-health applications and patient safety it is important to recognise that we have mixed relationships with technology. Some of us feel at ease using the latest gadget, others haven't mastered the mobile phone and feel very uncomfortable anywhere near a computer. The way we see, feel, understand and trust technology affects how we use it and this in turn affects patient safety.

The rapid development of technology makes it hard to keep up. The latest version always seems better than the one you bought last week and there are constant temptations to upgrade and improve. But this means multiple systems can be in use in one hospital, all of different ages and potentially not able to communicate with each other very easily. This increases the risk of staff not being familiar with the technology and not trained in its use. It also increases the risk of software related problems and the associated costs to sort them out. For managers it brings problems of not knowing who is most up to date and best able to advise the organisation on new technology.

Reporting and Learning about Adverse Events

It is vital in any organisation wishing to improve patient safety that staff report when things go wrong, or when there is a near miss. In any complex software there can be a hundred million lines of code and inevitably this will contain errors, making it difficult to find the source of a problem.

Automatic error reporting systems are built in to some software, but not all, so other ways of capturing this information becomes essential.

Even if problems are reported, if it relates to the software it is often very difficult to repeat what happened and find the root cause. The vendors of e-health applications often can't find the root cause of a problem because they have assembled the system from components manufactured by different companies – so even they are uncertain about how the system works as a whole.

Design of the Processes to use E-Health Applications

In improving patient safety it is important to recognise that human behaviour is a function of the system in which people work. For example emailing pathology test results to doctors may appear on the surface to be very efficient but if they are too busy to look at their emails more than once a day then this new system will guarantee that a patient's abnormal test results will not be acted upon immediately. If there is only one computer on each ward and doctors are queuing up to use it, then computerised decision support systems will not be used.

There are many techniques to help those implementing new technology to consider the processes and the potential risks that may arise. Failure modes and effects analysis is one such technique that is increasingly being used in healthcare. For example in one unit they had overlooked the need to ensure that the computer in the cardiac unit was always plugged into a socket powered by the hospital's generator in case of a power failure. If the computer screen showing where the probe was inside the patient's artery had gone blank in the middle of a procedure the outcome doesn't bear thinking about.

It is often faults in the design of the processes that create the conditions for staff to violate the rules and take short cuts. Leaving a computer logged in on a ward for all to use because it takes too long to keep logging off and on, sets up security problems and the possibility of one doctor reading records for the wrong patient. In one unit the staff took to carrying high-risk drugs around in their pockets because of problems with the computerised pharmacy system. This highlights the importance of carefully designing and thinking through the process for using technology in healthcare, not only during installation but on a regular basis thereafter as other parts of the system change and develop.

Design of the Technology

With the increasing movement of professionals between hospitals and between countries the issue of familiarity with the technology in use in healthcare becomes important.

Hardware
We know that not being familiar with the technology can cause errors yet we still do not have standardisation of even the basic equipment. In one study by the National Patient Safety Agency in the UK over 60 different types of infusion device were found to be in use in one hospital. Starting in the top left, some of the keypads counted down from '9', others counted up from '0' with the potential for patients to be given massive overdoses. In a truly safe hospital system, all technology would have a common user interface allowing staff to walk in to any ward or clinic and be able to safely use any device or technology.

Software
Even if the technology is well designed, the software can let the operator down. For example drop-down boxes in electronic prescribing systems having drugs in alphabetic order putting highly toxic drugs with similar names next to the most commonly prescribed antibiotics, with inevitable consequences. Electronic prescribing systems have alerts built in to them to notify a doctor of a potentially toxic drug or combination of drugs but these systems often have ways of turning the alerts off or ignoring them by quickly pressing the return button. If alerts regularly appear they can become irritating and over time their impact lessens to the point where they are completely ignored.

Technology and the Operator

Skills and knowledge can be acquired in using the technology but the human condition brings other factors into play that need considering in the context of patient safety.

Trusting the technology
In two tragic cases in the UK patients were overdosed when receiving radiotherapy treatment. Despite the procedures for checking doses, the staff had begun to trust each other and the machine and their levels of vigilance had reduced. Lisanne Bainbridge (1987) set out some of the principle 'ironies of automation' and here we find one: the fact that vigilance and monitoring, checking the performance of a machine over long periods of time is notoriously difficult for humans to perform but we often rely on it.

Applying what we know from other systems
When the computer at home freezes, after we have made our usual attempts to sort out the problem, we press the re-boot button, never quite understanding why it froze in the first place. Applying this approach to e-health applications can have much more serious consequences, losing valuable patient data or at worst re-setting carefully calibrated patient monitoring systems.

Readily available and non-judgemental support for people using complex technology is costly but vital with all applications in the hospital. Here we find another of Lisanne Bainbridge's (1987) 'ironies of automation': we leave the operator to carry out the tasks that the designer couldn't find a way to automate – such as the operator being left to recover a system breakdown. If the new technology has been introduced with the requirement to save money then often there is a downgrading of the skills of the people operating the sys-

tem and with fewer clinical staff operating e-health technologies, risks will inevitably increase.

Mental workload of the operator
Physician job satisfaction was measured in one study of telemedicine assessing in particular mental workload. The research into the telemedicine system found that the mental workload scores were high for the doctors and commensurate with those of air traffic controllers. This area requires much more attention as the technology becomes more complex.

Security and Backup

The loss of identifiable data held on computers is not uncommon. In November 2007 the government lost 25 million records giving details of names, addresses and bank accounts for people claiming child benefit. Despite systems and procedures and policies to prevent such loss, the rules are violated to save time and to help doctors with patient care – in one hospital I worked in, a doctor regularly saved on a USB key the records of the patients he was due to see the next day in outpatients, reading them at home in the evening. I found out when a member of his son's computer hacking 'club' rang anonymously to say he had gained access to the records!

E-Health applications are now being designed to allow remote access by healthcare staff and also by patients via the internet, making the systems increasingly at risk from viruses and illegal access. Good practice in IT dictates that hospitals have systems in place for regular security testing, reporting vulnerabilities; that vendors should take steps to 'harden' their systems when implemented, for example ensuring that applications that might increase vulnerability are switched off and services on the Internet are disabled, pop-ups and cookies blocked for example, but even these can be violated, especially if it means time consuming log-on procedures or slow functionality.

What about the Patient?

Studies of patient satisfaction with telemedicine are revealing – some patients are concerned about telemedicine meaning reduced social interaction with the doctor, feeling 'distanced' from the hospital; some are unhappy about having photographs taken and transmitted electronically (just look at what appears on YouTube!). Yet other studies have found patients prefer to communicate over the internet, avoiding travel to hospital and avoiding face to face contact. What we don't know is how all this affects patient safety – does the feeling of being distant from the doctor mean that patients are more or less likely to comply with their treatment? Are patients more or less likely to reveal personal details required for a diagnosis over a telemedicine link if they are not sure who is watching? What about cultural differences? What about language? More research is needed here.

What we do know is that patients and their families will interact with health technology in hospitals and at home. For example they will turn off irritating alarms; change dosages; and interpret and act on warnings. Family members will be asked to help or may play with the machine to see how it works. Again this is an unexplored area in terms of patient safety.

Quality Assurance – is the Technology an Improvement?

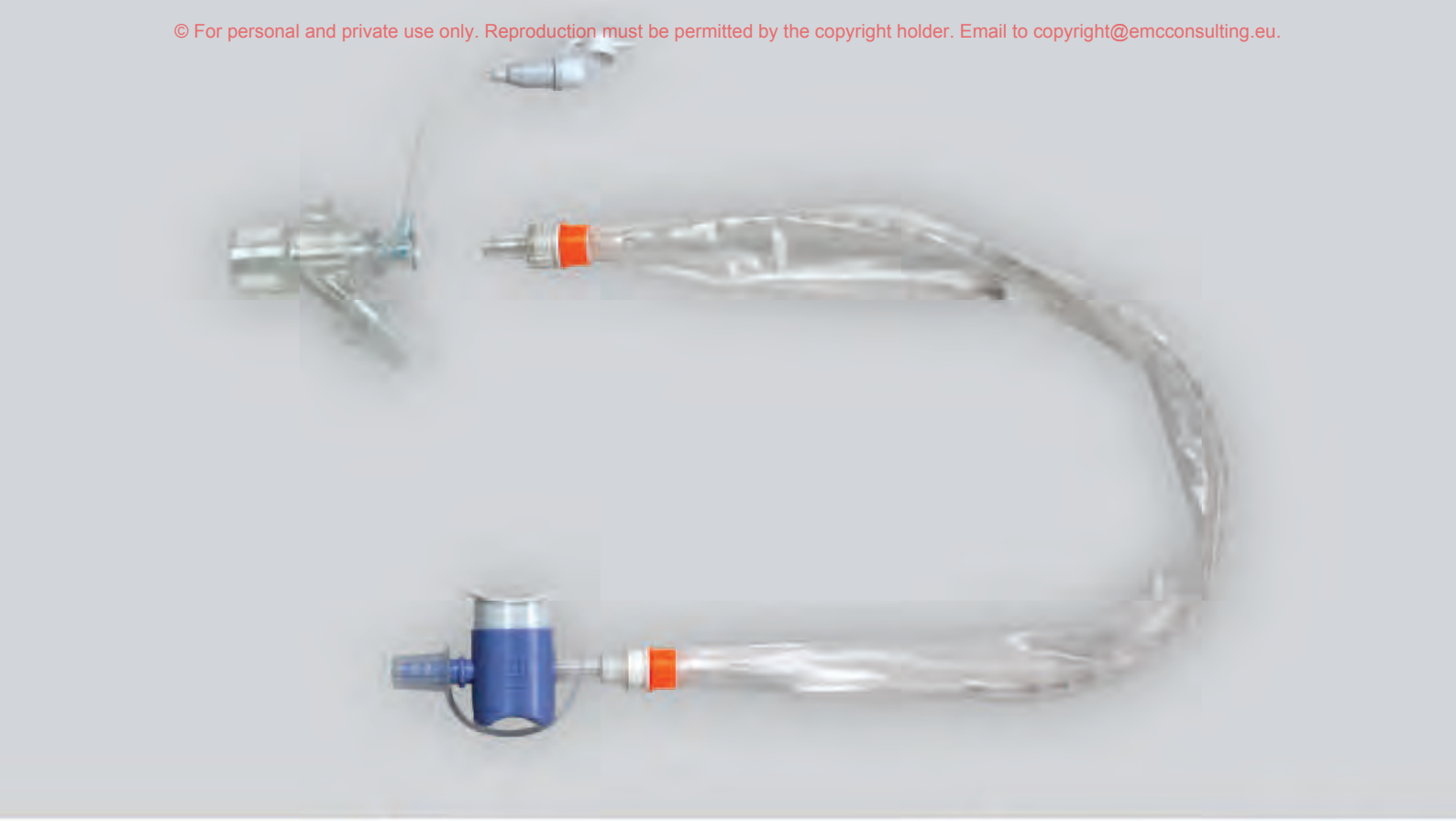
How accurate are the decisions being taken using the CDSS? Are the prompts and reminders being acted upon? Are appropriate tests and drugs being ordered? If the CDSS relies on information from other systems within the hospital, such as the laboratories and pharmacy, what reliability checks are performed to ensure these systems always communicate? What systems are in place to ensure that over time the knowledge base is kept up to date and that any new knowledge is checked and verified and agrees with local and national guidelines? And of most importance, how is patient morbidity and mortality affected by the CDSS – has the change been an improvement for patient care?

Management, Governance and Accountability

In the book 'Management Mistakes in Healthcare' a case study is presented relating to the purchase and installation of a new computer system in Heartland Healthcare System. The study sets out the management failures that can occur with the introduction of new technology ranging from recruiting people without the requisite IT skills and knowledge; ill-defined roles of IT contractors; an absence of goals and measures of success; the absence of accountability; non-adherence to purchasing protocols; and a failure to prevent the 'intra-staff' warfare that subsequently developed. Any one of the failures listed would cause problems with the introduction of new technology and could introduce the potential for systems not to be set up safely.

Patient safety needs to be writ large throughout the information technology strategy of any healthcare organisation and needs to be central to the running of all systems that interact with the technology and with patient care. For example in the human resource department issues arise such as staffing levels and skills mix required to use the new systems; policies about the use of temporary staff, who may not be suitably trained to use the applications; also the ongoing training and accreditation for both new and existing staff in the use of the technology. Many organisations have introduced new clauses in staff contracts concerning the misuse of IT for example.

