

## RULE ‘VIOLATIONS’ AND RESILIENCE IN HEALTHCARE

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### Abstract

There are many explanations for the violation of rules, and in this paper we report on examples from a healthcare setting. The research explores how nurses conceptualise safety rules when using medical equipment to treat patients. Do nurses intentionally violate the formalised rules set by the hospital and regulatory authorities? Unlike other work on rule violation, the focus here is on understanding how rule violation can be used as a measure of necessary performance variability. We found that the nurses studied had a limited awareness of what rules they were adhering to or intentionally violating. Instead, nurses performed the work in a way that was consistent with their own understanding of safe practice. Informal and dynamic safety behaviours were central to how resilience was created and sustained. Better management is needed to avoid situations where well-intentioned violations are not shared amongst colleagues. This is because a lack of team awareness can result in conflicting safety goals and potentially unsafe practice. When informal safety behaviours are shared, risks are open to group inspection.

## 1 INTRODUCTION

The conventional view on risk management considers human performance variability, of any kind, as a threat to safety and something that should be avoided. However in the Resilience Engineering community, it is asserted that performance variability is necessary and useful (e.g., Woods, 2006; Dekker, 2003). This is because in complex adaptive systems, work cannot be completely specified in advance. Indeed, safety rules often have to be violated when responding to threats and disturbance (see Hale & Borys, 2013). Woolfson et al. (1997) argued that rule violations could be evidence that workers are ‘involved in the process of risk assessment as fully legitimate active participants’.

There are many explanations for the violation of rules, and in this paper we report on healthcare examples by using a framework developed by Reason (1990). This framework was originally developed to account for human error. Violation can imply deviance and intentional harm. However from a human error perspective, violations can also occur when they are well-intentioned, targeting desired outcomes such as patient safety. In this paper the focus is on well-intentioned violations.

According to Reason (1990) explanations for the violation of rules include:

- **Routine violations** that have become a normal and accepted way of behaving.
- **Situational violations** in response to specific situations where the rules are not relevant.
- **Exceptional violations** in response to situations never before encountered; and optimising adaptations, done to explore the boundaries of system operation.

This paper aims to discover if these types of violations can be studied in healthcare practice. Unlike other work on rule violation (see Hale & Borys, 2013), the focus here is on understanding if rule violations can be used as a measure of performance variability. It has been suggested that ‘outcomes emerge from human performance variability, which is the source of both acceptable and adverse outcomes’ (Hollnagel, Wears & Braithwaite, 2015). Hospital managers and clinicians ‘understand’ what human error is. Conceptualising what is meant by performance variability is much harder. This paper attempts to make this conceptualisation easier.

## **2 BACKGROUND**

In the UK patient care is becoming increasingly complex with a mixture of chronic and acute conditions to be managed, and a tangle of new and old care pathways. There is also a constant state of technological change, e.g., paperless records and e-prescribing. These factors, along with the under-resourcing of the National Health Service (NHS), mean that the demands on healthcare providers are rarely predictable. The good news is that in most cases the NHS works, and patients get treated effectively. One reason for this could be that the organisation has the inherent capacity for resilience, i.e., clinicians often have to work around problems, devising solutions and making things work for patients despite pressures. However, it remains a source of frustration that progress on patient safety is patchy, and that patients are being harmed every day by errors that are avoidable (Leistikow et al., 2011).

Allowing clinicians to engineer multiple paths to successful patient care is ostensibly in conflict with promoting a standard rule-based way of working. In this paper this conflict is examined by studying the task of setting up an infusion device, which is an exemplar of an everyday nursing task. Infusion devices are widely used in hospitals, and allow for treatment (medication) to be given to a patient over a period of time at a predetermined rate.

Within the UK there is a range of rules and standards on how to setup an infusion device. These have evolved over time in response to clinical incidents, rather than to the changing demands of work practice. For example, infusion devices are now used to deliver a range of treatments that were previously administered in a different way. During nurse training the Standards for Infusion Therapy by the Royal College of Nursing are typically followed (RCN, 2010). When working in a hospital there are Hospital Trust rules that need to be adhered to. In addition, each clinical area within a hospital will often have supplementary standards and guidelines. All these need to be considered alongside the instructions provided by device manufacturers, which are specific to the models of devices being used. Our study explores the extent to which these rules and standards are adhered to.

Before reporting the study, we reflect on the ideology of standard work in healthcare:

"We know we need standard work in order to avoid the chaos of many people performing the same process in different ways, which creates variation and the need for workarounds" (Barnas, 2014).

