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ARTICLE

Historical perspectives of critical care in India and worldwide

Ujjwala Murkute[1]

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Abstract
This article highlights and describes the important historical developments in critical care medicine worldwide, including India's initial journey in this field. The concept of critical care is modern; however, its underlying foundations are profound and have their starting point in the work of Ignaz Semmelweis and Joseph Lister, who laid the foundation for scientific developments in medicine. The routes of critical care can also be found in the contribution of Florence Nightingale in the 1850s during the Crimean War, which included the concept of separate geographical areas for those who were sicker than others. With the emergence of this concept, the establishment of separate post-operative units, the formation of shock wards, the use of artificial airways and mechanical ventilators, the constant evolution of biomedical technology, etc., further led to advancements in critical care medicine. In India, critical care remained focused on cardiac and respiratory care in its initial days but later expanded to involve other unstable patients. The private sector took the lead in establishing separate critical care units, followed by government teaching hospitals. In the current era, critical care medicine represents tremendous growth in the field of biotechnology, innovative communication approaches, the use of multi-disciplinary approach, and essentially the use of evidence-based practices. Furthermore, the emergence of precision medicine has started influencing treatment choices and healthcare decisions to provide more personalized medical care.

Keywords History · Historical perspectives · Critical care · India · Worldwide · Critical care medicine

1 Introduction

Critical care developed from the acknowledgment that the necessities of patients with acute, life-threatening illnesses or injuries could be better met if the patients were sorted out into particular regions of the hospital (Jackson & Cairns, 2021). The separate specialty of critical care in terms of medical and nursing skills started emerging in the 19th Century as developemt of biomedical technology evolved over the time. This ongoing development improved the monitoring and therapeutics of critically ill patients, which has helped to achieve better patient care outcome. This also lead to recognition of the need for separate physical units for such patients with special medical and nursing care facilities (Ristagno & Weil, 2009, pp. 3–17). The idea of critical care is modern; however, its underlying foundations are profound.

One of the earliest scientific medical developments was by Hungarian doctor Ignaz Semmelweis, who worked at the first obstetric clinic at Vienna General Hospital, Austria (Martini & Lippi, 2021). In 1843, his clinical observations and logical reasoning led him to believe that unclean hands were the cause of puerperal sepsis. He later demonstrated that the mortality rate among mothers was lowered when hospital staff washed their hands with an antiseptic agent. For his contribution, Semmelweis is considered not only the father of hand hygiene, but his contribution became a model of epidemiology-driven strategies and is widely regarded as the foundation of scientific discovery in the field of medicine (Tyagi & Barwal, 2020, pp. 276–277). Similar findings were already proposed 6 years prior by Dr. Oliver Wendall Holmes from Boston, USA in relation to hand washing for the prevention of puerperal sepsis among mothers. However, it did not get wider reach and publicity in medicine at that time (Dunn, 2007).

Another prominent contribution came from Joseph Lister (1827–1912, a British Surgeon who used the work of Louis Pasteur on germ theory and established the practice of antisepsis. Around 1867, he promoted the idea of sterilization with carbolic acid, which improved the outcome of various

✉ Ujjwala Murkute
ujjwalamurkute@gmail.com

[1] Sadhu Vaswani College of Nursing, 10-10/1, Koregaon Road, Pune, Maharashtra 411001, India

surgical procedures. In 1867, he published his discovery of antisepsis, which revolutionized medicine and surgery. This work led Lister to be distinguished as the 'Father of modern surgery' (Michaleas et al., 2022). In later decades, these scientific developments had a major impact on the understanding of causal relationships and etiopathophysiology of various diseases, which led to the foundation of more complex health care, which is widely regarded as critical care medicine.

Critical care also has its roots in the work of Florence Nightingale, who stated in her observations that an unclean environment leads to higher mortality among wounded soldiers. She also recognized the importance of grouping the patients according to the severity of their illness. In Notes on Nursing, she states, "We kept the sickest patients close to the nursing desk while moving those requiring less nursing care to the end of the ward". In the 1850s, during the Crimean War, Florence Nightingale described the advantages of placing patients recovering from surgery in a separate hospital area. She insisted that patients who required the most consideration be nearest to the nurse's work area where they could be observed continually. This was the foundation of creating a focus on the importance of separate geographical areas for those who are sicker than others (Nightingale, 1860; Bambi, 2017, pp. 489–490).