E-Health has the potential to enable significant improvements in patient safety, it also brings with it new risks. Hospital boards need to have an understanding of these risks, an understanding of the theory of human error and systems thinking and ensure they have the requisite management systems in place to deal with them. ■



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PAPT – PATIENT ADMISSIONS PREDICTION TOOL

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Evidence-based research demonstrates that overcrowding in emergency departments causes ambulance diversion, increased hospital lengths of stay, medical errors, increased patient mortality, financial losses to hospital and physician, and medical negligence claims. Many hospitals still do not anticipate and prepare for the next day's volume and admission through the emergency department. And yet, contrary to the conventional wisdom that emergency patient volume is highly unpredictable, the number of admissions per day can be predicted with remarkable accuracy.
Forecasting presentations and admissions is a relatively easy solution. When implemented, it can protect everyone's access to emergency care.

In April 2008, the American College of Emergency Physicians (ACEP) published a report identifying solutions to the practice of 'boarding', or holding, patients admitted to the hospital in the emergency department, which is the primary cause of overcrowding. A boarded patient was defined as a patient who remains in the emergency department after the decision to admit him or her to the hospital has been made. Most emergency departments in the world are critically overcrowded and unable to respond to day-to-day emergencies, and the proposed solutions address the growing global crisis that is harming public access to lifesaving emergency care.

Solutions with the highest impact in reducing boarding and improving the flow of patients through emergency departments are:

- Move emergency patients who have been admitted to the hospital out of the emergency department to inpatient areas, such as hallways, conference rooms;

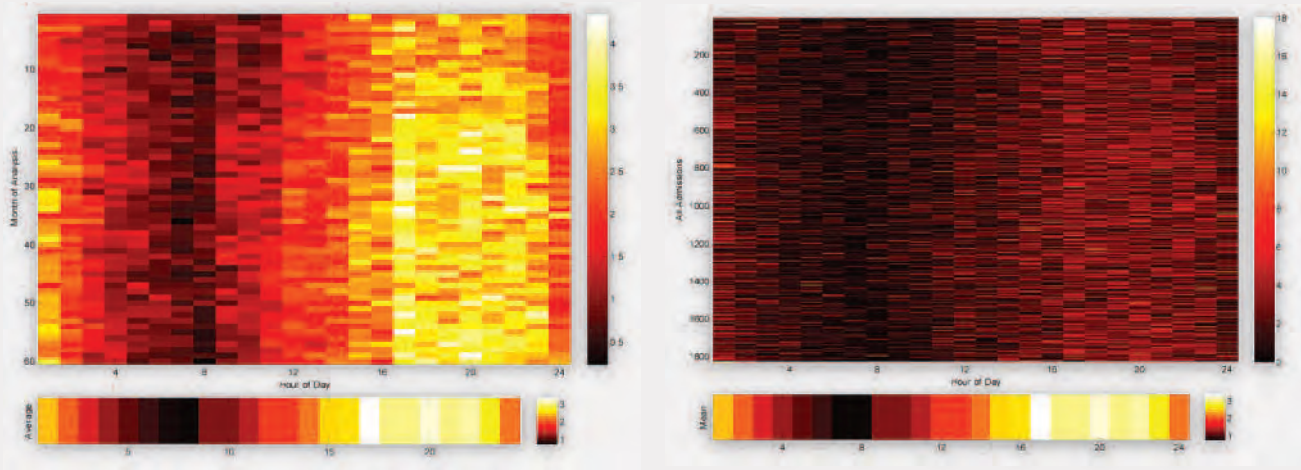

Figure 1. Peak admissions for patients leaving the ED;
Left: Admissions across every day in study period; Right: Monthly averages across study period.

- Coordinate the discharge of hospital patients before noon, and
- Coordinate the scheduling of elective patients and surgical patients.

Research Study: A Clinically Usable Software Package

The main aim of our study was to develop and validate a clinically usable software package that accurately predicts the number of admissions sourced from emergency department cases on any given day of the year, taking into account peak periods such as public holidays. The primary outcome measure was the accuracy of forecasts when validated against historical data from two differing hospitals. The resultant Patient Admissions Prediction Tool can assist with the allocation of inpatient beds to alleviate overcrowding.

The modelled data consisted of five years of ED presentations and admissions (1/7/02 – 30/6/07) from two hospitals chosen for their different demographic characteristics. Hospital A is a 280-bed regional facility, located 120km away from a major tertiary referral centre and services an area of approximately 410,000 km^2 with a resident population of about 280,000. Hospital B is a 750-bed busy urban facility and services a rather itinerant population of around 500,000. It is host to several annual events that attract large amounts of tourists. Despite their differences, presentations numbers for both hospitals across the five years were similar (218,000 – regional Hospital A, 278,000 – urban Hospital B). The urban hospital has a higher rate of admissions (33 percent) than the regional hospital (20 percent).

Many useful characteristics that can help shape health management practices have been identified from the data. For example, the date and time when admitted patients leave the ED, indicating the times of highest demand on hospital beds; patient arrival time in the ED, which represents a staffing impact with workload; and the days of the week which represent higher ED workloads and hospital bed demand. The data also enables the analysis of 'frequent-flyers' – those patients who presented multiple times during the analysis period.

From the analysis of this data, we have been generating forecast estimates and associated confidence intervals based on several forecasting approaches and validating the forecasts against actual data. The project also included packaging the most accurate technique into a stand alone software application.

Data Analysis

The data includes date and time of admissions which provides useful information on peak admission times experienced within the EDs. Figure 1 indicates the times of highest demand on hospital beds (admitted patients leaving the ED), indicated by a brighter colour. The vertical columns of the plots indicate the hour of day, and admission numbers are indicated by the colour bar. It is apparent that the highest demand for hospital beds occurs in the afternoon and into the evening. Every row on the left-hand plot represents a day from 1/7/02 – 30/6/07, while

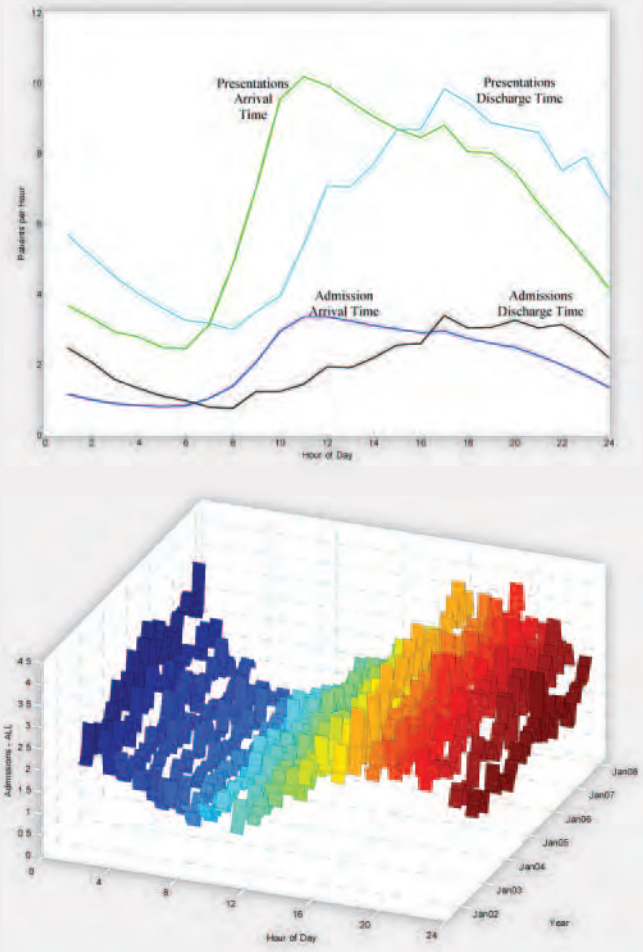

Figure 2. Peak admission times for patients leaving the ED; Top: Admissions across every day in study period; Bottom: Monthly averages across study period.

the rows on the right-hand plot indicate monthly averages throughout the study period. Similar assessment has been done for discharge times of all presentations (not just those admitted) and also for arrival times within the ED. The skew of the data to the end of the day is apparent.

Another point of interest is the time of arrival in the ED, as this represents a staffing impact with workload. Figure 2 shows the ED discharge time for the admissions that are shown in Figure 1. This discharge time refers to the time patients leave the ED and require a bed, as opposed to discharges leaving hospital. It also indicates the arrival time for this group, which peaks around 11:00hrs. However, admitted patients make up only a small subset of all the patients seen in the ED, and the two curves in the upper portion of the plot represent all presentations. We can see that the mean peak discharge time lags behind the peak arrival time by around eight hours and again see the skew of the data to the end of the day.

The hourly fluctuations of the data has also been studied using boxplots as shown in Figure 3, which show, for example, the quietest

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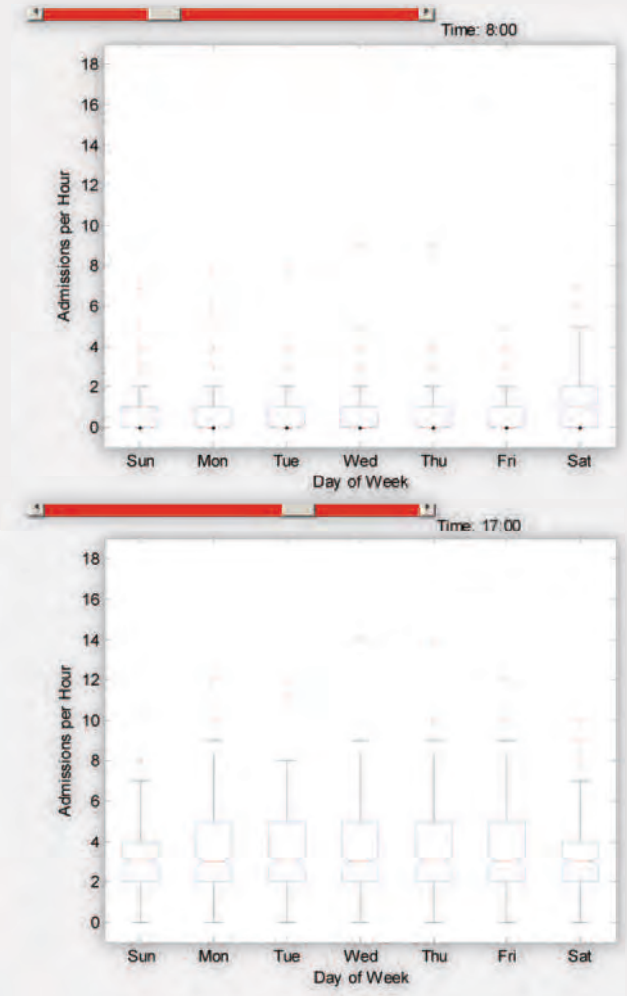

Figure 3. Box-plots of hourly admissions; Top: 08:00hrs; Bottom: 17:00hrs

time (8am) and the busiest time (5pm) for admissions. Median, upper and lower quartiles and outliers are represented in the plots.

It is also of interest to determine the days of the week that represent higher ED workloads and hospital bed demands. For example, Figure 4 shows the mean and 95% Confidence Interval band for the daily and monthly trends in the arrival time of all presentations (Left) and for admitted patients (Right) at the urban hospital. The busiest days for presentations are over the weekend and Mondays. Considering the arrival time for just those patients that are admitted, it can be seen that Mondays and Tuesdays are the busiest days. There has also been an overall increase (approximately 40 percent) in the number of patients presenting over the five years. Interestingly the trend over all the months-of-analysis for admitted patients shows a plateau effect, which could be attributed to bed capacity being reached, or the adoption of hospital avoidance strategies.

Forecasting

From the analysis of this data, we have been generating forecast estimates and associated confidence intervals based on several forecasting techniques. This modelling included stepwise multiple regression, exponential smoothing and Box-Jenkins Autoregressive Integrated Moving Average (ARIMA) models.

In our study, accuracy was treated as the main criterion for selecting a forecasting method, and the metric used in our evaluations was the Mean Absolute Percentage Error (MAPE). Data was divided into a training set and evaluated against a separate holdout set. The evaluation dataset spanned one year (364 days), allowing accuracy to be measured across summer and winter months and varying forecast horizons. The effect of varying the size of the training dataset was analysed and training lengths of one, two, three, four and 4.3 years were assessed. Also computed were the width of 95 percent prediction intervals (± x admissions) and the number of misses outside this prediction interval. This provides the user of the forecasts with worst and best case estimates and a sense of how dependable the forecast is.