It has been claimed that the standardisation of work can result in a demonstrable reduction of errors across some processes within some hospitals. For example, in Thedacare Hospitals (USA), a new standard led to the near elimination of medication reconciliation errors in inpatient units (Barnas, 2014). The need for this new standard was discovered by applying Lean management principals, which aim to better understand problems by performing root cause analyses *in situ*. Lean principles are derived from the Japanese manufacturing industry (Krafcik 1988). They are predominately about the identification and steady elimination of waste by promoting standard rule-based ways of working. If errors can be nearly eliminated by designing a new standard way of working why is resilience needed?

There are tensions between the need for standardisation versus the need for adaptability. It is suggested that people have learned to adjust what they do to match actual work conditions, resources and constraints (see Hollnagel et al., 2006). It is thought that the complexity and unpredictability of a healthcare work environment requires people to develop the adaptive capacity to handle everyday work (e.g., Hollnagel, Wears & Braithwaite, 2015). Within healthcare, there are heroes (at all levels and roles) that keep the system functioning (Barnas, 2014), by responding to new pressures. Indeed, it is also argued that there is too much reliance on resilience (Wears & Vincent, 2013). This paper explores the difficulties in balancing the need for standards and rules, and the need for resilience when using infusion pumps, and considers implications for safety from an organisational perspective. We explore these notions by considering concrete examples.

## **3 METHOD**

### **3.1 Participants**

The director of nursing, at one large NHS hospital in the UK, provided the names of nursing ward managers in clinical areas where infusion pump use was prevalent. Eight areas were contacted and a positive response was received from six. Each of these ward managers were asked to recruit five nurses who would be appropriate for the study. Our inclusion criteria were that they should be qualified staff nurses, who have undergone training with the infusion pump device, and that they regularly administer intravenous therapy. In total, n= 14 nurses across five clinical areas completed the study.

### **3.2 Research Design**

There were three phases to the study. The first phase was a semi-structured interview where details about a participant's experience relating to the administration of intravenous therapy were elicited. The second phase involved a participant collecting and redacting photocopies of prescriptions that they had recently administered using a pump. The third phase was an observed simulation where a participant demonstrated the programming of an infusion pump using the example prescriptions that they had collected.

### **3.3 Procedure**

**Initial interview.** Written consent was obtained before the interview began, and permission to make an audio recording was also sought. After the thirty minute interview was finished, the participant was briefed on the second phase of the study.

**Prescription data collection.** Over a period of one week the participant was required to collect and redact photocopies of prescriptions. The participant was then scheduled to attend a simulation session, one to two weeks after the initial interview, to talk about the documentation they had collected.

**Observed simulation (cognitive walkthrough).** The session lasted one hour. The participant was asked to select two different examples of therapies that had been recently prescribed, and that they had collected documentation on. For these two therapies the participant was asked to describe the steps they performed in detail, and demonstrate the programming procedure on a training pump. The programming procedure was captured on video. Only a participant's hands / arms were visible, and written consent was obtained. After each demonstration, a debriefing interview was conducted. This probed the differences between what was demonstrated versus actual practice on the ward. By demonstrating and then reflecting on practice, it was hoped that a detailed account of different work patterns would be obtained.

The same model of infusion pump is used across the hospital, although some clinical areas have different functionality enabled such as a drug library in the Intensive Care Unit, and the ability to adjust the pump pressure in Paediatrics. However, the basic programming task was the same across all of the pumps. This involved entering the VTBI value first, as mandated by the device, and then choosing to enter either the RATE or TIME value. The prescription chart / sheet and other documentation used during the programming procedure varied between the different clinical areas, as did the types of therapies administered.

### **3.4 Analysis**

For the purposes of this paper, the violation framework developed by Reason (1990) was used to categorise instances where participants varied from standard procedure. During the interviews and simulation, participants were asked to describe what the standard procedure was. The hospital guidelines for performing infusions using a pump were cross-referenced to check for incongruities. Selected situations were abstracted into scenarios enabling a description of a work practice pattern.

## **4 RESULTS**

During the first interview phase all participants suggested that using an infusion pump (as part of their current work practice) was straightforward. Overall the nurses were satisfied with the training that they received on the pump from the device manufacturer. They also talked positively about attending mandatory update sessions that outlined Hospital Trust standards and rules. When asked about what was most difficult, the focus was on correctly preparing the drug in the bag prior to using the infusion pump. The entry of values into a pump was not considered to be an especially important task step or particularly problematic. When nurses were asked where these values originated from, most said that they were already familiar with them, or that they simply retrieve values from the drug label or patient's prescription chart.