Dr Walter E Dandy, who was a renowned neurosurgeon and scientist of America, opened a special three-bed unit for the more critically ill post-operative neurosurgical patients in 1923 at the Johns Hopkins Hospital in Baltimore. He arranged for specially trained nurses to help monitor and manage such patients. In 1930, Dr. Martin Kirschner, a German surgeon, established a combined post-operative recovery and intensive care ward in the surgical unit at the University of Tubingen, Germany. The idea of a separate recovery room soon got adopted by many other operative units of different hospitals over a period of time (Hilberman, 1975, pp. 159–165; Vincent, 2013).

Despite the recognition of the need for special critical care, the emphasis remained on post-operative unstable patients and seriously injured patients in the first half of the 20th Century. Patients with serious consequences due to medical illnesses were not considered a priority for another few years. There was no provision or special care available at these specialized units. Moreover, these recovery units were not adequately equipped with specialized equipment, not even the primitive monitors that were available in the operating room at that time. So, these specialized units more or less remained just physically isolated areas where patients were accommodated. However, it was still advantageous in terms of economy and planning as most of the patient's care was rendered in large hospital wards. Thus, the progress of critical care medicine remained slow during the nineteenth century compared to other medical specialties (Vincent, 2013; Weil & Tang, 2011, pp. 1451–1453).

2 Impact of poliomyelitis epidemic

One of the most important periods during the evolution of critical care medicine is the poliomyelitis epidemic in the middle of the twentieth Century. A large number of poliomyelitis patients were admitted to a hospital with respiratory paralysis in the city of Copenhagen, Denmark. Tracheostomy was already a well-established practice much before the time of poliomyelitis intensified. However, patients were ventilated using Drinker-Shaw 'iron lung' and chest cuirasses, which were not available in large numbers. Patients were also developing respiratory failure due to accumulation of respiratory secretions (Kelly et al., 2014, pp. 376–379). Manual ventilation by medical students was also done when the number of patients admitted to the respiratory unit increased drastically. This necessitated the use of positive pressure ventilation outside of the operative unit in a desperate attempt to save dying patients. At the time, anesthesiologists were mainly responsible for artificial ventilation and were already trained in instrumenting the airway and maintaining ventilation. Professor Lassen, chief physician at the Blegdam Hospital, Copenhagen took a consultation from Dr. Bjorn Ibsen, an anesthetist and suggested that positive pressure ventilators used in modern anesthesia may help victims of respiratory paralysis. Dr. Bjorn Ibsen was the first to introduce the idea of positive pressure ventilation in 1953 during the Copenhagen Polio epidemic. Dr. Bjorn futher proposed the concept of specialized and dedicated units for ventilator dependent patients and recommeded that such patients should have their own nurses. He was instrumental in setting up the first intensive care unit (ICU) in Europe (Kelly et al., 2014, pp. 376–379; Vincent, 2013; West, 2005, pp. 424–32).

During this polio epidemic, adjusting the oxygen therapy in respiratory failure patients with the requirement of long-term ventilation became very crucial. This led to the invention of blood gas analysis by Astrup Siggard-Anderson and Severinghaus, which was of great help in managing patients with respiratory support (Kelly et al., 2014, pp. 376–379).

Around the same time, hospitals started grouping the patients requiring respiratory support in special units that were equipped with technical equipment to manage the airway and ventilate the patients. In those days, devices were mainly limited to monitoring and compensating for single organ systems in contrast to modern comprehensive hemodynamic monitoring and devices. A specially trained healthcare team was utilized to handle these devices and provide needed care to these patients (Kelly et al., 2014, pp. 376–379; Vincent, 2013).

