# Identifying resilience: A system safety review of trauma and orthopaedic theatres

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## **SUMMARY**

A system safety review to assess the resilience in Trauma and Orthopaedic (T&O) theatres was conducted in response to a number of Never Events. The imminent publication of the Patient Safety Incident Response Framework (PSIRF) paved the way for an alternative to traditional serious incident investigation, proposing a systems-based approach and enabling subsequent improvements to be based on 'work as done', rather than 'work as imagined'. Analysis identified opportunities for interventions that built system resilience, which were developed and tested by front line staff as part of a Quality Improvement (QI) collaborative. The approach demonstrated a practical application of the integration of systems theory, patient safety, resilience engineering and quality improvement approaches.

### **KEYWORDS**

Resilience, PSIRF, Quality Improvement, Systems, Work as Done, Safety II, SEIPS, CARe QI

### Introduction

In April 2021, Gloucestershire Hospitals NHS Foundation Trust (GHNHSFT) reported two patient safety incidents that met never event criteria, taking the total to six, since March 2019, within the T&O specialty.

Never events are defined within the National Health Service (NHS) as, "Serious Incidents that are wholly preventable because guidance or safety recommendations that provide strong systematic barriers are available" (NHS Improvement, 2018, p.4). The traditional response to such events is the completion of a patient safety investigation that retrospectively identifies the factors that contributed to the undesired outcome, with the aim of making recommendations for improvements to prevent reoccurrence (NHS England, 2015). At GHNHSFT this approach had been followed for the preceding cases, however the repeated incidents indicated that the desired improvement was not being achieved.

With the imminent publication of PSIRF laying the foundations for the introduction of systembased analysis and improvement (NHS England, 2022), an alternative approach was proposed, which sought to analyse the system that had generated the undesired outcomes, rather than the undesired outcomes themselves.

The approach utilised the Systems Engineering Initiative for Patient Safety (SEIPS) (Carayon et al., 2006) and CARe QI (Anderson & Ross, 2020), to explore the system and identify opportunities to build system resilience. Staff were supported in applying a QI approach (Langley et al., 2009) to the findings from the systems analysis to develop and test interventions, based on the reality of 'work as done' (Hollnagel et al., 2015). Since the application of this approach, the median time between never events in theatres, has increased from 46 days to 224 days.

## Method

## National Requirements

The Serious Incident Framework (NHS England, 2015) describes the investigatory process required within the NHS when a patient safety incident meets the Never Event criteria. Obligations are met through the creation and sharing of an investigation report, detailing the factors that led to the unintended outcome. With PSIRF (NHS England, 2022), on the horizon, work is under way to introduce system-based analysis tools, however the Serious Incident Framework requirements still need to be met, during this transitionary period. A change in approach warranted a discussion with the (then) local Clinical Commissioning Group (CCG), where a system investigation was proposed in parallel with a related incident investigation. To ensure the existing requirements continued to be met, an investigation report detailing the circumstances of the incidents, previous findings and the intention to review the entire system responsible for the unwanted outcomes, was produced within the mandated 60-day timescale. To promote transparency and enable process governance, regular oversight meetings were established, to which the CCG were invited to monitor progress of this alternative approach.

## System Analysis

With the scope of the review defined as 'procedures that involved implants, within trauma and orthopaedic theatres', high level process maps (Langley et al., 2009) were created with key staff, describing the intended process from patient identification through to patient recovery. These were created separately, for trauma and elective orthopaedic procedures. Due to covid-19 restrictions, they were constructed virtually using a google jam board (https:// jamboard.google.com/), the content of which was transferred to Microsoft Word for further review and amendment by the theatres staff. Although the process maps depicted 'work as imagined', they provided a sufficient outline of the process steps to enable the scope of the system review to be described and the next stage of the approach to be planned.

The systems analysis was conducted during a facilitated face to face workshop with approximately 40 multidisciplinary team (MDT) members from theatres, during which SEIPS (Carayon et al., 2006) was used. Staff were split into seven groups, one for each of the sections of the process that had been identified through process mapping. Individuals were allocated to a part of the process that they were familiar with, whilst being mindful of professional representation across the groups. After an introduction to the background and how to use SEIPS, the groups were tasked with identifying the system components, their interactions and their outcomes.

Following the SEIPS analysis, CARe QI (Anderson & Ross, 2020) was used to carry out observational studies of the theatres processes, with a focus on 'work as done' and with the aim of identifying indications of system resilience. Observers were introduced to the handbook, an overview of the project and the worksheets to be completed, through a virtual briefing over Microsoft Teams. Observations were scheduled across the same seven elements of the T&O processes that had been identified through process mapping and that had been subject to analysis using SEIPS. Observations were recorded on the worksheets provided by the CARe QI handbook and where necessary, to understand further what was being observed, questions were addressed to staff.

