Nurses as a source of system-level resilience: Secondary analysis of qualitative data from a study of intravenous infusion safety in English hospitals

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ABSTRACT

Background: Deviations from local policy and national recommended best practice are common in the administration of intravenous infusions, but not all result in negative consequences. Some are the result of nurses' clinical judgement. However, little is known about such practices and their effects on the safety of intravenous infusions. Our objective was to explore ways in which nurses contribute to system-level resilience when administering intravenous infusions.

Methods: We conducted a secondary analysis of qualitative data from debriefs and focus groups from a mixed methods study of errors and policy deviations in intravenous infusion administration across 16 English hospitals. Analysis focused on nurses' contributions to system-level resilience, drawing on Larcos's et al. framework of types of resilience.

Results: Five types of system-level resilience were identified in nurses' behaviour: anticipatory resilience, responsive resilience, resilience based on past experience, workarounds and nurses performing informal 'risk assessments' in relation to how best to treat individual patients. Examples of practices contributing to infusion safety were found for each of these types of resilience.

Conclusion: Our findings suggest nurses are a key source of system-level resilience. Some behaviours that may be considered deviations from policy or best practice are the result of reasoned clinical judgement to improve infusion safety in response to the specific situation at hand. Adaptive behaviour is necessary to cope with the complexity of practice. There is a tension between standardisation and supporting flexibility in safety management.

What is already known about the topic?

- Deviations from policy are common in the administration of intravenous medication, but not all deviations result in negative consequences.
- Some deviations from policy are the result of clinical judgement and calculated decisions made by nurses.
- A "Safety-II" perspective emphasises the ability of systems to succeed under varying conditions and humans are a necessary resource for system flexibility and resilience.

What this paper adds

- Focusing on nurses' contributions to resilience in intravenous infusion administration, our findings validate three of the four types of resilience presented by Larcos et al. (2016): anticipatory resilience, responsive resilience and resilience based on past experience.
- The fourth type of resilience suggested by Larcos et al. (2016), attentive resilience, was found to underpin all types of resilience.
- Our study reveals two further themes in the context of resilience: workarounds for policies perceived to be unfit for purpose and nurses performing informal 'risk assessments' in deciding how best to treat individual patients.

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1. Introduction

Nurses undergo training, education and lifelong learning to provide safe and high quality care (Gopee, 2005; ten Hoeve et al., 2013; Tucker and Spear, 2006). In nursing education, problem-solving is emphasised and is often presented as a systematic process in which one moves from assessment to evaluation of the effectiveness of an intervention (Tanner, 2006; Tucker and Spear, 2006). However, daily nursing practice is often more complex than this linear picture suggests. In practice, the planning and implementation of nursing interventions such as intravenous infusions require clinical judgement, and thus interpretation of the situation by the nurse (Tanner, 2006; Tucker and Spear, 2006). As a result, the actions that follow demand that standard approaches be modified or new approaches improvised according to the patient's response (Tanner, 2006). This flexibility and variability in clinical work can result in a gap between 'work-as-imagined' (e.g. as defined by management in policies) and 'work-as-done' (e.g. as experienced by staff on the front line) (Blandford et al., 2014; Braithwaite et al., 2017; Hollnagel, 2014), but such flexibility and variability are of paramount importance to achieving safer practice (Hollnagel et al., 2015). Essentially, mechanistic responses in complex systems are inadequate to cope with competing goals, underspecified rules and surprises.

In the context of intravenous infusions, non-compliance with policy is generally assumed to be a deviation from best practice. However not all policy deviations lead to negative consequences for patient care and some arguably support safer practice (Larcos et al., 2016). Recognising these issues, researchers such as Larcos et al. (2016) have examined system level 'resilience' in other healthcare contexts, on the part of both individuals and systems, and argued that safety is best achieved by promoting flexibility rather than simply by protocol compliance. The definition of Hollnagel (2013) further clarifies the term resilience as *"the intrinsic ability of a system to adjust its functioning prior to, during, or following changes and disturbances, so that it can sustain required operations under both expected and unexpected conditions"*. This entails what is sometimes referred to as a "Safety II" perspective. In contrast to a "Safety I" approach that focuses on what goes wrong (incidents), Safety II focuses on what goes right (normal work), and why, by emphasising the ability of systems to succeed under varying conditions and in which humans are a necessary resource for system flexibility and resilience (Hollnagel et al., 2015). Performance variability is a key concept for Safety II. Faced with competing goals, underspecified rules and unexpected events, people need to adjust their performance to succeed. This means that some adaptive capacity is essential to cope with the complexities of practice.

