Exploring Work System Factors Contributing to Nurse Drug Administration Errors

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SUMMARY

Double-checking medication, particularly in the paediatric and neonatal setting, is a widely used intervention for the reduction of medication administration errors and is standard practice in most UK hospitals. A systems analysis was undertaken with paediatric and neonatal nurses at a large NHS teaching hospital to understand the key challenges influencing the drug administration and the second checker process, and to support work system recommendation development. A qualitative explorative approach using the SEIPS 2.0 model was adopted for three focus groups and eight semi-structured interviews. In addition, a process map was generated and a Hierarchical Task Analysis conducted, identifying barriers and enablers specifically for the second-checker task and nurse involvement. To further validate the qualitative results, a review of reported drug administration incidences within the Family Health division was conducted. A variety of sociotechnical barriers were identified that currently hinder both the primary nurse and second nurse checker in this process. The task analysis identified differences that occur in practice when compared with the local standard operating procedure. An example of a barrier unique to the second nurse checker centred on the second nurse not challenging the primary nurse if there was a discrepancy in calculations. This work provided an enhanced understanding of the issues nurses' face and how these interact and affect their day-to day role. Recommendations arising from this work were wide ranging, highlighting that to try to resolve issues within a process, it is imperative that multiple areas are focused on.

KEYWORDS

Drug Administration, Systems Analysis, Hierarchical Task Analysis

Introduction

Double-checking medication, particularly in the paediatric and neonatal (NNU) setting, is used as an intervention to prevent or reduce medication administration errors and is standard practice in most UK hospitals. Although within the paediatric inpatient setting, systematic reviews demonstrate the high prevalence of medication errors (Gates et al., 2019, Sutherland et al., 2019), and double-checking medication is common practice. Studies evaluating the effectiveness of double checking to reduce medication administration errors have concluded there is insufficient or no evidence that the double-check process versus single checking is associated with lower rates of medication administration errors (Koyama et al., 2019, Westbrook et al., 2021).

At Nottingham University Hospitals NHS Trust (NUH), the standard is to have two registered health care practitioners, both check all steps of the medication administration process for children under 18 years (or 16 years if nursed on a non-paediatric ward). Where a calculation is

involved, both practitioners must perform an independent calculation and then share their individual calculation result to confirm accuracy. Both practitioners are to sign the prescription chart. Despite this standard, there have been several, significant administration medication errors, reported within the paediatric and NNU setting, resulting in patient harm. As a result, this piece of work aimed to identify work system factors and gain a better understanding of the key challenges paediatric and NNU nurses face in their day-to-day role, which may contribute and lead to drug administration errors, to support work system recommendation development.

Method

Work system factors were explored with paediatric and NNU staff using a qualitative explorative approach to understand the key challenges and system components influencing the drug administration and second checker process. A total of three focus groups and eight semi-structured interviews were conducted with eighteen paediatric and eight neonatal nurses at NUH between October to November 2023. The Systems Engineering Initiative for Patient Safety (SEIPS) 2.0 model (Holden et al., 2013) was used to form the theoretical foundation for data capturing processes. A deductive thematic analysis (Braun & Clarke, 2006) was undertaken to determine the common themes across the focus groups and semi-structured interviews, categorising the themes into the SEIPS 2.0 model work system factors. Work system factors identified were further classified into issues that were having a direct impact on the drug administration process and those that were indirectly influencing the process.
The nursing staff covered a variety of clinical specialities within the paediatric setting. Most of the participating nurses had between two- and five-years nursing experience, although a small proportion had extensive nursing experience (twenty years and above). Additional details of the participants and sessions held are included in Table 1.

Table 1: Participant characteristics for the three focus groups and eight semi-structured interviews

Staff group	Session	Number of Participants	Years of Registration (Range in years)	Median Years of Registration
Paediatric nurses	Focus groups (n= 3)	18	2-37	4.5
NNU	Semi-structured interviews	8	<1-34	3

A review of 768 reported Datix (a web-based incident reporting and risk management software used in many hospitals in the UK) drug administration incidents within the Family Health Division were also reviewed. Possible sociotechnical factors that may have contributed to the incident were noted and a deductive thematic analysis was undertaken to determine the common themes, categorising them into the SEIPs 2.0 model work system factors to further validate the qualitative data.

