

Review

Twenty-four hour presence of physicians in the ICU

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Abstract

Intensive-care units (ICUs) must be utilised in the most efficient way. Greater input of intensivists leads to better outcomes and more efficient use of resources. 'Closed' ICUs operate as functional units with a competent on-site team and their own management under the supervision of a full-time intensivist directly responsible for the treatment. Twenty-four-hour coverage by on-site physicians is mandatory to maintain the service. At night, the on-site physicians need not necessarily be specialists as long as an experienced intensivist is on call. Because of the shortage of intensivists, such standards will be difficult to maintain everywhere, but they should, at least, be mandatory for larger hospitals serving as regional centres.

Keywords: 24-hour coverage critical care, intensive-care units, organisation and management, outcome and process assessment

Introduction

Intensive-care units (ICUs) are the most expensive part of a hospital. It is therefore extremely important that they are used in the most efficient way. As in any other business, high quality and cost-effective performance in intensive-care medicine (ICM) can best be achieved when responsibility and management are given to those who have the special expertise.

In the past decade, it has become evident that a greater input of intensivists leads to better outcomes for patients and more efficient resource use. This became obvious from a discussion in the USA, where ICU structures differ greatly from those in Western Europe. In the USA, most ICUs are so-called 'open' units, in which critically ill patients in the ICU are cared for by their primary physicians, who are not specialists in ICM. In contrast, a 'closed' unit is one in which a full-time intensivist (or a team of intensivists) provides ICM. Closed ICUs predomi-

nate in Western Europe. Now there seems to be an increasing awareness in the USA that the closed ICU may be more efficient.

The input of the intensivist makes the difference. In closed units, the ICU is directly supervised by a full-time intensivist, who is directly responsible for the treatment. The ICU operates as a functional unit with a competent team and a closed, well-formalised organisation and management ('team model').

In principle, both types of ICU provide 24-hour coverage of service, because critically ill patients require continuous attention. This aim can be realised more efficiently in a closed unit. However, good reasons, this aim is far from being realised everywhere in daily practice.

In this review, we present the arguments for the concept of the closed unit (the team model) and the need for

APACHE II = Acute Physiology and Chronic Health Evaluation (severity scoring system); DIVI = Deutsche Interdisziplinäre Vereinigung für Intensiv- und Notfallmedizin (German Interdisciplinary Association of Critical Care Medicine); ESICM = European Society for Intensive Care Medicine; ICU = intensive-care unit; ICM = intensive-care medicine; SCCM = Society of Critical Care Medicine; UEMS = European Union of Medical Specialists.

24-hour coverage of intensive-care service, and we discuss problems of realisation and possible alternatives.

Transatlantic differences

In the USA, the leaders of the *Society of Critical Care Medicine* (SCCM) have advocated the team model for many years [1]. In this model, medical and nursing directors have significant authority over patient-care activities and administrative decision-making, there is a high level of nursing performance, and standardised protocols for care are used [2].

In the closed-unit model, many primary physicians resist relinquishing authority for their patients, and intensivists may tend to exclude the primary physicians from decision-making. Thus, the closed ICU concept has not been realised in many places. Further, there are not enough intensivists to provide full-time staffing for all units throughout the USA.

The situation of critical care medicine in the USA has been thoroughly analysed [3–5].

The most recent prospective US national survey, covering 393 ICUs, revealed that for critically ill patients, care was managed by a full-time intensivist for only 23%, an intensivist was consulted for 14%, and no intensivist was involved in the treatment of the rest [5]. In only 29% of the ICUs was a full-time intensivist available.

In Europe, the situation of ICM varies profoundly between countries, because of their different historical development. There are important differences in terms of structure as well as training and education. Nevertheless, the general model of ICU structure is the closed unit.

The situation of training and speciality status in Europe has recently been analysed in a survey by the *European Society for Intensive Care Medicine* (ESICM) [6]. Except in Spain, special competence in ICM is linked to a basic speciality (ICM as a subspeciality). In most European countries, access to postgraduate training in ICM is open to several disciplines ('multidisciplinary access', with ICM as a supraspeciality), finishing with a specialist registration ('accreditation').

In contrast to the situation of education and speciality status of ICM, the structural organisation of ICUs in Europe has not been analysed in a general, representative way. However, some important information can be extracted from the EPIC study ('European Prevalence of Infection in Intensive Care'). Vincent *et al* analysed structural characteristics of 1417 Western European ICUs [7]. In 72%, a committed 24-h doctor was on duty. Italy and Spain had the highest number of ICUs with a full-time doctor, while The Netherlands and Finland had the lowest number. In 67% of the ICUs surveyed there was an ICU director.