This study is a secondary analysis of data from a project exploring the nature and causes of intravenous infusion errors in 16 English hospitals ('ECLIPSE'). Full details, including the sampling strategy, are described elsewhere (Blandford et al., 2016). Lyons et al. (2018) report quantitative observational findings comparing what was being infused against what was prescribed to identify errors and other deviations from local policies and procedures. Furniss et al. (2018) investigated the gap between policy and practice in intravenous infusion administration in more detail. It was concluded that errors and more minor deviations in practice were common, with considerable variation among hospitals, but most had low potential for patient harm (Furniss et al., 2018; Lyons et al., 2018). The quantitative data collection was supplemented by qualitative focus groups and debrief discussions at participating hospitals, with a focus on exploring the context and reasons for the errors and deviations identified. Topic guides are provided in the appendix. Initial analysis by Furniss et al. (2018) and Lyons et al. (2018) suggested that many deviations from best practice concern nursing practice that contributes to, rather than reduces, the resilience of the system. We therefore wanted to examine this in more detail. The objective of this secondary analysis was to conduct a more detailed analysis of the ECLIPSE data to explore ways in which nurses contribute to system-level resilience in relation to the safety of intravenous infusions.

2. Methods

We conducted a secondary analysis of the focus group and debrief data collected as part of the ECLIPSE study in 16 National Health Service hospitals in England (Blandford et al., 2016). Approval from a National Health Services Research Ethics Committee (14/SC/0290), the Health Research Authority and each participating site were obtained for the original data collection. The present study is reported according to the consolidated criteria for reporting qualitative research (Tong et al., 2007).

2.1. Data collection

The 16 hospitals comprised a range of hospital types (teaching, district, specialist children's hospitals and cancer centres) and clinical areas (general medicine, general surgery, critical care, paediatrics and oncology) as described elsewhere (Blandford et al., 2016).

After completion of quantitative data collection at each participating site, we sought to better understand the outcomes observed by conducting explanatory data collection (Furniss et al., 2018; Lyons et al., 2018), using an approach based on interpretative description. First, a debrief meeting took place with the site observers to review the data collected. Second, a focus group was held at each site with key members of staff (e.g. ward managers, nurses, nurse educators), to elicit their reflections on errors and deviations identified at their site, exploring staff training, use of equipment, and use of policy and guidelines. Focus groups and debriefs were conducted by Furniss and Lyons, both postdoctoral researchers with experience in qualitative data gathering who were external to the study hospitals. During debriefs and focus groups, participants were provided with a report of the quantitative findings for their site, and the reasons and rationale behind any errors and deviations were explored. Debriefs focussed mainly on clarification and explanation of the data with the observers responsible for data collection. The focus groups then allowed a wider group of participants to discuss the findings and share their understanding of the causes and context of errors and deviations. Debriefs at 13 of the 16 hospitals and focus groups at 14 hospitals were audio recorded and transcribed verbatim. Detailed notes were taken for the remainder. Debriefs lasted a mean of 71 min and focus groups 88 min. 2–4 people participated in debriefs; 3–12 participated in focus groups (mean 6.2). Transcripts were not returned to participants for checking.

2.2. Data analysis

Analysis of the study's debrief and focus group data involved four main stages. Upon receipt, the transcripts were checked for accuracy and anonymity. During this process, annotations were made for notable fragments. Second, a summary report was created about each hospital based on the transcripts, highlighting key themes. Third, each transcript was independently coded line-by-line by one of three researchers with different backgrounds (human factors in nursing, computer science, and information systems). Coding was supported by NVivo. Building on the previous paper by Lyons et al. (2018), which identified nurses as a source of resilience, the analysis described in the present paper focused on this key theme: the kinds of behaviours exhibited by nurses

Table 1
Types of system-level resilience as described by Larcos et al. (2016).