The second session with participants involved asking them to demonstrate how pumps are programmed. Based on the interview data in the first session, it was expected that there would be little variance in how pumps are used. However as was discovered, nurses 'violated' rules on an everyday basis for a variety of different reasons. After each demonstration, participants reflected on how the pump was 'actually' programmed on the ward. This revealed twenty examples of violations / adaptations. Many of the nurses admitted that they had not had the opportunity to talk about the intricacies of their work before. Although the session was scheduled for one hour, some participants were enthused and sessions frequently overran.

#### **4.1 Routine violations / adaptations**

Findings challenge the assumption that the procedure of using an infusion pump is an activity that is executed by following formalised rules set by the hospital. Routine violations were performed because nurses had to adjust and adapt their performance in response to the way the team on the hospital ward operates. As demonstrated in the examples described below, nurses have their own personal conceptualisations of safe practice. Not sharing these can result in misguided safety goals.

**Routine Violation Example 1.** Nurses with over five years of experience of using different models of infusion pumps, unsurprisingly had a conceptualisation of safe practice that was different to nurses who had only ever used the latest infusion pump model. These more experienced nurses were familiar with calculating dosages from first principles, which meant that they were happy to recalculate doses themselves. In one scenario, nurses who regularly work together administering chemotherapy made a routine adaptation to their practice so that clinic appointment times were less likely to overrun (a threat to patient safety and experience). For example, when a doctor prescribes a chemotherapy treatment to be administered to a patient over three hours, the electronic prescribing system would calculate the required rate of the infusion. The less experienced nurses would simply transcribe this rate into the device. However, because the process of starting and stopping the pump at various stages of administration takes time (e.g., when flushing bags and priming lines), the therapy would actually be delivered over a longer time than prescribed. More experienced nurses now work with the less experienced nurses, adjusting the calculated rate of infusion so that the therapy is delivered on time and the clinic does not overrun. In this case nurses are violating procedure by not entering the infusion rate value shown on the electronic prescribing system.

**Routine Violation Example 2.** Two of the nurses interviewed believed that they should always enter an infusion volume that was less than the prescribed amount. The rationale for doing so was that they did not want the drug bag to run dry (empty), which would harm the patient as air would be infused instead. However, the infusion pump is designed to stop any air (including small bubbles) from being infused. Adjusting the prescribed value is unnecessary, and makes monitoring how much therapy was intended to be delivered harder (especially problematic when a different team member takes over care). Another nurse suggested that she enters an extra 10ml when programming the pump because of bag overfill by the drug manufacturers. However drugs prepared by pharmacy are not overfilled, so this adjustment is unnecessary. These routine violations are based on misunderstandings. It was suggested by one of the matrons that we interviewed that nurses are always personally responsible for the pumps that they program, and individual approaches are rarely discussed unless there is a noticeable impact on the team's performance.

#### **4.2 Situational violations / adaptations**

Do nurses intentionally violate the formalised rules set by the hospital and regulatory authorities? We found that the nurses studied had a limited awareness of what rules they were adhering to or intentionally violating. Instead, nurses performed the work in a way that allowed for the development of informal and dynamic behaviours with patient-safety or patient-experience in mind. As described in the examples below, the use of these informal safety behaviours can fluctuate on a daily basis. This is dependent on the skill mix of the staff on a particular shift and the types of patients being treated.

**Situational Violation Example 1.** In Paediatrics it is important that nutrients delivered using an infusion pump are recorded every 24 hours. To facilitate keeping track of how much therapy a patient has received, two nurses in Paediatrics reported that they reprogrammed pumps at midnight, which resets the pump's volume infused counter. This workaround made it easy for nurses during the day to check (at a glance) how much nutrients a patient had received in a 24-hour period. A third Paediatrics nurse (who worked in the same team) suggested that re-programming at midnight is not always sensible because staffing levels are lower and sometimes less skilled, and patients might be unnecessarily disturbed.

**Situational Violation Example 2.** In an outpatient clinic setting using an infusion pump to deliver blood products can sometimes take over four hours. This can be frustrating for patients who need to return home or to work. One nurse reported that she sometimes increases the infusion rate so that patients can leave faster. This involves careful monitoring of the patient, and is a patient-safety versus patient-experience trade-off.

#### **4.3 Exceptional violations / adaptations**

Conceptualising what is meant by performance variability is not possible without appreciating that it is the intrinsic variability in everyday work that allows for resilience to threats. In the examples of exceptional violations presented below, both individuals and teams are able to adjust and adapt their performance.