Theatres staff were notified during the morning team briefing when observations were to be conducted, as this was used as an opportunity to highlight the project that was under way and to provide reassurance around the purpose of the observations.

Completed worksheets were returned and reviewed with the aim of identifying evidence of the following resilience indicators within the observational descriptions:

- Anticipation
- Learning
- Adaptation
- Monitoring
- Responding
- Coordinating

Additionally, information on system outcomes and indications of misalignments in demand and capacity was noted. Resilience indicators were then used to construct a resilience narrative, which was used to identify improvement opportunities or areas that warranted further exploration.

# **Quality Improvement**

To support the translation of improvement opportunities into improvement projects, a QI collaborative was established by the GHNHSFT Gloucestershire Safety & Quality Improvement Academy (GSQIA). Through this collaborative, 20 multidisciplinary staff from theatres undertook 5 QI projects to test and learn from potential interventions aimed at building system resilience in the areas identified through the analysis.

The collaborative was initiated by a day of virtual QI training, conducted over Microsoft Teams and based around the Model for Improvement (Langley et al., 2009). This included identifying a project aim, measures of improvement and change ideas, as well as showing how to test and assess change ideas using Plan-Do-Study- Act (PDSA) cycles. Figure 1, demonstrates the linkages between the tools and approaches.



Figure 1: Linking system analysis with quality improvement

Teams were allocated a QI coach and a member of the Trust Human Factors Faculty to support them with their improvement work and over the following nine months, the teams worked to use QI methods to build system resilience. The work culminated in September 2022, with a celebration event where the teams presented their progress. Although the majority of findings required an improvement approach, some areas identified by the systems analysis instead warranted management review or validation by further audit. Instead of being adressed through the QI collaborative, these were allocated and tracked through a governance meeting, established to oversee the progress of the project.

## Results

From the high-level process maps, four process stages were identified for elective orthopaedic procedures and three for trauma, as shown in Table 1, below.

Elective Orthopaedic	Trauma
1.Patient & implant identification, pre-assessment	1. Day before & day of procedure: Trauma list
& listing.	creation and amendment process.
2. Implant request, stock check, and preparation.	2. Day of procedure: Pre-list and pre-procedure implant checks.
3. Day of procedure: Implant collection and checking prior to patient arrival.	3. During procedure: In theatre implant checks.
4. Day of procedure: Implant checks prior to fit for trays/ sterile packaged components and loan items.	

Table 1: Scope of System Review

The process stages were used to describe the scope of the SEIPS analysis and the observations. Each stage was allocated to an observer, with some observers covering more than 1 stage.

The resilience narratives constructed from the observations were compared with the SEIPS analysis, before being used to formulate the following recommendations identified in Table 2.

Table 2: Actions recommended by CARe QI

	Increase the successful completion of pre-assessment activities for elective orthopaedic cases.
roject	Improve the timely communication of necessary list changes within the two-week list 'lockdown' for
	elective T&O cases.
	Improving the storage of implants within theatres and the alignment of stock held with usage
a P	
	Improve the in-theatre checking process for implants.
	Improve the resilience of the 'golden patient' identification and notification, as part of the trauma
	list creation process.
۲.	Review the demands on the role of the theatre coordinator.
emer iew	Review the impact of theatre utilisation requirements.
anag Rev	Review capacity & demand of X-ray provision in theatres
Σ	Risk Review of staffing and skill mix accounting for case demand & complexity.
Audit	Assess the availability and provision of sets for expected case load
	Assess the consistency of staff inclusion in the pre list WHO briefing.

As the system analysis had been instigated in response to never events within T&O theatres, data showing their reoccurrence within theatres was monitored. Figure 2 depicts the dates on which never events occurred and shows the number of days elapsed between events. At the time of writing (8th February 2023) it has been 422 days since the last Never Event in theatres. This is depicted by a dotted line on the chart as the data point marks merely the date used for measurement, rather than the occurrence of a never event. This represents an increase in the median days between theatres never events from 46 days to 224 days, since the start of the QI collaborative.



Figure 2: Time since last Never Event in theatres

# Discussion

The approach described in this paper was instigated as a result of repeated Never Events within T&O theatres. Whilst thorough investigations had been previously carried out, the recommendations and actions had not been sufficient to prevent further occurrences. Developments within safety science recognise the limitations of a Safety I approach, (Anderson & Watt, 2020 & Hollnagel et al., 2015,) the basis for the traditional investigatory response to unwanted outcomes, when utilised within complex systems, such as healthcare. Similarly, the 'investigation – findings - recommendation – action' strategy, fails to take into consideration the body of evidence behind taking a quality improvement approach to develop and test changes to ensure effective and sustained improvement (Langley, 2009). The publication of PSIRF (NHS England, 2022), starts to correct these discrepancies and applying the approach as described, has presented an opportunity to test a systems-based approach that could be incorporated into a Patient Safety Incident Response Plan (PSIRP). The requirement for a patient safety incident investigation in response to a never event has, however, been retained within the PSIRF (NHS England, 2022).

