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VIEWPOINT

Performance of the Rapid Response Systems in Health Care Improvement: Benefits and Perspectives

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Introduction

In the last two decades, the rapid response systems (RRS) have been explored as initiatives to increase the safety of hospitalized patients. The main function is to identify and treat patients at risk, or who are presenting signs of clinical instability, and to prevent adverse events during hospital stay, with a consequent reduction in in-hospital mortality. Every year in the United States, more than 200,000 intrahospital cardiac arrests (CAs) occur, most of which could be avoided.[1] RRS are formed by two health care components called the afferent limb and the efferent limb.[2] The afferent limb is represented by the health care team in the admission units, responsible for the care of hospitalized patients and trained to activate the afferent limb, when physiological changes that predict adverse events are detected, especially cardiac arrests. The efferent limb is represented by a team of health care professionals, who respond to codes, and may be headed by a physician, a nurse or a physiotherapist. The efferent limb is better known as the rapid response team (RRT). In addition to these health care components, the rapid response systems must also have two other components, namely the administrative arm, which provides the necessary documentation and is responsible for the systems daily activities and the quality and governance arm, which contributes to continuous improvement and reassessment of the system. These systems have been implemented around the globe, but still in a non-uniform way in institutions and health systems with different characteristics. However, in Brazil, there are few reports on this issue.[3,4]

Keywords

Hospital Rapid Response Team; Patient Safety; Patient Care Team; Hospital Mortality.

Activating criteria

Failure in the early detection of clinical deterioration signs are frequent in the health institutions associated with the worst outcomes and increased hospital costs.[5] RRS activation criteria are based, mainly, on changes in vital signs, which are routinely monitored in the hospitalization units. Schein et al.[6], in 1990, studied the presence of clinical deterioration signs in the 24 hours prior to CA. Among the 64 patients evaluated, 54 (84%) presented at least one change in the clinical parameters during the eight hours that preceded the event.

In order to develop objective criteria for RRS activation, Franklin and Mathew[7] described the changes which preceded CA: mean blood pressure lower than 70 mmHg, mean blood pressure higher than 130 mmHg, heart rate lower than 45 bpm, heart rate higher than 125 bpm, respiration rate under 10 bpm, respiration rate over 30 bpm, change in the level of consciousness and chest pain. Veiga[3], on a case-by-case national basis, describes the results related with the changes in activation criteria, considering the epidemiological characteristics of the institution and maturity after 18 months of RRT. The RRT activation criteria described in the study that presented better results were: code blue (cardiac arrest); code yellow: heart rate less than 50 or more than 110 bpm; systolic blood pressure less than 90 or higher than 180 mmHg, with symptoms, respiratory rate under 10 or over 24 breaths/minute, decreased level of consciousness and/or sudden motor deficit, acute decrease of O_2 saturation to < 90%, seizures, acute bleeding and active screening for sepsis.

However, there are major weaknesses in vital signs measurement, both in relation to the frequency of data collection and even in relation to their assessment confidence level, especially concerning the respiration rate.[8,9] Failure in recognizing unstable patients leads to

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failure in the rescue and prevention of adverse events, which results in inefficient systems.

To minimize these issues, scores have been developed to improve detection of patients at risk.[10-11] These scores are easily executed and have a high reproducibility, and can predict elevated risks of cardiac arrest and need for ICU admission.[12] Nonetheless, scores that are based exclusively on vital signs have demonstrated limited accuracy, leading to lost opportunities to identify patients at risk of CA.

Therefore, the use of electronic systems, as well as new models of stratification of patients at risk of clinical deterioration, has been gaining ground, with the aim of ensuring the early identification and appropriate treatment of these situations.[5,13-14] Churpek et al.[15] assessed a model of electronic data, which not only analyzes the patient's vital signs, but also their laboratorial and demographic characteristics which, compared to models using vital signs alone, showed benefits in the early identification of patients at risk for CA, as well as their need for ICU admission. Similarly, Kang et al.[5] used an electronic score (eCART), in a study with 3,889 patients, which was able to identify risks at an earlier stage, compared to the usual RRT activation system.

Combined outcomes of CA and transfers to ICU or death in hospitalization units were assessed by Churpek et al, in 2014,[15] in a study with data from five hospitals, which included 269,999 hospitalizations, and compared electronic data variables with the MEWS score. In all the outcomes assessed, the electronic scores were higher than MEWS score ($p < 0.01$)

On the other hand, even though it increases the sensitivity of code activation, the structure proposed by the rapid response systems may be seen as a reactive response when the in-hospital patient is already at risk. There are some reports of proactive models, which are based on daily follow-up visits to patients considered at high risk, for example, those who have been recently transferred from intensive care units and surgery centers.[4,16] Other reports suggest the use of telemedicine units, which would provide support in patient care for the staff, while waiting for the rapid response team to arrive, leading to an earlier involvement of an intensivist in the management of the high-risk patient.[17] Table 1 describes the scores for clinical deterioration.[5,8,17,18-21]

Results

The practice of RRT is already well established when a decrease in the number of cardiac arrests is measured outside the ICU environment. Furthermore, there is also an influence between the time of implementation and the positive results, attributable to the organizational culture.

