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Impact of Rapid Response Teams on ICU (Christian P. Subbe)

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Rapid Response Systems (RRSs) improve timely referral to ICU, rate of unscheduled admissions and readmissions rates. Reliability of RRSs might be improved in future by automated monitoring devices that can support recognition and response.

Background

Co-location of patients with life-threatening illness allows for pooling of resources and expertise. Since the 1950s polio epidemic this has happened in Intensive Care Units. With the development of new technologies and drugs to support failing organs the management of critical illness has become more specialised, thus widening the gap between the level of care provided in ICU and that provided on general wards.

At the same time there is increasing evidence that early intervention in acute illness is associated with better outcomes in myocardial infarction, stroke, sepsis, acute kidney injury and other conditions. The better outcomes are probably both clinical (reduction of mortality and morbidity) and financial (shorter length of hospital stay and greater degree of self care on discharge from hospital). The timely delivery of appropriate interventions to patients with time sensitive pathology has therefore become a priority for health service delivery worldwide.

Unfortunately, however, delays in recognition of acute deterioration and treatment are frequent and widespread: international studies examining physiology prior to cardiopulmonary arrests or unplanned ICU admissions show a depressingly uniform picture of prolonged periods of physiological instability prior to adverse events (McQuillan et al. 1998). The causes for these delays are multi-factorial, and include poor knowledge of the physiology of acute illness, mental modelling of data leading to incorrect interpretation, cultural barriers to activate help across professional and hierarchical barriers and unavailability of experienced staff or ICU capacity. The resulting behavioural patterns impact on clinical outcomes of patients referred or admitted to ICU.

Rapid Response Systems: Afferent & Efferent Limb

Rapid Response Systems attempt to improve recognition of critical illness and response to patients at risk of catastrophic deterioration outside ICU on general wards. These two functions are labelled as the afferent and efferent limb.

The afferent limb identifies patients at risk, usually with the help of a structured system of assessment of physiological bedside observations. Vital signs are classified as normal or abnormal, either by using checklists to diagnose a significant abnormality for each parameter, or by scoring each parameter of a set of observations against a scoring table (see Table 1) and adding abnormalities into a summary score, which is then compared against a threshold value to trigger an alert (Subbe et al. 2001; Prytherch et al. 2010).

The efferent limb is a usually ICU based individual or team with critical care skills called the Rapid Response Team, Medical Emergency or Critical Care Outreach. The team can include critical care physicians, nurses and respiratory physiotherapists. If activated the RRT will attend to the patient on the general ward, perform an assessment of ph ysiological abnormality, underlying diagnosis and feasibility of ICU interventions and then initiate treatment and, if needed, transfer to cr itical care.

The impact of the service on patient-related outcomes depends on a 'chain of survival' (Subbe and Welch 2013) (see Figure 1) with reliable recording of vital signs, reliable recognition of abnormalities, reliable reporting of these by bedside staff to RRTs and a reliable response by the RRT. Failure of any of the elements of this c hain will lead to a 'f ailure to rescue' deteriorating patients and worse measures of severity of illness on arrival in intensive care (Oglesby et al. 2011).

Impact on Intensive Care Services

The on the whole positive evidence from the literature for the impact of Rapid Response Systems on patient safety is somewhat hampered by the large amount of heterogenous interventions that are being summarised under the label of RRS (Winter et al. 2013). RRTs can interact with ICU patients prior to admission and after discharge back to general wards. There is evidence for a reduction in unscheduled admissions from a range of publications, especially from Australia. In the UK literature there is additional evidence that some of this reduction is achieved by proactive discussions with patients and families around limitations of care and implementation of Do-Not- Attempt-Resuscitation orders (Morris et al. 2013).

Critical care outreach services provide follow-up of patients discharged from ICU, thus ascertaining that seemingly stable physiology at time of transfer is maintained. CCOs help to re-acclimatise patients to the lower levels of staffing on general wards after a time in ICU with its much higher level of nursing support. There is evidence that this sort of service might reduce re-admissions to critical care (Ball et al. 2003).