In a recent survey from the *German Interdisciplinary Association of Critical Care Medicine* (DIVI), Stiletto *et al* evaluated 349 ICUs (25.5% of all ICUs in Germany), including a large spectrum of different hospitals [8]. An intensivist was present in 74% of the ICUs during working hours but in only 20% at night. Outside working hours, non-specialist residents were present in the ICU in 56% of the hospitals. Thus, despite a high standard of intensive care in Germany, there was a lack of specialists available outside working hours in most of the ICUs. Also, here there are obviously not enough intensivists available to provide 24-hour coverage for every ICU. This may well be true in most European countries.

What are the essentials of an intensive-care service?

ICM is proactive, acute medicine. Consequently, all the diagnostic and therapeutic procedures necessary to recognise and to treat acute events adequately and without delay must be available both night and day. This requires adequate equipment (monitoring and devices for diagnosis and treatment), a competent staff (nurses as well as doctors), predefined procedures and treatment concepts, a thoroughly worked-out organisation, as complete information and communication as possible, an adequate, 24-hour covering consultant service of various specialities, 24-hour availability of diagnostic services and therapeutic interventions, and well-defined management structures. For example, the DIVI defined the requirements for certification of an ICU for training in ICM [9]. Under "the prerequisites of a training institution providing optimal specialist training in base specialty-related intensive care medicine" is the requirement that "patient care shall be provided continuously over a 24-hour period by physicians who are permanent staff members of the intensive care unit."

In any case, accreditation of an ICU for teaching ICM is possible only if there is a 24-hour service with on-site physicians.

Twenty-four-hour covering service, of course, not only requires specific preconditions in the ICU, it also includes an adequate, permanent within the entire hospital. According to the DIVI regulations [9], this includes the continuous availability of services, such as internal medicine, surgery, anaesthesiology, neurology, neurosurgery, paediatrics (if children are treated), laboratory, radiology, and blood bank.

The concept of team care relies not only on the expertise of the ICU team but also on the admitting or primarily responsible physician and the special expertise of other disciplines ('multidisciplinary approach'). Only then can the intensive-care service be optimised to provide a better outcome with acceptable consumption of resources through appropriate use of medications, reduction of potential complications, and a shorter length of stay.

Table 1**Arguments for why full-time, on-site specialists in the ICU improve care and efficiency**

- Expert team on-site may be more effective in reducing mortality, length of stay, complications, and even costs (or more effective with higher expenses).
- Dedicated team members are more motivated to perform well, because they are directly responsible.
- Special, expert consultation (e.g. clinical pharmacologists or bacteriologists) is more effective.
- Standardised, optimised procedures and protocols can be defined and be better fulfilled by a closed team:
 - Standardised weaning strategies or protocols: Mechanical ventilation in ICM has become increasingly sophisticated (e.g. protective lung ventilation). Errors in ventilation strategy are expensive (e.g. barotrauma, ventilator-induced lung injury). Weaning protocols may shorten length of stay in ICU.
 - Treatment protocols, e.g. for sedation: Sedation is expensive and requires continuous observation and experienced personnel. Errors in sedation are even more expensive (they increase the length of stay)!
 - Standardised, optimised procedures for antibiotics: Infections are expensive and increase the length of stay. Rational antibiotic strategies can be carried out more effectively.
 - Hygiene measures can be better controlled in a closed team (protocol implementation). Direct supervision is possible.
 - Standardised protocols for managing nutrition can be more cost-effective.
- Complications of invasive monitoring can be reduced by a dedicated ICU team: Experience in inserting, controlling, and maintaining invasive catheters is built up. Insertion techniques (e.g. for pulmonary artery catheters) can be standardised. Experience is gained in using the results for therapeutic decisions and to identify errors and artefacts.
- Uniform admission and discharge policies: The members of the ICU team are more familiar with the patient's history and actual situation (e.g. hidden complications, physiological stability, stress reaction).

Adapted from Carlson *et al* [2].

The concept of an ICU team

In the past decade, there has been increasing evidence that ICM can be more efficient if the ICU is run by a directly responsible team under the supervision of a physician especially competent for this task (i.e. an 'intensivist').

An overview of the arguments for the full-time, on-site specialist to improve efficiency of intensive care has been presented by DE Weiland (see Carlson *et al* [2]) (Table 1).

