Med Intensiva. 2014;38(7):438–443

medicina intensiva

www.elsevier.es/medintensiva

POINT OF VIEW

Intensive Care Unit without walls: Seeking patient safety by improving the efficiency of the system

F. Gordo[a,b,*], A. Abella[a]

[a] Intensive Care Medicine, Hospital Universitario del Henares, Coslada, Madrid, Spain
[b] Francisco de Vitoria University, Madrid, Spain

KEYWORDS
Intensive Care Unit;
Intensive Care Medicine;
Technology;
Rapid response teams;
Health service administration;
Hospital mortality;
Patient safety;
Early warning score;
Monitoring;
Vital signs

Abstract The term ''ICU without walls'' refers to innovative management in Intensive Care, based on two key elements: (1) collaboration of all medical and nursing staff involved in patient care during hospitalization and (2) technological support for severity early detection protocols by identifying patients at risk of deterioration throughout the hospital, based on the assessment of vital signs and/or laboratory test values, with the clear aim of improving critical patient safety in the hospitalization process.

At present, it can be affirmed that there is important work to be done in the detection of severity and early intervention in patients at risk of organ dysfunction. Such work must be adapted to the circumstances of each center and should include training in the detection of severity, multidisciplinary work in the complete patient clinical process, and the use of technological systems allowing intervention on the basis of monitored laboratory and physiological parameters, with effective and efficient use of the information generated. Not only must information be generated, but also efficient management of such information must also be achieved.

It is necessary to improve our activity through innovation in management procedures that facilitate the work of the intensivist, in collaboration with other specialists, throughout the hospital environment. Innovation is furthermore required in the efficient management of the information generated in hospitals, through intelligent and directed usage of the new available technology.

PALABRAS CLAVE
Unidad de cuidados intensivos;
Medicina intensiva;
Tecnología;
Equipos de respuesta rápida;
Administración de servicios sanitarios;

Unidad de cuidados intensivos sin paredes: buscando la seguridad del paciente mediante la mejora de la eficiencia del sistema

Resumen El término «UCI sin paredes» se refiere a una innovadora estrategia de tratamiento en cuidados intensivos que se basa en 2 elementos fundamentales: (1) colaboración de todo el personal médico y de enfermería implicado en la atención del paciente durante la hospitalización, y (2) apoyo tecnológico para protocolos de detección temprana de la gravedad identificando a los pacientes en situación de riesgo de deterioro en el hospital a partir de la evaluación de las constantes vitales y/o los resultados de las pruebas analíticas, con el claro objetivo de mejorar la seguridad de los pacientes críticos durante el proceso de hospitalización.

* Corresponding author.
E-mail address: fgordo5@gmail.com (F. Gordo).

0210-5691/$ - see front matter
http://dx.doi.org/10.1016/j.medin.2014.02.001

Mortalidad hospitalaria;
Seguridad de los pacientes;
Puntuación de alerta temprana;
Monitorización;
Constantes vitales

En la actualidad puede decirse que todavía queda un importante trabajo por hacer en cuanto a la detección de la gravedad y la detección precoz en pacientes en situación de riesgo de disfunción orgánica. Este trabajo deberá adaptarse a las circunstancias de cada centro e incluir formación para la detección de la gravedad, el trabajo multidisciplinario en el conjunto del proceso clínico del paciente y el uso de sistemas tecnológicos que permitan la intervención a partir de la monitorización de parámetros fisiológicos y analíticos, con un uso eficiente y eficaz de la información generada. No solo debe generarse información sino que también es necesario que esta se gestione de manera eficaz.

Es necesario mejorar nuestra actividad mediante la innovación en los procedimientos de gestión que facilitan la labor del intensivista, en colaboración con otros especialistas, en el entorno hospitalario. Además, se requiere innovación para gestionar de forma eficiente la información generada en los hospitales a partir del uso inteligente y eficiente de las nuevas tecnologías disponibles.

