

THE PENETRATING POINT

Rapid Response Systems: Should We Still Question Their Implementation?

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In 2006,¹ we questioned whether rapid response systems (RRSs) were an effective strategy for detecting and managing deteriorating general ward patients. Since then, the implementation of RRSs has flourished, especially in the United States where accreditors (Joint Commission)² and patient-safety organizations (Institute for Healthcare Improvement 100,000 Live Campaign)³ have strongly supported RRSs. Decades of evidence show that general ward patients often experience unrecognized deterioration and cardiorespiratory arrest (CA). The low sensitivity and accuracy of periodic assessments by staff are thought to be a major reason for these lapses, as are imbalances between patient needs and clinician (primarily nursing) resources. Additionally, a medical culture that punishes speaking up or bypassing the chain of command are also likely contributors to the problem. A system that effectively recognizes the early signs of deterioration and quickly responds should catch problems before they become life threatening. Over the last decade, RRSs have been the primary intervention implemented to do this. The potential for RRSs to improve outcomes has strong face validity, but researchers have struggled to demonstrate consistent improvements in outcomes across institutions. Given this, are RRSs the best intervention to prevent this “failure to rescue?” In this editorial we examine the progress of RRSs, how they compare to other options, and we consider whether we should continue to question their implementation.

In our 2007 systematic review,⁴ we concluded there was weak to moderate evidence supporting RRSs. Since then, 6 other systematic reviews of the effectiveness or implementation of RRSs have been published. One high-quality review of effectiveness studies published through 2008 by Chan et al.⁵ found that RRSs

significantly reduced non-intensive care unit (ICU) CA (relative risk [RR], 0.66; 95% confidence interval [CI], 0.54-0.80), but not total hospital mortality (RR, 0.96; 95% CI, 0.84-1.09) in adult inpatients. In pediatric inpatients, RRSs led to significant improvements in both non-ICU CA (RR, 0.62; 95% CI, 0.46 to 0.84) and total hospital mortality (RR, 0.79; 95% CI, 0.63 to 0.98). Subsequent to 2008, a structured search⁶ finds 26 additional studies.⁷⁻³⁰ Although the benefit for CA in both adults and children has remained robust, even more so since Chan’s review, mortality reductions in adult patients appear to have had the most notable shift. In aggregate, the point estimate (for those studies providing analyzable data), for adult mortality has strengthened to 0.88, with a confidence interval of 0.82-0.96 in favor of the RRS strategy.

This change has occurred as the analyzable studies since 2008 have all had favorable point estimates, and 4 have had statistically significant confidence intervals. Prior to 2008, 5 had unfavorable point estimates, and only 2 had favorable confidence intervals. As RRSs expand, the benefits, although not universal (some hospitals still experience no improvement in outcomes), seem to be getting stronger and more consistent. This may be secondary to maturation of the intervention and implementation strategies, or it may be the result of secular trends outside of the RRS intervention, although studies controlling for this found it not to be the case.¹⁰ The factors associated with successful implementation of the RRS or improved outcomes include knowledge of activation criteria, communication, teamwork, lack of criticism for activating the RRS, and better attitudes about the team’s positive effect on nurses and patients. Many of these factors relate to an improved safety culture in general. Additionally, activation rates may have increased in more recent studies, as greater utilization is associated with improved outcomes.³¹ Finally, RRSs, like other patient-safety and quality interventions, mature with time, often taking several years before they have a full effect on outcomes.^{31,32}

Despite these more favorable results for RRSs, we still see a large discrepancy between the magnitude of benefit for CA and mortality. This may partly be because the exposure groups are different; most studies examined non-ICU CA, yet studies reporting mortality

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used total hospital mortality (ICU and non-ICU). Additionally, although RRSs may effectively prevent CA, this intervention may have a more limited effect in preventing the patient's ultimate demise (particularly in the ICU).

We also still see that effectiveness reports for RRSs continue to be of low to moderate quality. Many reports give no statistics or denominator data or have missing data. Few control for secular trends in providers, outcomes, and confounders. Outcome measures vary widely, and none conducted blinded outcome assessments. Most studies use a pre-post design without concurrent controls, substantially increasing the risk of bias. The better-designed studies that use concurrent controls or cluster randomization (Priestley,³³ Bristow,³⁴ and the MERIT trial³⁵) tend to show lower treatment effects, although interestingly in the MERIT trial, while the cluster-randomized data showed no benefit, the pre-post data showed significant improvement in the RRS intervention hospitals. These results have been attributed to the control hospitals using their code teams for RRS activities,³⁶ negating a comparative improvement in the intervention hospitals.

Can we improve RRS research? Likely, yes. We can begin by being more careful about defining the exposure group. Ideally, studies should not include data from the ICU or the emergency department because these patient populations are not part of the exposure group. Although most studies removed ICU and emergency department data for CA, they did not do so for hospital mortality. ICU mortality is likely biased, because only a small proportion of ICU patients have been exposed to an RRS. Definitions also need to be stringent and uniform. For example, CA may be defined in a variety of ways such as calling the code team versus documented cardiopulmonary resuscitation. Unexpected hospital mortality is often defined as excluding patients with do not resuscitate (DNR) orders, but this may or may not accurately exclude expected deaths. We also need to better attempt to control for confounders and secular trends. Outcomes such as CA and mortality are strongly influenced by changes in patient case-mix over time, the frequency of care limitation/DNR orders, or by poor triage decisions.³⁷ Outcomes such as unanticipated ICU admission are indirect and may be heavily influenced by local cultural factors. Finally, authors need to provide robust statistical data and clear numerators and denominators to support their conclusions.

