

Intensive Care Medicine: Where We Are and Where We Want To Go?

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Introduction

Intensive care medicine can be defined as the science and art of detecting and managing patients with impending or established critical illness, in order to prevent further deterioration and revert the disease process or its consequences, so as to achieve the best possible outcomes.

Evolution of Intensive Care

Florence Nightingale was best known as ‘The Lady with the Lamp’ for her habit of making rounds at night to tend to injured soldiers during the Crimean war (October 1853 – February 1856). She recognized that some patients needed more frequent and careful monitoring than others and as a consequence started to place these patients closer to the nursing station [1]. It could be argued that this was the beginnings of the specialty of intensive care.

Similar insights also began to emerge in other parts of the world [2]. As a consequence of the 1952 Copenhagen poliomyelitis epidemic [3, 4], hospitals started to create the first areas specifically designed and adapted to provide intense support for failing organ systems. The introduction of this new branch of medical science (both physiological and technological), quickly required the development of a new setting for these skills, and the subsequent creation of a designated area in the hospital, known today as the intensive care unit (ICU). Subsequent to this, many different individuals, including Vladimir Negovsky, Peter Safar, Max Harry Weil amongst others, created the science of reanimatology [5, 6]. These pioneers, together with subsequent generations of clinicians and nurses, have continued to develop new knowledge and skills as well as the technology required to transform this diverse series of competencies into an integrated package of care, now known as the art and science of intensive care medicine [7].

Why We Need Intensive Care Units

It is the concentration of the skills, expertise and resources (both human and technical) together in one designated area that makes an ICU. This concentration enables optimal care and management of patients to be provided. There is reasonable evidence now that demonstrates that the care of critically ill patients by intensivists and critical care trained nurses can improve many patient related out-

comes as well as using the available resources more efficiently. These improved outcomes include a reduced rate of nosocomial infections, decreased complications, reduced length of ICU stays, and decreased mortality. If these resources are not concentrated, rather spread evenly throughout the hospital, with a couple of beds on each ward, then this ‘improvement by quantity’ is reduced with a less efficient use of resources and a decreased level of care being delivered to the patients.

The ICU of Today

The ICU is critically involved with many areas and specialties within the hospital. The location chosen for the ICU, however, commonly reflects the need for geographic proximity to the more acute areas, such as the emergency department and operating rooms. In addition, there needs to be some thought towards collocation with diagnostic facilities such as the availability of a computed tomography (CT) scanner and the availability of a 24-hour seven-day-a-week functioning laboratory. Most ICUs today have facilities and equipment located within the unit to perform the immediate analysis of arterial blood gas samples and some basic biochemistry and hematology tests. Since most situations in intensive care medicine are critically time-dependent, the successful provision of care is reliant on good relationships and communication between the ICU and the other services and departments of the hospital. This is also required to optimize the timing of admission and discharge of patients to, and from, the ICU.

The discharge process is especially important for a number of reasons [8]. A higher level of vigilance of recently discharged patients is necessary to identify and prevent any subsequent deterioration early. Failure to do so can compromise the patient and reverse any benefits that the ICU initially provided [9, 10]. Another risk to the recovering intensive care patient is inappropriate early discharge to the ward, due to lack of beds or time constraints [11], and although this is controversial [12, 13], it has been demonstrated that there is scope for improvement [14]. This need for an effective interface between the ICU and the other departments of the hospital has not only physical and architectural implications: it also has a crucial impact on human resource factors, both outside and inside the ICU. These include stress management, professionalism in facing and coping with rotating working patterns [15], and fatigue [16, 17].

Interfacing the ICU

Today, a significant number of ICUs in Europe (and also in Australia and New Zealand) are directed by a full-time, fully trained intensivist, leading a multi-professional team of experts in the field, able to provide all interventions potentially required by the patient 24 hours a day, 7 days a week. These professionals are also more and more involved in the management of unstable patients outside the ICU [18–21] in a movement called by Ken Hillman “critical care without walls” [21]. In the United States, the situation is slightly different, with a significant number of ICUs still using the so-called open model [22]. In this system, care and therapy are often supervised by nurses and younger physicians (with occasional mandatory or optional consultation with an intensive care professional), but under the

direction and orientation of a primary physician, paradoxically a system that the literature suggests provides less effective care [23].

This need for full-time, fully trained teams, with very intensive physician-to-patient and nurse-to-patient ratios, transformed the ICU into a very expensive and often scarce resource. The obvious implication of this is that it is vital to ensure that capacity is reserved for only those most likely to benefit from it. There is, therefore, a significant responsibility for the intensivist to triage patients appropriately so that those most likely to benefit are admitted, and those less likely to, are not. Often, however, the situation is more complex. ICU is but one part of the patient journey that takes in many differing parts of the hospital together with multiple professional consultations and interventions. ICU admission criteria must, therefore, be able to cope with not just the sick emergency patient but often also the elective patient whose admission has been planned even before hospital admission.