There is growing evidence of the superiority of this team concept [10]. A prospective, multicentre study of the structure, organisation, and effectiveness (standardised mortality rate) of nine ICUs in the USA (3672 admissions, 316 nurses, 202 physicians) [11] showed that most units faced great challenges in coordinating admission, discharge, and triage. Good collaboration between physicians and nurses and matching of responsibility with authority for such decisions facilitated this difficult process. Lack of clear admission and discharge criteria and decision-making by physicians with no knowledge of the status of the unit created most of the problems. The authors reporting the study proposed a list of best practices for coordinating care, which shows that organisation within the ICU plays an important role by optimising procedures (Table 2).

By 1984, Li *et al* [12] found improved survival of critically ill patients in hospitals and ICUs after the ICU team's supervision was turned over to an intensivist. A few years later, Brown and Sullivan [13] documented a reduction of 52% in ICU mortality and of 31% in overall hospital

mortality as a result of the presence of intensivists. Similar results were found later by other investigators [14–18].

In order to determine the effect of a trained intensivist on patient care and educational performance, Manthous and co-workers retrospectively reviewed the outcome in a community teaching hospital ICU during a period with and without a medical intensivist's supervision [19]. The supervision was associated with improved clinical and educational outcomes. Despite similar case mixes and similar severity of illness as assessed by scores on the Acute Physiology and Chronic Health Evaluation II (APACHE II) on admission, ICU mortality decreased (from 20.9% to 14.9%) and so did in-hospital mortality (from 34.0% to 24.6%) and disease-specific mortality, such as that due to pneumonia (from 46% to 31%). This improvement was consistent across all categories of APACHE II scores. The mean ICU stay decreased (from 5.0 to 3.9 days) and so did the mean total hospital stay (from 22.6 to 17.7 days). In addition, critical-care in-service examination scores for residents improved.

In a recent cohort study, two structural concepts of surgical intensive care were compared [20]. The study cohort was cared for by an on-site critical-care team supervised by an intensivist. The control cohort was cared for by a team with patient-care responsibilities in multiple sites, who were supervised by a general surgeon. Patients cared for by the critical-care service spent less time in the ICU, used fewer resources, and had fewer complications, despite having higher severity scores on the APACHE II. Presumed explanations for the better outcome for the ICU

Table 2

Examples of best practices for coordinating care within the ICU

Specific guidelines and protocols for medical and nursing care
Physicians with expertise in selected procedures, e.g. intubation, invasive monitoring
Updated protocols for limiting life-supporting therapy
Physicians' rounds made early, facilitating communication and planning
Orientation, written guidelines, close supervision for residents
Rounds and conferences with pharmacist, dietician, radiologist
Emphasis on decentralised services (satellite pharmacy, laboratory, radiograph viewing) in or close to the ICU

Shortened and adapted from Zimmerman *et al* [11].

team were (a) more active management of emerging care immediately available at the bedside (not just once or twice during a physician's visit), (b) continuous and immediate review of patients' data (not just late in the day), (c) unanticipated problems identified by the ICU nurse resulted in immediate medical activity by the ICU team (rather than a delayed response because a physician was not available). Also, differences in management style, such as teamwork with trained cooperation, predefined procedures, and treatment plans, were thought to account for the better outcome.

In a retrospective observational study in 46 Maryland hospitals, Pronovost *et al* [21] analysed the care of ICU patients who underwent abdominal aortic surgery. In-hospital mortality ranged from 0% to 66%. A multivariate analysis adjusted for patient demographics, comorbidity, severity of illness, and volume of patient throughput per hospital and per surgeon and hospital characteristics. It was found that not having daily rounds by an ICU physician was associated with a threefold increase in in-hospital mortality as well as an increased risk of cardiac arrest, acute renal failure, septicaemia, platelet transfusion, and reintubation. Thus, the outcomes were related to differences in the organisational characteristics of ICUs, which had considerable impact on outcomes of such patients having high-risk operations.

A prospective, observational study in two ICUs in France (382 patients) was performed in order to assess all iatrogenic complications (except adverse effects of drugs) occurring during an ICU stay [22]. Iatrogenic complications were found in 31% of the admissions: 13% of these complications were major, in some cases leading to death. A high or excessive nursing workload caused an increased risk of major iatrogenic complications.

Similarly, an observational cohort study in US acute-care hospitals with 225 postoperative patients after

oesophageal resection showed that there was an increased risk of postoperative pulmonary and infectious complications if one nurse had to care for more than two ICU patients at night [23]. The higher incidence of complications caused a 39% increase in hospital length of stay and a 32% increase in direct total hospital cost (including personnel cost).

Major iatrogenic complications are frequent and are associated with increased morbidity and mortality rates; they are often due to human errors. The organisational structures and management seem to be important for optimal performance in ICM.