Type of resilience	Description
Anticipatory resilience	Proactively making a decision or taking a course of action that has an expected consequence in a given situation.
Responsive resilience	Reacting effectively when a situation changes.
Resilience based on past experience	Drawing on existing knowledge to influence the sequence and nature of work activities.
Attentive resilience	Taking appropriate action considering the situation at hand.

that contribute to quality and safety of intravenous infusions. Initial inductive analysis suggested commonalities with the four types of resilience described by Larcos et al. (2016) (Table 1), as derived from Hollnagel (2009). Consequently, the fourth and final stage of analysis was a deductive analysis of how nurses' behaviour contributed to system-level resilience based on this framework. Two members of the team further checked the coding against this framework.

3. Results

We identified many different types of behaviour on the part of nursing staff that led to system-level resilience, summarised in Table 2. These accounted for three of the resilience themes presented by Larcos et al. (2016): anticipatory resilience, responsive resilience and resilience based on past experience. Larcos et al. (2016) also described attentive resilience in which appropriate action was taken considering the situation at hand, which we conceptualised as underpinning all of the examples we identified rather than being a separate category. Therefore, attentive resilience was excluded as a separate theme in our analysis. Our analysis also revealed two further themes: workarounds for policies perceived to be unfit for purpose and nurses performing informal 'risk assessments' in relation to how best to treat individual patients. Each of these five themes are next presented in turn.

3.1. Anticipatory resilience

Based on the cornerstones of resilience presented by Hollnagel (2009), Larcos et al. (2016) define anticipatory resilience as proactively making a decision or taking an unusual course of action that has an anticipated consequence in a given situation. This accounted for some of the deviations discussed in the debriefs and focus groups. For example, nurses reported taking action to save time on low risk infusions so that they could allocate more time to high risk infusions (e.g. chemotherapy). In other cases, nurses reported making changes to infusion rates if this was judged to be in the best interests of the patient, which could have been classed as a deviation. Recognising this, participants suggested that prescribing an infusion with the infusion rate expressed as a range might provide more flexibility to respond to patients' conditions where appropriate.

"You may have it on neonatal intensive care unit or someplace but we do it on ITU [intensive therapy unit] we get a range of an infusion, we'd get one to ten depending on what the patient's needs are. [...] The prescription doesn't have to get rewritten and the nurse can play around with the medication in the middle." (Site F)

Some trusts had detailed policies stating how intravenous infusion giving sets should be labelled and what information should be included; others did not have such policies in place. Practice in terms of giving set labelling (informally known as tube tagging

or line tagging) also depended on the ward and the type of infusion (intermittent versus continuous). Intensive care units were often mentioned as areas where nurses labelled giving sets to make practice safer (e.g. by differentiating lines) even if there was no requirement to do so.

"... I think you find on ICU [intensive care unit] that it is made standardised practice, to have a line tagging in place. [...] And it is our [informal] policy in critical care, and we always train new nurses to label all the lines. [...] Because obviously, wherever you got multi-lumen central lines etc., etc., you know, obviously you'll find lines hanging off it you [...] It's difficult to identify which is which where it gets near to the patient, so obviously at that point, line tagging is absolutely essential to see what's on what line going into the central line etc. [...]". (Site D)

Occasionally proactive practice when setting up infusions could also cause apparent deviations from best practice. For example one of the nurses reported that the use of blood giving sets for other types of infusion could be considered a deviation, but this may reflect critical care nursing staff anticipating that patients may urgently need blood products in the near future.

3.2. Responsive behaviour

Responsiveness is defined as reacting effectively when a situation changes (Larcos et al., 2016). Nurses reported not following a medication order if it was not possible to administer the medication exactly as prescribed. For example, when a prescribed volume of fluid (such as 1000 ml) was not currently available, nurses described modifying their practice based on what was available (such as giving two bags of 500 ml). This ensured the patient still received their prescribed treatment, although the medication order was not always updated to reflect what was actually given. Nursing staff perceived that this would result in delays and so they had to make a choice between interrupting or delaying treatment until a valid prescription was available, or starting treatment without the medication order precisely matching what was given.

