



Editorial

Resuscitation and rapid response systems

Just over 50 years ago, Peter Safar and colleagues began work on preventing mortality from cardiac arrest using a combination of rescue breathing and chest compressions, now known as cardiorespiratory resuscitation (CPR).¹ Since then, a range of improvements and additional interventions, e.g., different compression:ventilation ratios, automated defibrillators, intravenous drugs and therapeutic hypothermia, have been introduced. Most of the focus on improving outcome following in-hospital cardiac arrest (IHCA) has had one common denominator – they are recommended after the arrest has occurred. Furthermore, although the case-mix of those suffering cardiac arrest has undoubtedly changed, survival from IHCA has remained approximately the same.²

For several decades, evidence has existed that potentially reversible abnormalities of vital signs were common, sometimes for many hours, before IHCA,³ suggesting that cardiac arrest was potentially preventable. Logically, in the 1990s, this led to the use of abnormal vital signs and other observations as triggers for an expert-led, rapid response to patients that might otherwise have an IHCA or die.⁴ This concept – the Medical Emergency Team (MET) – was patient-centred and implemented across an organisation, similar to the way cardiac arrest teams had been operating in most hospitals for many years. The key difference was that the MET was activated *before* an arrest.

Members of staff working on general wards identified at-risk patients using MET criteria – key predefined vital sign and observational abnormalities – and triggered the MET response if one or more of these were identified.⁴ Unlike the traditional hierarchical approach to most emergencies (which may cause critical unintentional, but systematic, delays), the MET brings the correct expertise and skills for the patient's level of illness immediately.

While the concept of identification of at-risk patients followed by a rapid response has remained the core of what has become known as a Rapid Response System (RRS), there have been many modifications. For example, nuances to the original model have included the inclusion of “staff concern” to the MET calling criteria⁵; attempts to improve the MET calling criteria⁶; the use of early warning scores⁷; using a team without a physician^{8,9}; pre-emptive patient visits by a Rapid Response Team (RRT)^{9,10}; the development of RRTs in paediatrics¹¹; and the use of adverse events as markers for potentially preventable gaps in care.¹² It soon became clear that as well as early identification and response, a system approach was also necessary including auditing and administrative support.¹³

Early attempts at evaluating RRSs using before-and-after studies demonstrated impressive improvements in cardiac arrest rates.^{11,14,15} The largest cluster randomised trial, the MERIT study,

was underpowered and showed no improvement in the rates of IHCA or intensive care unit (ICU) admission, nor of mortality in patients without a do-not-attempt CPR (DNACPR) decision.¹⁶ The main reason for lack of statistical power was the significant variation between the outcomes of participating hospitals. A RRS is an organisation-wide system requiring commitment and enthusiasm. Unlike the evaluation of new drugs and procedures, the successful implementation of an RRS requires a large Hawthorn effect, and almost certainly explains the impressive results of before/after studies and the wide variation in the hospitals in the MERIT study.

A *post hoc* analysis of the MERIT study data suggests a significant inverse relationship between the proportion of early emergency team calls and the numbers of unexpected deaths and IHCAs across both intervention and control group hospitals.¹⁷ Furthermore, two recent meta-analyses demonstrated significant reductions in non-ICU IHCA in children and adults (>33% reduction), and of mortality in children (>20% reduction).^{18,19} It is difficult to imagine any other single intervention in acute hospitals that has had a similar impact.

RRSs have been widely implemented in North America, United Kingdom, Netherlands, Scandinavia, Australia and New Zealand, with other countries considering their use. Their widespread application may be changing the way we approach the care of patients in acute hospitals. For example, before RRSs there was almost no research in general wards areas on one of the most common interventions in acute hospitals – vital sign measurement. As a result of the implementation of RRSs, we are learning about their documentation, accuracy and clinical meaning.^{20–22} Similarly, little information existed about urgent calls for non-arrested patients on general wards.^{23,24}

The widespread use of RRSs has also focused attention on other important issues. For example, medicine is traditionally delivered in silos – in discrete geographical sites and by specialised teams. The concept of a RRS is one of the first multiprofessional interventions to span a whole hospital population and challenges this traditional approach. RRSs have also highlighted the failure by hospital staff to recognise patients at the end of life and the possibility that resuscitation may sometimes be inappropriate and futile.²⁴ Furthermore, as they operate across the whole organisation and aim to prevent the most serious adverse events, the measurement of the RRS effectiveness provides a measurement of patient safety.

There is much still much to learn about the optimal operation of RRSs. The epidemiology of deterioration remains poorly understood, although work is now emerging regarding the prevalence of MET criteria amongst hospitalized patients²⁵; diurnal variation of events²³; the impact of continuous monitoring^{23,26}; the value of different triggers for activating the system^{5–7,25}; the requirements

for training hospital clinicians; and the most appropriate response to deterioration. Cultural barriers influence RRS implementation and present a major future challenge.²⁷ Institutions do not reliably obtain vital signs on patients in a systematic and clinically relevant manner.²¹

The journal *Resuscitation* has been at the forefront of much of RRS research, having taken a broad view of resuscitation, exploring the prevention as well as the management of critical deterioration in many different settings. The journal has already contributed significantly to the evidence-base of RRSs, addressing issues such as staff education to prevent IHCA²⁸; MET calling criteria^{5,6,25}; early warning scores⁷; normal vital signs ranges²⁹; and technology related to RRSs.³⁰

The initiative by the editors of *Resuscitation* to provide a formal locus for research and opinion-based articles regarding the prevention of serious adverse events and the broader possibilities of RRSs is to be applauded. The decision underlines our belief that resuscitation should include the prevention of adverse events as a result of serious illness as well as optimal ways of managing it as it progresses. It also makes it clear that preventing IHCA should be as important to resuscitation researchers as its treatment, particularly because of the higher probability of it impacting favourably on patient morbidity and mortality. This edition of *Resuscitation* contains the first³¹ of what we hope will be a burgeoning number of papers submitted and published in the new 'Rapid Response Systems' section of the journal.

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