Results

Presentations to the ED and subsequent admissions to hospital beds are not random and can be predicted. Forecast accuracy worsened as the forecast time intervals became smaller: when forecasting monthly admissions, the best MAPE was approximately two percent, whilst for daily admissions this was 11 percent, for four-hourly admissions: 41 percent, and for hourly

Continued on page 30

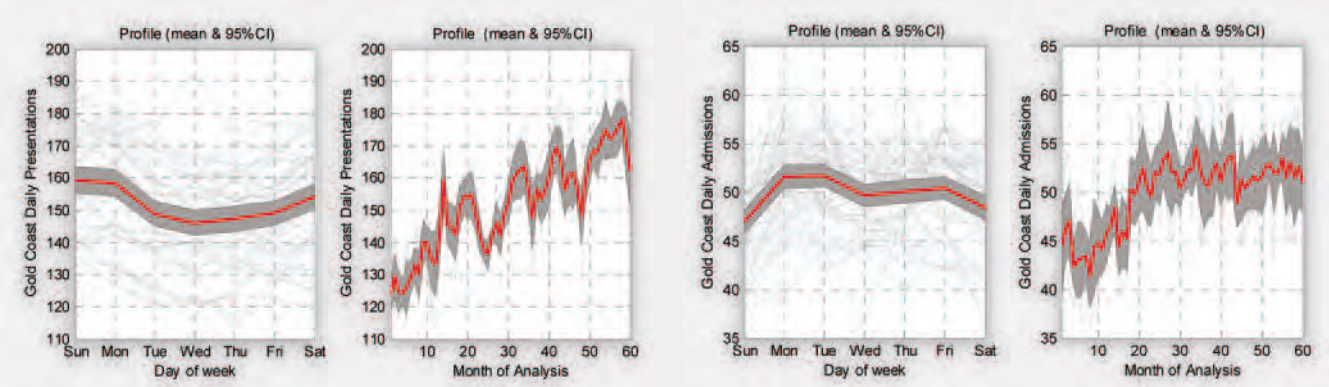

Figure 4. Peak admission times for patients leaving the ED; Left: Admissions across every day in study period; Right: Monthly averages across study period.

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ANTIMICROBIAL RESISTANCE AND ANTIBIOTIC USE IN THE ICU:
UTILISING COMPUTER SURVEILLANCE TO IMPROVE WORKFLOW AND OUTCOMES

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COSARA (Computerised Surveillance and Alerting of nosocomial infections, Antimicrobial Resistance and Antibiotic consumption in the ICU) is a software application designed and developed for the registration and integration of infection-related data in the ICU patient. The application architecture consists of three different software modules:

1. A registration module which in real-time requires the ICU-physician at each (electronic) antibiotic prescription;
2. A presentation module which provides the ICU-physician with all infection-related data of the individual ICU-patient in a concise and visually attractive way; and
3. An information module which incorporates infection-related data at the level of the ICU and can be used for surveillance purposes and to steer infection control measures.

Background

Nosocomial (i.e. hospital-acquired) infections are common, and are important contributors to unfavorable clinical and economic outcomes. In Belgium, these nosocomial infections are estimated to be responsible for a yearly excess mortality, an additional 607,880 hospitalisation days and a total extra society cost of more than 300 million euro. The ICU is clearly the epicentre of the nosocomial infection problem. Furthermore, it is estimated that 20 to 30 percent of these infections are preventable.

Given the importance of infection control in the ICU, one would expect that the medical files and nursing charts of the ICU patient would include a well documented overview of previous and current infections together with the prescribed antibiotic therapy and the associated microbiological data (i.e. cultured bacteria and antibiograms). Unfortunately however, this is not the case, not even in an ICU that utilises advanced computerisation. As such, the intensivist in charge returning to work on Monday, needs to investigate all infectiological details in a way a detective does, in order to be able to answer the following questions:

- Why was this antibiotic regimen chosen?
- Why was it changed after 2 days?
- What was the focus of this infection?
- Was this a firm diagnosis, or only a suspicion?
- Is there a positive culture?
- What was the severity of the infection?
- What is the resistance pattern of these cultured bacteria?
- Did the patient respond well to the initialised therapy?
- What is the radiological evolution?

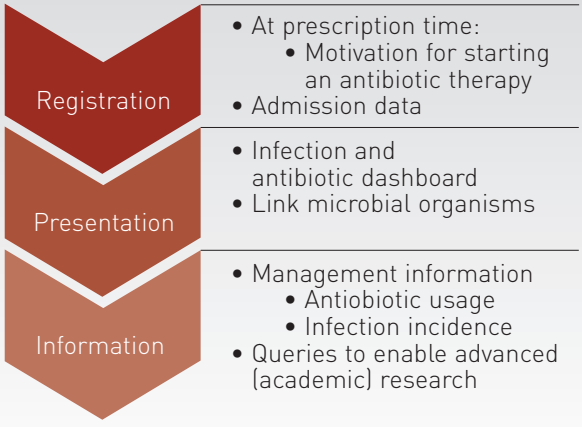

Figure 1. COSARA solution.

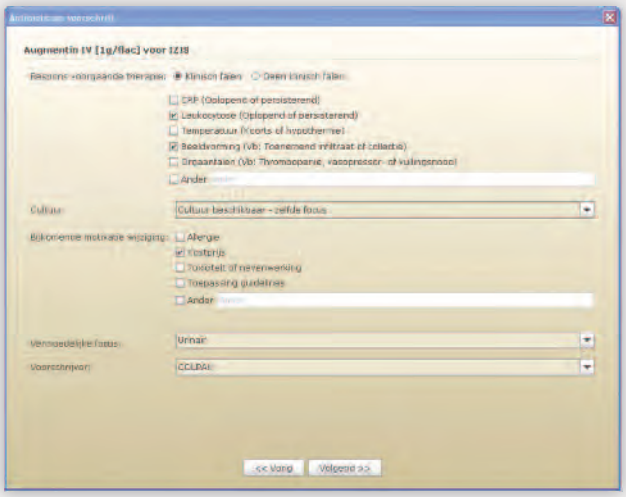

Figure 2. Pop-up screen at time of antibiotic prescription.

Consulting all these different data sources, and trying to integrate this retained information into a comprehensive infection status of an ICU patient is therefore often a very time consuming and frustrating job.

Furthermore, in the absence of a readily available standardised infection overview, high quality infection data are lacking. These data however, are essential to implement an efficient nosocomial infection surveillance system and to perform advanced clinical research regarding infection control.

Solution

An advanced and user-friendly software application (named the COSARA project) was developed by a consortium of the ICU and Information Technology departments from Ghent University in order to alleviate some of these issues. COSARA is an acronym for "Computerised Surveillance and Alerting of nosocomial infections, Antimicrobial Resistance and Antibiotic consumption in the ICU".

The goals of COSARA are to support the intensivist in the daily workflow by automatic integration of all relevant infection related data from different data sources. Besides a continuously available up-to-date view on all parameters regarding the infectious management for every single patient, the application also provides high quality data surveillance data on the ICU level with respect to incidence, severity and focus of infections, antibiotic drug treatments and the micro-organisms involved, including their resistance pattern. These data are stored in a relational database and can be used for clinical research.

Implementation

In the COSARA project, three main software modules were designed: A registration module, a presentation module and an information module (Figure 1). These modules are integrated with the existing hospital information systems.

At the moment of a new prescription of antimicrobial therapy, popup screens appear in real-time on the PC monitor (Figure 2) asking for a motivation for the start of this new therapy including the probable focus and the severity of infection. These pop-ups appear on the bedside or on the central PC monitor, depending on the workstation where the intensivist is prescribing the drug. There is no possibility to bypass these pop-up screens. As the registration maximally requires 20 seconds and does not require specialised training, the user acceptance is excellent, both by senior ICU-physicians and by fellows in training.

The presentation module is the core of the COSARA software. In one single surveyable graphical view, the intensivist can consult the selected patients' current and past infections during his/her ICU stay, together with the associated antibiotic therapies (Figure 3). After linking of a certain infection with the related microbial data, the graphical view shows the responsible micro-organism and, only one click away, the related antibiogram. The patient's evolution of infectious laboratory parameters (i.e. CRP, WBC count), together with the automatically captured daily SOFA scores, are shown in a graphical way.

Without any delay in loading time, all available chest X-rays are available in another tab (Figure 4), and even the chest X-rays taken before ICU admission are shown.

In contrast to the presentation module, which is focused on the individual patient level, the information module (Figure 5) is entirely focused on the ICU unit level. Incidence of specific infections, antibiotic usage, responsible micro-organism and resistance pattern can be analysed together with their evolution over time. Furthermore, it is possible to perform very advanced and refined queries for academic research.

Figure 3. Infection overview tab.

The benefits of COSARA are the potential to decrease the time to therapeutic intervention in case of infection (on the individual patient level), to decrease the intervention time for targeted infection control measures in case of outbreaks

Figure 4 and 5. Left: Thoracic radiography tab. Right: COSARA management module.

(on the ICU level) and to investigate accurately the impact of infection control programmes and antimicrobial exposure on the incidence of nosocomial infection and microbial ecology, taking into account a maximum of potential confounders. Eventually, the implementation of COSARA as a computer-based surveillance and alerting system will likely result in (1) less nosocomical infections, (2) reduced emergence of resistance, (3) better patient survival and (4) less costs for the society.

Continued on page 34

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1 Müller B et al. Crit Care Med 2000, 28(4): 977-983
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TELEPRESENCE USING ROBOTS IN ACUTE CARE FACILITIES

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The idea to be in two or more places at the same time is now feasible thanks to technology and telecommunications, which allow physicians to participate in the care of patients that are located at distant suburban communities. In the past, some patients received less than optimal treatment due to geographical remoteness, often relying on care by physicians lacking certain expertise. However, in current times, suburban hospitals can have a well-designed and well-equipped ICU supported by online physicians located in a high-care hospital.

The Programme

Telepresence is primarily based on the combination of robotics and telecommunications, which allows interaction between audio/video connections in real-time between two or more health teams geographically distant from each other. In our programme, acute care facilities include: Intensive Care Unit (ICU), Emergency Room (ER), Operation Room (OR), and (in the wards) the Rapid-Response team.

The main objective of Telepresence is to provide a high level of care to critically ill patients in places where a specialised intensivist is not available 24/7.

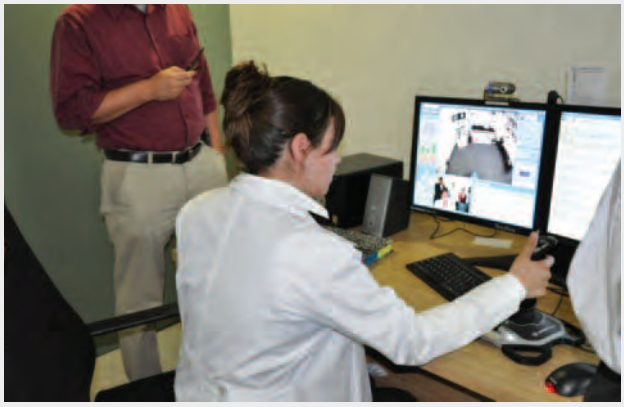

Photo 1. RP-7i® Control Station: Desktop monitor, camera, joystick DT, speakers, keyboard, mouse, microphone and computer. Intensivist at the Maternal and Perinatal University Hospital, Mexico.

Our remote presence robotic system works with a control station (Photo 1) connected to a robot RP-7i® (Intouch Health, Santa Barbara, CA, USA) by way of a wireless secured internet connection. The capabilities of the RP-7i® allow it to roam by remote control around the ICU or any other place in the hospital, as long as a Wi-Fi network is present. Personal communication between a 'distant' physician and a patient, other physicians, nurses, or the patient's relatives is possible thanks to a two-way audio/video communication projected on a wide, flat display placed at the robot's 'head' (Photo 2). In this way the patient, physicians, nurses, or any other member of the healthcare team can see and talk to the 'distant' physician without leaving his or her actual location. Telepresence allows the distance and time for diagnosis to be shortened considerably, further allowing the start of specialised medical attention for a critically ill patient, and additionally supports the nursing team and other medical fellows. In addition, it is possible to acquire medical reports, nurse's reports and laboratory results, as well as to supervise ventilator settings and give advice regarding guidelines, all of which may result in increased quality and safety during medical care at the ICU.

Experience of Telepresence with RP-7i® robots in Mexico

Our institute is leading and coordinating the experience of Telepresence in Mexico by using robots in acute-care facilities. The programme was launched in August 2009 at five suburban hospitals of 60 beds each, covering a population of about one million, either without social security or with 'Seguro Popular'. The programme is intended to compensate

for the lack of intensivists in towns/cities that are distant from the main city, and to guide and provide expert support to those physicians who do not have specialised expertise. The Telepresence programme uses an RP-7i® robot to support nine main processes in each hospital:

1) Rounds at acute-care facilities;
2) Care for pregnant women at high risk of death;
3) Advanced trauma life support;
4) Advanced cardiac life support;
5) Neurovascular disease;
6) Rapid response team;
7) Children with severe burns;
8) Coordination for air transportation; and
9) Influenza AH1N1.

