

# Reducing Failure to Rescue rates in a paediatric in-patient setting: a 9-year quality improvement study

Stephanie McHale<sup>1</sup>, Takawira C. Marufu<sup>1</sup>, Joseph C. Manning<sup>1,2</sup> and Nicola Taylor<sup>1\*</sup>

Author Affiliations:

1. Nottingham Childrens Hospital, Nottingham University Hospitals NHS Trust, Nottingham, UK
2. Children and Young People Health Research, School of Health Sciences, University of Nottingham, Nottingham, UK

## \*Corresponding Author:

Nicola Taylor. Paediatric Critical Care Outreach (PCCOT), Nottingham Children's Hospital, Queens Medical Centre Campus, Nottingham, NG7 2UH. Email: [Nicola.Taylor@nuh.nhs.uk](mailto:Nicola.Taylor@nuh.nhs.uk)

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## **ABSTRACT**

**Aim:** To identify and quantify Failure to Rescue (FtR) episodes from emergency events at a large children's hospital and understand the impact of targeted interventions on reducing FtR.

**Methods:** A quality improvement approach was adopted. From 2011 – 2019 all emergency event calls were systematically reviewed prospectively to identify FtR episodes. Root-cause analysis was performed to identify practice deficiencies. The Plan-Do-Study-Act fundamentals were used.

**Results:** A total of 520 (100%) emergency events were reviewed, with yearly mean of 58 events (SD 13, range 41- 81). Cardiac arrest events were the most common 132 (25.8%). Out of the total 132 (100%) cardiac arrest events, 116 (88%) occurred in paediatric critical care unit and only 16 (12%) occurred in general paediatric wards. Three hundred and twelve (60%) of the events were observed in children who had been inpatient for > 48 hours. Observed FtR figures over the nine years was characterised by high rate of 23.6% in 2011 when the project commenced followed subsequently by a sharp decrease after interventions and remained at 2.5% or below for the last six years.

**Conclusion:** Identifying rates of FtR events from routinely collected emergency events data can be used as a patient safety measure to identify emergency concerns. This enables progressive dynamic problem solving through delivery of strategic targeted interventions. The proposed interventions outlined in this quality improvement study have application to critical care nursing as mechanisms for reducing in-hospital unplanned admissions to paediatric critical care.

**Keywords:** patient safety; communication; education; children; cardiac arrest, Failure to Rescue

## INTRODUCTION

Approximately, 1.5 million children and young people (CYP) are admitted to hospitals in England every year (NHS Digital, 2020). Acute clinical deterioration is the commonest reason for unplanned admission (> 85%) to the Paediatric Critical Care Unit (PCCU) with CYP situated in the emergency department or on a hospital ward (Paediatric). Unanticipated deterioration is a major contributing factor to many of the 1500 avoidable paediatric deaths in UK hospitals each year (Deighton et al., 2016) - that is deaths that are potentially preventable, if the deterioration is recognised, escalated, and acted upon sooner (Deighton et al., 2016). Failure to Rescue (FtR) is defined as, *“the failure to prevent a death resulting from a complication of medical care or from complication of underlying illness”* (Burke et al., 2020). FtR is a failure to recognise, respond and escalate clinical deterioration, and has been recognised to be a significant cause of harm to patients in the National Health Service (NHS) (Findlay et al., 2012, Luettel et al., 2007).

FtR cases are frequently preceded by signs of physiological instability. Therefore assessment, measurement and monitoring of essential core physiological patient observations is crucial for timely recognition of acute deterioration (Bonafide et al., 2013). To mitigate FtR risk, some healthcare organisations have in place rapid response systems (RRS) for identification of unstable patients for early treatment (Sorensen and Petersen, 2015). The RRS consist of two limbs; afferent and efferent (Moore et al., 2012, Sorensen and Petersen, 2015). Fundamentally, the afferent limb involve bedside care givers who measure and monitor patients' condition for early identification of any form of deteriorating and when necessary trigger an alert to the efferent limb for rescue response (Moore et al., 2012). The efferent limb is primarily a medical emergency team consisting of clinicians and/ or nurses with special knowledge and skills in critical care and emergency medicine (Sorensen and Petersen, 2015).

