

Intensive care medicine and the intensivist: from 1850 to 2021

A medicina intensiva e o intensivista: de 1850 a 2021

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ABSTRACT

Intensive Care Medicine gained prominence in 2020 and 2021 due to the COVID-19 pandemic. It is a recent medical specialty, which many physicians and the public know little about. This article makes a historical perspective, from the emergence of the first areas for observation of critically ill patients in the nineteenth century to the present, to the impact of the pandemic and its consequences.

Keywords: Intensive care, Critical care, COVID-19, Historical aspects.

RESUMO

A Medicina Intensiva ganhou destaque no anos de 2020 e 2021 devido à pandemia por COVID-19. Trata-se de uma especialidade recente, e ainda pouco conhecida por muitos médicos e pelo público. Este artigo faz uma perspectiva histórica, desde o surgimento das primeiras áreas para observação de pacientes graves no século XIX, até o presente, com o impacto da pandemia, e as perspectivas futuras.

Palavras-chave: Medicina intensiva, Cuidados críticos, COVID-19, História, Ventilação mecânica

INTRODUCTION

The COVID-19 pandemic brought attention to one of the most recent medical specialties and that is undergoing rapid development. Many countries have encountered difficulties finding specialists capable of dealing with critically ill patients, and the shortage of intensivists is nothing new. However, even ending the pandemic will not reduce the demand for this specialist because, in most countries, there is an increasingly elderly population with multiple comorbidities. The evolution of intensive care medicine since the 1850s is intertwined with the development of modern hospitals. Knowing its history is of great value to understand the future of hospital medicine and what is expected of the physician who will work in these institutions.

THE BIRTH OF INTENSIVE CARE MEDICINE

The birth of Intensive Care Medicine as a recognized and formally established specialty is very recent. It became known in the United States some 40 years ago. However, the origin of Critical Care Medicine is much older, with its roots in the 19th century. During the Crimean War in the 1850s, nurses created a separate area for British soldiers who were severely wounded in the fighting or who had undergone a surgical procedure. The aim was to increase surveillance of the most seriously ill patients, and the initiative is attributed to the legendary nurse Florence Nightingale¹ (Figure 1).

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Figure 1

In the following years, until the beginning of the 20th century, more severe patients started to stay in private or semi-private beds, under the care of nurses in charge. In 1927, Dr. Walter Dandy² created a unit to improve the care of neurosurgical patients at the Johns Hopkins Hospital in Baltimore. The concept of a unit focused on the care of postoperative patients expanded rapidly, especially after World War II, when the initial concept was expanded to the initial care of the severely injured in the so-called shock rooms. In each of these cases, the emphasis was always on adopting life-saving measures based on vital signs and conducted primarily by nursing professionals. These professionals were initially trained to adopt routines established by surgeons and later by anesthesiologists, and these units had teams trained for

a partial period, typically 8 hours. The hospitals encouraged the families to pay, totally or partially, to permanent the nurses for longer periods since there were (as there are until today) economic limitations for adopting larger teams. When patients evolved to terminality, they were separated from the others to reduce their impact.

The Intensive Care Units (ICUs) of the 1950s had little or no specialized equipment and did not even have the primitive monitors of the operating rooms. Until the 1950s, ICUs were basically physical spaces where postoperative patients were accommodated for personalized monitoring. Some procedures aiming at compensating for the failure of a specific organ or system had been initiated in the previous decade: tracheotomy, for example, became routine, as the objec-

tive of ensuring an airway at this time, given that poliomyelitis had become epidemic in the USA in 1948 and Denmark in 1952. Ventilation was performed with Drinker-Shaw steel lungs³ (Figure 2),

which appeared in 1928, and with chest cuirasses. When hospitals were overloaded with patients with respiratory paralysis due to polio, they were manually ventilated by medical students.



Figure 2

These procedures were the predecessors of orotracheal intubation outside the operating room and mechanical ventilation. Piston ventilators, developed

by Morsch, were followed by the Bennet⁴ and Bird Mark 7⁵ (Figure 3), which provided intermittent positive pressure, in addition to the Emerson ventilator.⁶



Figure 3

In the 1960s, the first commercialized mechanical ventilator appeared that was capable of providing controlled pressures and flows, both inspiratory and expiratory, called Engstrom.⁷

Anesthesiologists were in charge of caring for patients using these devices, as well as sedation and neuromuscular blockade. In the Vietnam

War, intubation and mechanical ventilation were already more adopted⁸.

The hemodialysis machine (Figure 4) appeared with the dutch physiologist Kolff in 1943,⁹ being a savior for many American soldiers during the Korean War, when a hantavirus outbreak affected the population¹⁰, generating hemorrhagic fever.