As an additional benefit our programme has created a network of acute-care facilities, which are connected to our two most important high-care hospitals (a specialty university hospital, and a maternal/perinatal university hospital), and to a paediatric ICU specialised in severe burns.

In the future, we believe there will be an opportunity to coordinate and work with an international network of Telepresence, which means the availability of a virtual critical care medicine practice without borders.

The nerve centre of our programme is located in our hospital (maternal/perinatal university hospital) located in the state-capital, Toluca, Mexico. Five suburban hospitals are involved in the programme (Toluca, Atlacomulco, Valle de Bravo, Tenancingo and Tejupilco). The closest is the Atlacomulco suburban hospital (located 60km north of the state-capital) and Tejupilco is the most distant hospital (located 180km from the state-capital). In Toluca, we recently allocated an RP-7i® robot to a paediatric ICU which specialises in treating children with severe burns.

Acute Care Processes from August to December 2009	No. of cases	%
ICU Rounds	60	36.36
Emergency Department	27	16.36
Transfer by Helicopter	3	1.82
Operating Room	2	1.21
ATLS	5	3.03
Pregnant women with high risk of death	1	0.60
Rapid Response Team	5	3.03
Influenza AH1N1	62	37.57
Total no. of patients	165	100

Table 1. Telepresence using RP-7i robots in Mexico

Photo 2. RP-7i® Dashboard display. At centre, the RP-7i head with camera, flat display, microphone and speaker. Tejupilco ICU nurse team.

From August to December 2009, 165 interventions took place using the RP-7i® robot, the processes involved can be seen in Table 1. Three patients were transferred by helicopter due to severe brain injury and all survived hospitalisation. Generally, there was optimal internet broadband connection thus providing good video images and clear audio sounds. Malfunctions were mainly due to internet network failure at the suburban hospitals. Medical staff, patients and their relatives easily accepted the programme and were highly convinced about the expertise offered. The programme has technical support from the FONDICT at the UAEMex (State of Mexico Autonomous University).

Additionally, the programme has potential for improvement in other areas, for example: Network for access to web-based information (e.g. medical records, X-ray images, to monitor information and advice on ventilator settings, etc.), and Multi-Presence (Intouch Health®) education and teaching for nurses, physicians and medical fellows about critical care topics.

Conclusion

Technology and telecommunications applied in the ICU has created a new paradigm for critical care practice: This 'new' practice is known as Telepresence.

Telepresence can be applied to solve one of the major problems in the ICU, i.e. the lack of intensivists. Critically ill patients in towns/cities that are geographically distant from high-care hospitals will be able to receive specialised medical assistance and attention, thus increasing the quality and safety of care during hospitalisation in the ICU. ■

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

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Energy selection, J		
Internal	5-50	5, 10, 20, 30, 50
External	50-360 monophasic, 50-200 biphasic, 2-20 pediatric/neonatal	2-10, 15, 20, 30, 50, 70, 100, 125, 150, 175, 200, 225, 250, 275, 300, 325, 360; 2 user-configurable sequences
Paddle controls	Charge, discharge, energy select	Charge, discharge
Waveform shape	Biphasic preferred	Biphasic
Biphasic, energy, J	50-200	2-10, 15, 20, 30, 50, 70, 100, 125, 150, 175, 200, 225, 250, 275, 300, 325, 360; 3 user-configurable sequences (100-200, 100-300, and 100-360)
Synchronizer	Yes	Yes
Pediatric paddles	Yes	Built-in
Optional paddles	Any (based on user requirements)	A/P, internal, external sterilizable
Disposable electrodes	Adult and pediatric	Quik-Combo, Edge Quik-Combo for pacing/defibrillation/ECG, Edge Quik-Pace, Edge Pediatric Quik-Combo, REDI-PAK Quik- Combo (Edge REDI-PAK Quik-Combo)
ECG MONITOR		
Type	No preference	Color LCD
Screen, cm (in)	No preference	11.5 x 8.6 (4.5 x 3.4)
Sweep speed, mm/sec	25	25
Trace freeze	Optional	No
Lead configuration	I, II, III (3 lead)	I, II, III, paddles, aVL, aVR, aVF
Through-the-paddles monitoring	Yes	Yes
HR display	Yes	Yes
HR alarms	Yes	Adjustable, configurable
Freq response, Hz	0.67-40	0.05-150 or 0.05-40 diagnostic, user configurable; 0.67-40 or 1.0-30 monitor, user configurable; 2.5-30 paddles; 0.67-32 analog ECG out, except 2.5-30 for paddles
Lead-fault indicator	Yes	Yes
EXTERNAL PACEMAKER	Optional	Optional
Pacing mode	Demand, fixed rate	Demand or nondemand
Pacing rate, ppm	50-150	40-170
Output current, mA	0-140	0-200
Pulse width, msec	>20	20
ECG RECORDER	Yes	Thermal array, 50 mm
Paper speed, mm/sec	25	25
Auto/manual print	Auto, manual	Both
Annotation	Time, date, lead, gain, heart rate, operating mode	Time, ECG lead, ECG gain, HR, synchronization, discharges, SpO2, pacing parameters, presenting rhythms, therapy parameters, AED analysis
Summary feature	Yes	Enhanced code summary, critical-event record
OTHER MONITORED PARAMETERS		
Configured	Not specified	Not specified
Modular	Not specified	Not specified
BATTERY/LINE POWER	Both	Both
Number and type	No preference	1 Ni-MH
Integral or removable	Either	Integral
Operating time, hr	2 continuous ECG monitoring or 20 discharges	>2
Charging method	Any	AC line
Charging time, hr	<24	<2
Battery pack		
H x W x D, cm (in)		Integral
Weight, kg (lb)		Integral
UNIT		
H x W x D, cm (in)		21.3 x 26.2 x 26.2 (8.4 x 10.3 x 10.3)
Weight, kg (lb)	<9.1 (20)	5.8 (12.3) fully featured
External outputs	1 V ECG out	IrDA port and direct serial port
LIST PRICE		
WARRANTY		2 years, hospital
OTHER SPECIFICATIONS		AED mode quickly converts to manual mode when door is opened; user-configurable screen options; biphasic technology adjusts both shock duration and voltage; provides escalating energy levels as required; color-coordinated parameters on display; Masimo SET; docking station.
Supplier Footnotes	1 - These recommendations are the opinions of ECRI's technology experts. ECRI assumes no liability for decisions made based on this data.	

	LIFEPAK 15	DG 4000	DG 5000
	Worldwide	Worldwide, except North America	Worldwide, expect North America
	Yes	Not yet submitted	Not yet submitted
	Yes	Yes	Yes
		Not specified	Not specified
	5, 10, 20, 30, 50	No	2, 4, 6, 8, 15, 30
	2-10, 20, 30, 50, 70, 100, 150, 200, 300, 360; 2 user-configurable sequences	2 to 200 J	2 to 200 J
	Charge, discharge, print	Charge, printer, discharge	Charge, energy selection, printer, discharge
	Biphasic	Biphasic multipulse biowave	Biphasic multipulse biowave
	2-10, 15, 20, 30, 50, 70, 100, 125, 150, 175, 200, 225, 250, 275, 300, 325, 360; 3 user-configurable sequences (100-200, 100-300, and 100-360)	Energy levels in AED are configurable	Energy levels in AED are configurable
	Yes	Yes	Yes
	Optional	Yes	Yes
	Pediatrics, posterior, internal, external sterilizable	Adhesive pads, pediatric	Internal, adhesive pads, pediatric
	Quick-Combo, Edge Quik-Combo for pacing/defibrillation/ECG, Edge Quik-Pace, Edge Padiatric Quik-Combo, REDI-PAK Quik-Combo (Edge REDI-PAK Quik Combo)	Adhesive electrodes adult and paediatric	Adhesive electrodes adult and paediatric
	Color LCD with special mode for viewing in sunshine	Monochrom LCD	Color LCD
	17.1 x 12.8 (6.7 x 5.0)	13,2 x 7,5	21.1 x 15.8 (8.3 x 6.2)
	25	25	25-50
	No	No	No
	I, II, III, paddles, aVL, aVR, aVF, V1-V6, optional 12 lead	I, II, III, aVR, aVL, aVF	I, II, III, aVR, aVL, aVF, V1-V6
	Yes	Yes	Yes
	Yes	Yes	Yes
	Adjustable, configurable	Yes	Yes
	0.5-40 monitor, 2.5-30 paddles, 0.05-150 diagnostic	0,5-40 Hz	0,5-40 Hz or 0,5-150 Hz (according to ECG source)
	Yes	Audible and visual	Audible and visual
	Optional	Optional	Optional
	Demand or nondemand	Fixed, demand, overdrive	Fixed, demand, overdrive
	40-170	40-210	40-210
	0-200	0-150	0-150
	20	20	20
	Thermal array, 50 or 100 mm	Thermal array 72 mm, 3 traces	Thermal array 72 mm, 3 traces
	25	25	25, 50
	Both	Both, selectable	Both, selectable
	Time, ECG lead, ECG gain, HR, therapy parameters, synchroniza-tion, discharges, Sp02, SpCO, SpMet, presenting rythms, 12 lead, AED analysis, pacing parameters, ETCO2 and NIBP parameters Enhanced code summary, critical-event record	3 waveforms, all events and data measurements	3 waveforms, all events and data measurements
	Not specified	Sp02	Sp02, NIBP, etC02
	Not specified	Not specified	Not specified
	Batteries operated (1)	Battery and vehicle supply	Battery and vehicle supply
	2 Li-Ion	1 Lead-acid	1 + optional - lithium ion
	Removable	Removable	1 intenal, optional 1 removable
	6.0 typical	3 h monitoring	2 h monitoring (4 h with the second battery)
	External system	Internal, 100-240 VAC and 9-48 VDC through ambulance bracket	Internal, 100-240 VAC and 9-48 VDC
	1.5 Ni-Cd, 3 SLA	16 h to 80%	1 h to 80%
	4.1 x 7.5 x 13.7 (1.6 x 2.9 x 5.4)	6,6 x 17,8 x 3,4	2.3 x 9.5 x 10.2 (0.9 x 3.7 x 4)
	0.59 (1.3)	0.9	0.34 (0.75)
	31.7 x 40.1 x 23.1 (12.5 x 15.8 x 9.1)	27 x 16 x 31	28.9 x 17.7 x 27.1 (11.4 x 7 x 10.7)
	8.6 (18.9) Basic; 9.1 (20.1) full featured	5.3	5.6 (12.3) with 2 batteries and paddles
	ECG, data transfer via modem/serial	RS232, USB	RS232, USB, Ethernet
		Not specified	Not specified
	2 years, hospital; 1 year, out of hospital	1 year	1 year
	AED and manual defibrillation; data storage; NIBP/Sp02/SpCO/SpMet/ ETCO2; Muse CV and LifeNet compatible; battery system using Smart battery technology; configurable; upgradable; 2 IBP inputs; 100 mm printer; Bluetooth wireless transmission; diagnostic interpretive 12-lead ECG.		24 hr of trends, 10 secondes 12 lead ECG sequence transmis-sion through Ethernet network or GSM (USB modem)
	1 - Line power available soon.		