The term ''Intensive Care Unit (ICU) without walls'' refers to innovative management of Intensive Care, based on two key elements: (1) collaboration of all medical and nursing staff involved in patient care during hospitalization and (2) technological support for severity early detection protocols by identifying patients at risk of deterioration in conventional hospitalization wards. This concept emerges from the conviction that we should try to improve patient safety throughout the hospitalization process (from hospital admission to discharge – not only while the patient is admitted to the ICU), striving to improve the efficiency of the system through rational use of the available resources. The crucial point is collaboration among the different hospital Departments involved in critical and potentially critical patient care (i.e., Intensive Care Medicine, Clinical Departments and Surgical Departments), and the nursing units involved in the management of patients in conventional hospitalization wards.[1]

Problem: why has the model of ICU without walls emerged?

The objective of Intensive Care Medicine, as defined by the international societies of Intensive Care Medicine in the Santander 2012 statement,[2] is to provide critically ill patients with medical care tailored to their needs, of high quality and as safe as possible. Intensive Care Medicine is one of the main elements in modern healthcare systems – Intensive Care Units (ICUs) being in increasing demand, and with an important healthcare cost impact. It is believed that in the United States more than half of the population will be admitted to an ICU at some point in life, and that a significant percentage will die in these Units, consuming between 0.5% and 1% of the country's Gross Domestic Product.[3,4] More than 5 million patients are admitted annually to ICUs in the United States. The 5 primary ICU admission diagnoses are, in decreasing order: respiratory insufficiency/failure, postoperative management, ischemic heart disorders, sepsis, and heart failure. However, the availability of ICU beds varies greatly across different countries and healthcare systems.[5]

The management of some critical processes entails major economic and sanitary resource consumption. As an example, in our country (Spain), the annual incidence of severe sepsis is 14.1 cases/10,000 inhabitants, with an overall mortality rate of 33% and a mean hospital stay of 28.9 days. The annual cost of such management (Community of Madrid, Spain) is 70 million €, which represents a significant impact in terms of healthcare resource consumption.[6] In 2005, critical care services in the United States were estimated to cost $81.7 billion, or 0.66% of the gross domestic product.[3,4]

ICU patients are in a critical condition, i.e., with potentially life-threatening organ dysfunctions or disorders. They require continuous monitoring and often need organ functional support measures. Although these patients conform a heterogeneous population, all of them share the need for a higher level of acute care than most hospitalized subjects. Frequently, patients in the ICU require cardiovascular or ventilatory support, invasive monitoring and intensive observation by nursing and medical staff members, with a greater reliance upon technology to keep critically ill patients alive (e.g., mechanical ventilation, hemodialysis, plasmapheresis, extracorporeal membrane oxygenation, etc.). Despite the widespread belief that the mortality rate is inherently high in our specialty, the percentage of patients who survive to discharge from the ICU is 90% in overall terms.[7]

Scarcity of available ICU beds sometimes leads to rejection of ICU admission[8] or to delays in admission to these Units, and that early discharge in turn can lead to a later need for patient re-admission.[9] Both circumstances are clearly correlated to an increased patient risk and a poorer prognosis (increased length of stay and mortality in both the ICU and in Hospital), and imply greater associated costs arising from the need to use more complex support techniques, an increased need for vital support, and a longer length of stay in the ICU and in Hospital.[3,10,11] As an example, Cardoso et al.[11] have reported that each hour of delay in admission of a patient to the ICU is associated with a 1.5% increase in the risk of death in the ICU and a 1% increase in Hospital mortality. Likewise, Sakr et al.[12] have found mortality among critically ill patients to be clearly related to the initial evolution of organ failure and the SOFA score at the time of admission to the ICU. If readmission to the ICU proves necessary, there is a four-fold increase in mortality risk, and the length of Hospital stay is moreover doubled.[13,14] Furthermore, information is still lacking on the influence of the

availability of beds in the ICU upon the decisions referred to patient triage and upon the outcome of patients in which admission has been rejected.[15]

Not all potentially acute patients are admitted to the ICU; indeed, we can find patients in conventional hospitalization units with diagnoses such as severe sepsis, septic shock, acute organ dysfunctions, and even supposedly specific conditions such as acute respiratory distress syndrome (ARDS).[16,17] In addition, we must have a forecast of available ICU beds for high-risk surgical patients who benefit from scheduled admission, since it may result in an improved prognosis.[18] More than 50% of all hospitalized patients do not receive optimal treatment before admission to the ICU, and a large percentage of admissions are moreover avoidable.[19] Chen et al. have recently reported that 70% of the patients with a predicted mortality rate of over 30% were not admitted to the ICU and received treatment in conventional hospitalization wards.[20]

