HealthManagement
Promoting Management and Leadership

Volume 3 / Issue 2 / 2008 - Features

IT and the Intensive Care Units

COMPUTER-SUPPORTED DECISION MAKING: AN EVALUATION

A hospital's intensive care unit (ICU) has several characteristics which make it favourable for extensive use of information technology. Firstly, it has an overwhelming amount of data, often leading to data-overload and loss of information. Secondly, intensive care medicine has a short diagnostic-therapeutic cycle compared to other medical disciplines. IT can therefore play a pivotal role in supporting and supervising the process of medical decision making. Thirdly, intensive care medicine is extremely expensive and consumes a large portion of available healthcare resources. In the U.S.A., it is estimated that ICU medicine costs between 0.5% and 1% of the gross domestic product. An integrated computerisation of the ICU could optimise use of resources, leading to substantial cost savings.

J o h a n D e c r u y e n a e r e

and Kirsten Colpaert

are with the Department of Intensive Care

Medicine, Ghent University Hospital,

Belgium.

Current Situation

The development of a dedicated ICU-IT-system is now so complex and time-consuming that on-site development is nearly impossible. Commercially available products are purchased and adapted to match as closely as possible the local needs of the ICU. Only a few bigger companies and maybe a dozen smaller companies currently offer dedicated software solutions for the ICU. None of the available software products are perfect and although they share many common features, they differ in smaller ways, resulting in product-specific advantages and disadvantages.

All of the software products share two main functions:

Ó recording and automatic storage of data from the different monitoring devices surrounding the patient, including the data from the monitor and the mechanical ventilator and automatic capture of syringe pump infusion rate, and

Ó the replacement of all handwritten forms by computerised equivalents such as the Computerised Physician Order Entry (CPOE), including the electronic prescribing of medication.

Most ICU-IT-systems offer some basic form of workflow management and some even have basic alerting properties, but advanced computer decision support is still lacking.

Potential Benefits

Benefits of IT systems: These are hard to measure. From the management viewpoint, only direct financial benefits are important. Unfortunately, an immediate financial return of investment (RoI) is – at least now – hardly achievable. Non-financial benefits are however at least as important, such as improving the quality of care, decreasing the length of stay in the ICU and achieving a higher survival rate. In an indirect way and seen over a longer time span, this will also lead to minimized ICU costs.

Time: Several studies have investigated the impact of IT in the ICU on nurse time. The older studies showed no time benefit, but a recent well-designed study showed that the introduction of an ICU-IT-system in a cardiosurgical unit reduced documentation

time of the nurses by 29 minutes for every 8-hour shift (Bosman et al. 2003). This time was completely re-allocated to direct patient care.

In our ICU, nurses generally experience the new system as time-neutral. However, it is important to take into consideration that the computer-

based ICU file is now much more complete and accurate. ICU physician workload is considerably higher, especially for physicians in training, but again, the amount and quality of the patient information is substantially more valuable.

Computerised Physician Order Entry (CPOE): In 1999, the Institute of Medicine declared in their report “To Err is Human - Building a safer Health System” that at least 7,000 patients die in US hospitals annually as a result of medication errors. These errors frequently result from problems with the paperbased medical record. Increasing prescription complexity also means that the physician’s memory is not always a reliable bridge between research advances and clinical practice. Not only do adverse drug events (ADE) cause patient harm, their costs are estimated to be at least $2,000 per ADE.

CPOE features thus help to minimise human error, improve medication management, facilitate reporting and improve resource utilisation. Even in its most basic form, a CPOE system can reduce the number of poorly written prescriptions, which can lead to the wrong drug, wrong dose or wrong route of administration.

Evidence for CPOE use generally is shown in the box on page 25. Only a few studies have been published evaluating the impact of CPOE on medication errors in the ICU. A recent prospective study conducted in our adult SICU demonstrated an impressive decrease in medication prescription errors after the implementation of an ICU-IT-system with CPOE (27% vs. 3.4%, p<0.001; Colpaert et al. 2004). This was mainly due to the almost complete elimination of true prescription errors and incorrect orders, which have no real potential to cause serious harm. However, there was also a six-fold decrease in the more important ADEs.

Decision Support And Computerised Guidelines: Some ICUIT- systems already have basic alerting possibilities, but sophis ticated computer-based decision support is still a sort of “Holy Grail”. The lack of computerised decision support is not only a technological problem but is also due to a lack of well-tested, effective and universally-accepted decision support models and rules for the ICU.

Some groups have already developed extensive and computer- based detailed treatment guidelines. These guide the clinician by using embedded decision rules and combining them with the actual physiological data of the patient to provide immediate bedside decision support.

ICU Management and Research: An ICU-database is an essential tool for benchmarking, for comparing ICU performance using standardised outcomes and for controlling ICU costs. An even greater potential lies in ICU research. Using large databases, which combine data from different centers, will undoubtedly lead to significant research advances, particularly in outcome research.

Future Trends

Although current ICU-IT-systems succeed in providing a paperless ICU, many of the above-mentioned benefits have yet to be realised. Many problems remain unsolved: a too rigid user-interface, the technological complexity of the systems, the poor integration of ICU-IT-systems with other hospital information systems and the high implementation and maintenance costs. All these factors help to explain the fact that after decades of development, only a minority (probably less than 5%) of ICU departments currently make use of one of the available systems. Another essential factor is that current ICU-IT-systems only provide very limited support for the interpretation of the massive amounts of data that far exceeds human decision-making limits. Indeed, current systems do not have advanced bedside clinical decision support or advanced support of the ICU workflow processes.

However, it is universally believed that the next major progress in ICU-IT-systems will be the implementation of a whole range of (semi)-intelligent software programs, providing continuous assistance to the ICU team while caring for the critically ill patient. These software programs are often called “intelligent” agents, because they perform a clearly defined task, normally performed by a human. In the ICU, many smaller tasks are performed simultaneously. Medications are added and infusion pump rates are continuously adapted against specific monitoring parameters (e.g. insulin pump according to glycaemia levels). In some cases, a hierarchy of agents is needed. An example is the prescription of medication, where one subagent is responsible for the right dosing ithe presence of renal failure, another in the presence of hepatic failure and a third one for checking interactions between the different prescribed drugs.

Other IT developments such as telemedicine, robotics, use of personal digital assistants (PDAs) and use of web-based ICU registries also hold considerable promise in the future.

Conclusion

Computers have been used for more than thirty years in the ICU and currently available programs automatically record all monitoring data and replace all paper forms by an electronic equivalent, resulting in a paperless ICU. However, widespread implementation is still lacking due to the high implementation costs, the complexity of hardware and software configuration, interfacing problems with other hospital departments, the lack of proven benefits, the fear that computers will replace physicians in decision making, and concerns about security.

It is our conviction that within the next few years, full ICU computerisation including advanced real-time and bedside decision making capabilities will become essential to guarantee the highest quality of care for patients, to optimise nurse and physician work flow, to ensure economical ICU

management, and last but not least, to support advanced research by using large multi-centre patient databases.

For references and citations, please contact **editor@hitm.eu**.

Published on : Sun, 3 Feb 2008