**Exceptional Violation Example 1.** Some new trial therapies require scaled doses, starting small and rising incrementally. These treatments have protocols associated with them. However protocol documents are often poorly designed with unnecessary information, and are sometimes difficult to interpret. In one scenario, a nurse identified that the new trial documentation was potentially confusing, and redesigned the document to avoid the potential for error. This document was appropriated by other nurses, and worked well with no adverse outcomes reported. It transpired that the treatment in question was frequently erroneously administered at other hospitals. Nurses were aware of the need to anticipate problems and to ensure that additional resources were available in case they were needed (in this case the unofficial protocol document).

**Exceptional Violation Example 2.** On a ward an unusually large number of patients were receiving infusion therapy and staffing levels were below normal. This meant that patient infusions would finish and there would be a delay in the continuation of therapy (changing over drug bags). Nurses on the ward developed a strategy and programmed the pump so that it would alarm early, notifying nurses that the new drug bag should be prepared. This worked well until there was a shift change. Incoming nurses could not calculate how much therapy a patient had received because the pumps were programmed in a non-standard way.

## 5 DISCUSSION

The examples highlighted in this paper demonstrate the complexity and unpredictability of a healthcare work environment, and the requirement for individuals and teams to make adaptations and adjustments to everyday work. There is no standard way of working even when using equipment that is standardised throughout the hospital (all the clinical areas have the same make and model of infusion pump). The results from this study of a seemingly bounded task show that understanding performance variability is possible, but classifying adaptive behaviour by suggesting they are well-intentioned rule violations (Reason, 1990) might be naïve.

We found that the nurses studied had a limited awareness of what rules they were adhering to or intentionally violating. Instead, nurses performed the work in a way that was consistent with their own understanding of safe practice. This involved adjustments and adaptations to work in response to:

- Accepted ways of behaving within their peer group.
- Specific situations where the standard rule-based approach was not relevant.
- Making trade-offs to maximise levels of patient safety and patient experience.

Nurses do not behave algorithmically; instead they recognise cases from previous experience and adapt. This is a source of resilience. Nurses were aware of the need to anticipate problems and to ensure that resources were available in case they were needed. This awareness impacts on performance even when planning routine tasks. Nursing behaviour was not constrained by formalised rules when using infusion pumps. Instead they devised their own working practices with an implicit and sometimes wrong model of safe behaviour. Studying these working practices, and then comparing them across other clinical team members, allows us to consider which may increase the likelihood of desirable outcomes.

The informal safety behaviours identified appear to enhance the capacity of the system for resilience. Many are socially distributed and managed across the clinical team. Despite the existence of shared informal behaviours, it was also found that individuals had their own conceptualisations of safe practice. Some of these personal conceptualisations involved risky and potentially unsafe workarounds. This led to situations where some nurses were performing work tasks and violating formalised rules without thinking about or recognising the risks involved. There is a need to understand these adaptations in more detail, and to better manage the likelihood that they lead to desirable outcomes.

In the study of infusion pump use reported in this paper, it is difficult to conceive how the development of new rules and standards could replace the need for adaptive performance as suggested by Barnas (2014). Wallace and Ross (2006) argued that “Instead [...] of rules with the hidden implication ‘do this or you will be fired’, they should perhaps be offered more in a ‘these are some of the methods we have developed of doing these particular tasks here, and we have found them useful’ p219. Although the task of using an infusion pump appears relatively straightforward, there is significant performance variability between individuals who often have varied, and in some instances conflicting safety goals. When informal safety behaviours are shared, risks are open to group inspection.

## **6 CONCLUSION**

This research aimed to discover if rule violations can be studied to better understand performance variability and the capacity for resilience. Findings provide evidence that formalised rules do not constrain the performance of nurses in a way that discourages adaptive performance. Understanding why rules are violated reveals informal safety behaviours, which are central to how resilience is created and sustained.

Organisations need to better manage adaptive performance within safety-critical work environments. Healthcare practitioners have a personal responsibility for the safety of their patients. Their conceptualisation of safe practice is also personal. Thus, performance variability is intrinsic to healthcare practitioners. Our work provides evidence of situations where formalised rules have been 'violated' and superseded by informal safety behaviours. This may enhance the capacity for organisational resilience, in instances where informal safety behaviours are socially distributed and risks are open to group inspection. Better management is needed to avoid situations where safety behaviours are not shared resulting in conflicting safety goals.

*"In (the hospital)...hardly anyone knows all the extant rules, much less exactly which situations they apply to for whom and with what sanctions. If this would not otherwise be so in our hospital it would be true anyway because of the considerable turnover of nursing staff. Also noticeable to us as observers was that some rules once promulgated would fall into disuse, or would periodically receive administrative reiteration after the staff had either ignored these rules or forgotten them"* Strauss et al. (1963).

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