Twenty-four-hour coverage

Acute deterioration of the condition of a critically ill patient can happen at any time, not only during working hours. Emergency situations in the ICU tolerate no delay. Any organ dysfunction is often much more difficult to reverse if treatment has been delayed (e.g. 'golden hour of shock'). This is especially true in surgical ICUs.

But a 24-hour service is mandatory not only for the critically ill patient in the ICU: every large, acute-care hospital relies on a continuous, competent ICU service. Especially in a hospital destined for emergency care and acute poly-trauma treatment, emergency situations need an active, skilful ICU service available around the clock.

ICM is titrated care at the physician level, as Crippen points out [24]: "Picture your hospital emergency department with a physician on call from home. Is this a place that you would bring a sick person to be evaluated?" It is problematic to let physicians of the house staff care for critically ill patients during nonworking hours. Usually they are less experienced, less informed about the patients' special problems, and overworked. Occasionally, they are even unavailable when needed, because they have to deal with other tasks, such as anaesthesia.

Certainly, a well-organised ICU may often run by itself during the night. However, if an emergency arises, an immediately available physician is needed who knows about the special situation of this particular patient, who is trained in emergency procedures (e.g. endotracheal intubation, defibrillation, cardiovascular resuscitation, and pharmacological support), who knows how to use the technical ICU equipment (which is becoming more and more specific), who is familiar with the organisational procedures in the unit as well as in the hospital, who is able to call immediately for further help and expertise if needed, and, last but not least, who is part of the ICU team – an important precondition for unambiguous communication and effective actions. The last precondition, especially, should not be underestimated. Even if a physician has great expertise in handling emergency situations, the lack

of corporate identity with the ICU team may make communication more difficult.

For activities within the unit, we definitely prefer the involvement of a dedicated member of the ICU team. This need not necessarily be a physician with the highest level of expertise, as long as there is a competent intensivist in the background (e.g. on call). But he or she must be thoroughly familiar with the ICU service. In contrast, the background service must be provided by experienced intensivists. If sufficient intensive-care specialists are not available, it is certainly preferable to run the ICU at night with nonspecialised physicians who at least belong to the ICU team, instead of calling house-staff physicians who know nothing about this acutely deteriorated patient.

Even during nights without any emergencies, physicians in the ICU have a lot to do, such as finishing up the activities of the past day (e.g. protocols, medical reports) and preparing the actions planned for the next day (e.g. treatment plans, requests for diagnostic procedures). Completion of all these time-consuming tasks will help to make the next day's activities better organised and more efficient.

Potential problems and drawbacks

It could be argued that working in intensive care for a long period of one's medical career is too hard and stressful, producing symptoms of burnout.

Guntupalli and Fromm [25] evaluated the prevalence of burnout among internal medicine intensivists in the USA. In this study, 248 randomly selected intensivists responded to a mailed survey using the Maslach Burnout Inventory. Only 28% of the physicians who responded performed full-time (75–100%) practice of critical care. Although many of the physicians practiced other aspects of medicine than critical care, 67% of them reported being most happy while on service for critical care, and this was despite the fact that most (61%) indicated that critical care was more stressful. Higher levels of emotional exhaustion occurred in individuals who indicated they were most happy when off service for critical care. Those who were less happy while on critical care tended to work shorter blocks of time on critical care.

Another problem is certainly the increase in cost if the ICU must be staffed for a 24-hour coverage. Then, shift-work has to be organised which must be in conformity with the relevant industrial law. In any case, this shift-work is more expensive. This, however, is a problem that must be solved from the perspective of the hospital as a whole. The question is how much increase in acute care performance and quality improvement would be needed and desirable.

In a health-care system with very limited resources, reduced numbers of ICU beds may force the intensivist to

operate a restricted admission and discharge policy even to a level at which risks for the patient seem unacceptable.

This becomes evident when the frequency of night ICU discharges increases; such discharges are more likely to be 'premature' in the view of the clinicians involved. Goldfrad and Rowan [26] found that night discharges from ICUs were increasing in the UK as a result of insufficient intensive-care beds in many hospitals. This practice is of concern because patients discharged at night fare significantly worse than those discharged during the day.

In future, a nationwide regionalisation of ICUs in larger hospitals only may be a more economic way of facing the increasing expenditures for ICM.

In most countries, there is definitely a shortage of intensivists. The reasons for that are complex.

In their estimation of the future requirements of intensivist for adult critical care in the USA, Angus *et al* [5] predicted that the growing disease burden created by the ageing population would increase the need for more specialists in ICM. They predicted that consequently, the proportion of care provided by intensivists would fall to below current standards in less than 10 years. This shortfall would not be prevented by the present initiatives to promote critical care training.

