The changing landscape of intensive care medicine

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Abstract: This manuscript is a very general and non-political review on major issues concerning the evolving structural and organizational aspects of intensive care medicine, which may influence the outcomes of patients. It merely raises a multitude of issues, which deserve discussion in the different contexts of countries or communities.

Key words: Concentration of intensive care; regionalization of intensive care; interclinical transport of intensive care patients; tele-ICU.

History of Intensive Care Medicine

The first Intensive Care Units (ICU’s) were established in the late 1950s and the specialty of Intensive Care Medicine began to develop. The majority of units were open, with patients managed by their primary admitting physician. Increasing complexity of health care and advances in diagnostic technology and therapies has been accompanied with an increasing complexity in the reorganization of ICUs around the world.

As a result, and depending on geographical and historical issues, there are now different types of ICU: neuro, trauma, post-surgical, post-transplant, burns unit, respiratory, infectious, neonatal, pediatric, coronary unit, intermediate care, etc. In recent years, it was realized that many ICU patients had similar problems, regardless of the reason for their critical illness, and that closed units, in which patients were managed by a team of specially qualified intensive care physicians and nurses, provided patients with better care and were associated with improved outcomes (1, 2). The important role of the intensivist in maximizing patient outcomes was also recognized (3), and specialist training programs began to develop as intensive care medicine became a specialty in its own right.

Intensive care costs are expected to escalate because of the demographics of an aging population and increasing complexity of illness.

This coincides with the growing shortage of critical care physicians and nurses to manage these patients.

In this narrative review, we will discuss the role of centralization, regionalization with community outreach, and telemedicine in the delivery of intensive care medicine.

Centralization of Intensive Care Medicine

What is better: a hospital with one general ICU of 30 beds or with 3 specialized ICUs with each 10 beds? While the discussion about this concentration versus fragmentation of intensive care delivery has not yet settled, initiatives are employed to increase hospital ICU case volume to improve outcome by centralization of ICUs. Centralization of Intensive Care Medicine means that critically ill patients with a predefined severity of illness will be transferred from local to tertiary centers. The evidence supporting centralization of intensive care comes from successful analogous systems in trauma, cardiovascular and cancer surgery, pediatric, and neonatal care. This has led to the concentration of these services. The rationale behind centralization is twofold. Firstly, by focusing allocated healthcare funds on only a smaller number of specialized centers, the financial burden can be contained; secondly, health outcomes are potentially improved by treating patients in high volume facilities. Smaller hospitals in general have less technology, a smaller number of experienced personnel. In high-volume hospitals, by virtue of having better resources and
more patients, it is believed that patients’ outcome is better because ‘practice makes perfect’ and larger centers better adhere to ‘best practices’. Although most doctors would agree that the overall association between volume and outcome is robust, the consistency and magnitude of the relationships varies greatly in the literature and the relationship between hospital volume and outcomes for specific high-risk intensive care treatments or patient categories is less well understood. Several reports in North America, Europe, and Australia-New Zealand addressed the relationship between hospital volumes and outcomes in intensive care medicine (4-25), while a recently published review of the Dutch national Intensive Care registry did not show this relation for the Dutch context (26). However, we must keep in mind that differences exist in the way intensive care medicine is practiced in the United States. In Europe, Canada, Australia and New Zealand ICUs tend to be staffed by Anesthesiologists/Intensivists with a closed-unit policy. Whereas, in the US, ICUs may be staffed by Intensivists as well as other types of specialists, with an open-door policy. Furthermore, an impact of jurisdictional healthcare funding on the volume-outcome relationship is plausible. In Canada, the UK, Australia and New Zealand, a universal single-payer system exists, whereas in the US a fee-for-service/prospective payment system is common. In the U.S., where much of the supporting data have originated, patients may be selectively referred to institutions with better outcomes. That is, high volumes are a result of patients selecting institutions with good care, and good outcomes are not causally related to high volumes. Although most doctors would agree that the overall association between volume and outcome is robust, the consistency and magnitude of the relationships varies greatly in the literature. Furthermore, major concerns regarding the current research must be addressed:

Risk-adjustment techniques were often poor and differences in patient-mix obvious confounders; few investigators have looked at the appropriateness of patient selection for specific procedures; Researches usually did not control for differential use of specific processes of care that are known to result in better outcome; Very few investigators sought to identify the simultaneous contribution of hospital and physician volume to outcomes. A low-volume doctor at a high-volume hospital may have significantly poorer results than a moderate-volume doctor at a moderate-volume hospital.