SUPPLIER	ECRI-RECOMMENDED SPECIFICATIONS 1	ZOLL	ZOLL
MODEL	**Basic Defibrillator/Pacemaker**	**R Series - Code Ready Professional Manual defibrillator**	**E Series - Professional Manual Defibrillator**
WHERE MARKETED		Worldwide	Worldwide
FDA CLEARANCE		Yes	Yes
CE MARK (MDD)		Yes	Yes
DEFIBRILLATOR			
Energy selection, J			
Internal	5-50	1-10, 15, 20, 30, 50	
External	50-360 monophasic, 50-200 biphasic, 2-20 pediatric/neonatal	1-10, 15, 20, 30, 50, 75, 100, 120, 150, 200	1-10, 15, 20, 30, 50, 75, 100, 120, 150, 200
Paddle controls	Charge, discharge, energy select	Energy select, charge, discharge , recorder on/off	Energy select, charge, discharge , recorder on/off
Waveform shape	Biphasic preferred	Rectilinear biphasic	Rectilinear biphasic
Biphasic, energy, J	50-200	1-10, 15, 20, 30, 50, 75, 100, 120, 150, 200	1-10, 15, 20, 30, 50, 75, 100, 120, 150, 200
Synchronizer	Yes	Yes	Yes
Pediatric paddles	Yes	Integral	Integral
Optional paddles	Any (based on user requirements)	Adult/pediatric, internal, anterior/ posterior	Adult/pediatric, anterior/ posterior
Disposable electrodes	Adult and pediatric	Yes, OneStep resuscitation electrode familly ZOLL padz Electrodes	Yes, ZOLL padz Electrodes
ECG MONITOR			
Type	No preference	Integral, Color, VGA, Liquid crystel display (LCD)	Integral, Color, High Resolution LCD
Screen, cm (in)	No preference	16.5 (6.5) diagonal	14,3 (5,63)
Sweep speed, mm/sec	25	25	25
Trace freeze	Optional	No	No
Lead configuration	I, II, III (3 lead)	I, II, III (3-lead); I, II, III, aVR, aVL, aVF (5-lead); P1, P2, P3 with one step pacing electrode	I, II, III (3-lead); I, II, III, aVR, aVL, aVF (5-lead); I, II, III, aVR, aVL, aVF, V1-V6 (12-lead)
Through-the-paddles monitoring	Yes	Yes	Yes
HR display	Yes	Yes	Yes
HR alarms	Yes	Selectable 20-280	Selectable 20-280
Freq response, Hz	0.67-40	0.05-150	0.05-150
Lead-fault indicator	Yes	Audible alert and on display	Audible alert and on display
EXTERNAL PACEMAKER	Optional	Optional	Optional
Pacing mode	Demand, fixed rate	Demand or fixed rate	Demand or fixed rate
Pacing rate, ppm	50-150	30-180	30-180
Output current, mA	0-140	0-140	0-140
Pulse width, msec	>20	40, rectilinear	40, rectilinear
ECG RECORDER	Yes	Thermal array (80 mm width)	Thermal array (80 mm width)
Paper speed, mm/sec	25	25	25 mm/s or 50 mm/s (apparent), configurable for 12 lead output
Auto/manual print	Auto, manual	Auto, manual	Auto, manual
Annotation	Time, date, lead, gain, heart rate, operating mode	Time, date, energy, heart rate, pacer output (pacer version only), QRS sync mark, ECG-size lead, alarm, defib test (OK/fail), analyse ECG, ECG Bandwidth,more	Time, date, defib energy, heat rate, pacer output (Pacer version only), QRS sync marker, ECG SIZE, lead, alarm, DEFIB TEST OK/FAIL, ANALYZE ECG, PADS OFF, ANALYSIS HALTED, NOISY ECG, SHOCK ADVISED, NO SHOCK ADVISED, ECG TOO LARGE, and diagnostic bandwidth.
Summary feature	Yes	Yes	Yes
OTHER MONITORED PARAMETERS			
Configured	Not specified		
Modular	Not specified	SpO2, etCO2, NIBP	SpO2, etCO2, NIBP, SpCO, SpMET, 12-lead
BATTERY/LINE POWER	Both	Both available	Both available
Number and type	No preference	1 Lithium Ion, rechargeable	1 Li Ion or 1 SLA
Integral or removable	Either	Removable	Removable
Operating time, hr	2 continuous ECG monitoring or 20 discharges	60 discharges at max energy or 4hr continuous monitoring	Li Ion: 4.25 hours continous ECG monitoring or 100 discharges
Charging method	Any	AC	AC
Charging time, hr	<24	<5 hr	Li Ion: < 5 hours
Battery pack			
H x W x D, cm (in)		4.4 x 16.5 x 5.7 (1.7 x 6.5 x 2.25)	Li Ion: 4.4 x 16.5 x 5.7 (1.7 x 6.5 x 2.25)
Weight, kg (lb)		0.77 (1.7)	Li Ion: 0,77 (1,7)
UNIT			
H x W x D, cm (in)		20.8 x 26.7 x 31.7 (8.2 x 10.5 x 12.5)	5.75 in. high x 13.1 in. wide x 10.5 in. deep; 14.6 cm high x 33.3 cm wide x 26.7 cm deep
Weight, kg (lb)	<9.1 (20)	5.8(13.0) with battery pack and OneStep Cable	5,99 (13,2)
External outputs	1 V ECG out	1 V ECG out	1 V ECG out
LIST PRICE		available through local ZOLL representative	available through local ZOLL representative
WARRANTY		available through local ZOLL representative	available through local ZOLL representative
OTHER SPECIFICATIONS	**Supplier Footnotes** 1 - These recommendations are the opinions of ECRI's technology experts. ECRI assumes no liability for decisions made based on this data.	The first Code ready defibrillator. Features a large color screen, an optional Advisory function, and the intuitive ZOLL user interface. Performs automatic selftest of the complete system. Allows rapid deployment and administration of therapy through a unique OneStep Cable and OneStep electrode system for Monitoring, Defibrillation, Cardiovertion and Pacing. Features unique Real CPR Help for real-time feedback on CPR performance. Allows minimizing interuptions to CPR with SeeThru-CPR and CPR idle time display. Optional wireless transmission of CodeReady Data to the BioMed Network; SurePower Battery Monitoring and Management System	* ZOLL's Real CPR Help®, which measures chest compressions and rate and depth in real time, and provides visual and optional audible feedback. All CPR data can be recorded and reviewed using RescueNet Code Review software. * See-Thru CPR®, unique to ZOLL, which allows CPR artifact to be filtered, letting you see organized rhythms without pausing compressions. * EasyRead Tri-Mode Display™ screen for use in both pitch darkness or direct sunlight. * Unique synchronisation with the ZOLL AutoPulse mechacal Chest compression device for optimal timing of the shock * Built-in GPS clock, allowing users to synchronize dispatch, defibrilltor, and intervention call times, improving overall data accuracy. * felxible patient data transmission capabilities from the field to a variety of destinations.

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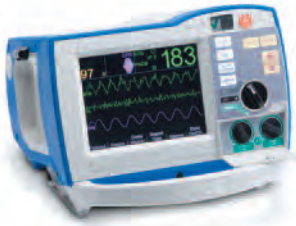

You've been there. A code is chaotic. People are demanding action, and a life hangs in the balance. You reach for the defibrillator and discover it's not ready. It could be delays and confusion from multiple cables, compromised or missing electrodes, depleted batteries, unclear controls, or confusing alarms.

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AUTOMATED HAND HYGIENE MONITORING

Perspectives for Healthcare Staff, Management, and Infection Control Specialists

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Hospital acquired infections (HAI) cause two million infections yearly, resulting in 88,000 deaths globally (Pittet et al. 2004). They are defined as infections occurring 48 hours after being admitted to a healthcare facility and are secondary to the patient's original condition (Larson 1999). Most HAI must be treated with antibiotics, resulting in increases in antibiotic-resistant organisms, lengthened hospital stays, massive inefficiency in hospital systems, disability and in some cases death. Annual costs of HAI in the United States range between five and 11 billion dollars (Ricks 2007; Kelvens et al. 2007). An estimated five percent to 19 percent of their patients are infected, with 30 percent in intensive care units. In Europe, reported numbers range from 6.7 percent to 14 percent, causing 15,000 deaths a year. Preventing HAI is therefore one of the most important goals of infection control research.

It is estimated that one third of HAI are preventable (Larson and Kretzer 1995). Hand washing is the single most important measure to reduce the risks. Hand washing is often neglected or performed incorrectly. Studies observing hygiene practices agree that 40 to 60 percent of doctors and nurses fail to wash hands between patients (Thompson et al.1997). Some of the reasons that have been listed include the lack of priority over other required procedures, insufficient time, inconvenient placement of hand wash facilities, allergy to hand hygiene solutions, and lack of leadership from senior staff (Thompson et al. 1997; Larson and Killien 1982; Gould 1994; Boyce 1999).

Consequently, different approaches have been suggested to improve compliance including education, surveillance and monitoring quantities of disinfection products consumed. Educational programmes have failed to produce sustained improvements (Pittet et al. 2004; Boyce 1999). Observational methods are extremely expensive and have shown to be poor predictors of actual compliance (Mortel and Murgo 2006). Keeping track of disinfection product consumption does not provide reliable and accurate data on the number of hand wash opportunities (JCAHO 2004).

In recent years, commercialisation of wearable hand hygiene products opened the possibility for more efficient hand hygiene activities by allowing staff to disinfect while moving from place to place. The potential advantages are significant since the convenience and availability of the dispenser enables a stronger habit of hand hygiene. Pilot testing of wearable dispensers found that participants increased the frequency of hand hygiene between patient contact from an average of 37 percent to 49 percent (p=.006) (Moore et al. 2006). This level of improvement is in the range anticipated but still unacceptably low. Sustained compliance greater than 60 percent seems unlikely unless a radically new technology can be developed. This paper reports on a novel electronic hand hygiene system with monitoring and reminding properties.

A New Technology

Toronto Rehabilitation Institute, Canada, developed a hand hygiene monitoring system to enhance and record hand wash frequency. The new technology consists of three main components: (1) small wearable electronic monitors, (2) protected zones installed to define individual patient environments, and (3) personal wearable alcohol gel dispensers.

The monitors identify when staff enter and leave a patient environment by using infrared communication with controllers installed in the patient zones. The zones are defined by infrared emitters with regulated intensity, mounted inside direction elements that are adhered to the ceiling and arranged in groups to precisely cover the patient areas. The monitors work in combination with the dispensers and perform moni-

toring, data logging and hand hygiene prompting functions, according to programmable logic rules. Each monitor records in real-time the events of the user entering and leaving patient areas and hand hygiene actions. These records are later downloaded and performance printouts are generated. Patient zone controllers are configured to transmit zone identifiers and additional specific information (e.g. risk level), so the wearable monitor can provide different prompting options if specific hand hygiene procedures are required. Although the above described system has the potential to radically increase the frequency of hand washing, there are obvious privacy issues since the system can be used to determine how much time staff spend with a patient, not just whether hands are washed. Therefore, the first phase of the larger study focused on exploring the acceptability and usability of the system.

The Study

An exploratory study was conducted at a large teaching facility in Toronto, Canada. The study consisted of a field test in which participants tested the device, and focus groups to explore the acceptability of being monitored and the usefulness of the system (Boscart et al. 2008). Staff felt this technology was a convenient and secure approach to remind them of the hand wash act. Staff also liked the consistency of the system when it provided reminders to disinfect hands before approaching and leaving patients. Overall, staff felt comfortable with receiving individual performance data and indicated that the system has capabilities to increase compliance and improve sustainability of hand hygiene.

Perspectives for Healthcare Staff, Management, and Infection Control Specialists

The data collected have important potential to healthcare staff using the system, management, infection control specialists, and policy makers. The system is able to provide the time of entering and leaving identified patient zones, and also indicates the time hands were disinfected. Subsequently, individual compliance can be calculated. This information can be compared with anonymised unit, facility, or job category performance to provide the individual with a reliable framework of his or her own hand wash behaviour. From the management's perspective, these detailed data are valuable for several reasons. First, a manager can easily identify and compare performance at an individual, unit and facility level. The system can also present frequencies of hand disinfections registered per location and records if this disinfection took place before entering the zone or as a response to a reminder from the system. Different levels of access and anonymous data can be built in. The system will also allow identification of specific situations (e.g. mealtimes, physician rounds), locations, or times (e.g. night shifts) of hand hygiene. Specific trends can be monitored and subsequently addressed with tailored interventions. The individual data collected automatically can then serve as an evaluation of any given intervention, thereby avoiding expensive and time-limited observations of hand wash compliance.

Another advantage of this system is not directly related to hand hygiene, nevertheless it is one that has potential to improve care and efficiency. The data collected will provide reliable information on the specific healthcare provider's time spent with an individual patient. The duration of specific procedures or therapy can be calculated per patient. These data might be particularly helpful to calculate staffing on a timely basis, taking into account the fluctuating patient conditions, treatments and available staff.

Currently, compliance is calculated based on limited observations of some staff in specific areas within the facility. Not only does the Hawthorne effect interfere with the data collection, the reliability of the data collected is questionable (Mortel and Murgo 2006). This novel system will be able to provide accurate and timely data for managers and infection control specialists on hand hygiene compliance when entering or leaving a patient zone.