In this situation, intensivists, in collaboration with other hospital specialists, must continue working to improve performance: the aim is to be more EFFECTIVE by decreasing morbidity and mortality among our patients; to be more EFFICIENT by reducing the length of stay in the ICU and in Hospital, reducing drug expenditure and the use of consumables (curbing the costs associated with healthcare and improving its health performance); and to improve PERCEIVED QUALITY on the part of the patients, their family, and the healthcare team.[21,22]

The early clinical care of patients at risk admitted to conventional hospital wards could favorably influence the clinical course and disease prognosis. In effect, if the clinical condition is serious enough, admission to the ICU must be advanced, avoiding unnecessary delays in treatment. Even more importantly, however, if the patient clinical condition allows diagnostic reorientation or intensified therapeutic measures, clinical improvement might be achieved, thereby avoiding the need for admission to the ICU, and also allowing better management of the available healthcare resources (ICU beds).[1]

In recent years, the concept of early detection has become so ingrained that the European Resuscitation Council recommendations on the management of cardiac arrest presently include as first link in the ''survival chain'' the introduction of measures aimed at preventing cardiac arrest, by detecting previously occurring pathophysiological alterations. This is a necessary measure, for despite structured organization and quality in management of cardiac arrest, the results obtained are disappointing, with a survival rate to Hospital discharge of about 17% according to the American Heart Association (AHA). In the case of an initial shockable rhythm, this figure increases to 37%, but drops to only 11% in the case of asystolia or pulseless electrical activity.[23,24] It has been demonstrated that during the hours before a serious patient event occurs (aggravation or even cardiac arrest), detectable physiological changes have already developed. These altered parameters are common to initial disease in general, since they reflect organ failure, such as heart rate, blood pressure, respiratory frequency, oxygenation, urine output, or level of consciousness.[25–29] In other words, most cases of in-hospital cardiac arrest are not a sudden or unpredictable event.

Solution: early detection of severity

Working methods are thus required to allow the early detection of acute and potentially acute patients in any location within the hospital, with intervention in the early stages of the disease before damage becomes established. Such measures may comprise direct admission to the ICU, or diagnostic and/or therapeutic intervention in the ward where the patient is located, with protocolized close follow-up. Moreover, it is clear that the best results are obtained from collaboration among professionals. It is therefore essential to work with the Ward physician. In this way the medical care provided by intensivists has gradually crossed the physical boundaries of the ICU.

The implementation of this workflow benefits from the continuous training of the healthcare staff involved: intensive care and hospital physicians and nurses. The aim is to strengthen the concept of early detection, and to train in the detection of warning signs and in the initially required actions.[26,30] Nurses play a key role, since they spend more time in contact with the patient, and are responsible for taking vital signs.

Different solutions have been proposed to detect patients at risk:

1. On request systems: such systems involve the definition of alarm or severity criteria that trigger warning to the intensivist. These criteria are usually a combination of clinical and laboratory values, such as blood pressure, heart rhythm alterations, hypoxia or respiratory frequency alterations, decreased level of consciousness, or lowered diuresis.

   Initially, each hospital designed its own alarm systems, based mainly on Australian multiparametric designs, and on the English model using combined and weighted systems that generate a graded response rate according to the score achieved.[31,32] Up to 25 alarm criteria have been described. This wide range reflects a lack of full confidence in their usefulness, and moreover does not allow comparison among studies. In fact, the success of the Medical Emergency Teams lies in correctly identifying patients at risk and in the level of monitoring of the healthcare staff involved. The criteria therefore must have sufficient sensitivity, must be simple to obtain, and should not increase the workload. In addition, continuous training of healthcare staff is easier when these criteria are stable and concise. In the year 2010, an alarm system known as ViEWS[33] was published. It includes 7 clinical variables with different scores according to their degree of alteration. The sum of all items can be used to scale the type of response to be given in each situation. In 2012, this system was externally validated in a Canadian study[34] as an early predictor of hospital mortality. That same year a modified ViEWS system was described, including lactate levels, and affording an improved positive predictive value referred to hospital mortality.[35]
2. On request systems designed for specific diseases: The evolution of different diseases such as stroke, acute coronary syndrome, polytraumatism or sepsis, among others, has proved to be dependent on how quickly treatment is started. In this sense, there are specific alarm systems

