

Critical care without walls

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Critical care medicine is a relatively young specialty that was developed in response to potentially reversible life-threatening illness and was facilitated by developments such as new drugs, support equipment, and monitoring technology. It has been largely practiced within the four walls of an intensive care unit (ICU). However, now there are increasing numbers of critically ill and at-risk patients in acute hospitals who are suffering potentially preventable, serious complications that may result in death because of a lack of appropriate systems, skills, and expertise outside of the ICU. Critical care specialists are expanding their roles beyond the four walls of their ICUs and becoming involved with strategies such as the medical emergency team, a concept designed to recognize critical illness early and to respond rapidly to resuscitate patients wherever they are in the hospital. *Curr Opin Crit Care* 2002,

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Abbreviations

MET medical emergency team
MODS multiorgan dysfunction syndrome

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Although there is debate about where exactly the first intensive care unit (ICU) was built, it is commonly acknowledged that the specialty was born from the need to artificially ventilate patients with poliomyelitis [1]. During the poliomyelitis epidemic in Copenhagen, Denmark, in the early 1950s, the physician caring for the patients sought the opinion of an anesthetic specialist on the possibility of supporting respiration until the acute phase of the disease abated. Mortality was reduced from 80% to about 40%. Thus, critical care was born from a combination of medical and anesthetic skills and knowledge, and the patients were cared for in one specific area by dedicated staff.

Over the next two decades, ICUs grew out of recovery rooms and existing general wards and were eventually purposely built. They required a larger bed space than previously because of the equipment and monitoring necessary to support critically ill patients. Specifically trained nursing staff began caring for the critically ill in ICUs. In many countries, there are now also specifically trained critical care medical specialists, who solely practice critical care medicine. The first critical care journals and textbooks appeared in the early 1970s. At around the same time, the first world conference on intensive care was held in London, United Kingdom. Many countries now have active critical care societies with large memberships. There are now many journals and hundreds of textbooks specifically covering critical care, as well as scores of conferences held every year. As critical care specialists, we have much to be proud of. A thriving and exciting medical specialty—well established and recognized by our medical colleagues—all within 50 years.

Current management of the critically ill outside of the intensive care unit

The actual space that defines an ICU was an essential incubator for the critical care specialty. It enabled us to develop our craft within the security of its four walls. It also enabled us to develop skills and acquire knowledge unique to our specialty; the mystery surrounding our new equipment and knowledge about the critically ill was important in the political struggles associated with carving out real and virtual territory from existing specialties. The specialty of critical care would not have developed if we had been forced to transport ourselves and our equipment to the patient's bedside throughout the hospital. However, the security and sense of accomplishment also may have contained our thinking to within the four walls of the ICU. Our clinical role and

research agenda remains largely within the confines of those four walls.

Although the management of the critically ill within the ICU has improved markedly over the last 50 years, the standard of care for the same patients outside of the ICU is questionable. Serious adverse events, including death, occur in up to 17% of hospital patients, and approximately 70% of them are preventable [2•,3,4]. Almost half of all patients who die without a “not for resuscitation” order in acute hospitals have serious and potentially reversible abnormalities in their vital signs in the 24 hours before death [5•]. Over 80% of in-hospital cardiac arrests are preceded by serious abnormalities in vital signs within 8 hours of the arrest [6,7].

The high incidence of potentially preventable antecedents that precede cardiac arrest and death may also precede admission to the ICU. Up to 41% of ICU admissions are potentially avoidable [8•], and up to 50% of these patients had received substandard care in the wards before admission. The common antecedents that precede admission to the ICU from the general wards include abnormalities in respiratory rate, heart rate, and systemic oxygenation [9]. It appears that if the same skills existing within the ICU were applied across the entire hospital, patient outcomes may be improved [10•].

Impact of delayed resuscitation

The serious impact of delayed resuscitation is not surprising. The importance of “lead-time” bias has been emphasized previously [11]. Tissue ischemia usually begins outside of the ICU; the concept of the “golden hour” emphasizes one of the most important aims in management of the critically ill—to rapidly restore oxygenated blood flow to tissues. There is good evidence that multiorgan dysfunction syndrome (MODS) begins at a very early stage and possibly as a result of gastrointestinal tract ischemia [12–16].

It has been suggested that ischemia and bacterial translocation from the gastrointestinal tract is the match that lights the fuse (complement), which activates the blasting cap (the macrophage) that sets off the explosion of mediators that leads to MODS [17]. Whether this is too simplistic an explanation, it has intuitive appeal and conforms with extensive evidence that delayed resuscitation leads to adverse outcomes.

Despite this knowledge, research in intensive care is largely driven by what happens within its four walls, particularly in the area of searching for magic bullets, after the presence of MODS has been established [18]. Paradoxically, there is little research on the development of systems that care for at-risk patients before irreversible organ failure has occurred.