Volume/outcome may also be biased by a large contingent of inexperienced doctors-in-training in high volume centers whereas moderate or even focused small volume centers maybe extensively staffed by very high-experienced professionals;

A wide variation in the definitions of high volume and low volume for a given topic are found in the literature;

Few studies explored changes in volume and performance over time, although it has been noted previously that performance gaps between low- and high-volume hospitals tend to narrow over time as specific treatment protocols and procedures become effective;

A negative publication bias diminishing the number of studies failing to report the association cannot be excluded;

Any relationship between volume and outcome is only true on average and outcomes vary widely among individual hospitals and physicians;

Volume is only a proxy measure of other things because it cannot directly produce good or bad results;

Most studies are outdated and do not represent current intensive care practices anymore;

To conclude, the discordant literature on volume-outcome relationships in the intensive care environment is far from conclusive. Furthermore, mortality is an increasingly misleading outcome in ICU studies (27)) It has been widely recognized that mortality has decreased in the ICU over time both overall and in specific emblematic syndromes such as sepsis and ARDS, without much more progress to be expected. While mortality may be a metric which can indicate process failure if suddenly increasing, it is a poor metric of the level of care. Within this discussion functional long term outcome of patients after ICU discharge is getting more and more into the focus of research (28, 29).

Besides concerns about the current evidence there are some practical concerns with regards to a centralized Intensive Care system. Evidently, one difficulty is to determine which patient at what time point should be transported to a high-facility special Intensive Care. Although transportation of critically ill patients is safe when appropriate ambulance systems are used (30-35), risks of transport and impact on transferring patients may outweigh benefits of centralization.

Critically ill patients may be at risk of clinical deterioration due to the stresses of transport, due to progression of their underlying disease or due to
adverse events related to clinical care occurring before or during transport. As communication is known to be the leading source of adverse events and errors in healthcare the increased number of patient handovers due to patient transport may contribute to communication errors resulting in reduced quality of care.

On the other hand the value of early intervention does not unequivocally argue against centralization because first line treatment and stabilization of vital parameters can take place in the local hospital. Certainly centralization might delay definitive treatment for some critically ill patients if therapies are postponed until patients reach regional care centers.

If ICU services are reduced at small volume hospitals then other programs may need to be reduced or eliminated. These measures may affect individual patients. If local services to non-critically ill patients are reduced, patients might have to travel long distances to get specialty care, or might lose access altogether. Similarly, patients on hospital wards who become precipitously ill might not have immediate access to an ICU. Thus, even if transfer to a regional referral center improves survival for patients who are transferred, it is possible that remaining patients at non-designated centers with reduced resources will face increased risk.

Furthermore, the centralization of specialty services may lead to a reduction in available specialists for patients in peripheral communities, as specialists are moved to high-volume centers. The removal of specialty programs from hospitals may also lead to an erosion of staff morale and pride.

Transferring patients to referral hospitals potentially disconnects critically ill patients from clinicians who have cared for them over time. The benefits of a physician with established trust and knowledge about chronic medical problems may be lost under centralized care. Approximately one quarter of ICU patients originate from the hospital ward. Under a centralized system, these patients will be transferred away from physicians who have cared for them throughout their hospitalization. Similarly, centralization will likely require families to travel further to visit their critically ill relatives. Even under the current system the emotional burden for families of patients with critical illness is high. Also, a geographical obstacle is created for the provision of longitudinal care, rehabilitation and chronic disease management following critical illnesses. Patients from remote areas may also feel a sense of depersonalization when transferred to large, high-volume hospitals.

Regionalization of intensive care may be established in different ways, depending on the local situation:

1. Transportation of certain patient categories from the satellite hospitals to the tertiary center.
2. Community outreach, meaning that intensivists from the tertiary center are 24/7 available for on-site consulting in the satellite hospitals.
3. Rotating programs between the regional intensivists in the satellite hospitals (low volume) and their colleagues in the tertiary (academic) centers (high volume) could increase physician’s competence and motivation for regionalized intensive care.
4. Tele-consulting facilities within the network that are 24/7 available.
5. Combination of 24/7 Teleconsulting with community outreach on demand and or rotating programs.

We would like to emphasize here that neither of the systems exclude each other. The different aspects of regionalization of intensive care delivery will now be discussed.

1. Interclinical transport

In a regionalized ICU network, patient categories that should be transferred to a tertiary centre can be defined based on the specific facilities in the region.

An organized transport system is essential in regionalization of critical care. The make-up and structure of such a system will have to vary according to the local landscape and geography.

2. Community outreach

Quality improvement through regional outreach is a strategy whereby all hospitals within a
region work together to benchmark outcomes and improve quality. Rather than systematically transfer patients to high-quality hospitals, physicians’ expertise is brought to patients. There are several examples of how quality improvement through outreach can work (36). Potential benefits of regional outreach include increased survival, cost savings, benchmarking and increased adherence to evidence-based practice. Potential risks are the difficulties in evaluating the efficacy of the system and the maintenance of the improvement.