"So they did only have 500mls available? So they needed to give a litre, so they split the prescription, not the prescription, but they split where they signed by 500mls and they gave 500mls, so they signed it twice, 500 ml bags against the prescription that is one litre. ..." (Site B)

Frequently, patients' conditions fluctuated and required nursing staff to think critically about the medication prescribed. In such cases, improving the safety of intravenous infusions might mean the patient no longer needed the drug or amount that was initially prescribed. Safer practice in these instances would require that nurses adjusted their plan according to the changing situation, based on their clinical judgement and preferably informing the prescriber, but those actions could lead to a deviation from what was prescribed (particularly if there was a delay in updating the documentation).

"[...] the prescription there for [noradrenaline] for example, but if it's not required we stop it. So in that situation it could be a discrepancy as well because the medication order is signed to be given, but we're not giving it because of clinical judgement." (Site B)

Patients' clinical conditions also affected nurses' judgement as to how to interpret the medication order; for example, by adjusting the concentration of a drug.

"I think what happened is [the] patient had deteriorated, so rather than getting loads and loads of fluid through the noradrenaline they increased the concentration of the noradrenaline. So rather

Table 2

Examples of nurses ensuring that system goals are managed safely and effectively in intravenous infusion therapy.

Example	Resilience themes
Greater attention is given to medications some nurses perceived as being higher risk, such as insulin and chemotherapy.	Anticipatory Nurses performing own risk assessment
Using a blood giving set to run fluids when they are anticipating a patient may need blood.	Anticipatory Responsive
Nurses adjust their action (e.g. 2 × 500 ml bags of fluid) if the product ordered by the prescriber (e.g. a 1000 ml bag of fluid) is not available.	Responsive
Nurses may increase the concentration of an infusion if needing to reduce the amount of fluid the patient is receiving.	Responsive Past experience
Nurses sometimes question prescribers if they perceive mistakes are being made in prescribing.	Responsive
Nurses are resourceful in searching through different charts when patients are transferred from one area of the hospital to another, as any infusions already in progress might be prescribed on different charts or different systems. Nurses use their clinical judgement in continuing fluids as in the best interest of the patient while waiting for doctors to write a new prescription.	Anticipatory Past experience
Keeping a medication order active when it is no longer required, such as for noradrenaline in critical care, in case the blood pressure falls and the medication needs to be restarted.	Anticipatory Responsive
Labelling of giving sets is seen as making practice safer in critical care areas where patients have multiple infusions, even if not required by local policy.	Anticipatory Responsive Past experience
Following verbal orders (for example a verbal decision on a ward round to start a medication) although the medication order will not be written until the prescriber has time.	Responsive
Adjusting the times at which infusions are given in order to space infusions at appropriate intervals when an earlier infusion started or finished late.	Responsive Nurses performing own risk assessment
Working around policies perceived to be impractical (e.g. giving small volume sodium chloride flushes without a medication order, as it was perceived to be impractical for them to be individually prescribed).	Workarounds
Additive labels not being fully completed, such as with details of batch numbers, if the infusion is only due to be up for a matter of minutes.	Workarounds Nurses performing own risk assessment
Nurses perceive it is less important/risky for patients not to be wearing an identity band if they are oncology day case patients who can communicate effectively, if they are known to staff, or only receive fluid replacement rather than other medications, and therefore might choose to focus on getting higher risk patients to wear them.	Nurses performing own risk assessment

than giving an 8 mg syringe driver they gave 16 mg syringe driver. So with regards to the prescription, it was still within that… um range, but they just increased the concentration of the medication to give them less fluid and so the medication doesn't run out as quick. So they're still getting the same dose, but just a more concentrated form [… (Site F)

There were other situations in which deviations from the medication order were identified as a result of nurses acting in the patient's best interest. These included occasions on which one of several infusions was delayed to avoid risks of administering incompatible infusions via the same intravenous access, where verbal orders were given, or where nurses had requested doctors to makes changes to the medication order, but this could not be done.

"…we saw somebody put up a fluid and there was no prescription for it […] well they'd increased the fluids overnight, overnight there's skeleton staff, [name] had requested a prescription to be written, but it hadn't. […] at the moment the surgical team were in theatre, there's nobody to come and write a prescription […] so what do you do, do you just not put up the fluid that the child needs?" (Site I)

In addition, patients might have been away from the ward for tests, which led to nurses having to 'catch up' with infusions. In situations like this, nurses aimed to provide safe practice while dealing with competing priorities, all of which could have an impact on the patient's condition.