To assess FtR reduction procedures, a quality improvement (QI) project was used to identify and quantify FtR episodes from emergency events at a large children's hospital using

inpatient paediatrics emergency events data and; develop, implement and understand the impact of targeted interventions on reducing FtR.

## **METHODS**

### **Setting**

This prospective quality improvement project was conducted at a 110 bedded children's hospital (includes; 92 ward beds, 10 paediatric critical care beds and 8 high dependency care beds), which is part of a large acute NHS trust (including trauma centre) that provides services to over 2.5 million people. The children's hospital employs nearly 800 nurses, has 22,000 (approx.) inpatient admissions per annum and has co-located paediatric emergency and paediatric critical care departments. The hospital has a RRS, which consists of the Paediatric Early Warning Score (PEWS) as part of the afferent limb, and the Paediatric Critical Care Outreach Team (PCCOT) as the efferent limb. FtR had been identified in multiple incident inquiries and was implicated in five of the top 10 organisation's clinical risks. In response, the children's hospital (led by SM and NT) designed a method to collect data to systematically review all inpatient paediatric medical emergency calls and emergency events.

The project was commenced in January 2011 and used the model for improvement; which entails the application of an aim statement, Plan-Do-Study-Act (PDSA) cycles, as well as iterations of the workflow based on the observations from these tools (Langley et al., 2009). The project aimed to improve the recognition of the deteriorating patient and reduce harm from deterioration by reducing avoidable delays to urgent treatment and appropriate escalation of care (Simmonds et al., 2015).

Using research project definition as outlined by the Health Research Authority (2013) this study was classified as an quality improvement audit and therefore formal ethical approvals were not required, however project conduct complied with Good Clinical Practice (GCP) standards set forth in the Declaration of Helsinki of 1975 (World Health Organisation, 1995).

The project was registered with the local hospital clinical governance department [Registration number: 52300].

### **Study population**

All CYP admitted to hospital from 2011 – 2019 (approximately 170 446 patients). Emergency calls from all inpatient clinical areas within the children's hospital were monitored and included.

### **Data collection**

The study was led by the hospital Paediatric Critical Care Outreach Team (PCCOT). All hospital medical emergency calls were logged by switchboard on a Nerve Centre database, which is part of the hospital patient electronic records system. PCCOT monitored the database for any paediatric emergency calls or cardiac arrests in PCCU. All events were reviewed within one week of occurrence. A standard project data collection form was completed (see Supplementary File 1), recording patient demographic data, type of event (cardiac arrest, respiratory arrest, peri-arrest, seizure and medical emergency), clinical area where the emergency call was raised, time from admission to hospital to event occurrence, and whether the patient required critical care admission or not.

### **FtR operational definition**

The National Patient Safety Agency (NPSA) (Luettel et al., 2007) outlined FtR criteria that define potential points of failure prior to initiating appropriate intervention which constitutes one or more of the following; a) 'failure to measure basic observations', b) 'lack of recognition of the importance of worsening vital signs', c) 'failure to clearly and appropriately articulate patient assessment by' healthcare professional, d) 'delay in response to deteriorating vital signs' and e) failure of the clinical team to appreciate the severity of the patient's condition (Clarke, 2004).

In this study, FtR (numerator) was defined as an avoidable morbidity and/ or mortality due to failure in measuring, identification, recognition and communication of the patient's condition by healthcare staff. FtR cases were identified from total yearly reported medical emergencies (denominator). Medical emergencies consisted of only paediatric events where a '2222' call was raised and/ or cardiac arrest of patient on PCCU ('2222' is the standardised hospital emergency number in the UK). Data was collected from patient notes, observation charts, patient electronic records and DATIX® (online electronic incident reporting system) where applicable. Additionally, all emergency call events were also discussed with staff involved.