Certainly, the lack of specialists in ICM is due to various aspects of professional 'politics'. ICM is difficult to define and it is not a speciality as such in almost every country. ICM, being a relatively young discipline, is still fighting for acceptance in the great orchestra of medical specialities.

The *European Union of Medical Specialists* (UEMS) has formalised a definition of intensive care medicine [27]:

Intensive Care Medicine (ICM) combines physicians, nurses and allied health professionals in the co-ordinated and collaborative management of patients with life-threatening single or multiple organ system failure, including stabilisation after severe surgical interventions. It is a continuous (i.e. 24 hrs) management including monitoring, diagnostics, support of failing vital functions, as well as the treatment of the underlying diseases.

In this statement, there is no doubt about the 24-hour coverage of the intensive-care service.

Nevertheless, it is difficult to find a general acceptable definition of an ICU and the preconditions mandatory for its effective function.

On an interhuman level, the primary physicians are anxious not to lose control over their individual patients being

treated in the ICU. Many primary physicians regard themselves as the only legitimate academic advocates of the individual patient and they reject any sharing of treatment responsibility with the intensivist.

In their paper on organising critical-care services, Hanson *et al* [20] predicted that "in future, the provisions of critical care services is likely to be affected by diminishing reimbursement, loss of individual physicians; autonomy in health maintenance organisation practices, ... and an increasing emphasis on demonstrable quality and efficiency in patient care." Presumably, the situation in European countries is comparable in interdisciplinary competition and in the pressure imposed by cost containment.

Does new technology solve the problem?

Telemedicine has been used to overcome geographical barriers, by bringing the necessary expertise (e.g. for neurosurgical problems) to patients in remote locations. Recently, this modern technology has been utilised to transfer intensivist expertise to ICU patients [28].

In a surgical ICU with no intensivist on site in an academic-affiliated community hospital, Rosenfeld *et al* [29] performed an observational study to evaluate the benefit of remote monitoring methods (such as video conferencing and computer-based data transmission). During a 16-week period, an intensivist was consulted by telemedicine to obtain clinical information and to communicate with the on-site ICU personnel. This intervention period was compared with two 6-week control periods within the year before. During telemedicine communication, the severity-adjusted ICU mortality (compared with both baseline periods) decreased by 68% and 46%, respectively, the incidence of ICU complications by 44% and 50%, the length of stay in the ICU by 34% and 30%, and ICU costs by 33% and 36%.

These results suggest that telemedicine can be used to provide intensivist expertise to remote ICU locations if such expertise is not available on site. Of course, such remote monitoring and consulting services cannot replace the on-site expertise and direct proactive care of an intensivist within the ICU team. However, a solution of this kind may be useful to overcome the lack of intensivist availability in smaller hospitals. Restructuring of a nationwide distribution of ICUs ('regionalisation of intensive care services') may take on a completely new aspect through the use of such innovative technology.

In a review on emerging trends in ICU management and staffing, Lustbader and Fein pointed out [30]: "As technology advances, telemedicine will play a greater role in providing intensivist coverage to ICUs during off hours or to community hospitals in remote areas. Advanced technology and reorganisation of critical care services offer

opportunities for creative and non-traditional ways to deliver improved care to patients."

However, such telemedical communication may considerably increase the workload of these few intensive-care experts, who will then get involved in a select group of highly complicated cases only from a remote perspective. Further, the question of legal responsibility is complex when remote consultants must rely on indirect information.

Conclusion

High-quality, cost-effective performance in ICM can best be achieved when responsibility and management are given to those who have specialist expertise. There is now increasing evidence that the responsible involvement of intensivists leads to better outcomes for patients and more efficient use of resources. In the team model, an on-site team of dedicated nurses and physicians who are directly responsible for the treatment but who also call on the multidisciplinary expertise of various consultants runs the ICU. Such an ICU must be under the direct supervision of a full-time intensivist fully trained in the entire spectrum of ICM and able to handle all emergency procedures.

Consequently, there must be 24-hour coverage by on-site physicians to keep the expertise available around the clock. These physicians need not necessarily have the same level of specialised expertise as an intensivist, as long as an experienced specialist is available on call.

Because of the shortage of intensivists in most countries, it will be difficult to meet such requirements everywhere. However, at least for larger hospitals, which serve as regional centres, this 24-hour cover by on-site physicians must be advocated by the intensive-care societies and professional organisations. Unfortunately, there is still considerable resistance to this concept, as many specialities propagate an exclusive claim of ownership in ICM.

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