2. Evolution, Distribution, and Regulation of Intensive Care Units

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THE DEVELOPMENT OF THE ICU

The intensive care unit (ICU) has been called the hallmark of the modern hospital (205), yet it is a recent development, having come into existence only in the last 25 years. The development of ICUs was preceded by the rapid growth of postoperative recovery rooms (115) following World War II. As early as 1863, however, Florence Nightingale had foreseen the utility of a separate area for observing patients recovering from the immediate effects of surgery (172).

To a large extent, the initial stimulus for a separate recovery area for specialized care was a managerial response to overwhelming medical demands. The Massachusetts General Hospital, for example, when suddenly faced with treating 39 survivors of the Boston Coconut Grove Fire in 1942, set up a makeshift "burn unit" which it maintained for 15 days, until the majority of patients had been sent home (115). In the North African and Italian campaigns of World War II, shock wards were established to resuscitate battlefield casualties and to care for injured soldiers before and after surgery (115). After the war, an acute shortage of nurses provided much of the impetus for the spread of recovery rooms in the United States.

Although recovery rooms were established initially as a means of managing large numbers of patients more efficiently, the medical benefits of better postoperative nursing care soon became apparent, and recovery rooms flourished. In 1951, only 21 percent of community hospitals had recovery rooms; a decade later, virtually all hospitals had them (205).

During the 1950s, using the recovery room as a model, a few ICUs began appearing on both sides of the Atlantic. An early version of what has become known as a respiratory ICU, for example, was set up in Denmark during the 1952 polio epidemic in Scandinavia. After 27 of 31 patients suffering from respiratory or pharyngeal paralysis at Copenhagen's Blegdam Hospital died, the hospital's senior anesthetist performed a tracheotomy on a 12-year-old girl and inserted a cuffed endotracheal tube. The patient underwent prolonged manual ventilation and survived.

With this new lifesaving, if laborious, technology in hand, a separate area to care for polio victims was established in the hospital. "At an early stage the following measures were adopted: 1) patients who were likely to develop respiratory complications were transferred to special wards for observation and recording vital signs, etc.; 2) tracheotomies were done under general anesthesia and cuffed tubes were used; 3) manual, intermittent positive-pressure ventilation was used instead of or to supplement respirators; and 4) secondary shock was treated" (121).

In addition, the hospital developed an elaborate personnel system, involving anesthetists, epidemiologists, nurses, medical students, and hospital workers, to provide continuous care for patients and to maintain the machinery being used. As a result of these measures, the mortality rate for polio victims was reduced from 87 to 40 percent.

With the exception of Danish experience, ICUs, like recovery rooms, were established initially more for managerial than for medical reasons. A major factor in their early development was the need to relieve nurses who were so busy caring for a few critically sick patients that they were neglecting the remaining patients on the wards (30). In addition, ICUs were even seen as a means of reducing the cost of medical care (115).

By the late 1950s, the rapid development of the mechanical ventilator provided the medical rationale for establishing ICUs. This life-supporting technology needed to be monitored too closely to be dispersed throughout the hospital ***(136,200).*** In a number of hospitals, the general ICU was a direct outgrowth of a respiratory ICU set up to

care for patients suffering respiratory paralysis caused by polio (36) or tetanus (155).

In 1958, only about **25** percent of community hospitals with more than 300 beds reported having an ICU. By the last half of the 1960s, most U.S. hospitals had established at least one ICU ***(205).***

ADVANTAGES AND DISADVANTAGES OF ICU CARE

Early advocates of ICUs identified a number of advantages for establishing a separate intensive care unit (frequently called an "intensive therapy unit" in England and Europe) (25,47,178,208,231):

- maintenance of high standards of care for seriously ill patients by using specially trained physicians and nurses;
- provision of more continuous observation and frequent measurements of relevant indicators of clinical condition;
- concentration of technologies in one location to avoid duplication of equipment and personnel;
- direct access to patients for major procedures and therapies, including resuscitation;
- avoidance of upsetting the regular ward routine and disturbing less ill ward patients;
- fostering high staff morale and team work; and
- opportunities for concentrated education and research.