"So that then you would delay the next dose… […] But, you know, then you still try and work to try and get it back on track otherwise you end up totally out of sync. One dose is going to have to be given a little bit earlier then, just to get it back on track." (Site C)

Prescribing errors were not the focus of our study. However, our data also suggest that nursing staff sometimes improved infusion safety by questioning medication orders if they thought a mistake might have been made.

"[…] it's very clear in our policy that if it doesn't match [prescription and smart pump drug library], then, speak to your ward pharmacist. Speak to a pharmacist or speak to the prescriber to challenge that prescription. It's very clear in our policy that we don't just hope for the best." (Site K)

Analysis of the above example showed that in this particular case, the enquiry led to the medication being given correctly, but the prescription had not been adjusted. However, an example was also found where an unusual prescription was given by the nurses as per usual which was, with hindsight, in that case not the right course of action.

"Interviewer: […] Tazocin which was prescribed over three hours which apparently is quite unusual."

"Participant: We found out if they'd given it as a bolus because they didn't really understand the prescription so they just did it in the normal way." (Site G)

3.3. Past experience

This was defined as drawing on existing knowledge to influence the sequence and nature of work activities (Larcos et al., 2016). Apart from the current situation in which nurses were working, their approach to infusion safety seemed to differ according to their familiarity with the infusion, their training and previous experience.

Often, different medication charts and prescribing systems were used within the same hospital, leading to apparent deviations because the relevant medication order could not be found by the observers. If patients had transitioned through the hospital they might have arrived from another clinical area with infusions running. In these cases, nurses knew they had to scrutinise the pa-

tient's documents to find the original medication order to provide safe infusion therapy.

> *"And you have so many different charts, as well. For instance, you get a kid from [unclear], they have a different drug chart in A&E [accident and emergency], and he goes to [another ward] and gets a different drug chart. Gets worse and goes to ICU [intensive care unit], has another different drug chart. Or goes to theatre then to ICU, and you've got some drugs that are written on some piece of paper in illegible writing. [...]You can't find it. You're relying on what people have told you beforehand." (Site L)*

Infusions started in another clinical area might have been prescribed on a different document, and/or not yet re-prescribed onto the relevant documentation for the new area. If medication was not yet re-prescribed, nurses were left to decide between not providing further infusions or continuing the medication and requesting a new medication order later.

3.4. Workarounds

We identified several examples where nurses consciously worked around policies that were perceived to be inefficient or unworkable with the aim of supporting effective and timely patient care. For example, although verbal orders were not permitted, staff often acknowledged that practice deviated from policy in this respect.

> *"Our medicines policy is perhaps a bit naïve in saying we should not do verbal orders. Which is fundamentally what it says at the moment. And then perhaps we do need to go back to revisit where verbal orders are taken, which would be additional, you know." (Site D)*

> *"Often we'll [medical team] walk around and say can we give another fluid bolus, and we'll walk off because we're busy, and we'll say that's allowable for two boluses, and then needs a formal signature. And then two further boluses can be given like that, repeatedly. Because we were just finding that [...] for the nursing staff to hunt us down to try and get a signature would consume a lot of their time." (Site H)*

Staff at some hospitals had created more formal workarounds in relation to administration of small volume flushes such as 10 ml 0.9% sodium chloride, as they did not feel it was realistic that these were individually prescribed. While some hospitals used patient group directions (NICE, 2017) to allow nurses to administer flushes to pre-defined groups of patients, and some used pre-filled syringes licensed as medical devices rather than medicines, others reported it to be 'common practice' to give flushes that were neither prescribed nor covered by a patient group direction.

> *"Yes. It happens across the trust. [...] Because, the trust doesn't want to pay for the expense of medical devices because obviously it costs [...]" (Site D)*

> *"Practically, the number of prescriptions that would have to be written for saline flushes, we did look at this would it be possible to have a patient group [direction], but then we got medical devices that are used for saline flushes and you've got saline flushes, so do we have a PGD [patient group direction] just for those times that you don't use a medical device." (Site I)*

The use of additive labels to specify anything that has been added to an infusion was noted as a mechanism to improve the safety of intravenous therapy. Some hospitals used pre-printed additive labels with blank boxes that had to be completed by the nurse. However, additive labels were not always completed in accordance with policy. Several reasons were given for incomplete or missing labels; these included saving time on low risk infusions

and the perceived irrelevance of some of the requested information, particularly batch numbers.