that combine clinical and laboratory data, and provide a decision tree for the initial procedures and the need to notify the ICU.[36–39] The most recent case is represented by the septic patient care programs, designed and disseminated in many hospitals following the worldwide initiative of the Surviving Sepsis Campaign. A number of publications in our setting have shown these initiatives to afford greater adherence to clinical practices guidelines, with benefit for this group of patients, a shortened hospital stay, and even lesser mortality.[40–42]

3. Prospective detection of patients at risk: This comprises a different approach, with the assessment of patients who, for various reasons, are considered to be at risk of severe worsening. The following criteria can be established:
   - Discharge from the ICU in certain situations, including after a long ICU stay, evolving organ failure, surgical patients with concomitant severe medical conditions, etc.
   - Patients admitted to hospital wards and considered to be ''at risk'' because of their acute condition, such as those admitted to Emergencies or Emergency Observation Areas.

The issue to be resolved in these patients subjected to prospective evaluation after due screening (according to physical location in the hospital) is precisely the impossibility of covering all inpatients, which should be the ultimate goal. In this context, and thanks to the digitalization of medical records, it is now possible to use electronic systems to detect pre-defined parameters, such as laboratory data, microbiological information, vital signs or nursing notes, with a view to identifying candidate patients.

The program can be complemented with the use of remote vital signs monitoring. This would be useful to intensify the treatment and follow-up of patients who are not in a critical situation requiring admission to the ICU.[43] Furthermore, collaboration with other specialists must be included, so that a daily bidirectional patient ''session'' is established to allow the ''hospital'' physician (with an internist and/or surgeon as the leading example) to conduct joint assessment of patients which because of their disease, evolution or clinical history, are of particular concern to the attending physician.

The literature already offers the results of over 10 years of experience with strategies aimed at early detection and intervention in critically ill patients. These strategies are called rapid response systems (RRSs), Medical Emergency Teams (METs) or Critical Care Outreach (CCO) systems, usually led by an intensivist. Such teams aim to improve patient outcomes through recognition and intervention before serious deterioration occurs implying cardiac arrest or urgent admission to the ICU. These teams must be trained to assess, diagnose, initiate treatment and decide ICU admission if necessary; the intensivist therefore offers the appropriate professional profile in this sense.[26,44–46]

The recent systematic review published by Winters et al.[47] shows that many hospitals have implemented rapid response systems over the past 15 years to improve recognition of and response to deteriorating patients in the general hospital ward. Moderate-strength evidence suggests that RRSs are associated with reduced rates of cardiorespiratory arrest and mortality. Important components of successful RRSs include criteria and a system for response team notification and activation; a response team; and an administrative and quality improvement component to train staff, collect and analyze event data, provide feedback, coordinate resources, and ensure improvement or maintenance over time. Implementation issues are critical in RRSs, because rates of use are often suboptimal because of various barriers that could be improved.

Previous recommendations and clinical guidelines have always stressed the importance for all hospitals to develop a plan based on their needs, resources and organization. The fundamental aspects are multidisciplinary collaboration, staff training in the recognition and correct interpretation of the severity signs, the leadership of an intensivist, and involvement of the hospital executive bodies.

Our solution: the ICU without walls project[1,48]

Given this background, in our center we decided to develop an Intensive Care Medicine management system fundamented upon critically ill patient safety throughout the hospitalization process. It establishes a strategic focus on ''early detection of the critically ill patient outside the ICU'', which refers to the identification of patients at risk outside the Unit, and is based on the recognition, diagnostic orientation and early treatment of acute patients, in collaboration with other clinical specialties, and regardless of their location within the Hospital.

