

## Beyond Mortality: Improving Outcomes for Children Who Deteriorate in Inpatient Settings

Damian Roland, BMed Sci, BMBS, MRPCH, PhD<sup>1,2\*</sup>

<sup>1</sup>SAPPHIRE Group, Health Sciences, Leicester University, Leicester, UK; <sup>2</sup>Paediatric Emergency Medicine Leicester Academic (PEMLA) Group, Children's Emergency Department, Leicester Royal Infirmary, United Kingdom.

The past 20 years has seen an explosion of approaches to improve the recognition of children who deteriorate in the hospital. Early Warning Scores, Rapid Response Teams, Situational Awareness, and Parent-Triggered Activation systems are a few of the safety initiatives implemented worldwide. Many have an inherent face validity; for example, it would appear to be intuitive that highlighting the changes in physiology via a Pediatric Early Warning Score (PEWS) would enable staff to recognize a change in disease process and intervene accordingly. However, although mortality trends have been shown to diminish over time,<sup>1</sup> the evidence base supporting their impact has often been quite heterogeneous.<sup>2,3</sup> In particular, a recent international randomized control trial of a PEWS approach was found not to improve overall mortality.<sup>4</sup>

A major challenge with the evaluation of these patient safety systems is the reliance on mortality as an outcome measure. This is relatively rare, even in large tertiary institutions with complex patients and finding other proxy measures of quality of care are important. Hussain et al. have created a relatively easy to measure metric, an emergency transfer (ET). The benefit of the ET is its simplicity and transferability, which is described as follows:

"Emergency Transfer (ET) is defined as any patient transferred to the ICU where the patient received intubation, inotropes, or three or more fluid boluses in the first hour after arrival or before transfer."<sup>5</sup>

All these components are easily extractable from written or electronic records and are representative of meaningful deterioration. Pressure on bed states, challenges with staff skill mix, and increasing parental expectation may all impact on decisions to transfer patients. The ET metric is relatively immune to these biases as its tight time definition separates it from the previous Bonafide et al.<sup>6</sup> measure (similar interventions but within a 12-hour window) as being centered on an abrupt critical change, rather than a potential drift toward deterioration. This makes the measure useful not only to an individual institution to measure the impact of an intervention but also internationally, as a comparison between

institutions will not be influenced by health system differences.

The ET metric is important as Hussain et al. have demonstrated that it is associated with a worse outcome for the child both as a concrete outcome (increased mortality when it does occur) and as an experience (a longer stay in hospital). "You can't improve what you can't measure" is an old improvement maxim, and only by broadening our use of alternative metrics of care will we be able to understand which interventions will make a difference to patients. Certainly, evidence suggests that cultures, hierarchies, and leadership may well be as important as other more concrete or tangible tools,<sup>7</sup> but these have seldom been evaluated as part of studies on improving the response to deterioration. The pediatric early warning system utilization and mortality avoidance (PUMA) study, a research program funded by the National Institute for Health Research (United Kingdom), is exploring these tools and will likely report later in 2019.<sup>8</sup>

Two immediate practical implications of this work emerge, which should be of relevance to clinical leaders in children's hospitals. The first is that it is highly likely that there will be some events you cannot anticipate. A bronchiolitic infant is always likely to suddenly plug off, and invasive group A streptococcus is a mastery of mimicry and deceit. The authors noted that even with a mature, long-standing Rapid Response System process, ETs were still associated with adverse outcomes. Therefore, it may well be that the ET metric measured over time delineates a locally defined acceptable level of unplanned intensive care admission. If your hospital is significantly above this, they must seriously look at how they can improve their performance. It should be noted here that there were only 45 ETs identified in 4.5 years in Cincinnati and 50% of these were from specialist units within the hospital. It is possible that perhaps the ETs will in the future become as rare as mortality is today, and as hospitals improve, new frames of reference will be needed.

These new references are likely to come from high-performing child health institutions such as those in Philadelphia and Cincinnati, and this leads to a second important principle that hospitals should acknowledge. One of the reasons for patient safety success is the relentless pursuit of excellence. The very act of consistently, and transparently, auditing and analyzing performance is vital to change outcomes. We should digest, evaluate, adopt, and improve the research that groups such as these are undertaking as, although sometimes imperfect, they should also inspire us to ensure that children in our own institutions are as safe as they possibly can be.

\*Corresponding Author: Damian Roland, BMed Sci, BMBS, MRPCH, PhD;  
E-mail: dr98@le.ac.uk; Telephone: +44 (0)116 258 6089; Twitter: @damian\_roland.

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