3 Establishment of shock wards

During World War II, shock wards were built up for gravely injured soldiers to resuscitate them more effectively. There was also a scarcity of trained nurses. This led to grouping post-operative patients into a particular area, which helped hospitals in efficiently using the trained medical personnel and provide close monitoring and appropriate treatment to such patients. These post-operative units were mainly staffed with professionally trained nurses. The major emphasis was placed on monitoring vital signs, following a routine established by the surgeon, which was supported by anesthesiologists later on. Over the period, along with the improvement of technology, the invasiveness of surgical interventions increased, which led to increased duration of surgical operations and an increased need for specialized post-operative observation. This further intensified the need for specialized post-operative care and specialized health care providers (Barone et al., 2003, pp. 237–241; Kelly et al., 2014, pp. 371–379).

In 1958, Dr Max Harry Weil, who is regarded as the "Father of modern intensive care" and Dr Hebert Shubin, opened a four-bed shock ward at USC Medical Center, Los Angeles, USA, to improve the recognition and treatment of serious complications in critically ill patients. Dr. Weil also thought of coining the term 'critical care,' which was used to describe the expertise and equipment used to save gravely injured patients. He envisioned a multi-disciplinary team that would go beyond physicians and include specially qualified nurses and pharmacologists. That same year, Dr Peter Safar opened a multi-disciplinary ICU at Baltimore City Hospital. Dr. William Shoemaker, a surgeon at the University of California at Los Angeles, also significantly contributed to analysis of hemodynamic responses in trauma and critically ill patients. Over the next decade, critical care units began to be established in hospitals across Europe, the USA, and Australasia. In other countries, ICUs are a more recent development; for example, the first ICU in India was established in 1971 (Kelly et al., 2014, pp. 371–379; Vincent, 2013; Chernow, 2016).

4 Emergence of new technology in the field of medicine

In slow but steady progress, there was explosive growth in technology advancements, including increased knowledge of anesthesia, the development of the first successful dialysis machine, new resuscitative measures with intravenous (IV) fluids and blood products and introduction of the first external defibrillator. This progress in biotechnology proved beneficial for the critical care practice (Kelly et al., 2014; pp. 371–379). The development of positive pressure ventilators in the 1950s was one of the important milestones toward well-established critical care practice. Piston ventilators, developed by Morch, were followed by the Bennett and the Bird intermittent positive pressure valves and the Emerson "pressure cooker" ventilator. In the 1960s, the Engstrom was the first commercially available ventilator that could separately control inspiratory and expiratory pressures and flows. Several other specialty devices for the treatment of single-organ failures were developed. This especially included the treatment of renal failure with a dialysis machine which was introduced by the Dutch physiologist Kolff in 1943 (Weil & Tang, 2011, pp. 1451–1453).

Meanwhile, lessons learned from World War II and the Korean War solidified the concept of triage. Initially, the concept was restricted to military medicine, where it was used to deliver medical help systematically among wounded soldiers. During World War I, the approach remained to save treatable patients rather than gravely injured ones so that soldiers could be deployed back to the battlefield. In World War II, military physicians developed more detailed protocols to assess the wounded soldiers and utilize the scarce resources accordingly. By the late 1950s, these concepts had also been incorporated into the hospital system (Iserson & Moskop, 2007, pp. 275–281).

5 Introduction of the term "Critical Care medicine"

The term "Critical Care Medicine" was first introduced in the late 1950s at the University of Southern California (USC) from the concept that seriously ill and gravely injured patients may have significantly better chances of survival if provided with close observation and special care with advanced equipment by trained health professionals (Ristagno & Weil, 2009, pp. 3–4). Apart from conventional management, it was supported by "real-time" electronic monitoring of vital signs, hemodynamic and respiratory parameters, and complementary blood and body fluids measurements. In the 1960s, external cardiopulmonary resuscitation (CPR) was introduced, leading to decreased mortality. The availability of accessible monitoring of electrocardiogram (ECG), arterial and central venous pressure, pulmonary artery pressures, and arterial blood gases further improved the outcome of critically ill patients. Coronary care units were developed for patients with myocardial infarction and heart failure. In these units, patients were continually monitored for cardiac dysrhythmias. Nurses followed the particularly designed protocols to aggressively manage dysrhythmias (Criley et al., 1984, pp. 756–758; Kasaoka, 2017; Morrow et al., 2012, pp. 1408–1409; pp. Vincent, 2013).