Although we need to do our best to improve the quality of the RRS literature, the near ubiquitous presence of this patient-safety intervention in North American hospitals raises a crucial question, "Do we even need more effectiveness studies and if so what kind?" Randomized controlled trials are not likely. It is hard to argue that we still sit at a position of equipoise, and randomizing patients who are deteriorating to standard care versus an RRS is neither practical nor

ethical. Finding appropriate concurrent control hospitals that have not implemented some type of RRS would also be very difficult.

We should, however, continue to test the effectiveness of RRSs but in a more diverse manner. RRSs should be more directly compared to other interventions that can improve the problem of failure to rescue such as increased nurse staffing³⁸⁻⁴⁰ and hospitalist staffing.⁴¹ The low sensitivity and accuracy of monitoring vital signs on general wards by staff is also an area strongly deserving of investigation, as it is likely central to the problem. Researchers have sought to use various combinations of vital signs, including aggregated or weighted scoring systems, and recent data suggest some approaches may be superior to others.⁴² Many have advocated for continuous monitoring of a limited set of vital signs similar to the ICU, and there are some recent data indicating that this might be effective.^{43,44} This work is in the early stages, and we do not yet know whether this strategy will affect outcomes. It is conceivable that if the false alarm rate can be kept very low and we can minimize the failure to recognize deteriorating patients (good sensitivity, specificity, and positive predictive value), the need for the RRS response team may be reduced or even eliminated. Additionally, as electronic medical records (EMRs) have expanded, there has been growing interest in leveraging these systems to improve the effectiveness of RRSs.⁴⁵ There is a tremendous amount of information within the EMRs that can be used to complement vital-sign monitoring (manual or continuous), because baseline medical problems, laboratory values, and recent history may have a strong impact on the predictive value of changes in vital signs.

Research should also focus on the possible unintended consequences, costs, and the cost-effectiveness of RRSs compared with other interventions that can or may reduce the rate of failure to rescue. Certainly, establishing RRSs has costs including staff time and the need to pull staff from other clinical duties to respond. Unintended harm, such as diversion of ICU staff from their usual care, are often mentioned but never rigorously evaluated. Increasing nurse staffing has very substantial costs, but how these costs compare to the costs of the RRS are unclear, although likely the comparison would be very favorable to the RRS, because staffing typically relies on existing employees with expertise in caring for the critically ill as opposed to workforce expansion. Given the current healthcare economic climate, any model that relies on additional employees is not likely to gain support. Establishing continuous monitoring systems have upfront capital costs, although they may reduce other costs in the long run (eg, staff, medical liability). They also have intangible costs for provider workload if the false alarm rates are too high. Again, this strategy is too new to know the answers to these concerns. As

we move forward, such evaluations are needed to guide policy decisions.

We also need more evaluation of RRS implementation science. The optimal way to organize, train, and staff RRSs is unknown. Most programs use physician-led teams, although some use nurse-led teams. Few studies have compared the various models, although 1 study that compared a resident-led to an attending-led team found no difference.¹⁷ Education is ubiquitous, although actual staff training (simulation for example) is not commonly described. In addition, there is wide variation in the frequency of RRS activation. We know nurses and residents often feel pressured not to activate RRSs, and much of the success of the RRS relies on nurses identifying deteriorating patients and calling the response team. The use of continuous monitoring combined with automatic notification of staff may reduce the barriers to activating RRSs, increasing activation rates, but until then we need more understanding of how to break down these barriers. Family/patient access to activation has also gained ground (1 program demonstrated outcome improvement only after this was established¹³), but is not yet widespread.

The role of the RRS in improving processes of care, such as the appropriate institution of DNR orders, end of life/palliative care discussions, and early goal-directed therapy for sepsis, have been presented in several studies^{46,47} but remain inadequately evaluated. Here too, there is much to learn about how we might realize the full effectiveness of this patient-safety strategy beyond outcomes such as CA and hospital mortality. Ideally, if all appropriate patients had DNR orders and we stopped failing to recognize and respond to deteriorating ward patients, CAs on general hospital wards could be nearly eliminated.

RRSs have been described as a band-aid for a failed model of general ward care.³⁷ What is clear is that many patients suffer preventable harm from unrecognized deterioration. This needs to be challenged, but are RRSs the best intervention? Despite the Joint Commission's Patient Safety Goal 16, should we still question their implementation? Should we (and the Joint Commission) reconsider our approach and prioritize our efforts elsewhere or should we feel comfortable with the investment that we have made in these systems? Even though there are many unknowns, and the quality of RRS studies needs improvement, the literature is accumulating that RRSs do reduce non-ICU CA and improve hospital mortality. Without direct comparison studies demonstrating superiority of other expensive strategies, there is little reason to reconsider the RRS concept or question their implementation and our investment. We should instead invest further in this foundational patient-safety strategy to make it as effective as it can be.

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