## **Dissemination**

Findings were disseminated through bespoke educational forums and governance strategies. Potential FtR events identified during the reviews were discussed with the hospital Patient Safety Team, senior team involved and if required the Clinical Director. Where necessary a further independent review was considered. Findings were also presented at various corporate meetings.

## **Statistical Analysis**

Descriptive statistics of observed rates for total FtR and demographic data are presented. We described patient characteristics using percentages for categorical data. Yearly total emergency events data for the 9 year period and survival to discharge rates following in hospital cardiac arrests are presented as mean and standard deviation (SD). Total mortality was calculated per 1000 admissions. Chi<sup>2</sup> test was used to calculate statistical significance on yearly reduction in failure to rescue frequency with  $p \leq 0.5$  considered significant. Data was calculated in Microsoft Excel 2010.

## **RESULTS**

A total number of 520 emergency events fitting study criteria were recorded during the study period (Table 1). Observed mean events was 58, (SD 13), ranging from 42 - 81. Cardiac arrests were the most frequent events (n=132, 25.8%), however the majority of these (n=116/132, 88%) were inpatients located in paediatric critical care unit (PCCU) or theatre areas (Supplementary File 2, Table 1). Collectively the other event categories (respiratory arrest, peri-arrest and other) had a total of 258 (49.6%) events.

**\*\*Table 1: Total number of emergency events reported 2011-2019 n (%).\*\***

More than half (59.6%) of events were from children who had been inpatients for > 48 hours. Nearly half (41.7%) of emergency events were observed in the < 1 year age group in comparison to other age groups (Table 2) . This events distribution was consistent throughout the years and was not accounted or reflected in the admission by age numbers. Rather this highlights vulnerability and dependency of the paediatric patients less than two years of age who are deemed one of the most at risk group.

**\*\*Table 2: Yearly emergency events reported by age group n (%)\*\***

### **Mortality and cardiac arrest survival rates**

Table 3 shows the mortality and cardiac arrest survival rates. Total observed in-hospital mortality rate for those who had FtR per 1000 admissions was 0.22. Yearly mortality rates varied during study period ranging from 0.12 - 0.41. Similarly yearly survival to discharge rates following in-hospital cardiac arrest varied across study period ranged from 43% - 80%, with a mean of 65% (SD 11%).

**\*\*Table 3: Yearly mortality rates and survival to discharge rates following in-hospital cardiac arrest\*\***

### **Failure to Rescue rates**

Observed FtR (Figure 1) over the nine years was characterised by high rate of 23.6% in 2011 when the project commenced and was followed subsequently by a sharp decrease; 14.2% in 2012, 9.5% in 2013, 4.5% in 2014, 1.5% in 2015, 2% in 2017, 2.5% in 2019 with no FtR incidents observed in 2016 and 2018 following interventions. Using 2011 data as baseline, failure to rescue frequency reduction from 2014 – 2019 was statistically significant chi-squared test  $p < 0.05$  (see Supplementary File 2, Table 2).

**\*\*Figure 1. Failure to rescue trend\*\***

Using the descriptors from the NPSA (Luettel et al., 2007) all the cases identified in this study as FtR incidents were linked to one or more of the following; failure to recognise the deteriorating patient (for example, poor recording or delayed in interpretation of observations and Paediatric Early Warning Score (PEWS)), failures in communication (for example missed information during verbal communication, handovers and documentation) and systems errors (for example where patient transfer or step down processes has not been fully complied with). All cases were reviewed at both local and hospital levels followed by individual event lessons learned immediately disseminated and actioned in practice to mitigate future risk.

### **Strategies to mitigate FtR**

Recognition and documentation: Arising from thematic analysis of FtR case reviews, a programme of work was set to address specific FtR deficiencies. These include educational programmes led by PCCOT and other wider patient safety initiatives such as introduction of electronic observations (E-obs) and severe sepsis bundle compliance.