5.1 Early hurdles in intensive care units

In the initial few years of establishing intensive care units, a major hurdle faced by healthcare team members was not being familiar with newly developed cardiac monitors, ventilators, and other equipment. They were also unfamiliar with newer invasive and noninvasive procedures as they lacked formal training in such areas. There were also difficulties in making rapid decisions while handling a group of seriously ill patients, which is crucial in a critical care setting. Therefore, in the beginning, healthcare team members, including physicians and nurses, helped each other to operate the new equipment, recognize cardiac dysrhythmias on electrocardiographs, and swiftly and efficiently carry out CPR (Calvin et al., 1997, pp. 363–367).

Early ICUs were reasonably separated, marginally mysterious, and somewhat alarming spots. Staff and visitors (when permitted) were frequently gowned with personal protective equipment, adding to the feeling of tension between the patient and their families. Patients were often sedated and calmed to encourage mechanical ventilation therapy. It was also believed that sedating patients would decrease their distress and agitation. Visiting hours were highly restricted to avoid any physiological disturbances in ICU patients, to limit the interference with care being provided, and also to reduce the potential contamination of the ICU working environment (Berwick & Kotagal, 2004, pp. 736–737; Romaine-Davis, 1999, pp. 350–351; Vincent, 2013).

5.2 Growth and advancements in critical care in the later half of the twentieth Century

From 1950 to 1970, we witnessed some crucial developments in critical care. As patient needs became more complex, medical knowledge and useful medical technologies started growing tremendously. Technological advancement necessitated additional government and private funding to support the ongoing developments. At the same time, society's values and demands for quality health care started intensifying, stimulating patient-oriented medical care and reorganizing specialized nursing care. Critical care units were an outgrowth of this reorganization. By the 1970s, the ICU was a standard unit in most hospitals worldwide. Since then, technical advances have continued rapidly, bringing improved monitoring capabilities and new strategies to manage life-threatening problems (Fairman & Lynaugh, 1998, pp. 22–41; Weatherall et al., 2006).

The multiple factors that have influenced the growth and development of critical care include technological, social and economic forces.

Technology: When intensive care was in its infancy, not many patients were expected to survive. With little knowledge of medical science and technology, there wasn't much help offered to critically ill patients admitted to the intensive care unit. However, the availability of modern technology and advancement in treatment options greatly impacted the critical care environment and its outcome.

Social: Earlier, ICUs were seen as places where seriously ill patients were kept to die. Slowly, expectations were raised for patient recovery as the ability to treat the earlier untreatable diseases started growing. The average age of patients recovering from ICU was increased. Most chronic debilitating diseases that had little hope earlier then became treatable with better patient outcomes.

Economic: Post World War II, there was a significant change in the overall healthcare system. The number of patients with insurance started increasing. Hospitals began to look for insurers and individual clients for revenue rather than charitable donations. Hospitals started advertising newer technologies and better services, attracting patients with high-quality accommodations. This change in financial perspectives led to the recognition of the values of a better and home-like atmosphere rather than impersonal larger wards (Fairman & Lynaugh, 1998, pp. 22–41).

5.3 Emergence of need for specialized manpower

In the initial years of the intensive care unit, patients were exclusively treated by their consultant physician depending on the type of illness and physiological system disturbance. Though the patients were grouped under the same roof, each patient was treated by a different doctor. Most physicians and surgeons of the 1960s and 1970s were understandably neither conversant nor comfortable with the formidable new Critical Care technology at the bedside nor with increasingly invasive intravascular devices (Weil & Tang, 2011, pp. 1451–1453). Meanwhile, an understanding of the physiological consequences of serious illnesses started developing, and it was found that irrespective of the origin of the illness, the seriously ill patients had similar health issues that needed close monitoring & intensive care. Physicians and surgeons, therefore, had little option but to surrender or at least share responsibility for diagnosing and managing the critically ill patients with a new cadre of physicians, surgeons, and anesthesiologists trained in this field. These specially qualified intensive care physicians were the early intensivists. These intensivists, specially trained nurses, respiratory therapists, etc. formed the critical care team, a well-established concept today. Over the years that followed, specialists in internal medicine and especially pulmonologists, surgeons (especially trauma surgeons), and anesthesiologists were attracted to and later certified in the subspecialty of critical care medicine (Pronovost et al., 2002, pp. 2151–2162; Romaine-Davis, 1999, pp. 350–351; Vincent, 2013).