From the outset, there was disagreement on which patients would benefit from ICU care. Early units attempted to exclude "terminal care cases, chronic cases, and disturbed or disturbing patients" (23). Some emphasized that intensive therapy should be provided to support vital functions until the underlying disease process could be corrected or run its course (200). Other early commentators saw the ICU simply as the place for the "critically ill" **(187),** or advocated the use of the ICU as a last resort for a "final desperate attempt" to save a life (36). Lack of agreement persists on which patients should have priority access to ICU care.

While the advantages of the ICU were recognized early, so were the potential disadvantages (25,64,178):

- a noisy, intrusive environment for seriously ill patients;
- interrupted continuity of medical responsibility;
- mental and physical strain on the ICU staff;
- overenergetic treatment—for both hopeless and less serious cases;
- decreased nursing skills on the general wards as the sickest patients are removed;
- potential for high cost with unfair claims on the hospital budget; and
- increased cross-infections among seriously ill patients in the same area.

Stated another way, in some situations, application of intensive care maybe unnecessary because the condition is not serious enough; unsuccessful because the condition is too far advanced; unsafe because the risk of complications is too great; unsound because it serves no useful purpose for the patient; or unwise because it utilizes too many resources **(125).**

Despite recognized patient care problems and, more recently, cost concerns, ICU beds have continued to proliferate. There is substantial evidence that, at least for some types of patients, care provided in ICUs is extremely effective. For many medical problems, care of patients outside an ICU would be unthinkable to the modem clinician. At the same time, it is remarkable that such an allpervasive and cost-generating innovation has developed primarily because of "a priori" considerations, with few critical evaluations of its effectiveness (198). The growth of ICUs has been fostered by a highly favorable reimbursement system (6o), by the development of professional medical and nursing critical care societies which constitute a strong constituency for continued expansion of ICUs ***(166),*** and by Federal policies which either

have directly stimulated ICU development (e.g., the Regional Medical Program) or have tended preferentially to exempt ICUs from expansion restraints (205).

DEFINITIONS

In the broadest sense of the term, "critical care medicine" has been used to include management of critical illness or injury at the scene of onset, during transportation to a medical facility, in the emergency department, during surgical intervention in the operating room, and finally in the hospital-based ICU (207). Some consider critical care to be the highly technical treatment that is provided to the most severely ill or injured subset of the population receiving concentrated care in a specialized unit (128,208). Thus, critical care may be considered a higher level of management than intensive care. This case study, however, will follow the lead of the 1983 NIH Consensus Development Conference on Critical Care Medicine and not distinguish the two terms (262); it will consider both intensive care and critical care to be the care provided in separate units generally known as "intensive care units."

From the original recovery rooms and ICUs, other types of units providing specialized care have evolved. In fact, the Joint Commission for the Accreditation of Hospitals provides standards for "special care units," which encompass a broader spectrum of functions than ICUs **(126).** Since the early 1960s, when the ability to identify and treat potentially life-threatening arrhythmias was first developed, most cardiac patients have been treated in coronary care units (CCUs) (59). CCUs generally developed independently of ICUs to utilize the new technology of rhythm monitoring to preserve the health of relatively stable patients, rather than to relieve nurses faced with caring for ward patients, which was the primary impetus for the development of ICUs (205). Today, CCUs treat patients with a relatively narrow range of diagnoses, primarily patients with suspected or actual heart attacks and related problems. CCU patients are not as ill, have fewer physiologic systems involved, require fewer therapeutic services ***(67),*** have better outcomes (31,249), have a greater need for a quiet, stress-free environment **(28),** and pose different evaluation and policy issues than do patients in ICUs. In short, CCUs serve a different primary function from ICUs (238), and most hospitals with more than 100 beds have separate CCUs and ICUs (4). Because they cannot afford to operate separate units, smaller hospitals frequently combine the separate functions of coronary and intensive care. As a result, some of the data sources cited in this study, including Medicare cost reports, have necessarily combined ICUs and CCUs as critical care or special care units.

In recent years, special care units have diversified in other ways (166). First, they have evolved along specialty or subspecialty lines. Thus, burn, cardiovascular surgery, pediatric, neonatal, and respiratory as well as medical and/or surgical intensive care units are now common. Neonatal, pediatric, and burn units raise distinct issues and will not be considered in this case study. Second, units have differentiated into increasingly distinct levels of intensity of care, e.g., step-down and intermediate care units. These newer types of units, usually adjacent to the coronary or intensive care unit, generally provide more concentrated nursing levels than those on the general medical or surgical floors, but they do not provide intensive therapy.