Model implementation

Implementation of the model has been carried out on a sequential basis, and an analysis of the results of each of the steps has been made. The process began in 2008 with the following steps:

1. Implementation of urgent care codes for diseases whose treatment is time-dependent:
   - Sepsis Code
   - Acute Coronary Syndrome Code
   - CPR Code
2. Detection of patients at risk in the Emergency Department.
3. Follow-up of patients discharged from the ICU with a poor prognosis risk in the hospitalization ward.
4. Development of a computer-based laboratory data identification system.
5. Expansion of the activity throughout the Hospital, in collaboration with other clinical and surgical specialties.
6. At present, the ICU without walls project is fully operational and is supported by clinical results. It has recently incorporated the possibility of wireless (WiFi) monitoring, in order to improve the control of vital signs in conventional hospitalization wards by means of the Guardian® system (Philips).

We have created an electronic alarm system, defining the analytical indicators of severity, determined to detect patients at risk with diseases in which early intervention could improve the prognosis and reduce the occurrence of

complications and therefore the associated health costs. The system downloads all laboratory data available in the hospital environment or in the Emergency Department during the previous 24 h, and software is used to identify all laboratory test results in which any concrete indicator exceeds any of the predefined thresholds – creating a file with the altered parameter, the extraction time and its value, and the patient identification and location, thereby enabling early detection of these patients.

Conclusions

At this time it can be affirmed that there is still important work to be done in the detection of severity and early intervention in patients at risk of organ dysfunction. This work must be adapted to the circumstances of each center and must include training in the detection of severity, multidisciplinary work in the global patient clinical process, and the use of technological systems for intervention referred to laboratory parameters and the monitoring of physiological parameters – with effective and efficient use of the information generated. Not only information must be generated, but also efficient management systems for this information must be sought.

Conflict of interest

The authors declare no conflicts of interest.