> *"Participant 1: So, the batch number should go on the documentation that you keep, whereas putting a batch number on a label that you're putting a bag up, you give it an hour, then you throw it in the bin. What is the point in that, surely?*
>
> *Participant 2: Some of my infusions are ten minutes. So, by the time you... Through two pages worth of paperwork to get a ten minute bag up..." (Site B)*

3.5. Nurses performing risk assessments

We identified examples of nurses performing their own informal 'risk assessments' in how best to use their time in supporting safe care. For example, although incomplete additive labels were not deemed good practice, nurses reported this as a way of freeing up time to focus in greater detail on higher risk infusions. On occasions nurses did not label giving sets, even when there was a policy requiring it. The perceived risk of not labelling giving sets differed depending on the type of infusion (e.g. replacement fluid versus a specific drug).

> *"I don't know if they tag all of the fluids necessarily. They tag all of the infusions of drugs because they want to make sure that when they change a syringe or the vial that they're connecting the right to the right. But I don't know if they would do it necessarily with IV [intravenous] fluids, which is probably something we need to pick up." (Site P)*

Although most participants acknowledged the importance of patients wearing identity bands for safe intravenous therapy, it was perceived that some situations did not allow patients to wear them (e.g. emergency) or made it difficult for them to be issued (e.g. broken printer, limited availability of staff). In these instances, nurses might have to make a decision between breaking the policy stating an identity band was necessary for treatment versus not giving a treatment that a patient needs urgently.

> *"... there were times in [emergency department] when you'd come for [resuscitation] and you wouldn't get your ID [identity] bands." (Site N)*

In practice, the risks associated with missing patient identity bands were felt to differ depending on the patient. Specifically, risks were perceived to be lower for inpatients who were alert and able to confirm their identity verbally, 'known' oncology outpatients, and patients receiving fluids rather than other medications.

> *"it all depends what they receive, if they just have fluids it [identity band] probably doesn't matter, yes, whether it's the right patient or the wrong patient, unless they have sort of cardiac failure etc., but you don't want to give the chemotherapy to the patient or things like that, or any medication which has more implications." (Site B)*

However, as the following quotation illustrates, such risk assessments may not always be appropriate, given that intravenous iron is also a relatively high risk medication.

> *"[...] we almost never make a chemotherapy error that I know of but we'll make errors with other things, you know. Because, again, that, sort of, attention to detail and the seriousness of doing, like, you probably would never make an error with insulin, or, you know... Because you, you can't... You just can't make errors with that stuff, but you can make an error with an iron infusion. [...]" (Site B)*

4. Discussion

Our data suggest that nurses are key contributors to system-level resilience, i.e. rather than mechanistically following rules they adapt and cope with the complex realities of practice. A review by Parry et al. (2015) identified factors that contributed to nurse medication administration errors and they suggested that greater attention has traditionally been given to the contribution of the environment to medication errors; such as the nurse's workload, interruptions and distractions, the complexity of patients and the leadership within the organisation. They argue that little attention has been focused on the interaction between the nurse with their environment and how this can change the nurse's behaviour to cause error. In this paper we have identified how nurses interact with a changing environment and alter their behaviour to improve safety, by acting with greater autonomy. We identified examples of three of the four types of resilience suggested by Larcos et al. (2016), as originally derived from Hollnagel (2009). We suggest that their fourth resilience type, attentive resilience ("*Taking appropriate action considering the situation at hand*"), can instead be considered as an overarching theme. We also identified two further types of resilience: workarounds, and nurses performing their own risk assessments in making best use of their time. The differences between Larcos's et al. and our classification may relate to the taxonomy used by Larcos et al. (2016) being originally developed to describe system-level strategies in general (Lundberg et al., 2009) rather than individuals' contributions to system-level resilience in a healthcare setting.