Staff education programmes initiated included; a mock arrest programme and the Paediatric Recognition and Acute Management of the ill child (PRAM) in-house course. This is now a requirement for all registered nurses working in the Children's Hospital to undertake a yearly mandatory full day in-house course on recognition and immediate management of the deteriorating child. For new nursing staff the course is part of the induction programme which

includes training on accurate recording and interpretation of PEWS. Moreover one to one or ward specific fundamental training on emergency care requirements such as; oxygen therapy, setting up humidifiers and nasopharyngeal airways is now readily available.

Communication: The situation, background, assessment, recommendation (SBAR) QI and patient safety communication tool has been built into PRAM programme to offer structured and standardised communication. The tool is now being utilised in nursing handover documents and all patient transfer documentation have been developed using an SBAR format.

Systems: Intra-hospital transfer documentation with patient safety check list was developed and PCCOT worked with wards in introducing daily patient safety briefings and SBAR handovers.

## **DISCUSSION**

In this prospective QI project, we sought to demonstrate the value of FtR rates from emergency events in paediatric patient population as a potential, readily available means of monitoring patient safety. A quality measure that uses routinely collected data. After identification, quantification and reviewing of FtR individual cases and addressing deficiencies, we observed a sharp fall of FtR rates from 23.6% in 2011 to 0% in 2018 and 2.5% in 2019. Our observation asserts that improving recognition of deteriorating patients and reducing avoidable delays to urgent treatment and appropriate escalation of care during care delivery using specific targeted organisational interventions has a potential to improve patient safety. Yearly collection and review of data allowed systematic problem identification (knowledge of emerging concerns) resulting in progressive and dynamic problem solving (improving staff knowledge and skills). The project enabled the children's hospital to proactively and not reactively approach patient safety issues. Required improvements and changes were addressed in a timely manner through specific processes, clinical practices and education strategies.

Our results support previous studies that reported several associations between FtR and patient safety quality indicators (Burke et al., 2020, Griffiths et al., 2013, Simmonds et al., 2013). Simmonds and colleagues (2013) demonstrated clinicians' change of behaviour in response to a rapid response feedback mechanism that informed individual clinicians of their response to the treatment of critically ill patients from which they could learn and improve. After the intervention the study reported an improvement in early treatment of patients identified as at risk. Griffiths et al. (2013) observed that lower rates of FtR were associated with a greater number of nurses and doctors per bed. Furthermore, the study reported that higher total clinically qualified staffing per bed was associated with lower mortality based FtR.

Survival to discharge post in-hospital cardiac arrest has been between 43% - 80% over the study period. This is comparable to three previous USA studies. Girotra and colleagues Girotra et al. (2013) showed that risk adjusted survival to discharge rate increase from 14.3% in 2000 to 43.4% in 2009. Bhanji et al. (2017) reported survival rate of 36.3% on cardiac arrests during nights and weekends only, while Holmberg et al. (2019) reported rates between 19% - 66%. The wide survival rates range could be due to differing case mixes within study population environments. Only 12% of cardiac arrests occurred in general paediatric wards compared to 88% in PCCU and theatres. Similar results were reported by Berg and colleagues who noted a shift of paediatric cardiac arrests from the wards to critical care (Berg et al., 2013). Their figures suggest that only 4 - 6% of in-hospital paediatric cardiac arrests occur in the ward areas versus critical care. This variation could be accounted for by the plausible notion that once the patient is observed to be deteriorating requiring input from the efferent limb of the RRS, they are more likely to be transferred from the normal ward environment to critical care. Due to physiological instability sicker patients are more likely to suffer cardiac arrest.