REQUIREMENTS OF AN ICU

A detailed consideration of the design, organization, staffing levels, skills, personnel policies, and other components of an ICU is beyond the scope of this study. Yet in general, all intensive care units meet these requirements:

- care for severely ill or potentially severely ill patients;
- employ specially trained registered nurses on a one-nurse to one- to three-patient basis;
- identify a physician as the director of patient care and administrator of the unit;
- have 24-hour acute care laboratory support; and
- provide a wide range of technological services, with the help of expert medical subspecialists and ancillary personnel (51,166).

While the availability of physicians in ICUs varies with the size and type of hospital, all ICUs combine intensive nursing care and constant patient monitoring (116). In community hospitals, the ICU medical director is frequently not full-time and shares patient care responsibilities with other staff physicians who also have major non-ICU responsibilities. In these units, day-to-day management and administrative decisions are made by the head nurse of the ICU (283). Large hospital ICUs tend to have full-time medical directors.

The NIH Consensus Panel has identified the minimal technological capabilities that an ICU should provide, regardless of the type of facility in which it is located (176):

A. cardiopulmonary resuscitation;
B. airway management, including endotracheal incubation and assisted ventilation;
C. oxygen delivery systems and qualified respiratory therapists or registered nurses to deliver oxygen therapy;
D. continual electrocardiographic monitoring;
E. emergency temporary cardiac pacing;
F. access to rapid and comprehensive, specified laboratory services;
G. nutritional support services;
H. titrated therapeutic interventions with infusion pumps;
I. additional specialized technological capability based on the particular ICU patient composition; and
J. portable life-support equipment for use in patient transport.

SPECIALTY V. MULTISPECIALTY ICUs

Since their development two decades ago, hospitals have differed on whether to establish one or more multispecialty ICUs to treat the range of seriously ill medical and surgical patients or to set up separate ICUs for patients with similar problems **(208).** For reasons of efficiency and economy, smaller hospitals generally have a combined medical and surgical ICU. The smallest hospitals also combine coronary care with intensive care in a single unit (4).

Larger hospitals, particularly teaching hospitals, often have separate general medical and surgical units as well as separate subspecialty units for specific types of medical problems, e.g., cardiac surgery and respiratory care. The Massachusetts General Hospital, for example, has nine separate subspecialty ICUs ***(248).*** However, even hospitals of similar size and type have adopted different approaches to the issue of multispecialty v. separate specialty ICUs (136).

The major rationale for multispecialty ICUS is a medical one, namely, that regardless of the underlying disease, many life-threatening physiological disturbances are quite similar in seriously ill patients (43,208,265). Thus, a basic purpose of ICU care is to support general physiologic responses to stress in order to provide time for a specific therapy for the underlying illness to take effect (89,116,199,222). At times, ICUs primarily treat physiologic disturbances, not diseases; they save lives primarily by supporting oxygenation, often with respirators (209), and by prevent-

ing circulatory collapse and shock (222). Since physiologic complications are similar regardless of precipitating factors, there is a strong medical rationale for multispecialty intensive care provided by comprehensively trained generalists (8).

Increasingly, concerns about efficiency and rising costs have supported maintaining multispecialty units rather than separate subspecialty units. With multispecialty units, there maybe less duplication of expensive equipment, although ICUs generally do not utilize "big ticket" technologies (6). More importantly, because of highly variable clinical demands for ICU care, ICU occupancy can vary dramatically, and combining medical and surgical specialty and subspecialty units permits greater efficiency in the use of personnel, particularly nurses, which is a major cost factor in ICUs (212).

Traditionally, however, demand for ICUs has developed along subspecialty lines, usually in response to the availability of new medical technology. For example, the mechanical respirator led to the respiratory ICU, and the advent of coronary artery bypass surgery led to the postcardiac surgery ICU. In addition, specialists often feel that physicians trained in other fields do not have sufficient understanding and skill to care for patients with particular "subspecialty" problems. Indeed, some have advocated a separate surgical ICU for each surgical specialty in a large hospital (81). Others feel that nursing personnel skilled in one subspecialty, such as cardiology, may be unsuited by temperament, motivation, and training for work in other subspecialties (147).