Triage of Admissions and Discharges

The development of admission (and discharge) criteria is a very complex issue, full of ethical implications, both to the patient and to society. Being a potentially life-saving asset, an ICU bed is also a scarce and costly resource that should be used in the most cost-effective way. Consequently, all possible expertise should be used when deciding whether a certain patient should, or should not, be admitted to an ICU, a decision that is notoriously difficult to get right with any precision [24]. Usually, several objective and subjective factors – both ICU related and patient-related – have an impact on this decision, such as the number of beds available, the admission diagnosis, the severity of illness, age and operative status [25]. Several proposals for standards for ICU admission have been proposed, with the most well-known being those from the Society of Critical Care Medicine [26] (**Box 1**).

In a recent multicenter study in France, Maité Garrouste-Orgeas et al. [27] demonstrated that the decision to deny ICU admission to a certain patient was common (23.8 %), explained by the patient being too well to benefit (55.4 %), too sick to benefit (37.2 %), the unit too busy (6.5 %), and/or refusal by the family

Box 1. Scheme of priorities to assess triage decisions [26]

- Priority 1 assigned to patients who are critically ill, unstable, in need of intensive treatment and monitoring that cannot be provided outside of the ICU. No limits are generally placed on the extent of the therapy that these patients can receive
- Priority 2 assigned to patients who require intensive monitoring, and may potentially need immediate intervention. This category includes patients who are at risk for intubation and invasive mechanical ventilation. No therapeutic limits are generally placed for these patients
- Priority 3 assigned to patients with underlying disease and/or acute illness with a reduced likelihood of recovery. Due to their long-term outcome, they may receive intensive treatment to relieve acute illness, but limits on therapeutic efforts may be set
- Priority 4 assigned to those who are generally not appropriate for ICU admission, either because they are ‘too well to benefit’ or ‘too sick to benefit’. This level also includes those patients who have the capacity to make decisions and who decide to refuse aggressive interventions, although still require ‘comfort’ care at a level not deliverable on a normal ward setting.

(0.7 %). The same authors demonstrated in multivariate analysis that the two patient-related factors more strongly associated with ICU refusal were dependency and metastatic cancer and that the most important organizational factors were the unit being full, the specific center, phone rather than face to face referral, and daytime admissions (odds ratio [OR] 0.52; 95 % confidence interval [CI] 0.32–0.84) [27].

Given the uncertainty of all these decisions, several authors in recent years have proposed that for patients with very severe disease, especially those with cancer, that a so-called ‘ICU trial’ should be offered; in other words, patients are admitted and fully treated for a limited period of time and then re-assessed for the continuation of life-sustaining therapy [28, 29]. If the patient is not benefiting from the ICU care, then appropriate decisions with regards end-of-life-care should be made, according to the state of the art, the law, and religious preferences, a process quite heterogeneous in different cultures [30–33].

For situations where the demand for intensive care could largely exceed supply in a short period of time, as happened during the epidemic of severe acute respiratory syndrome (SARS) in Hong-Kong [34] and in Toronto [35], or in certain places of the world during the recent influenza A (H1N1) virus pandemic [36, 37], contingency plans should exist in anticipation for both the need to increase the capacity of intensive care services and also for triage of patients who could benefit more from ICU admission, ideally based on objective and pre-defined criteria [38, 39].

As a consequence of all these factors, during their ICU stay all patients must be continuously evaluated for the need to remain in the ICU. According to consensus definitions, a discharge decision should be taken “when a patient’s physiologic status has stabilized and the need for ICU monitoring and care is no longer necessary” [26]. However, this issue is more complex than it seems at first glance. Since the 1980s, many published outcome studies have presented data on vital status at ICU discharge and also at hospital discharge. Consequently, it has become clear that a significant number of patients either deteriorated or died following ICU discharge but before leaving the hospital (the so-called post-ICU mortality or occult mortality). Several published studies have raised attention to the magnitude of this phenomenon, which can be as high as 36.7 % of all deaths [40]. Some patients deteriorate and then need to be re-admitted to the ICU often soon after ICU discharge [41–44], again a common phenomenon carrying a large associated mortality [45].

Where are we Going and Where do we Want to Go?