Figure 4

Electric defibrillators with practical utility were discovered in the 1950s¹¹, and used in patients with coronary artery disease. The first transvenous pacemakers also appeared at this time¹², and with them the coronary units. The monitors, as we know them today, were not yet routinely used. The only ones were those present in organ support devices.

The first multifunctional monitors with alarms (initially analog) appeared in the late 1950s

and early 1960s¹³, evolving into the current digital devices. The monitoring was increased by laboratory measurements, such as cardiac enzymes and lactate, allowing an anticipatory action in life-threatening situations.

The vast majority of clinicians and surgeons in the 1960s and 1970s still did not feel comfortable with the formidable technology that emerged for critical care but gradually began to share the responsibility for diagnosing and managing these

patients with a new class of physicians. These patients were daily managed by surgeons, anesthesiologists, and clinicians, and they were the first intensivists. The multidisciplinary team also started to emerge, with intensivist nurses, physiotherapists, and shortly afterwards, pharmacists. In the following years, clinicians, pulmonologists, and surgeons (mainly trauma) were attracted to the subspecialty in the United States of America (USA). In European countries and Australia, anesthesiologists began to tread the path of the operating room and critical care units. The intensivist physician started to be seen as someone who has his specialty and acts to improve critically ill patients' outcomes.

The ICU has undergone several revolutions over the years, and one of them was announced by Shoemaker in 1974¹⁴, when he predicted that critical care would be guided by protocols in the years to come. This prediction proved to be one of the most accurate, and in fact, protocols were largely responsible for reducing adverse events and improving patient care.

At the beginning of the third decade of the millennium, we live the revolution associated with Artificial Intelligence. The emergence of *big data* will give wings to a technology that promises to anticipate diseases and offer specific treatment for each patient, besides incorporating protocols and automatic updates to the ICU machinery software. Each device at the bedside will be interconnected and exchange information that will be crossed by a network of artificial neurons, offering solutions to the problems presented by the patient. The capacity of such machines to cross variables is infinitely greater than that of the human brain and to store data. Medicine as a whole is being revolutionized, and Intensive Care Medicine, due to the large amount of data generated by the continuous monitoring of vital signs, is in the front line of this process¹⁵.

THE INTENSIVIST

The need for physicians capable of providing quality intensive care medicine has only grown in recent years. The US had, in 2010, about 103900 ICU beds out of a total of 641395 hospital beds,

garnering about 16.2% of them¹⁶. Even in the richest country of the world, less than 1/3 of ICUs had trained intensivists on their roster¹⁷. However, specialized care is increasingly demanded as insurers and regulators will no longer turn a blind eye to basic infection prevention failures and lack of protocols, heralded as revolutionary by Shoemaker nearly 50 years ago.

This is a specialty with high levels of stress, especially due to the high workload associated with intense family interactions and the theme of omnipresent death. The hospital work period also has an increased risk of conflict with non-intensive care physicians, besides often including care in areas outside the ICU, working in any area of the hospital where there are critically ill patients¹⁸.

In addition to being one of the most recent specialties, Intensive Care Medicine is also little understood among medical students, as it still occupies a small space in the curriculum of medical schools around the world. It is not unusual for the student to spend more time dedicated to more specific specialties, such as ophthalmology, and spend almost no time with critically ill patients. There is no doubt that this fact constitutes a paradox since, in many developing countries, future physicians will likely have their first job working in an emergency room. The medical curriculum should be updated urgently, and more space should be given to the Emergency specialty. Little wonder, first world countries are increasingly restricting the presence of doctors without specialty in critical sectors, and this should also be the trend in emerging nations, even if belatedly.

Instead of focusing on a specific human body system - like cardiologists or pulmonologists - intensivists have a more generalist view of the patient. The intensivist is responsible for coordinating the many decisions that will be made in critically ill patient care, including those involving other specialists. An intensivist physician can improve outcomes, reduce complications and reduce the length of stay in the ICU.

Routine activities are (1) assessing, monitoring, and reviewing critically ill patients or those at risk of developing a severe illness; (2) providing organ support, such as the use of vasoactive and inotropic drugs, endotracheal intubation, performing percutaneous tracheostomy; (3) invasive

monitoring, with arterial cannulation and cardiac output measurements; (4) hemodialysis; (5) use of ultrasound; (6) transferring patients between sectors or institutions.

It is possible to develop other skills, considered sub-specialties, among them academic research, skills in cardiology ICU, echocardiography, use of Extracorporeal Membrane Oxygenation (ECMO), neurointensivism, pediatric intensivism, pre-hospital emergency, palliative care, quality or management, trauma, transplants and medicine related to patient transport.