References

1. Calvo Herranz E, Mozo Martin MT, Gordo Vidal F. Introduction of a management system in intensive care medicine based on the safety of the seriously ill patient during the entire hospitalization process: extended intensive care medicine. Med Intensiva. 2011;35:354–60.
2. World Federation of Societies of Intensive and Critical Care Medicine; Federación Panamericana e Ibérica de Sociedades de Medicina Crítica y Terapia Intensiva; European Society of Intensive Care Medicine; Sociedad Española de Medicina Intensiva, Crítica y Unidades Coronarias; Société de Réanimation de langue Française. Santander Statement: Intensive Care Medicine. Patient-centered care for the critically ill; 2012 http://www.semicyuc.org/sites/default/files/santanderstatement_english.pdf [accessed 09.05.13].
3. Pastores SM, Dakwar J, Halpern NA. Costs of critical care medicine. Crit Care Clin. 2012;28:1–10, v.
4. Halpern NA, Pastores SM. Critical care medicine in the United States 2000–2005: an analysis of bed numbers, occupancy rates, payer mix, and costs. Crit Care Med. 2010;38:65–71.
5. Murthy S, Wunsch H. Clinical review: international comparisons in critical care – lessons learned. Crit Care. 2012;16:218.
6. Inigo J, Sendra JM, Diaz R, Bouza C, Sarria-Santamera A. Epidemiology and costs of severe sepsis in Madrid. A hospital discharge study. Med Intensiva. 2006;30:197–203.
7. Steering Committee of the Sociedad Española de Medicina Intensiva, Crítica y Unidades Coronarias (SEMICYUC)1. Intensive medicine in Spain. Med Intensiva. 2011;35:92–101.
8. Robert R, Reignier J, Tournoux-Facon C, Boulain T, Lesieur O, Gissot V, et al. Refusal of intensive care unit admission due to a full unit: impact on mortality. Am J Respir Crit Care Med. 2012;185:1081–7.
9. Pilcher DV, Duke GJ, George C, Bailey MJ, Hart G. After-hours discharge from intensive care increases the risk of readmission and death. Anaesth Intensive Care. 2007;35:477–85.
10. Wunsch H, Gershengorn H, Scales DC. Economics of ICU organization and management. Crit Care Clin. 2012;28:25–37, v.
11. Cardoso LT, Grion CM, Matsuo T, Anami EH, Kauss IA, Seko L, et al. Impact of delayed admission to intensive care units on mortality of critically ill patients: a cohort study. Crit Care. 2011;15:R28.
12. Sakr Y, Lobo SM, Moreno RP, Gerlach H, Ranieri VM, Michalopoulos A, et al. Patterns and early evolution of organ failure in the intensive care unit and their relation to outcome. Crit Care. 2012;16:R222.
13. Kramer AA, Higgins TL, Zimmerman JE. The association between ICU readmission rate and patient outcomes. Crit Care Med. 2013;41:24–33.
14. Kramer AA, Higgins TL, Zimmerman JE. Intensive care unit readmissions in U.S. hospitals: patient characteristics, risk factors, and outcomes. Crit Care Med. 2012;40:3–10.
15. Colmenero M. The ritual of the lack of beds. Med Intensiva. 2011;35:139–42.
16. Esteban A, Frutos-Vivar F, Ferguson ND, Penuelas O, Lorente JA, Gordo F, et al. Sepsis incidence and outcome: contrasting the intensive care unit with the hospital ward. Crit Care Med. 2007;35:1284–9.
17. Ferguson ND, Frutos-Vivar F, Esteban A, Gordo F, Honrubia T, Penuelas O, et al. Clinical risk conditions for acute lung injury in the intensive care unit and hospital ward: a prospective observational study. Crit Care. 2007;11:R96.
18. Rhodes A, Cecconi M. Can surgical outcomes be prevented by postoperative admission to critical care? Crit Care. 2013;17:110.
19. McQuillan P, Pilkington S, Allan A, Taylor B, Short A, Morgan G, et al. Confidential inquiry into quality of care before admission to intensive care. BMJ. 1998;316:1853–8.
20. Chen LM, Render M, Sales A, Kennedy EH, Wiitala W, Hofer TP. Intensive care unit admitting patterns in the Veterans Affairs health care system. Arch Intern Med. 2012;172:1220–6.
21. Martin Delgado MC, Gordo-Vidal F. The quality and safety of intensive care medicine in Spain. More than just words. Med Intensiva. 2011;35:201–5.
22. Moreno RP, Rhodes A, Donchin Y, European Society of Intensive Care. Patient safety in intensive care medicine: the Declaration of Vienna. Intensive Care Med. 2009;35:1667–72.
23. Nolan JP, Ornato JP, Parr MJ, Perkins GD, Soar J. Resuscitation highlights in 2012. Resuscitation. 2013;84:129–36.
24. Nolan JP, Soar J, Zideman DA, Biarent D, Bossaert LL, Deakin C, et al. European resuscitation council guidelines for resuscitation 2010 section 1. Executive summary. Resuscitation. 2010;81:1219–76.
25. Hillman KM, Bristow PJ, Chey T, Daffurn K, Jacques T, Norman SL, et al. Antecedents to hospital deaths. Intern Med J. 2001;31:343–8.
26. DeVita MA, Bellomo R, Hillman K, Kellum J, Rotondi A, Teres D, et al. Findings of the first consensus conference on medical emergency teams. Crit Care Med. 2006;34:2463–78.
27. Buist MD, Bernard S, Anderson J. Epidemiology and prevention of unexpected in-hospital deaths. Surgeon. 2003;1:265–8.
28. Franklin C, Mathew J. Developing strategies to prevent in-hospital cardiac arrest: analyzing responses of physicians and nurses in the hours before the event. Crit Care Med. 1994;22:244–7.
29. Goldhill DR, White SA, Sumner A. Physiologic values and procedures in the 24 h before ICU admission from the ward. Anesthesia. 1999;54:529–34.
30. Grenvik A, Schaefer JJ, DeVita MA, Rogers P. New aspects on critical care medicine training. Curr Opin Crit Care. 2004;10:233–7.