Patient outcomes were significantly improved with the specially qualified health personnel. Recognizing the

importance of a qualified intensive care team, various training programs started developing to cater to the needs of the ICU. As a result of this, intensive care medicine became a specialty in its own right. As the concept of critical care expanded in medicine, even more seriously ill patients started seeking medical care. The quantity of critical care research also increased, which further added to the understanding of mechanisms of critical illness (Kelly et al., 2014, pp. 371–379; Pronovost et al., 2002).

5.4 Establishment of the society of critical care medicine

Many international organizations have been established to enhance the advancement of services offered in critical care medicine. One of the major organizations is the Society of Critical Care Medicine (SSCM). It is the largest non-profit medical organization in the practice of critical care and was established in 1970. It is an independently incorporated, international, educational, and scientific society based in the United States. SCCM is the only organization representing all critical care team's professional components (Weil & Tang, 2011, pp. 1451–1453).

6 Development of critical care in India

6.1 Slow progress in 19th Century

As in most other developing nations, critical care medicine as a specialty has developed very slowly and only recently in India. The main reasons behind the slow initial growth of the discipline of critical care medicine in India were twofold: the government initiatives were (and still are) directed towards making primary health care universally available and reducing the deaths due to communicable and preventable (using vaccination programs) diseases. The other reason was a lack of awareness about this discipline in society in general and even in the medical fraternity (Kulkarni et al., 2020, pp. 188–96; Prayag, 2002, pp. 479–80).

6.2 Establishment of coronary care units

India is a diverse country with different levels of health care: primary, secondary, and tertiary. The coronary care units were developed in the early to mid-1970s. It has been over 50 years since the first multi-disciplinary critical care unit opened in a private hospital (1971) and, much later, in a public hospital (1985) in India. The first coronary care unit in India was started in 1968 at the King Edward VII Memorial Hospital, Mumbai, one of the prestigious teaching hospitals. This unit was followed by the establishment of intensive care units at other hospitals in Mumbai and later in other large cities of India (Udwadia et al., 1997, pp. 317–330).

6.3 Focus on cardiac and respiratory care

Critical care units in the early 1970s, though centralized, were designed and equipped chiefly to offer intensive care to patients with acute myocardial infarction and other manifestations of ischemic heart disease. The concept of critical care was still developing and was limited to respiratory and cardiac care. Thus, the number of critical care units caring for life-threatening illnesses other than coronary heart disease grew slower. Ventilator support was very basic and was generally offered to only patients who were terminally ill. Adequate monitoring facilities and devices were not yet available and were only limited to some special rooms created in the general ward of the hospital (Kulkarni et al., 2020, pp. 188–96; Prayag, 2002, pp. 479–80; Udwadia et al., 1997, pp. 317–30).

6.4 Establishment of the Indian Society of critical care medicine

The growth of Critical Care Medicine as a super specialty in India has its route linked with the growth of the Indian Society of Critical Care Medicine. In the mid-1980s, there was a significant improvement in the standard of care, particularly evident in the larger teaching and private hospitals in the cities of India. The specialty of critical care grew slowly to begin with and was sustained mainly due to sheer, individual brilliance in the beginning, but grew at an exponential rate once the Indian Society of Critical Care Medicine (ISCCM) was formed by a group of physicians from various cities of India in 1993. The establishment of ISCCM boosted various academic and scientific activities, awareness of critical care, and development of continuing education and research work. Apart from successfully running various academic programs in critical care medicine, ISCCM has made significant contributions in publishing scientific papers and monographs through journal publications in critical care (Prayag, 2002, pp. 479–80).

The number of organized critical care training programs was increasing in the country; however, it did not materialize the learning into practice, and it was left to individual interested trainees to attend such training programs. During this time, many of the consultants went abroad especially the United Kingdom and Australia, to get advanced training in this upcoming field. After returning, they started their practices with an isolated focus. The initial centers of such activity were Mumbai, Pune, and Chennai, and they remained the centers of academic creativity and administrative ability till date. (Prayag, 2002, pp. 479–480; Udwadia et al., 1997, pp. 317–330).