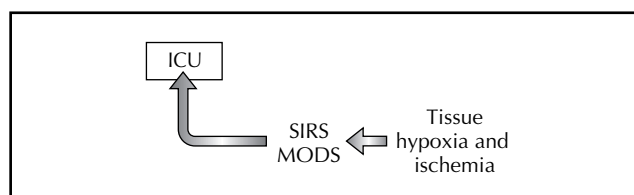
Perhaps early intervention with simple therapy such as fluid resuscitation and oxygenation may prevent MODS from developing, possibly even preventing the need for admission to the ICU (Fig. 1). At a time when supranormal oxygen delivery was a fashionable area of research, the intervention occurred after the patient was admitted to the ICU. Careful reading of these studies suggests that many patients admitted to both the treatment and control groups were significantly hypovolemic and had been for some time before their admission to the ICU [19–23]. In interpreting those articles and that era of research, it could be concluded that earlier restoration of intravascular volume may have been more effective than late supranormal oxygen delivery. For example, when goal-directed therapy was initiated at an earlier stage, in the emergency department, patient outcome improved [24•].

There is a similar obsession currently with the development of anticytokine drugs as magic bullets for the treatment of MODS after the patient has been admitted to the ICU as opposed to earlier and more aggressive resuscitation. A recent survey of clinical critical care specialists suggested that research into the best ways of delivering and organizing services for the critically ill was a higher priority than the more common magic bullet-related research [25]. The second highest priority in this survey of clinicians was related to whether early intervention affected outcomes of critically ill patients in the ICU. In other words, it appears that the average clinician, who may not necessarily have the time and resources to conduct research him or herself, would prefer a refocusing from the current clinical research, limited to within the four walls of the ICU, to broader, system-based delivery research.

The changing role of hospitals

The role of acute hospitals is rapidly changing, mainly because of economic imperatives [26,27]. Hospitals are expensive and are made up of increasingly concentrated and specialized manpower and equipment. Whereas at one time most small towns had their own hospitals, the number of acute hospital beds and hospitals is decreasing across the developed world. The acute hospital is in-

Figure 1. Prevention of death and serious complications



Early intervention with simple measures such as organ and fluid resuscitation may prevent the development of multiorgan dysfunction syndrome (MODS) and expensive and complicated technology-based treatment in the ICU. SIRS, systemic inflammatory response syndrome.

creasingly treating critically ill patients who have potentially reversible conditions. Ambulatory care services, alternative institutional care, and increased support within the patient's own home are some of the changes occurring in health care. As these changes occur and the proportion of critically ill patients in hospitals increases, specialized areas such as operating rooms, emergency rooms, and ICUs will assume greater importance.

These changes put pressure on the hospital to manage patients on its general wards with increased acuity. The current expertise and skills of clinicians managing patients on general wards may not match the needs of that population. Recently graduated physicians have had little formal training in critical care [28,29].

The move to increasing specialization in medicine may also be contributing to inadequate care for the critically ill. Even if a single organ specialist has been exposed to acute medicine and resuscitation at some time in his or her training, his or her skills will soon deteriorate without continuing education and active involvement in the field. It may be as difficult for a single organ specialist to maintain knowledge and expertise in acute medicine and resuscitation as it would be for a critical care physician to maintain competence in other single organ specialties.

Senior physicians' lack of appropriate clinical skills has been a major reason for the development of a new specialist—the hospitalist [30]. This specialist is specially trained and works mainly in the area of hospital medicine, including acute medicine. In fact, many of these specialists have an intensive care training background [31] and may begin to provide expertise in the care of the critically ill outside of the four walls of the ICU.

Moving outside of the walls of the intensive care unit

The quality of care before admission to the ICU suggests that there are many problems in the management of patients outside of the ICU environment. For example, the mortality rate of a matched group of patients with sepsis is much higher when the patients are managed on a general ward compared with an ICU [32]. Patients admitted from the general wards have a higher severity of illness and mortality rate than those admitted from the operating rooms or the emergency department [8•,9]. Admissions to the ICU from the general wards are inadequately managed by medical staff who often have little idea of how to recognize a critically ill patient and do not have the skills and training appropriate for the patient's level of illness [8•].

Intensivists, like anesthesiologists, seem comfortable waiting inside their own territory for patients to be delivered to them. They are site-defined general specialists, like emergency physicians, as opposed to organ-

defined (*eg*, cardiology), population-defined (*eg*, pediatricians), or procedure- or technology-defined (*eg*, surgery or radiology) specialists [30].

Where does this leave critically ill patients in an acute hospital? Should intensivists continue to wait until the at-risk patient reaches a threshold in which he or she resembles an ICU patient with often irreversible MODS and is referred to the ICU by our specialist colleagues or is admitted as the result of a catastrophic event, such as cardiac arrest?

There are several ways of extending the availability of intensivists to patients outside of the walls of the ICU. First, the walls can be expanded to accommodate every seriously ill or potentially seriously ill patient within a hospital. A 60-bed ICU in a 100-bed hospital would presumably manage the acutely ill better than a 6-bed ICU in a 1000-bed hospital, depending, of course, on the level of illness within the hospital population.