In short, the debate over the desirability of generalists v. specialists which exists in medicine generally is also being waged in the intensive care world. The trend, which is supported by the Society for Critical Care Medicine, is to cross traditional departmental and specialty lines and to create a "multidisciplinary specialty" equally skilled at caring for medical and surgical problems (95,274). An attempt to define the boundaries of critical care medicine by examination and prescribed training has recently been developed by the American Board of Medical Specialties (8). In 1980, the Boards of Internal Medicine, Pediatrics, Anesthesiology, and Surgery joined together to offer a certificate of special competence in critical care medicine (95). This examination has yet to be given. In 1982, some 50 fellowship programs in critical care medicine in the United States were training approximately 150 physicians to become critical care generalists (91,92). Another 36 programs were training fellows in pediatric critical care medicine. Despite the new cadre of critical care generalists, however, many hospitals continue to maintain separate specialty and subspecialty ICUs along departmental lines.

DISTRIBUTION OF ICU BEDS

It is difficult to estimate precisely the number of ICUs and ICU beds in this country because of the ways in which hospitals report their bed capacity. This is particularly a problem with smaller hospitals, which may designate their ICUs as CCUs or mixed ICU/CCUs in the annual American Hospital Association (AHA) survey. In addition, the annual AHA survey includes multiple ICUs reported from single hospitals. From 1981 AHA survey tapes, it can be estimated that 78 percent of short-term general hospitals have at least one ICU or CCU, and that 93 percent of hospitals larger than 200 beds have a separate ICU (106). Overall, in 1982, 5.9 percent of the total hospital beds in non-Federal, short-term community hospitals were ICU and CCU beds. This figure does not include pediatric ICU beds, neonatal beds, or burn care beds, which add another 0.2 percent, 0.7 percent and 0.1 percent, respectively, to the total number ICU beds (4).

Table 1 shows the distribution of reported ICU beds by size of hospital. In general, ICU beds are fairly evenly distributed across all sizes of hospitals. In 1982, for example, hospitals larger than 500 beds, which account for 22.6 percent of total short-term general hospital beds (4), have 24.8 percent of reported ICU beds. Table 2 shows the

Table 1 .- Distribution of ICU Beds in Short-Term, Non-Federal Hospitals, by Size of Hospital, 1982

Hospital bed size	Total hospital beds	Percent of total	Total ICU/CCU beds	Percent of total
<100	146,706	14.5	5,889	9.9
100-199	195,425	19.3	10,677	17.9
200-299	179,312	17.7	11,302	18.9
300-399	144,012	14.2	9,312	15.6
400-499	120,682	11.9	7,692	12.9
>500	229,043	22.6	14,826	24.8
Total	1,015,180	99.3	59,698	100.0

SOURCE: American Hospital Association, *Hospital Statistics,* 1983 edition.

Table 2.-ICU/CCU Beds as Percent of Total Beds by Hospital Size for Short-Term Nonfederal Hospitals, 1982

Hospital bed size	Percent ICU/CCU beds
<1oo	4.0
100-199	5.5
200-299	6.3
300-399	6.5
400-499	
>500	: : :
Total	5.9

SOURCE: American Hospital Association, *Hospital Statistis,* 1983 edition,

Table 3.–Distribution of ICU and CCU Beds, by Region, 1981

Region	Per 10,000 population	Per 100 hospital beds
New England		5.8
Middle Atlantic	; : :	
South Atlantic	2.9	: : :
East North Central	3.3	6.7
East South Central		5.3
West North Central	; : ;	5.0
West South Central	2.6	5.2
Mountain	2.6	6.2
Pacific	2.7	7.0
Total	2.9	5.9[a]

[a]Hospital data in this table includes Federal hospitals and specialty service short-term hospitals.

SOURCE: American Hospital Association, *Hospital Statistics,* 1982 edition; and U.S. Department of Commerce, Bureau of the Census, *State and* Metropolita *Area* Data Book, 1982,

percent of ICU/CCU beds as a percentage of total beds by hospital size in 1982. For hospitalsof200 beds or more, the ICU/CCU bed percentage is very consistent.

Table 3 indicates the distribution of combined, non-Federal intensive and coronary care bedsby region as of 1981. (Coronary care beds makeup about **25** percent of the total.) There are some variations in the number of these beds as a percent of total beds, with the Pacific, East North Central and Mountain States having the highest percentages. However, as Russell pointed out, the distribution of ICU/CCU beds is much more uniform when considered in relation to population, rather than to hospital beds **(205).**

Finally, as shown in table 4, the distribution of ICU beds varies somewhat according to hospital sponsorship.