The aim of the approach was a shift in focus from safety I and 'work as imagined' to safety II and 'work as done'. A Safety I approach could not be avoided in its entirety, as the review was triggered by the never events and the SI framework still required an investigation report. The system safety review, however, took a safety II approach and sought opportunities to build system resilience,

changing the focus from 'ensuring that 'as few things as possible go wrong' to ensuring that 'as many things as possible go right''. (Hollnagel et al., 2005, p.4). Utilising the CARe QI handbook, enabled the adaptations and variations within the system to be witnessed, whilst SEIPS supported the collection of a diversity of views. These in combination helped to capture the complexity and the reality of 'work as done', whilst recognising the value of staff engagement through involvement in the analysis and improvement processes.

The change in approach supported a wider scope of review, leading to the identification of latent factors and improvement needs in areas that had not been identified through the previous traditional Safety I investigation processes undertaken by GHNHSFT. This supports the findings from those such as Anderson & Watt (2020), Hollnagel et al. (2015) & Wigg et al. (2020) who have highlighted the limitations of the investigation processe.

# Limitations

The application of the approach was affected by varying restrictions associated with the Covid-19 pandemic, which impacted on staff availability due to sickness and the ability to arrange staff gatherings, due to restrictions in group size and proximity. This required the approach to be modified in the following ways:

- Limitations in the number of staff allowed to gather in indoor spaces resulted in the SEIPS workshop being hosted across multiple rooms, limiting the team interactions and knowledge sharing.
- QI teaching was conducted virtually over MS Teams, replacing the preferred format and length of session offered by a face-to-face workshop.

Access to front line staff was an essential component of the approach but also the greatest challenge. Shortages led to the process taking longer than anticipated and limited the number of observations that would have otherwise been conducted to get greater system representation. This was also the greatest challenge for the teams working on the quality improvement projects as their time was limited by the continual need to staff theatre lists, due to limited staff availability.

Whilst the use of CARe QI enabled the reality of the work system to be observed, it was not possible to observe all shifts, days of the week, teams at work or variation in process. The observations therefore represented a sample of the system at work and so may not have been representative of all permutations, or captured all factors that limited system resilience. Similarly, any issues that were observed, may have been over represented due to the limited sample size of the observations conducted. This risk was mitigated to some extent by utilising two system analysis tools, so that their outputs could be compared. This comparison did not highlight any missed opportunities or anomalies in the findings.

Completing this system safety review also required a trade-off between enhanced scope and complexity and the time required. The length of time that that it took for this approach to be developed, agreed and implemented was substantially longer than the prescribed 60-day limit for an SI investigation. Whilst the investigation report produced in parallel to meet the SI obligations was completed within the 60 days' timescale, the recommendations were linked into the system safety review. Being permitted the time to undertake the approach without the development of the standard action plan, required a degree of negotiation due to historical expectations of the investigation process and its outputs.

Further practical considerations included the necessity to split the system to be reviewed into sections identified through the use of process mapping. Whilst this precluded an entirely holistic approach to the analysis, it was a necessary response to the complexity of the system and to enable

the logistics of the approach to be managed. These logistics were subsequently coordinated by the Trust safety department, in conjunction with a member of theatres staff. Having an individual point of contact within the theatres team proved to be an essential component in the coordination and delivery of the approach, as they were able to apply their knowledge of the teams and the processes to the planning and implementation, such that it had the best chance of success and theatre team involvement.

Each of the individual QI projects were tracked through their own identified measures, whilst the overall impact of the approach considered the recurrence of never events. Whilst this data indicates a substantial increase in time since the last never event, it is not possible to attribute this to the system safety review alone, due to the lack of a control group for comparison and the inability to control the myriad of variables within the operational environment.

## Conclusion

The approach required advance planning, staff involvement and a considerable amount of time and coordination, in exchange for a much broader, system focussed review, based on work as done, rather than work as imagined. The advent of PSIRF can support the use of such approaches more regularly in the future, however organisationally this will require a shift in expected timescales, staff involvement and outputs. The benefit of the system analysis is multi-faceted – from the intelligence that the process unearths about complex systems to its ability to highlight the adaptability of staff through the differentiation between work as imagined and work as done. Additionally, its ability to involve and engage staff in the diagnostic and improvement process should not be underestimated.

With PSIRF now published, the learning from this practical application of systems analysis, resilience engineering and quality improvement, can be used to inform the development of PSIRPs within the NHS, providing an opportunity in the future to focus on '*ensuring that 'as many things as possible go right''*. (Hollnagel et al., 2005, p.4).

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