Our speciality has sustained a continuous growth in recent years. In the early 2000s, it was estimated that intensive care beds represented 13.4 % of all hospital beds in the USA, costing upwards of \$55.5 billion, accounting for 13.3 % of all hospital costs and 0.56 % of the gross domestic product (GDP). In the last few years, the panorama has changed [46], with the number of intensive care beds, days (as a percentage of the total hospital days) and occupancy rates continuing to increase. Also, the costs per day of intensive care medicine have increased by 30.4 % with a corresponding increase in the annual costs associated with this speciality of 44.2 %; in 2005, this represented 13.4 % of hospital costs, 4.1 % of national health expenditure, and 0.66 % of the GDP, If we add to this number

other costs incurred by caring for patients with critical illness the overall number accounts for 1 % of the GDP in the USA. In Europe, despite the fact that the heterogeneity is much greater across countries [47] or even inside the same country [48], the mean costs per intensive care bed per year could be as low as 30,990 euro or as high as between 225,000 to 471,330 euro in the UK (depending on the level of care) [48], similar to those in Germany [49]. Despite the fact that these numbers are consistently lower than the numbers presented in the USA, pressure on the economy remains an issue.

This panorama is likely to change, due to the increasing age of the population, with the increasing prevalence of comorbid diseases, together with significant advances in medical science. These factors when combined result in the application of more complex and costly procedures to an increasing fragile population, in which complications will have greater consequences due to the increasingly narrow cost-effective margin of a significant number of interventions. As a direct consequence of these changes, there has been a shift from the almost exclusive presentation in medical conferences and medical journals of new devices and drugs to an increasing discussion of topics that 15 years ago would not have been accepted in a large major conference, or would rarely have been heard. Examples are the increasing efforts put on patient safety [50–52], detection and prevention of adverse events [53–56], and cultural changes regarding patient safety and error management [57–61]. A major example of these changes in priorities and culture was the signature by more than 80 Scientific Societies, industry representatives and patient representatives of the Declaration of Vienna, during the last Annual Congress of the European Society of Intensive Care Medicine, a public call for attention and action to these issues [51]. This declaration was just a first step in an ongoing-process that includes the public presentation of a revised version of the structural norms for European ICUs [62] and the revision of mandatory indicators for ICU evaluation. Benchmarking and other methods of comparative evaluation of the effectiveness and the cost-effectiveness of ICUs will have a growing impact in the decisions made by purchasers of intensive care [63, 64]

In the future, maximization of the volume-outcome relationship will certainly lead to the fusion (or the closure) of small ICUs [65–69] and to the re-arrangement of existing ICUs and services into large networks, trained and evaluated for organizational performance and not just for clinical performance [70]. New drugs and devices will be subjected to ever greater scrutiny before utilization, with the quality of the trials in which they proved their efficacy (and cost-efficacy) being more highly scrutinized for adverse events than previously, and clearly separating practice guidelines and clinical orientations from industry campaigns [71, 72]. We will certainly have new tools and devices, new drugs and interventions [73], but we cannot just sit and wait for a magic bullet to appear, we must be proactive in applying existing (and new) interventions to decrease mortality [74], which translate evidence into practice [75].

This optimization in the use of resources will allow us to develop better and earlier triage criteria and a more extensive use of ICU trials [28]. As the utilization of critical care expands, we will need to be increasingly conscientious that our efforts are being applied only to those patients most likely to benefit from them. End-of-life practices must, therefore, be incorporated into the assessment of quality [30, 76]. For this to be fair, clear, honest and transparent these issues have to be better and more openly discussed with the patients and their families [77–79]. This debate must start before admission to intensive care with discus-

sion and re-education that resets the expectations, desires and perceptions of the general public to allow for more rationale decision making and an assurance that these therapies are directed only to those most likely to benefit.

The education and training of the next generation of intensivists [80–82], needs to be re-evaluated. In the USA, it is probable that the pendulum has already swung beyond the point where the equilibrium between the need for these specialists and the ability to provide them can be restored just by training alone. This will inevitably result in increased outsourcing of several medical interventions to other professional groups, for instance the increase in the use of physicians-assistants and nursing practitioners. New technologies such as tele-ICU [83] can help solve this problem but their effectiveness has not yet been demonstrated in a convincing fashion, as recently shown [84, 85].

Europe, the home country of the closed ICU model and of the fully trained, fully dedicated intensivist, will make an effort to meet the increasing demand with more intensivists, shifting education and training programs from time-based to competency-based curricula [86, 87], such the CoBaTrICE (Competency Based Training program in Intensive Care Medicine for Europe) collaboration [88], and by an increased use of simulation for critical situations [89, 90]. This will not be an easy process. It will need a change in our perception of teaching and the skills of our teachers [91, 92], but it can and should be done.

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