6.5 The current practice of critical care in India

It is a matter of as much diversity as the country itself. Three types of hospitals in India deliver patient care. The government mostly runs community hospitals, resulting in no cost to the patients. These hospitals mainly focus on primary and essential medical care. Critical care medicine requires the availability of many advanced technologies and specially trained manpower to utilize them. These hospitals almost always suffer from poor funding and inadequacy of trained healthcare workers. Thus, the progress of critical care services was comparatively slower in theses hospitals than in private hospitals. There are currently more than 300 medical colleges with hospitals attached to them in public sector. Additionally, there are more than 1000 district hospitals. Only a tiny proportion (< 10%) of all these hospitals, however, will boast appropriately equipped or staffed intensive care units (ICUs). These hospitals thus contribute only a tiny proportion of the available ICU facilities. Societies, trusts, or companies usually manages private tertiary care hospitals. Patients are levied a charge for these services that is proportional to their income; a small percentage of beds are provided for free. As per the current estimation, 85% of patients are self-paying. ICUs in private tertiary care hospitals are usually very well equipped and thus form the major contributor to the critical care facilities in the country, albeit at a higher cost to the patient. Finally, a segment of healthcare facilities in India consists of small hospitals or nursing homes. Modestly equipped and managed chiefly by medical professionals, these are realities representing the vast middle and lower classes, and they contribute about 40% of available beds for the country. The patients also usually pay for the services here. The need and the viability of facilities for critical care are being acknowledged by this segment, and currently, the facilities are on the upswing (Yeolekar & Mehta, 2008, pp. 221–222). Manpower development of the specialist has always been a crucial component of critical care medicine. As previously mentioned, most of the current ICU directors use to get training abroad. The certificate course in critical care, the first organized training activity in critical care medicine, was started a few years ago by the ISCCM and has been evolving well. Several hospitals have developed training modules, and more students are coming out of this training program regularly. As a result, the Post Doctoral Fellowship in Critical Care Medicine conducted by the National Board of Examinations has recently been announced. With this, the first steps for training in critical care on a national-level curriculum are now being taken. Training nurses, technicians, and therapists has begun in some isolated foci but has not evolved into a meaningful training activity (Divatia, 2013, pp. 169–173).

The care in Indian ICUs has evolved from cardiac care to multi-system diseases. Critical care in India is thus at the crossroads of development. Currently, the work of critical care practitioners from India is being recognized at the international level. India has been a representative in the Council of the World Federation of Societies for Intensive and Critical Care Medicine (WFSICCM) since 2001. Indian consultant has also been represented as Asia Pacific representative on the council of the European Society of Intensive Care Medicine (ESICM) (Prayag, 2014).

7 Critical care units in 21st Century

Newer technologies started emerging at a faster pace. The present ICU is unrecognizable from that of 60 years back as far as innovations are concerned. Mechanical ventilators have become more sophisticated, versatile, and easier to handle. The advancement of radiological imaging, including ultrasound units, CT scans, MRI scans, etc., has reduced the need for invasive procedures required in the diagnosis of critical illness. The focus of critical care management has now shifted to less invasive, less interventional, and more patient-friendly (Breslow et al., 2004, pp. 31–38; Vincent, 2013). In contrast to the restricted visitor policy in earlier times, now most of the ICU follows an unrestricted or slightly restricted visiting policy as the role of the family in patient recovery is recognized, and their presence during hospitalization has proven beneficial. Today, the ICU has a better patient and family-friendly environment and provides a more welcoming atmosphere for patients and their families than in the past (Carson et al., 1996, pp. 322–328). Newer ICUs have also incorporated improved patient communication techniques as they were key to building therapeutic relationships. Communication with the patients and their loved ones regarding the progress of the patient's health and anticipation of outcomes have become vital components in building therapeutic relationships between the patient and the health team. The importance of the involvement of the patient and their family in patient daily care, decision-making, and end-of-life issues is well recognized in the current scenario (Carson et al., 1996, pp. 322–328; Vincent, 2013). Patient management improved as there was emergence of a multi-disciplinary approach**.** It was developed over the period of time as critical care became more sophisticated and complex. The increasing involvement of a variety of health care experts e.g., nutritionists, physiotherapists, and pharmacists, became routine practice in critical care units over a while (Ghorra et al., 1999, pp. 163–171; Kahn, 2007; Vincent, 2013).