Discussion

In developing a technology to monitor staff's hand washing activities, the need arose to explore concerns about being continuously aware of hand hygiene. The research team built a prototype version and collected data from staff. Participants were very excited about the new technology. They responded positively because the opportunity to obtain help to improve their performance appealed to their professionalism. The ability to be able to select whether the data is anonymous or is attributed was welcomed. Staff expressed a desire that the data be maintained anonymously for an introductory period until they had thoroughly familiarised themselves with the technology and had had an opportunity to adjust their practices to achieve optimal performance.

When a patient suffers or dies from a HAI, there are financial ramifications in addition to the human costs. Based on research endorsed by the World Health Organization, improvements in hand hygiene could reduce infections and costs substantially. Implementation of the new hand hygiene monitoring and reminding system in all hospitals in Ontario, Canada, would cost approximately 12 million Canadian dollars annually. Given the 77,395 HAI a year in Ontario (Zoutman et al. 2003; Canadian Institute for Health Information 2003-2004 and 2004-2005), with an extra cost of an HAI of 6000 Canadian dollars, the total annual cost of HAIs in Ontario could be over 460 million Canadian dollars. If this system could increase hand hygiene by only 10 percent, 3,870 of these HAI could be avoided yearly, resulting in 19 Canadian dollars million in cost savings (Wodchis et al. 2008).

Conclusions

A new hygiene compliance monitoring system has been developed that has the potential to reduce transmission of infec-

tions and associated costs. The new solution can provide managers, staff and infection control specialists with hand hygiene performance data collected automatically. The feedback from early testing has given the research team confidence to expedite the completion of the technology and its commercialisation in an effort to increase hand hygiene compliance and reduce transmission of infections with consequent reductions in costs, morbidity, and mortality. ■

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Continued from page 16

admissions: 51 percent. Presentations were more easily forecast than admissions (daily MAPE ~seven percent). Subgroups within the data with more than ten admissions or presentations per day had forecast errors statistically similar to the entire dataset.

The best method for forecasting data used in our study was averaging (smoothing) using a four-year training period, and potential exists for the model to be implemented in other facilities. Sensitivity analysis showed that smoothing techniques worked best with as much historical data as possible, but regression was best with the most recent data.

When compared to existing prediction models at one of the hospitals, the new techniques shave Mean Absolute Percentage Error of daily admission predictions from 20 percent to 11 percent. Based on a mean admission rate of 50 admissions per day, this improvement in forecasting performance corresponds to ±five beds. When a new ED wing opened in the catchment area, the error from existing predictions worsened to 30 percent, whilst error from the new models was 11.8 percent. This improvement in forecasting performance corresponds to ±nine beds.

The admissions and presentations predictive modelling has been implemented as a stand alone software application. The programme has been designed to run in an unsupervised manner, where forecasts for admissions and presentations are refreshed every hour. It is also possible to run the programme once or repeatedly for a specific date. Initially this choice is determined from the welcome screen, along with the confidence limits to adopt for prediction intervals. The project has also resulted in the development of a User Experience Base via detailed consultation with ED and bed management planning staff to identify user expectations and functional requirements for a prediction tool.

Conclusion

As a result of this study, it can be concluded that accurate forecasting tools are important aids to many areas of hospital management, including elective surgery scheduling, bed management, and staff resourcing. We have produced a tool that can predict ED admissions and thus allow appropriate allocation of in-patient beds and operating theatres. With regular feed of site specific retrospective data, this tool should have considerable utility for acute facility bed management and health service planning.

The project team have identified an extension of this project to formally evaluate the impact of the prediction tool in these areas. Such evaluation is essential to quantify the potential benefits of the model such as reduced ambulance bypass occurrences and elective surgery cancellations. Future research into this aspect has recently commenced. ■

CARDIOLOGY MANAGEMENT

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   - ❑ Other Physician (please specify)

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   - ❑ Interventional Cardiology
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   - ❑ Paediatric Cardiology
   - ❑ Other (please specify)

1b. I am Chief of my Department
   - ❑ Yes
   - ❑ No

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1c. What is your occupation? (check only one)
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   - ❑ Cardiology Business Manager
   - ❑ Cardiology PACS Administrator Executive
   - ❑ Chief Information Officer / IT Manager
   - ❑ Chairman / Managing Director
   - ❑ Director
   - ❑ Chief Financial Officer / other executive titles

Other
   - ❑ Medical Physicist
   - ❑ Academic
   - ❑ Chief Technologist
   - ❑ Manufacturer
   - ❑ Business Consultant
   - ❑ Distributor / Dealer

All respondents reply to the questions below

2. In what type of facility do you work? (check only one)
   - ❑ Private clinic
   - ❑ Hospital (check number of beds)
     - ❑ More than 500 beds
     - ❑ 400-499 beds
     - ❑ 300-399 beds

3. How many beds is your ward equipped with?
   - ❑ More than 30 beds
   - ❑ 15 - 30 beds
   - ❑ Less than 15 beds

4. With what technologies or disciplines do you work? (check all that apply)
   - ❑ Echography
   - ❑ Interventional Cardiology
   - ❑ Angiography
   - ❑ Cardiac CT
   - ❑Cardiac MRI
   - ❑ Cardiology PACS

5. What is your role in purchasing
   - ❑ Final say
   - ❑ Influence
   - ❑ No role

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ICU CARE PRIOR TO ADMISSION TO THE ICU: THE IMPORTANCE OF THE EMERGENCY DEPARTMENT

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The demand for ICU resources is high and continues to increase. This may challenge the ability of critical care services to expediently admit patients from other hospital locations. Critically ill patients are common in the Emergency Department (ED), and as ED waiting times increase, may result in prolonged management of patients in the ED if an ICU bed in not available. It is therefore likely that the management of critically ill patients in the ED will require increased resources due to current heathcare delivery issues.

However, expert resuscitation in the ED is vitally important as early diagnosis and stabilisation has a substantial impact on patient outcomes. ED care may reduce not only mortality, but also morbidity such as organ dysfunction and hospital length of stay (LOS). Expert diagnosis and resuscitation in the early stages of critical illness may prevent disease progression, impede the development of multi-organ dysfunction, and decrease mortality and therefore imparts a significant morbidity and mortality advantage. In some cases, resuscitation in the ED may decrease the need for ICU admission.

Expert resuscitation includes simultaneous assessment, diagnosis and initiation of life saving therapies, regardless of patient location. The use of invasion procedures to optimise gas exchange, medication delivery, and physiologic monitoring is considered the standard of care to maximise good patient outcomes. Invasive procedures include emergent endotracheal intubation, central line insertion, and arterial catheter placement, among others. These procedures are often performed by intensive care physicians and emergency physicians.

Despite this, little is known about the duration of time critically ill patient remain in the ED prior to admission to ICU. Also, invasive procedures performed on critical ill patients during their ED phase of care have been incompletely described.

The Provision of Critical Care in a Canadian Tertiary Care Emergency Department

The provision of critical care in an academic Canadian emergency department has been recently described. Data of patients from the Queen Elizabeth II Health Sciences Center in Halifax, Nova Scotia, Canada who were resuscitated in the ED and admitted directly to a mixed medical/surgical/neurosurgical intensive care unit during a one year period illustrates the care of critically ill patients in the Canadian healthcare system. This ED is an adult (age >17 years) tertiary care ED with approximately 70,000 patient visits per year. The ICU's are "closed" units and are staffed by 24 hour/day intensivists who provide consultant support to the ED and other in-hospital emergencies, in addition to the referral of critically ill patients from the provinces of Nova Scotia and Prince Edward Island, and on occasion from New Brunswick and Newfoundland.

Of the 68,765 patients which presented to the ED during the study period, 178 patients were admitted to an ICU (ICU admission rate 0.26 percent). The median age of patients was 55 years, 59.6 percent were male and the in-hospital mortality rate was 21.9 percent (39/178).

The median LOS in the ED for critically ill patients requiring ICU admission was 4.9h (mean 6.5h, range 1.4-28.2h) and the median hospital LOS was 9 days (mean 20.8 days, range 1-362days). The ED diagnosis of critically ill patients varied. Patients who survived (139/178) were discharged home (111/178 62.3 percent) or to long term care or other facilities (26/178, 14.6 percent).

The majority of patients received at least one invasive procedure in the ED (Table 1). One hundred and twenty five patients (125,178, 70.2 percent) required endotracheal intubation during the first 24 hours of their hospital admission. The majority of intubations (118/125, 94.4 percent) were performed in the ED (80/125, 64.0 percent) or the prehospital setting

	Prehospital (n, #)	Emergency Department	ICU <6 hours	ICU 6-24 hours
Endotracheal Intubation 125/178 (70.2%)	38/125 (30.4%)	80/125 (64.0%)	4/125 (3.2%)	3/125 (2.4%)
Central venous catheter 56/178 (31.5%)	0	10/56(17.9%)	30/56 (53.6%)	16/56 (28.6%) Other%:1/16
Arterial Line Catheter 99/178 (55.6%)	0	14/99 (14.1%)	71/99 (71.7%)	14/99 (14.1%)
Chest Tube 8/178 (4.5%)	0	4/8 (50.0%)	1/8 (12.5%)	3/8 (37.5%)

Table 1. Invasive procedures completed in patients admitted to an ICU directly from the ED

(38/125, 30.4 percent). Central venous access was obtained in 56/178 patients (31.5 percent). Only 17.9 percent (10/56) of patients who had a CVC inserted in the initial 24 hours of ICU admission had this procedure performed in the ED.

Interestingly, the majority of patients requiring central venous access (30/56, 53.6 percent) had the CVC inserted within the first six hours of admission to the ICU. Similarly, arterial catheters were inserted in 99/178 patients (55.6 percent) with 14.1 percent (14/99) inserted in the ED and 71.7 percent (71/99) inserted in the first six hours of ICU admission.

Discussion

Critically ill patients remain in the emergency department for prolonged periods of time. Other studies have demonstrated that the mean duration of stay in the emergency department for critically ill patients is 4 – 6 hours, and patients remaining in the ED an additional 75 minutes after admission order are placed. Earlier implementation of invasive procedures and critical care therapy may improve patient outcomes. Early goal directed therapy, delivered in the ED during the treatment of sepsis, has been shown to significantly decrease patient mortality.

Our experience provides the most recent data on this patient population. We have confirmed that critically ill patients remain in the ED for a prolonged period of time. This in itself may not be significant if the care provided in the ED setting simulates that provided in the ICU environment. This means that the invasive procedures regarded as beneficial for patient outcomes are provided when a patient will benefit, despite their hospital location. If the patient is in the ED, necessary procedures should be performed during this phase of care.

Our data raises the issue of a potential delay in the insertion of invasive procedures until after admission to an ICU, as the majority of central venous catheters and arterial catheters were not inserted until after ICU admission, yet emergent endotracheal intubation was performed in the ED. In addition, our finding that the majority of these procedures were performed immediately upon ICU admissions (<6 hours) may support this hypothesis. Therefore, the possibility that life saving treatments and/or monitoring may have been delayed 4.9 hours is possible, if invasive procedures are considered a surrogate to the provision of optimal patient resuscitation.

The reasons for our findings are unclear. It is possible that ED physicians at our institution are more comfortable with airway management than the other more invasive procedures. Physicians often obtain invasive procedure skills during training, and due to various reasons skill maintenance may be a factor. The availability of other personnel with invasive line or arterial catheter insertion skills, such as a critical care consult service, may impact on the opportunity to perform these procedures. Other factors include volume of critically ill patients, ED nursing skill, time pressures inherent in a busy ED, in addition to others.

It should be noted that this study was not designed to determine the impact of invasive procedures on patient outcomes, yet the delays in these are striking. Further research is needed to confirm our findings, and to elucidate any association with patient outcomes.

Potential strategies to improve resuscitation practices:

1. **Assess current practice in ED resuscitations:** Hospitals should identify current practice and resuscitation deficiencies in order to determine potential solutions. Data on the provision of critical care in the ED is the initial step in improving ED resuscitations.
2. **Provide Targeted Education:** After identification of skill and knowledge deficits, educational strategies for healthcare providers involved in the resuscitation of critically ill patients should be developed. Educational programmes should target a wide audience, including physicians, nurses, and respiratory therapists. Programmes may include additional training in invasive procedures in concert with sessions on optimal resuscitation practices.
3. **Ensure Skill Maintenance:** Initial education and training need to translate into the maintenance of resuscitation skills over a period of time. Planning for follow up educational sessions to ensure skill maintenance is encouraged.

4. **Provide Support for ED Resuscitations:** Support between the specialties of critical care medicine and emergency medicine should be encouraged. In some situations, the presence of an intensivist in the ED during resuscitations may aid in improving patient outcome.