3. Rotating programs

Rotating programs between Intensivists in the satellite hospitals (low volume) and their colleagues in the tertiary (academic) centers (high volume) could increase physician’s competence and motivation for regionalized intensive care. One important effect of rotating programs is certainly the ongoing personal contact between Intensivists within the entire region which lowers the threshold for tele-consulting in an acute setting. Similarly, clinical research networks and academic teaching networks (residencies, clerkships) could increase the standards of care in participating centers.

4. Teleconsulting and Telemedicine

A distinction between Teleconsulting and Telemedicine should be made. While Teleconsulting means that the Intensivist in the local hospital is contacting the colleague from the tertiary centre with regards to a defined problem or patient, Telemedicine means online monitoring of a remote ICU by a tele-Intensivist from a tertiary centre. According to local agreements, the tele-intensivist may eventually deliver care as well.

Teleconsulting can be performed at different levels, depending on the used technology, from only audio contact via telephone to combined videoconferencing with access to the local Patient Data Management System.

Intensive Care Telemedicine is becoming increasingly practiced in the USA, potentially related to the shortage of Intensivists and the presence of remote rural smaller hospitals. Several studies suggested that implementation of Telemedicine was associated with better adherence to protocols and guidelines, faster response times to altered parameters and even reduced intensive care mortality when the tele-Intensivist, apart from monitoring patients, was allowed to therapeutically intervene in the patients’ care (37-45).

Most studies use a before-and-after study design and are subject to numerous biases, including unmeasured changes in case mix, temporal trends, coincident interventions, and random variation. Additionally, ICU telemedicine often introduces multiple interventions at the same time, including audiovisual surveillance, staffing changes, decision-support tools, and new electronic medical records. Introducing multiple different interventions simultaneously makes it difficult to understand the specific mechanism of the effect. These studies also do not consistently describe the organization and management of participating ICUs prior to introducing the telemedicine program, making it difficult to put the research into clinical context. All these studies therefore do not close the book on ICU telemedicine. Telemedicine is a potentially valuable change in ICU care, but its complexity means that ‘telemedicine improves care’ is hardly a testable hypothesis. The Critical Care Societies Collaborative stated that future research should be organized around a conceptual framework that includes standardized methods for assessing the pre-implementation ICU environment and describing the ICU telemedicine intervention. Key topic areas to be addressed include the effect of ICU telemedicine on the structure, process, and outcome of critical care delivery. The American College of Chest Physicians Critical Care Institute made a first step in this research agenda by developing and conducting a survey of ICU telemedicine practices (46). Analyses of the survey revealed substantial variation in the practice of ICU telemedicine, including ICU telemedicine center staffing patterns; qualifications of providers; case sign-out, ICU staffing models, leadership, and governance; Intensivist review for new patients; adherence to best practices; use of quality and safety information; and ICU physician sign out for their patients. The unique power of ICU telemedicine is its ability to facilitate critical care provision over large distances. Consequently, telemedicine may be the best solution in rural areas in which distance between hospitals is large. Telemedicine may also be most successful in small hospitals without access to trained Intensivists. In other settings, rather than using ICU telemedicine to prevent medical errors, perhaps it could be better used to implement best ICU practices. The use of ICU telemedicine is likely to expand in the coming years. Its application should not necessarily wait until definitive evidence of effectiveness exists yet neither should its adoption be uninformed by high-quality research. In this regard, it is essential that expansion of telemedicine be accompanied by critical evalu-
tion leading to a comprehensive evidence base. Technology alone cannot bring about significant changes in outcome. The organizational structure, support, strength of leadership, method of implementation, and ongoing commitment will determine whether implementation of ICU telemedicine will be successful. Given all these reasons, it seems intuitive to the authors of this review, that implementing a tele-ICU system is beneficial. However, significant barriers to implementation must be considered and understood: financial barriers, technical and logistic challenges, cultural and organizational resistance, issues related to intellectual property, reimbursement and regulation. Physicians typically are cited as the greatest barrier to implementation of telemedicine options. They may be uncomfortable dealing with new technology, may perceive a threat to their clinical autonomy and fiscal concerns, and may believe the lack of direct interaction, eye contact, and other sensory input with the patient may cause them to miss critical diagnostic cues.

The design of centralized or regionalized systems must account for the financial and political implications of removing a source of revenue away from small, community hospitals and physicians in those hospitals, facing the fact that the implications of a centralized system are extremely difficult to foresee. Therefore centralization should not be implemented without a thorough understanding of the structural implications for both accepting and referring hospitals, including the impact of centralization on daily census, resource utilization, and other hospital services.

Authors’ opinion

It is the authors’ opinion that centralization of intensive care medicine delivery has to many major drawbacks to justify its implementation. On the other hand, the authors believe that regionalization of intensive care medicine may reduce health care costs and improve overall quality and accessibility of intensive care medicine. According to the facilities available in the specific region, regionalization may include limited intercritical transportation, community outreach, Intensivists’ rotating programs, teleconsulting and telemedicine.

References