High-dependency units or ICU step-down units are another answer [33–36]. They are often attached to ICUs and share facilities, including common medical and nursing staff. The level of acuity of the patients is lower, and the staff to patient ratio is lower. ICU step-down units are aimed at accommodating patients in that gray area between the general ward and the ICU: patients who are too sick for the general wards and not sick enough for ICU. They are often used for discharging patients from the ICU to a lower level of care, but one that is presumably more appropriate than a general ward. Step-down wards make intuitive sense in terms of improving patient outcome, but there are currently few conclusive data on their exact role. For that matter, there are few convincing data on the effectiveness of ICUs, but they also make intuitive sense.

Critical care specialists have had little trouble extending their four walls over the last five decades. What about at-risk patients in the remainder of the hospital? It would seem logical that if rapid resuscitation is effective for patients with severe multitrauma and for patients in the emergency department, then the same principles would apply for the patients on the general wards of the hospital. The first of these principles was the medical emergency team (MET), which replaces a hospital's cardiac arrest team [37•,38,39]. The MET concept involves using calling criteria based primarily on abnormal vital signs (Table 1). These criteria are widely displayed around the hospital, and the staff is educated on the importance of calling the MET if patients exhibit any of these criteria. By being involved in a MET system, critical care specialists are beginning to become involved in the establishment of systems for the management of the critically ill across the whole hospital in a way similar to the way in which systems were created for the optimal

Table 1. Medical emergency team criteria

Airway	Threatened
Breathing	All respiratory arrests
Respiratory rate < 5 breaths/min	
Respiratory rate > 36 breaths/min	
Circulation	All cardiac arrests
Pulse rate < 40 breaths/min	
Pulse rate > 140 breaths/min	
Systolic blood pressure < 90 mm Hg	
Neurology	Sudden decrease in level of consciousness
Decrease in Glasgow Coma Scale score of > 2 points	
Repeated or prolonged seizures	
Other	Any patient who you are seriously worried about who does not fit the above criteria

management of trauma patients [40,41]. The team, organized and staffed by the ICU staff, is activated in the same way as a cardiac arrest team, hopefully resuscitating patients in the early stage of their illness rather than waiting until they die and then calling a cardiac arrest team.

The implementation and operation of a MET system sends a message that critical care physicians specifically trained in acute medicine have the appropriate expertise to deal with the seriously ill or the potentially seriously ill. Their expertise is sought in exactly the same way as one specialist consults another, except that the process for consultation has to be rapid, standardized, and systematic, because the patient's illness could be life threatening. After resuscitation by the MET, the patient's primary clinician is contacted by the team concerning further management, and a joint decision is made. The system has been shown to decrease cardiac arrest rates and unanticipated admissions to the ICU [42,43]. A large, multicenter, randomized, controlled trial is currently being conducted on the effectiveness of the MET concept in Australia. Similar systems in which intensive care staff members are consulted early are being formally established in the United Kingdom [44]. Although the debate continues over intensivists running "closed," rather than "open," units, perhaps we should extend the debate and discuss whether the hospital remains "closed" (patients are totally under the care of the primary physician, even when their condition deteriorates) or "open" (patients are accessible to intensive care specialists when they become seriously ill).

There are, of course, other options for managing the critically ill in hospitals that do not necessarily involve critical care physicians. Emergency physicians, for example, have the skills to recognize the seriously ill and provide acute resuscitation. Although emergency physicians are, like intensivists, site-defined specialists, there is no logical reason why they could not extend their service into the hospital. Taking this argument further, critically ill patients may have improved outcomes if they were removed from the general ward of the hospital, taken to

the emergency room, rapidly triaged, urgently resuscitated, and admitted to the ICU or returned to their general ward bed.

A concept developed in the United States—that of the hospitalist—is rapidly developing. Hospitalists undergo specific training, including acute medicine and care of the critically ill, and their career is confined to acute hospital care [30]. They appear to have similar acute medical skills to emergency and intensive care clinicians.

There are many other areas in which critical care physicians are beginning to think and act outside of their box. We are competent at dealing with end-of-life issues in hospitals, and that expertise can be used outside of the ICU. We are becoming more interested in the long-term outcome of patients not only after they leave the ICU but after their discharge from the hospital [45,46]. Our specialty is also involved in organizational and cost issues, including debates about balancing what critical care can deliver and its worth to the community [47,48].

In order to highlight the challenges of poor system design resulting in potentially avoidable admissions to the ICU, the research community needs to move its focus from within the ICU, especially the emphasis on magic bullets after the damage has occurred, to developing and evaluating new systems to prevent the damage at an earlier stage. Health services research is a new and developing field that offers new methodologies and approaches for addressing these questions [49].

Conclusions

In moving outside of our box (the ICU), we need to have confidence in our specialty and the skills and knowledge that are needed to practice acute medicine and resuscitation. It is no longer acceptable for the sickest patient in the hospital to be managed by the most junior physicians, with no training and little supervision, or even by senior physicians with territorial and financial claims rather than the appropriate skills and knowledge necessary to optimally care for the seriously ill. For many reasons, there are increasing numbers of seriously ill pa-

tients in hospitals who are being managed in an inappropriate way while critical care physicians wait within their four walls for the results of that substandard care to cause serious illness and injury before they are consulted.

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