Table 4.—Percentage of ICU/CCU Beds in Short-Term Hospitals, by Hospital Sponsorship, 1976 and 1982

Type of hospital	Percent of hospital beds that are ICU or CCU beds 1976	1982
Nongovernment not-for-profit	5.0	6.2
Investor owned (for-profit)	4.4	5.4
State and local government	4.2	5.1
All non-Federal	4.7	5.9
(Federal hospitals)[a]	(3.7)	(3.4)

[a]Reporting from Federal hospitals includes hospitals other than short-term general hospitals, including long-term care facilities. Percentages of ICU/CCU in Federal hospitals are not strictly comparable to those in non-Federal hospitals.

SOURCE: American Hospital Association, *Hospital Statistics,* 1977 and 1983 editions.

EXPANSION OF ICU BEDS

While the number of community hospital beds increased only about ***6*** percent between 1976 and 1982, reported ICU and CCU beds in community hospitals increased by ***29*** percent, or an average of almost 5 percent a year. Moreover, over half of that reported increase occurred between 1979

to 1981. In this 2-year span, reported ICU beds increased 14.3 percent and reported CCU beds grew 15.4 percent (4), despite the absence of any dramatic medical breakthroughs that would explain such a sharp rise. While the number of coronary artery bypass graft surgery procedures performed in the country was increasing by perhaps *20* percent a year during these years (257), the increase in the number of such operations could explain only a very small increase in ICU beds.

One can speculate, therefore, that the Medicare policy implemented in 1980 (73) that tightened limits on routine bed charges—commonly known as the "section 223 limits"—but not on special care bed charges or ancillary services, created a strong stimulus for hospitals to add more ICU beds (60) or, perhaps, to reassign beds to special care where possible. The most dramatic rise in ICU/CCU beds between 1979 and 1981 occurred in hospitals with more than 500 beds, which accounted for almost 55 percent of the total increase in ICU/CCU beds in these two years (4). In 1982, the number of ICU/CCU beds increased 4 percent, while total community hospital beds increased only 1 percent. Thus, while ICU bed expansion has continued at a much faster rate than hospital beds generally, the pace of growth found in 1980 and 1981 has slowed. ,

REGULATION OF ICUs

Along with the medical and organizational reasons for their expansion, ICUs and CCUs were encouraged by the Federal Government in the 1960s initially in the Regional Medical Programs (205).

In the 1970s, State certificate-of-need (CON) statutes were passed in most States. CON statutes require a prior determination by a governmental agency that certain major capital expenditures or changes in health care facilities are needed (19). Early evaluations showed that CON programs helped forestall the addition of general hospital and long-term care beds (19). However, ICU beds have generally been approved by CON agencies.

In addition, Salkever and Bice (211) found that while CON programs controlled expansion in bed supply to some extent, they stimulated other types of hospital investment. Specifically, they found that assets per hospital bed, for equipment and other nonlabor products, actually increased as a result of CON. A subsequent, more definitive study confirmed the findings that the CON requirement generally has been successful in limiting the number of beds, but not the intensity of resource use or costs *(188).* Ironically, the threat of CON review may have encouraged hospitals to convert low-asset routine care beds into comparatively high-asset ICU beds (166).

Equipment used in ICUs rarely requires CON approval. The national threshold for requiring CON approval in the National Health Planning and Resources Development Act of **1974** (Public Law **93-641)** was **$150,000, and** most ICU equipment is well below that level. The cost per bed of typical ICU cardiac monitoring equipment in 1978, for example, ranged from $6,000 to $8,500 (6). A new ICU respirator costs between $10,000 to $15,000 (87).

The construction costs of each patient unit in the ICU was estimated to cost between $44,ooo and **$75,000** in **1978** dollars (6), Renovation costs were much less. Thus, hospitals with sufficient capital can escape CON review altogether by gradually expanding and upgrading already existing ICUs (119,166). As was noted earlier, hospitals reported about a 15-percent increase in ICU beds between 1979 and 1981, a time when CON programs were functioning in virtually every State. The current trend toward raising CON thresholds practically assures that CON regulation of ICUs will remain a minor issue.