31. Gao H, Harrison DA, Parry GJ, Daly K, Subbe CP, Rowan K. The impact of the introduction of critical care outreach services in England: a multicentre interrupted time-series analysis. Crit Care. 2007;11:R113.
32. Gao H, McDonnell A, Harrison DA, Moore T, Adam S, Daly K, et al. Systematic review and evaluation of physiological track and trigger warning systems for identifying at-risk patients on the ward. Intensive Care Med. 2007;33:667–79.
33. Prytherch DR, Smith GB, Schmidt PE, Featherstone PI. ViEWS – towards a national early warning score for detecting adult inpatient deterioration. Resuscitation. 2010;81:932–7.
34. Kellett J, Kim A. Validation of an abbreviated Vitalpac Early Warning Score (ViEWS) in 75,419 consecutive admissions to a Canadian regional hospital. Resuscitation. 2012;83:297–302.
35. Jo S, Lee JB, Jin YH, Jeong TO, Yoon JC, Jun YK, et al. Modified early warning score with rapid lactate level in critically ill medical patients: the ViEWS-L score. Emerg Med J. 2013;30:123–9.
36. Van der Werf F, Bax J, Betriu A. por el Grupo de Trabajo de la Sociedad europea de Cardiología (SEC) sobre el manejo del infarto agudo de miocardio con elevación del segmento ST (IAM-CEST). Guías de Práctica clínica de la sociedad Europea de Cardiología (ESC). Manejo del infarto agudo de miocardio en pacientes con elevación persistente del segmento ST. Rev Esp Cardiol. 2009;62:e1–47.
37. Tisherman SA, Barie P, Bokhari F, Bonadies J, Daley B, Diebel L, et al. Clinical practice guideline: endpoints of resuscitation in trauma patients. 2003 Eastern Association for the surgery of trauma (EAST). J Trauma. 2004;57:898–912.
38. Jauch EC, Saver JL, Adams Jr HP, Bruno A, Connors JJ, Demaerschalk BM, et al. Guidelines for the early management of patients with acute ischemic stroke: a guideline for healthcare professionals from the American Heart Association/American Stroke Association. Stroke. 2013;44:870–947.
39. Dellinger RP, Levy MM, Rhodes A, Annane D, Gerlach H, Opal SM, et al. Surviving Sepsis Campaign: international guidelines for management of severe sepsis and septic shock, 2012. Intensive Care Med. 2013;39:165–228.
40. Ferrer R, Artigas A, Suarez D, Palencia E, Levy MM, Arenzana A, et al. Effectiveness of treatments for severe sepsis: a prospective, multicenter, observational study. Am J Respir Crit Care Med. 2009;180:861–6.
41. Ferrer R, Artigas A, Levy MM, Blanco J, Gonzalez-Diaz G, Garnacho-Montero J, et al. Improvement in process of care and outcome after a multicenter severe sepsis educational program in Spain. JAMA. 2008;299:2294–303.
42. Castellanos-Ortega A, Suberviola B, García-Astudillo LA, Holanda MS, Ortiz F, Llorca J, et al. Impact of the Surviving Sepsis Campaign protocols on hospital length of stay and mortality in septic shock patients: results of a three-year follow-up quasi-experimental study. Crit Care Med. 2010;38:1036–43.
43. Wilcox ME, Adhikari NK. The effect of telemedicine in critically ill patients: systematic review and meta-analysis. Crit Care. 2012;16:R127.
44. Chan PS, Jain R, Nallmothu BK, Berg RA, Sasson C. Rapid response teams: a systematic review and meta-analysis. Arch Intern Med. 2010;170:18–26.
45. Kim MM, Barnato AE, Angus DC, Fleisher LF, Kahn JM. The effect of multidisciplinary care teams on intensive care unit mortality. Arch Intern Med. 2010;170:369–76.
46. Chan PS, Jain R, Nallmothu BK, Berg RA, Sasson C. Rapid response teams. A systematic review and meta-analysis. Arch Intern Med. 2010;170:18–26.
47. Winters BD, Weaver SJ, Pfoh ER, Yang T, Pham JC, Dy SM. Rapid-response systems as a patient safety strategy: a systematic review. Ann Intern Med. 2013;158:417–25.
48. Abella Alvarez A, Torrejon Perez I, Enciso Calderon V, Hermosa Gelbard C, Sicilia Urban JJ, Ruiz Grinspan M, et al. ICU without walls project. Effect of the early detection of patients at risk. Med Intensiva. 2013;37:12–8.