In this QI project we used FtR definition descriptors from previous studies (Luettel et al., 2007, Griffiths et al., 2013, Findlay et al., 2012) as an approach to identify cases of FtR,

providing some evidence of reliability. Specific variable characteristics derived from FtR definition descriptors include, not taking and recording observations, not recognising early signs of deterioration, and failure to communicate (both verbal and written). These characteristic variable items have face validity; they are all known predictors of or surrogates for patient safety (Griffiths et al., 2013, Aiken et al., 2002, Silber et al., 1992). Mitchell (2008) described the origins of patient safety inadequacies by classification in terms of type (error), communication (failures between professionals or between patient and professional, and between professionals and non-medical staff), and system failure (failure in clinical performance and patient management). Additionally, effective communication has been reported as one of the key ways to improve patient safety (Belim and Vaz de Almeida, 2017).

### **Strategies to reduce FtR rates**

Various specific targeted interventions primarily focusing on moving away from resuscitation to rescue were used to address identified concerns. Current literature outlines some of the strategies to reduce FtR rates and improve healthcare system processes. These include the use of simulators, bar codes, and computerized entry via clinical applications, as well as team resource management (Mitchell, 2008). Patient safety education training provision by healthcare organisations have been recognised essential in providing a supportive system enabling healthcare workers to keep patients safe and enabling continuous professional development.

Given the high rates of FtR in the first year of the study [Year 2011], there was a huge stakeholder campaign to put systems in place to address the concerns and themes highlighted during individual case reviews. Key to this drive was improvements on education and training across the Children's Hospital. Bespoke structured educational programmes were designed, changes to the admission process were introduced and there was implementation of electronic observation system (e-obs) in all paediatric clinical areas to

standardise vital signs recordings and escalation process and easy records access and review. To drive improvement in staff knowledge and skills, the courses provided include the five day new starter 'Acute Care Skills Course' for newly qualified nurse to bridge transformation from student to a qualified practitioner, and a registered nurse yearly mandatory Paediatric Recognition and Acute illness Management (PRAM) course. The courses are updated year on year in response to specific FtR learning needs and this informs ongoing Trust paediatric education and Recognise and Rescue patient safety strategy.

### **Study limitations**

The present QI project results should be interpreted in view of the following limitations.

Firstly, data was collected at a single site, limiting the generalisations that can be made due to context specific factors. However, our main results do compliment findings from previous similar studies thus providing confidence of the transferability of the conclusions drawn from this study.

Secondly, efforts to identify FtR cases during the course of the study period could have resulted in flagging more patients in need of rescue through raised awareness, but these additional patients may be less sick and at lower risk of dying. This would result in a reduction of FtR rate regardless of the interventions implemented. However, all FtR cases in this study were identified as prospective reviews of reported medical emergencies which we did not have control over.

Thirdly, this study only included '2222' emergency calls from specific paediatric inpatient areas and/ or cardiac arrest in PCCU. This is not the whole hospital patient population and where no '2222' call was made there may still have been cases of FtR that are not known or included in the analysis.

Lastly, we acknowledge that decrease in FtR rates may not be due to the implemented interventions alone, but could also have been influenced by overall improvement of care across the organisation.

## **CONCLUSION**

To our knowledge, this is the first such QI project to identify, quantify and demonstrate the use of FtR rates to address paediatric patients' safety and quality of care delivery. Although resource intensive, this QI process continues to be a useful tool for measuring and monitoring patient safety, particularly in respect to FtR, within a large Children's Hospital. This is a dynamic process where issues can be addressed in a timely way to help inform systems, pathways, guidelines and policy reviews. Opportunities for learning are maximised by the prompt, systematic reviews of the events leading to action plans for individuals, teams or specific ward areas. Education strategies around recognise and rescue are based on themes highlighted from the audit.

### **What is known about the subject**

- Failure to Rescue (FtR) is a major patient safety concern and a cause of significant harm to patients.
- FtR can be used as a quality measure for the care delivered to the patients.

### **What this paper contributes.**

- This study demonstrates the use of emergency events routine data to identify failure to rescues cases in paediatric in-patients and it also shows the benefits of approaching patient safety concerns proactively and not reactively.
- The study suggests that targeted interventions implemented for a specific paediatric population within a hospital wide safety culture reduced rates of FtR.

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