Table 1 - Scores for assessment of clinical deterioration

Authors	Number of patients	Outcomes	Diagnostic accuracy	Year of publication
Buist et al.[8]	6,303	In-hospital mortality	Positive predictive value: 16.2%. Four or more abnormal observations – 88.2%	2004
Goldhill et al.[18]	63	ICU Admission	Sensitivity – 97%; Specificity – 18%	1999
Goldhill & McNarry[19]	548	Mortality within 30 days	Sensitivity – 7.7%; Specificity – 99.8%	2004
Subbe et al.[20]	709	ICU admission; Number of cardiac arrests; mortality within 60 days	Endpoints ROC-curve analysis	2001
Hodgetts et al.[21]	250	Cardiac arrests	Sensitivity/specificity: 100/17%; 98/36%; 94/61%; 89/77%; 86/89%; 84/96% and 52/99% for scores 1,2,3,4,5,7, and 9, respectively.	2002
Kang et al.[5]	3,889	Cardiac arrests and transfers to ICU	Transfer to ICU – eCART > 54: sensitivity – 52.5% and specificity 88.5%. Cardiac arrests – eCART > 54: sensitivity – 80% e specificity -86%.	2016
Churpek et al.[15]	56,649	Cardiac arrest risk and transfer to ICU	Sensitivity – 65% and specificity – 93%	2014

However, when the impact of RRT on the reduction of mortality is assessed, the data are still conflicting. A meta-analysis study and a systematic review, including 18 studies, showed a 33.8% reduction in the number of CA outside the ICU, without in-hospital mortality reduction.[22] A study involving more than 400,000 patients in 10 American hospitals,[23] compared mortality before and after the implementation of RRT, and showed that in-hospital mortality decreased in six hospitals. Nevertheless, it is not possible to attribute these results to the RRT. Jung et al.[24] in their turn demonstrated a reduction in mortality associated with the team performance ($p = 0.002$). A recent study shows a correlation between the hospital length of stay and worsened prognosis, in patients who presented with CA after admitting service within 48 hours of the RRT consultation.[25]

However, new perspectives have been studied to better evaluate the effectiveness of RRT.[25,26]

Brunsveld et al.[27] assessed unexpected deaths, that is, without a pre-existing limitation of treatment, rather than all-cause mortality, where the improvement in survival after introduction of a RRT was more pronounced compared to all deaths as the endpoint.

Nonetheless, several aspects can also be associated with outcomes resulting from RRT, such as time of RRT activation. During daytime hours, latency time from changes in vital signs to RRT activation was shorter, compared to nighttime hours. Besides, activation during nighttime hours was associated with higher mortality.[28,29]

Inclusion in the Guidelines of The American Heart Association - Advanced Cardiac Life Support (ACLS)

In the updated version of the Guidelines of the American Heart Association, released in 2015, “Surveillance and Prevention” were included as the first link in the chain of survival. In this context, the presence of rapid response teams (RRT) in the institutions was encouraged, with the aim of providing initial intervention in patients with clinical deterioration and preventing in-hospital cardiac arrests.[21] Other organizations, such as the Joint Commission and the Institute for Healthcare Improvement also encourage the presence of RTT in hospitals.[3]

A Brazilian study, which evaluated the presence of RRT in a large-sized hospital, showed statistically significant reduction in the number of cardiac arrests (CAs) after the implementation of RRT ($p < 0.001$).[3]

The involvement and training of care staff are essential in the continuous and systematic search for clinical decompensation, at an early stage.

Broadening the scope of performance

Recently, several studies have been published, with assessments of the RRT performance in end-of-life patients’ care. Studies have shown that up to 25% of RRT activation involved patients with pre-existing limitation of treatments.[25] Smith et al.[26] showed that after implementation of rapid response teams, there was a significant increase in the do-not-resuscitate orders ($p < 0.001$), which may impact on reduction of resource utilization among this group of patients.

Conclusions

RRT implementation is related with in-patient safety, prevention of severe adverse events, such as cardiac events and impact on outcomes, resulting in reduced mortality. New scopes of performance have been established. However, the major challenge still lies in the early identification of clinical deterioration.

Author contributions

Conception and design of the research: Veiga VC and Rojas SSO. Acquisition of data: Veiga VC and Rojas SSO. Analysis and interpretation of the data: Veiga VC and Rojas SSO. Writing of the manuscript: Veiga VC and Rojas SSO. Critical revision of the manuscript for intellectual content: Veiga VC and Rojas SSO.

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