THE TRAINING OF INTENSIVISTS AROUND THE WORLD

Many intensivists are trained in other specialties, and in Brazil, five are accepted as prerequisites for residency in Intensive Care Medicine: Internal Medicine, General Surgery, Anesthesiology, Neurology and Infectology. Currently, there is an ongoing alteration in the medical residency for direct access, which will now be done over 3 years. There are also the Specialization Programs in Intensive Care Medicine recognized by the Brazilian Association of Intensive Care Medicine (AMIB), which last three years and have as a prerequisite the graduation in medicine. These programs are offered by Training Centers. It is also possible to become a specialist in Intensive Care Medicine by working in ICU, requiring at least 8 years of uninterrupted practice in an ICU. All these paths need the accomplishment of the Intensive Care Medicine Specialist Title Exam, applied by AMIB, for the candidate to be recognized as a specialist¹⁹.

In Portugal, a specialty with internship in Intensive Care Medicine is required, such as Internal Medicine (or other clinical specialties), General Surgery (or other surgical specialties) or Anaesthesiology. The Classic Route Training Plan includes a minimum of 6 months training in Internal Medicine, 3 months in Anaesthesiology, 3 months in Echocardiography, 2 months in Bronchoscopy, and 24 months in Intensive Care Medicine. After completing this training, the candidate can take the Medical Board Examination to acquire the degree of Specialist in Intensive Care Medicine²⁰.

In the United States, the specialty requires a fellowship in Critical Care after completing a residency in another specialty. The fellowship at Wake Forest School of Medicine²¹, for example, gives preference to Internal Medicine or Emergency Medicine as prior residencies but considers the completion of other residencies in other specialties (accessed through Step 1 and Step 2 exams). The institution considers the fellow's background to determine whether the training will last 1 or 2 years. There is also the traditional method, with 2 years of residency in Internal Medicine, followed by another 2 - 4 years of Critical Care/ Pulmonary Medicine, completing 5 to 6 years of training. The paths vary.

Other countries have different training: residency in Spain²² is also done by direct access and involves 5 years of training, the first two with rotations in Clinical Medicine, Surgery, Anesthesiology, Nephrology and Pulmonology. The remaining 3 years are spent in critical units.

THE ARRIVAL OF COVID-19 AND INTENSIVE CARE MEDICINE

The COVID-19 pandemic exacerbated a chronic deficiency globally: the lack of physicians specialized in the care of critically ill patients. Because it is a specialty that is perceived as grueling, underpaid, not well known, and a leader in *burnout*²², few students take on the challenge of embracing it. The pandemic increased the number of ICU beds up to 4 times in many hospitals worldwide. Consequently, many countries are searching for physicians specialized in Intensive Care Medicine, with attractive salaries. There is no doubt that the pandemic will leave its mark in almost every aspect of human life, and obviously, Critical Care Medicine would be no exception²⁴: (1) the emergence of a system of prevention, preparedness and response for crises of this dimension. In the next pandemic, which unfortunately will occur, the health system will be better prepared to triage more effectively who has and who does not need an ICU bed. Health institutions will be much more prepared to meet the high demand for the most varied inputs and prioritize what is necessary; (2) the maintenance of expan-

dable ICU beds. If ICU beds were lacking before, this deficiency is now made much more evident. With an increasingly aging population and chronic diseases, the institutions will need to increase their beds for critically ill patients and still can expand these beds in emergencies, such as the COVID-19 pandemic (3) focus on human resources. Institutions will have to focus on maintaining a malleable staff, which will increase according to demand. Another focus will have to be on the well-being of these teams, highly subject to *burnout*, by the very characteristic of their performance; (4) efficiency and optimization in end-of-life care, including telemedicine and telephone for communication with the families. To establish realistic goals for the care of critically ill patients, respecting the most varied cultural conceptions of death; (5) development of more effective epidemiological registers.

CONCLUSION

The perception of Intensive Care Medicine as a complex area of action, with several skills, and extremely useful in the hospital environment, is recent.

There is no doubt that after the pandemic, the general public has become much more aware of the value of an intensive care bed, and greater attention will be paid to this medical specialty. The tendency is to valorize the specialty, as the population is in an aging curve, and critical care beds should occupy larger shares in hospitals. The future points the way to an increasingly more technological ICU, which will demand proficiency from the physician. Soon, decisions will be shared with automated algorithms, and all devices at the bedside will be electronically connected, exchanging and crossing information with each other. Critical care will be personalized and adapted to the smallest details of the individual patient, with complex molecular analyses (*multi-omic data*)²⁵. Due to their multifunctionality and generalist vision, the intensivist enters the 21st century as the prototype of the physician of the future, with a great capacity to act and be useful anywhere on the planet.

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