In line with Tanner (2006), our study illustrates that nurses use a variety of reasoning patterns when judging individual clinical situations. For example, nurses weighed the advantages and disadvantages of waiting to start or continue infusions until everything conformed to policy (e.g. a medication order adjusted or a flush prescribed). Farre et al. (2017) reported that nurses contribute to medication safety in paediatrics; our data suggest that this is also the case in adult settings. Our analysis focused on how nurses contribute to resilience (e.g. through workarounds and efficiency-thoroughness trade-offs) but also revealed at least one example where nurses' decision-making could have contributed to unsafe care. Acknowledging the need for adaptation to create safety in complex systems is not without its downsides: this same source of everyday success can also lead to failure (Hollnagel, 2012).

Our data also suggest that some behaviours that might be considered deviations from policy or best practice result from reasoned clinical judgement by nurses with the aim of improving patient care. We do not advocate deviating from policy or best practice; rather, we highlight what nurses are doing in practice and reflect on what this might mean for managing safety. In this regard our approach has been informed by a Safety-II approach (Hollnagel et al., 2015), which encourages one to engage with the 'messy' world of 'work as done' and focus on how people contribute to the system performing successfully. This contrasts with a Safety-I approach that focuses on what goes wrong, and might design ill-fitting procedures based on a simplified notion of 'work-as-imagined', and/or chastise those who deviate from policies and procedures. The mature view of policy and procedure management is to create organisational processes that draw together work-as-imagined and work-as-done so that management and frontline staff have a shared and realistic understanding of how work is being conducted, with the associated trade-offs and risks (Hale and Borys, 2013; Wears and Hunte, 2016).

Our findings raise questions about how to balance between standardisation and adherence to rules on the one hand and flexibility and adaptation on the other. There is a need to explicitly identify where policy and standardisation are supporting resilient performance, and how policies are best framed to accommodate the complexities of practice and the realities of work as done. Nurses spend considerable time trying to cope with complexity and degradations in the system as part of their everyday clinical work. Some examples of nurses' resilience resulted from complexity that could be eliminated. For example, greater standardisation and integration of prescribing systems within the same organisation would allow nursing staff to focus on other aspects of patient safety. Similarly, electronic prescribing would allow alterations to prescriptions to be performed away from the patient's bedside. In line with other studies (Furniss et al., 2018), our findings in relation to workarounds also suggest that some policies should be reviewed to better align with clinical practice. This might include giving nurses greater autonomy to make minor changes to medication orders or to administer flushes in line with an agreed scope of practice. If systems are able to pinpoint where policy adjustments are needed, repeated workarounds could be decreased. A national policy for intravenous medicines would avoid the need for nurses to learn a new set of local instructions each time they move to a new Trust. Taking more of a Safety-II approach that emphasises the necessary flexibility and adaptation in the system rather than solely looking towards eliminating variability through standardisation and technological support, one might ask how we equip nurses to make appropriate trade-offs and better informed risk assessments, and how to manage workarounds. This alternative and complementary strategy could improve system-level resilience but further work is needed to explore how a Safety-II approach can be operationalised to improve patient care. This study has identified areas for attention related to intravenous medication administration.

5. Strengths and limitations

Our methodological approach, drawing on qualitative debriefs and focus groups following quantitative data collection, allowed us to develop a more nuanced understanding of how nurses contribute to system level resilience rather than focusing on deviations from policy and best practice. However, the origins of the data, starting from observations of deviations, meant that examples of resilience that were noted were those associated with deviations. A further limitation is that attendees at the focus groups and debriefs were self-selecting and may not represent the full range of healthcare professionals across different grades and clinical areas. While we asked open questions in a non-judgemental manner and maintained anonymity, it is also possible that responses were subject to social desirability bias. Finally, the original coding of the transcripts was not formally checked by multiple researchers, although several members of the research team checked the coding against the framework presented in this paper.

6. Conclusion

Nurses are a key source of system-level resilience in improving the safety of intravenous infusions. Our data suggest that at least some behaviours that might be considered deviations from policy or best practice are the result of reasoned clinical judgement made by nurses with the aim of improving patient safety. Intravenous infusion safety therefore cannot be entirely captured by focusing on error and adherence to policy; clinical practice is more complex. Incorporating a Safety II approach, recognising that the workarounds and informal risk assessments that nurses make to maintain safety may add resilience to intravenous infusion administration, should inform future evidence based practice, to better align work as imagined and work as done.

Conflict of interest

None.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.ijnurstu.2019.103468.

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