The use of evidence-based practices have a significant role in the development of modern medicine. Many well-designed and randomized controlled trials helped to improve the standard & safety of critical care medicine and also helped to discard the practices which proved detrimental

to patient's health. Many such researches proved that some well-established practices were more harmful than beneficial, and they caused significant morbidity in critically ill patients e.g., the use of high tidal volumes, routine insertion of pulmonary artery catheters, excessive sedation, etc. (Chitty & Black, 2007).

Critical care beyond the walls of the ICU is a relatively newer concept aimed at improving patient outcomes. In many critical care settings, the concept of ICU has been expanded beyond the fixed wall of ICU by bringing ICU care to patients wherever they might be. As a part of this expansion, the concept of Rapid Response Teams was established to attend, assess, and provide treatment for deteriorating patients who are yet to reach ICU. The provision of such services improved the survival rate of the critically ill and expanded the scope of critical care. This experience assisted in the evolution of emergency services on the home front. Trained emergency personnel could assist in getting seriously ill and injured patients into the health care system sooner. The development of electronic or virtual ICUs is helpful for ICU teams to monitor patients from remote locations (Halpern & Pastores, 2010, pp. 65–71; Hillman, 2002, pp. 594–599; Vincent, 2013).

The term 'Precision Medicine' has gained popularity in recent years as the world is witnessing tremendous growth in biomedical discoveries. The term precision medicine implies that there will be the incorporation of a wide array of individual data, including clinical, lifestyle, genetic, and further biomarker information, to deliver more accurate, safer, and personalized health care (König et al., 2017). The National Research Council's 'Toward Precision Medicine' proposed the definition of precision medicine as "The tailoring of medical treatment to the individual characteristics of each patient...to classify individuals into subpopulations that differ in their susceptibility to a particular disease or their response to a specific treatment". This also includes the concepts of directing preventative or therapeutic interventions for those who will benefit and sparing expense and side effects for those who will not (National Research Council (US) Committee, 2011). With precision medicine, a person will be characterized by increasing precision from the molecular level to the genomic level, including the body's interactions with nutrients, medications, microbes, therapeutic devices, and environments. However, precision medicine requires a large-scale collection of biological, radiological, and translational bioinformatics datasets to achieve this aim. With a collection of huge sets of multidimensional data, there is an increasing need for more complex and standardized methods of data analysis and emerging computational techniques for interdisciplinary translations. With the use of novel statistical methods, larger data can produce the discovery of useful, reproducible health and disease patterns and their interrelationships. As critically ill patients are more complex, clinicians should focus more on patients' cellular and molecular responses rather than grouping them based on their clinical presentations. This clinical practice approach is known as 'treating the individual and not the disease'. Precision medicine will play a significant role in determining the healthcare decisions to provide the most effective and personalized treatment in the coming future (Ginsburg & Phillips, 2018, pp 694–701; König et al., 2017).

8 Conclusion

Critical care medicine is one of the fastest-growing medical fields in terms of patient numbers and represents an increasingly important part of healthcare systems in the developed world. Critical care medicine is also slowly beginning to have a presence in developing countries, and one of the current challenges is to ensure adequate funding, training, and equipment for these newer contributers of the critical care arena. The need for critical care beds continues to increase as there is a constant increase in demand for critical care worldwide. As a result of this, the ratio of ICU beds to hospital beds will continue to rise as the ICU occupies an ever-larger role at the center of acute care hospitals. We have come a long way but still have some distance to cover as we strive to ensure that critical care medicine provides effective, efficient, evidence-based care to all who need it. Hence, the third and current era of Critical Care Medicine evolved from the Intensive Care in the Nightingale era. Critical care medicine has evolved over the years in terms of structure, process, and outcomes. Intensive Therapy was largely a 20th-century development in the United States and Western Europe and later in the rest of the world. Fewer and less-invasive interventions, more humane care, earlier diagnosis and treatment, expansion of the service beyond the physical walls of the ICU, and better national and international collaborations with experts across the globe are just some of the many changes that this field has witnessed since the first ICUs were developed some 60 years ago.

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