In 2000 the Service Development Organisation in the UK funded a detailed examination of the impact of the introduction of CCOs on the performance of ICUs. An interrupted time-series analysis of the database of the Intensive Care National Audit and Research Centre (ICNARC) with ICU data matched at unit level against data about the timing of implementation of RRSs showed statistically significant reductions in the number of patients admitted to ICUs after cardiopulmonary arrests and a lower severity of illness on admissions to ICU following the introduction of RRTs (Gao et al. 2007). Outcomes related to utilisation of ICU bed days were confounded by an increase in intensive care funding with a concomitant rise in the number of ICU beds around the same time as the intr oduction of outreach services.

The only large scale multi-centre randomised controlled trial of Medical Emergency Teams showed little effect on

the primary outcomes, which included unscheduled admissions to ICU, but results were confounded by the rather variable compliance with monitoring and escalation protocols in the intervention group (Hillman et al. 2005).

Future Directions

Given that the philosophy of RRSs is compelling it is disappointing that data supporting the impact on critical care services is relatively weak. Given the persistence of 'failure to rescue' and under utilisation of RRTs in patients with obvious physiological abnormalities it is clear that the search for system improvements has to continue.

Low reliability is often related to human factor issues (Leonard 2004), and reliability can be improved by automating processes with the potential of reducing error rates.

Electronic systems to record bedside observations lead to more reliable recording of vital signs. This concerns the completeness of the set of vital signs, including the key respiratory rate as well as an improvement in the frequency of recordings in line with agreed monitoring plans. A subsequent study analysing nearly one million sets of vital signs showed, however, that despite the support that electronic systems provide, clinical staff did not repeat highly abnormal vital signs in nearly a quarter of all patients affected at night thus indicating ongoing human factor issues (Smith et al. 2013).

Similar observations were made after the introduction of spot-check monitors that have the ability to calculate Early Warning Scores, and are able to advise clinicians by suggesting investigations or interventions in response to abnormal values of physiology on their screen. Implementation of these systems in a clinical trial enrolling nearly 20.000 patients in the U.S., UK and Australia led to a more reliable recording of respiratory rate and a reduction in the number of abnormal sets of vital signs prior to a call out of the RRT. In the group of patients with abnormal vital signs a reduction in the need for inotropes was observed. The impact on ICU utilisation was inconsistent, with an increase in the U.S. and a reduction in Australia and the UK (Bellomo et al. 2012).

	3	2	1	0	1	2	3
Systolic Blood pressure (mm Hg)	≤70	71-80	81-100	101-199		≥200	
Heart rate (bpm)		≤40	41-50	51-100	101-110	111-129	≥130
Respiratory rate (bpm)		≤8		9-14	15-20	21-29	≥30
Temperature (°C)		≤35		35-38.4		≥38.5	
AVPU score				Alert	Reacting to Voice	Reacting to Pain	Unresponsive

Table 1. Early Warning Score (Subbe et al. 2001) Every set of vital signs is scored and parameters are added to achieve a summary score. .

The more advanced systems are able to cover most of the 'chain of survival'. In addition to the automated recording of vitals signs with wireless sensors, Early Warning Scores are automatically calculated and the frequency of automated measurements can vary with the degree of abnormality. Notifications about abnormalities can be sent to a central con- sole on the ward, in Critical Care or to members of the RRT. In principle recording, recognition, reporting and response should therefore all be improved. Clinical trials are currently in progress to assess how this form of monitoring affects patient- related outcomes, behaviour of human teams at the bedside and, last but not least, admissions to cr itical care.

Figure 1. Chain of Survival: it is crucial for patient safety that each element of the chain performs reliably.

Conclusions

RRSs can facilitate the flow of critically ill patients from general wards into and out of the ICU. For optimisation of the impact of RRSs on patient outcomes improvements in system r eliability are required.

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