Implications for the administration of ICU resources: Optimal resuscitation should be available for critically ill patients despite their hospital location. Care provided in the ED is vitally important, as may allow rapid stabilisation and prevent progression to multi-organ dysfunction and death. The implementation of strategies to ensure aggressive resuscitation occurs in the ED should be a priority. Resources may need to be allocated for education, skill acquisition, and necessary equipment. If this is not possible, ICU services may also need to be readily involved in the early phases of ED resuscitation if optimal patient outcomes are to be achieved. ■

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Continued from page 20

Future Expansions

In a future version, COSARA will be extended to generate specific alerts indicating alarming trends in (i) nosocomial infection incidence, (ii) microbial ecology, and (iii) antimicrobial consumption, using expert based thresholds and longitudinal data analysis. Besides the alerts itself, COSARA will automatically provide the associated information in order to make the interpretation of every alert easy and efficient.

Another extension of COSARA will include the integration of a rule base-expert system assisting the intensivist with respect to the optimal choice and duration of antimicrobial therapies. Already in 1998, Evans [1] showed in an article in the New England Journal that a computerised anti-infectives management programme can improve the quality of patient care and reduce costs. However, at that time, important technological barriers were still present, problems that are now solved within the COSARA software.

Conclusion

Advanced computerisation of the ICU has allowed the development of specific software (COSARA) designed to capture and integrate all data related to infection and antibiotic prescription in the ICU patient. These data are returned to the ICU physician as a comprehensive and up-to-date 'infection status' of the individual patient, assisting in daily decision-making. In addition, this software builds up a high-quality database, which provides a sound basis for infection surveillance and control policy as well as testing research hypotheses. ■

"In one single surveyable graphical view, the intensivist can consult the selected patients' current and past infections during his/her ICU stay, together with the associated antibiotic therapies."

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Part Three: Required Resources

SERIES ON EARLY MOBILISATION OF CRITICALLY ILL PATIENTS

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In the previous articles in this series we discussed the safety, feasibility and benefits of early mobilisation of intensive care unit patients (Korupolu, Chandolu and Needham 2009). In this article, we discuss the personnel and equipment required for incorporating early mobilisation into routine clinical care.

Personnel

A culture change to support early mobilisation may be needed in some ICUs where deep sedation and bed rest are common. Support from organisational leaders is important to facilitate culture change and provide adequate resources and support. Leadership from multiple disciplines, including representatives from medicine, nursing, respiratory therapy and physical therapy is necessary for effective collaboration and coordination in the ICU (Hopkins, Spuhler and Thomsen 2007).

The availability of appropriately trained staff is essential. A multidisciplinary team, consisting of nurses, physical therapists, respiratory therapists, and assistants or technicians can help make mobilisation safe and available for all eligible ICU patients. Ambulation of a typical ICU patient requires the assistance of one or more staff in addition to the physical therapist to move all necessary ICU medical equipment while the patient is walking.

In the 16- bed medical ICU at Johns Hopkins Hospital where a comprehensive critical care physical medicine and rehabilitation program exists, the following full-time staff are dedicated to early mobility therapy: two physical therapists providing six day per week therapy, a technician, and a clinical programme coordinator. An ICU physician serves as medical director of the programme (Korupolu, Gifford and Needham 2009).

Consultation services of a rehabilitation physician are also available. Respiratory therapy, occupational therapy and speech language pathology clinicians also provide rehabilitation care to patients in the MICU along with other hospital units.

Equipment

We will discuss equipment resources for both ambulation and pre-ambulation activities of ICU patients.

Equipment for ambulation
Certain rehabilitation medical devices and standard equipment used for intra-hospital patient transfer may facilitate early mobilisation. This equipment includes: a walker, wheelchair and rolling IV pole. During ambulation, a walker provides support and balance in addition to the physical therapist's assistance, and a wheelchair provides an immediate place for patient rest in case of fatigue or exercise intolerance. An IV pole allows provision of any medication infusions during ambulation. Monitoring of patients' vital signs may be facilitated using a portable oximeter and a portable cardiac monitor or wireless telemetry system.

Ambulation of a mechanically ventilated patient requires a standard ICU ventilator under battery power, a special portable or transport ventilator, or an ambu bag with oxygen supply. In our experience, a portable ventilator enhances the convenience of this process and allows walking for longer periods.

Special custom-designed equipment for ICU patients and the ICU environment can further improve the feasibility of early mobilisation (Burns and Jones 1975; Kirshblum and Bach 1992; Needham, Truong and Fan 2009). For example, a custom designed walker with an emergency seat and a wheeled tower with the ability to transport all of the ICU equipment may reduce the number of staff required to ambulate a ventilated ICU patient (Needham, Truong and Fan 2009).

Equipment for pre-ambulation therapy
Pre-ambulation therapies, as described below, may reduce the loss of muscle mass and help preserve range of motion in

comatose or deeply sedated patients, profoundly weak patients, and haemodynamically unstable patients who cannot tolerate or participate in ambulation.

Neuromuscular electrical stimulation (NMES)

This therapy applies an electrical impulse through electrodes placed on the skin over target muscle groups, which results in passive contraction of skeletal muscles. The safety and benefits of NMES has been studied in patients with chronic obstructive pulmonary disease (COPD), congestive heart failure (CHF) and long-term mechanical ventilation with improved muscle strength, quality of life and physical function (Maillefert et al. 1998; Quittan et al. 2001; Zanotti et al. 2003). Recently published studies in ICU patients suggest that NMES may decrease loss of muscle and have a systemic effect on microcirculation (Gerovasili et al. 2009a; Gerovasili et al. 2009b). Clinical practice guidelines indicate that NMES may be considered as an adjunctive therapy for patients who are critically ill, bedbound and/or at high risk of developing skeletal muscle weakness (Gosselink et al. 2008; Nici et al. 2006).

Cycle ergometer

A bedside cycle ergometer can allow patients to be involved in passive, active-assisted, and active rehabilitation therapy. In a randomised trial of cycling in mechanically ventilated ICU patients, benefits included improved isometric quadriceps force and six-minute walk distance at hospital discharge (Burtin et al. 2009).

Dynamic tilt table

The dynamic tilt table is an innovative exercise device that combines the benefits of traditional tilt table standing with active exercise. It allows severely deconditioned patients to perform graded weight bearing activity in a gravity reduced environment (Trees et al. 2003). A dynamic tilt table is commonly used to prevent muscle contractures, improve lower limb strength and increase arousal (Chang et al. 2004).

Conclusion

Appropriately trained personnel and some basic equipment are important for a successful early mobility programme. At least one rehabilitation therapist dedicated to an ICU may be an important foundation in creating a new programme. In addition to standard rehabilitation and ICU equipment, specialised rehabilitation devices and equipment custom-designed for the needs of ICU patients may further enhance the safety, feasibility and benefits of mobilisation activities. ■

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ICU MANAGEMENT

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MEDICAL TECHNOLOGY & HEALTHCARE COSTS

How Innovation Increases the Financial Burden

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Health policy makers have focused on cost containment, for the past several decades, as a means to deal with the rapid rise in healthcare costs in the western world. All kinds of measures have been introduced in all kinds of healthcare systems. Virtually all of them have one thing in common – they failed to achieve cost containment. When trying to explain failure, health policy experts point to the spread of medical technology. The same innovations that save so many lives seem to be responsible for making our healthcare systems financially sick. The exact impact of new medical technology on long-term spending growth remains subject to some controversy. Most experts believe medical technology advances to account for one-half to two thirds of annual spending increases. It is apparent that new medical technology is the dominant driver of increases in healthcare costs and hence insurance premiums.

Medical Technology & Its Impact on Healthcare

The term "medical technology" refers to procedures, equipment and processes by which medical care is delivered. Hence medical technology innovations can relate to new medical and surgical procedures (e.g., angioplasty, joint replacements), the discovery of new drugs (e.g., biologic agents), the implementation of healthcare IT systems (e.g., electronic medical records and transmission of information, telemedicine), or the development of new medical devices.

How Does New Medical Technology Affect Healthcare Costs?

While some new technologies, e.g. vaccines, do result in lower short-term spending, research shows that, on balance, advances in medicine result in increased spending. Rettig* describes the mechanisms by which new medical technology affects healthcare costs:

- Development of new treatments for previously untreatable terminal conditions, including long-term maintenance therapy for treatment of such diseases as diabetes, end-stage renal disease, and AIDS;
- Major advances in clinical ability to treat previously untreatable acute conditions, such as coronary artery bypass graft;
- Development of new procedures for discovering and treating secondary diseases within a disease, such as erythropoietin to treat anaemia in dialysis patients;
- Expansion of the indications for a treatment over time, increasing the patient population to which the treatment is applied;
- Ongoing, incremental improvements in existing capabilities, which may improve quality;
- Clinical progress, through major advances or by the cumulative effect of incremental improvements, that extends the scope of medicine to conditions once regarded as beyond its boundaries, such as mental illness and substance abuse.

The effect of a particular new technology on healthcare expenditures depends on a variety of factors. Central to any calculation is the impact on the treatment cost per individual patient. Does the new technology supplement existing treatment? Is it a full or partial substitute for current approaches? Will the direct costs of the new technology affect the use or cost of other healthcare services such as hospital days or physician office visits?

A second factor relates to the level of use that a new technology achieves. Does the new technology extend treatment to a broader population? Greater availability of technologies such as MRI, CT, coronary artery bypass grafting, angioplasty, cardiac and neonatal intensive care units, as well as PET are associated with greater per capita use and higher spending on these services. The impact of this is dependent on the kind of healthcare delivery system in place.

In non-budgeted 'open' healthcare systems, such as the US and some EU countries, the unrestrained use of technologies result in their broad application, thereby incurring high healthcare costs. Nations with a greater degree of health system integration and regulation have relied on expenditure controls and global budgets to control costs. Although diffusion of technology takes place more slowly in more tightly budgeted systems, the use of innovative technologies in those systems tends to catch up over time.

Diffusion of New Technologies in the US & EU: The Case of PET/CT

The type of healthcare delivery system impacts on the diffusion of medical technology, as is well illustrated in the case of PET/CT. The rapid growth of PET/CT in the US can be attributed

to the highly competitive nature of the healthcare business. More than 40 percent of the approximately 2,000 PET/CT scanners worldwide are installed in the US. The culture of healthcare provision in Europe is very different, with central governments controlling expenditure rather than competing independent hospitals. This led to significant discrepancies in the availability of PET and PET/CT imaging throughout western Europe.

The applicability and recognition of PET/CT as an imaging modality in diagnostic oncology is affected by several factors in Germany. Reimbursement seems to be a major obstacle for the diffusion of PET/CT in Germany. Despite studies by Dietlein et al*, showing the cost-effectiveness for several PET indications, the Federal Joint Committee of Physicians and Health Insurance Funds in Germany issued a statement in 2002 refusing reimbursement for outpatient PET studies. This decision dramatically reduced funding of PET and PET/CT studies, limiting reimbursement for in-patients and self-financing private patients.

Additionally, excessive requirements for regulatory approval of radio-pharmaceuticals and fear of radiation levels are serious problems influencing the development of PET and PET/CT scanners. In Germany, approximately 55 PET/CT systems are in clinical use (April 2009) in university medical centres, community hospitals as well as private practices. Approximately 30 percent of the university medical centres still do not have access to PET/CT imaging seven years after introduction of this technique into clinical routine (personal communication with different vendors).

It is not possible to directly measure the impact of new medical technology on total healthcare spending; rather, innovation in the healthcare sector occurs continuously, and the impact of different changes interrelate. The size of the health sector (e.g., percentage of gross domestic product) and its diversity (numbers of procedures, products, and interventions) also render direct measurement impractical.

Thus, economists have used indirect approaches to estimate the impact of new technology onto healthcare costs. In a landmark paper, Newhouse* determines the impact of medical technology on healthcare spending by first estimating the impact of factors that can reasonably be accounted for (e.g., spread of insurance, increasing per capita income, aging of the population, supplier-induced demand, etc.). He concludes that the factors listed above account for well under half of the growth in real medical spending, and that the bulk of the unexplained residual increase is to be attributed to technological change – what he calls "the enhanced capabilities of medicine."

Medical Technology Assessment/ Avoidable Cost Drivers

"Medical Technology Assessment" is a multidisciplinary field of policy analysis that evaluates the medical, social, ethical and economic implications of the introduction, development and diffusion of a technology. There are three main causes why medical technology is not being used cost-effectively.

First, patients do not pay directly for the healthcare they receive, so they sometimes make unreasonable demands on physicians regarding their diagnostic work-up or subsequent treatment.

Second, a new technology may be adopted because of its clinical superiority to existing technologies, but there is no market mechanism to ensure that it will be used where it is clinically most appropriate or where it offers highest value for a patient compared with other diagnostic or treatment options.

Third, because there is no market mechanism for determining the value of medical technology, there is currently no generally accepted screening process to assess its value. In the diagnostic imaging technology category, increases are largely driven by growth in the number of installed machines. This has led to overcapacities in many areas and created incentives for doctors to prescribe unnecessary procedures. Also, direct-to-consumer marketing fuels blind demand among consumers for advances in devices and drugs.

Factors Affecting the Growth of New Medical Technology

Many factors influence innovations in medical care. Consumer demand for better health is a prime factor. Research shows that the use of medical care rises with income: a wealthy population provides a fertile market for these innovations. Consumer demand is affected by increased public awareness of medical technology through the media, the Internet, and direct-to-consumer advertising.

Health insurance systems that provide payment for new innovations also encourage medical advances. Medical treatments can be very expensive. Their cost would be beyond the reach of most people unless their risk of needing healthcare could be pooled though insurance. The presence of health insurance provides some assurance to researchers and medical suppliers that patients will have the resources to pay for new medical products, thus encouraging research and development. Equally, the promise of better health through improvements in medicine increases demand for health insurance, as consumers look for ways to assure access to the highest level of medical care.

Other factors driving the continuing flow of new medical technology include the desire by professionals to find better ways to treat their patients. Like most other professionals, healthcare workers are also motivated by professional goals (e.g., peer recognition, tenure, prestige) to find ways to improve practice. Furthermore, direct providers of care may incorporate new technology because they feel the need to offer the "latest and best" to compete with other providers for patients. Commercial interests such as those inherent to pharmaceutical companies and medical device makers represent the dominant force driving medical innovation.

Its profound impact is easily visualised by examining medical innovation over a 40-year period in Germany. The difference is vast – commercially motivated innovations made in Germany saved many lives, while at the same time making healthcare considerably more expensive. Finally, public and private investments in basic science research lead directly and indirectly to improvements in medical practice - government-sponsored investments in basic science are increasingly regarded as programmes to assure economic prosperity. ■

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HIGHLIGHTS OF HEALTH IN SWITZERLAND

Aging Population Presents New Health Challenges

Information courtesy of:

Swiss Health Observatory
Neuchâtel, Switzerland &
World Health Organisation (WHO)
Geneva

Migration and Health

Around a third of the Swiss population are people with an immigrant background. This means that they either immigrated to the country or were born here but have at least one parent who immigrated to Switzerland. Although a large proportion of immigrants are well integrated and their health is hardly any different from that of Swiss citizens, studies have shown that they are exposed to specific health risks. For example, infants of African, Sri Lankan or Turkish nationality, as well as those from the former Yugoslavia, have higher mortality at birth than Swiss children.

Mothers from Africa and Sri Lanka are the most likely to give birth to infants with low birth weights; the likelihood of a stillbirth is also particularly high among them. In surveys, people from Turkey assess their own state of health as bad or even as very bad. Consequently, they frequently see a doctor and take painkillers or tranquillisers.

The Older Working Population

Baby boomers in Switzerland are growing old. As a result, the number of over 50-year-olds in the working population is rising steadily. Known in Switzerland as the "older employed", their share rose from 25 to 28 percent of the working population from 1996 to 2007. It is estimated that by the year 2020, one third of the working population will be aged 50 or older.

Consequently, older people are generating a growing share of Switzerland's gross domestic product (GDP). Because their health determines their ability to work, it is also becoming more significant for economic reasons. This trend is likely to pick up steam, particularly because a debate about an extension of working life is currently underway in Switzerland.

Healthy Aging

People in Switzerland currently have one of the world's highest life expectancies at birth. It is therefore not surprising that the number of elderly people, particularly those over 80, is rising markedly. According to estimates by the federal statistical office, approximately 600,000 more people aged over 80 will be alive in 2050 than today.

Resources and Demand for Medical Services

All residents of Switzerland have access to the resources provided by the healthcare system. This is guaranteed by the Health Insurance Act. Nevertheless, some medical services are not equally available everywhere, because resources and demand for these resources are unevenly distributed from one canton and region to another. But existing regional differences are not reflected equally in all medical services.

In Switzerland, the impact of regional differences is mainly seen on three levels: between urban and rural areas, between eastern and western Switzerland, and between border regions and non-border regions. The difference between urban and rural areas makes itself felt first of all in outpatient care. In urban areas, medical services are markedly more comprehensive. These resources are also partly available to patients in non-urban areas, namely when they travel to cities for treatment. But people who live in cities still make use of inpatient services more frequently than people who live in other regions.

Costs, Financing, Efficiency and Solidarity

In 2005, a total of CHf 53 billion, or approximately 11.4 percent of GDP, was spent on health goods and services in the healthcare

sector in Switzerland. This put Switzerland in second place in the world, behind the United States. Inpatient care accounted for 46 percent of all healthcare spending and outpatient care for 54 percent.

In 2005, private households paid 66 per cent of all healthcare expenditures. The Confederation, the cantons and the municipalities accounted for 27 percent. A large proportion of these expenditures went to subsidise inpatient care facilities, particularly hospitals. In Switzerland, seven percent of financing requirements – a relatively small share of the total – are covered by private enterprise contributions to accident insurance, old-age and survivors' insurance (aHV) and invalidity (disability) insurance (iV). The situation varies considerably across the country.

There are marked differences from one canton to another, both with respect to the structure of healthcare provision and to costs. In some cantons almost three times as much is spent on health as in others. There has been considerable debate about the causes for these differences. At the forefront of the debate are divergences in the organisation, structure and availability of services – on top of which come sociodemographic and socioeconomic differences. A relatively centralised healthcare structure and a high proportion of medical specialists or specialist hospitals have variously been blamed for above-average costs in some cantons. It is worth noting that health factors play a less significant role.

The Principal Healthcare Challenges

The Swiss healthcare system will face major challenges in the coming years. In all likelihood, the demand for medical services will continue to grow and consequently also the costs. This trend has different causes. Demographic shifts probably play the most important role: as the number of older people is rising, so is the demand for medical and nursing services. Furthermore, it is to be expected that certain chronic diseases such as cardiovascular diseases will be more common in the future. General medico-technical progress is also likely to result in more extensive diagnostic and treatment capabilities.

Lastly, it is well known that the more prosperous a society is, the more use it makes of medical services. Against this background, calls for a more effective control of rising costs and premiums are growing ever louder in Switzerland. Moreover, healthcare services and healthcare professions themselves are also undergoing structural change. It is particularly noteworthy that a growing number of medical personnel are working part-time and that the proportion of women and medical specialists is also growing. On the other hand, the number of medical school graduates is not keeping pace with demand. If these trends continue, a decline in the availability of medical services is to be expected. ■

Facts & Figures

Full name: Swiss Confederation (26 'Cantons')
Population: 7.72 million (International Monetary Fund, 2008)
Capital: Bern
Largest city: Zurich
Area: 41,284 km²
Major languages: German, French, Italian, Romansch
Major religion: Christianity
Life expectancy: 79 years (men), 84 years (women) (UN)
Monetary unit: Swiss Franc (CHF)
GNI per capita: 59,880 dollars (World Bank, 2007)

Population profile

About 7.7 million people lived in Switzerland in 2008. The most striking demographic feature is the increase in the proportion of elderly people. As the large birth cohorts of the late 1940s approach retirement age, the number of people in Switzerland 65 and over is expected to grow. The birth rate in Switzerland was the average for Eur-A in 2003. Natural population increase and net migration in Switzerland are above the Eur-A averages.

Life expectancy (LE) and healthy life expectancy (HALE)

From 1980, life expectancy in Switzerland rose about 4.7 years, to 80.6 in 2002. Infant and neonatal mortality rates have remained stable below European averages since the mid-1990s. According to WHO estimates, a person born in Switzerland in 2002 could expect to live 80.6 years on average: 83.3 years for women and 77.7 years for men.

OUTBREAK OF COCKROACHES IN AN INTENSIVE CARE UNIT

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Healthcare-associated infections are common in the intensive care unit (ICU) and represent a significant burden for patients and the healthcare system. Often resistant to many antimicrobial agents, viruses and bacteria are transmitted by the droplet and airborne routes or by the hands of healthcare workers. Prevention is of the utmost importance for these three routes of pathogen transmission. Although vector-born transmission and parasitical infections do not play a major role in ICU settings, it can be surprising to discover some unexpected visitors and how they arrived in your ICU....

	Blattella germanica	Ectobius vittiventris
Scientific name	Blattella germanica	Ectobius vittiventris
English name	German cockroach	Field-dwelling cockroach
Habitat	Domestic worldwide	Green areas
Size	10-15 mm	10 mm
Ability to fly	no	yes
Life span	18 months	Up to 24 months
Nuisance	Can transmit pathogens	no
Eradication	Permethrin, hydromethylnon	Keep outside, no insecticide available

Figure 1. Characteristics of Blatella germanica and Ectobius vittiventris

We reported an outbreak of cockroaches in the medical ICU of the University of Geneva Hospitals in summer 2006 (Uçkay et al. 2009). The ICU is located on the ground floor next to an outdoor recreational area. Smoking inside hospital buildings is strictly prohibited for patients and healthcare workers.

Roughly 30 cockroaches had been observed either hiding inside oxygen masks, moving around on the light panels below the ceilings, or dropping on to intubated patients during night shifts. External pest control experts identified the species as Ectobius vittiventris, a field-dwelling cockroach. It had entered the ICU through

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the French windows from the outdoor recreational area. Despite verbal recommendations and repeated interdictions to the contrary, doors had been secretly opened using screwdrivers to allow healthcare workers to smoke during night shifts.

Medical reasons to combat cockroaches are two potential health problems. First, cockroaches may provoke allergic reactions (Tungtrongchitr et al. 2004). Second, most "nosocomial" cockroaches may carry medically important microorganisms such as Escherichia coli, Klebsiella sp, Acinetobacter baumanni, Pseudomonas aeruginosa or fungi on their external surface or in the alimentary tract with the possibility to disseminate these via the orofecal route (Cotton et al. 2000; Salehzadeh et al. 2007).

Successful management relies on the species-level identification (among some 4000 species worldwide) to tailor control strategies. E. vittiventris lives outdoor, does not fear light, and is also active during daytime. It is easily confused with Blattella germanica (the German or croton cockroach), probably the most important cockroach pest worldwide in terms of frequency and danger for patients. B. germanica is nocturnal, cannot fly, and is always encountered within human habitations. In contrast to B. germanica (Figure), E. vittiventris is considered harmless for ICU patients, but might become a serious public relations problem for the hospital for obvious reasons. Not surprisingly, we did not observe any allergic reactions or an increase in the colonization rates of multiresistant organisms.

Since E. vittiventris is unable to reproduce inside buildings, stopping the entry from outside terminates the outbreak. Indeed, our outbreak was halted within three days after information to healthcare workers and permanent reclosure of all windows. So far, no recurrence has occurred after three years. No other measures such as the use of insecticides, review of the air circulation system, or changes to the architectural structures were necessary. ■

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IN FOCUS:
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www.sgi-ssmi.ch

Guiding principles of SSICM

The Mission (why are we here?) and Vision (where do we go from here?) of the Swiss Society for Intensive Care Medicine (SSICM) were formulated by the SSICM board in the year 2009, adopted at the board meeting held on June 17, 2009, and presented at the SSICM annual meeting on September 24, 2009.

Mission

The Swiss Society for Intensive Care Medicine (SSICM) promotes high-quality, effective, efficient and comprehensive care of all patients with acute life-threatening disease or injury. Our main focus is the optimisation of patient care processes and the care of our patients' families, as well as the promotion of interdisciplinary collaboration. We promote postgraduate training and continuing medical education of all healthcare professionals involved in intensive care medicine. We promote and support research in intensive care medicine. We participate actively in activities concerning health politics at the national and international level.

Vision

The SSICM serves as a competent and dependable partner for all issues related to intensive care medicine in the Swiss healthcare system. All healthcare professionals who are involved in the provision of intensive care medicine are represented within SSICM. The core tasks of these professionals are carried out in highly specialised ICUs. SSICM actively supports and promotes continuous, high- quality patient care in the ICU. SSICM also promotes the development, implementation and management of additional concepts for alternative approaches to patient care, such as intermediate care (IMC) and medical emergency teams (METs). The development and implementation of such new models may help to avoid transfer of patients to the ICU, through provision of appropriate patient care in general acute care wards and in units independent of or affiliated with the ICU.

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