In addition, a process map was generated using the qualitative data and the local standard operating procedures (SOPs) on medication administration to identify the necessary tasks to be undertaken during a two-nurse drug administration process. A Hierarchical Task Analysis (HTA) (Shepherd, 1998) was conducted to create a detailed representation of each action required in each step of the drug administration process. The HTA was then used to map the identified barriers and enablers specifically for the second-checker task and nurse involvement.

Results

A wide variety of sociotechnical barriers were identified that currently hinder both the primary nurse and second nurse checker in the drug administration process. These included nurse fatigue (SEIPS: person component), managing the demands and interruptions from patients, their relatives and other health care professionals (SEIPS: person component) and a lack of NUH hand-held devices (SEIPS: Tools and Technology component). Poor internal environment factors included high temperature, noise, overcrowding and excess medication stocked within the clean utility rooms and nursing bay (SEIPS: Internal Environment component), along with a lack of nursing staff and managerial support (SEIPS: Organisation of Work component) created a challenging environment for nurses. Additional information around the identified sociotechnical barriers can be found in Table 2.

The findings on the barriers identified in the focus groups and interviews were supported by the results from the analysis of the 768 Datix reviews. Where incidents identified work system barriers as contributing to medication errors, these mirrored the sociotechnical factors identified in the qualitative data. The most common sociotechnical issue cited attributing to an error was sub-optimal staff levels (SEIPS: Organisation of Work component). Poor communication between staff and patients/relatives (SEIPS: Person component), poor nursing handovers (SEIPS: Task component), along with high and competing workload (SEIPS: Task component) and staff inexperience (SEIPS: Person component) were also frequently listed as potential contributory factors to a drug administration error.

Table 2. Sociotechnical Barriers Identified in the Drug Administration and Second Checker Process

Work system	**Barriers**
Person – Health Professional	Interruptions, staff fatigue, staff confidence
	Poor handwriting on medication cards
Person - Patient	Acuity of patient, Patient not wearing wrist bands
Person - Family	Pressure and interruptions from family
Task	High and competing workload and demands
Tools & Technology	Lack of devices, difficulty locating necessary equipment e.g. reference sources & keys
	Difficulty using and interpreting digital app
	Medication cards – off ward, multiple cards in use
Internal Environment	Utility room location and layout – crowding, not fit for purpose
	Ward layout and environment – crowding, high noise levels & temperature
Organisation	Staff levels, loss of experienced staff and skill mix of staff
	Poor communication, assignment of staff tasks
	Pharmacy opening times at weekends and out of hours, clinical support out of hours
	Timing of organisational procedures e.g. Delivery of intravenous Total Parenteral Nutrition (TPN), nurse shift patterns
	Cultural attitude to questioning senior staff
	Lack of support from senior management, expectations of senior staff
External Environment	Time of time e.g. day vs night

Conversely, nurses identified enablers within the work system. These included patients being well known to the nursing staff e.g. a long-stay patient or a frequent attender, as nurses felt drug

administration was easier due to familiarity with the patient's medication regimen. Parents supporting the nurse by undertaking oral medication administration to their child where applicable or parents understanding the ward environment and making less demands and interruptions on the nurse also helped to free up a nurse's time. A suitable skill mix of nurses (including agency staff) on a shift allowed all nurses to undertake second checks and administer intravenous medications in a timely manner. A nurse's confidence to challenge the first nurse if they felt mistakes had occurred was also viewed as an enabler to the second check process.

The HTA identified differences that occur in practice when compared with the local SOP. These included where medication was prepared (SEIPS: Internal Environment component), preparing medication before the second nurse check occurred, the second nurse not always witnessing medication administration and not signing the medication card immediately post administration (SEIPS: Task components). Interviewed nurses knew the correct two–person check procedure but consciously deviated from the recommended procedure to enable them to fulfil other tasks. This highlights the everyday 'trade-offs' that nurses must make to enable them to complete all their patient related tasks. The trade-offs staff made should not be seen as deviations from the SOP as a choice, but rather because of trying to balance the demands of the work system, the task requirements and potential risks. As a result, the possibility of trade-offs should be considered when designing SOPS to enhance safety.

Key issues identified directly impacting the drug administration process centred around the lack of nursing staff, staff mix on a shift (SEIPS: Organisation of work component), competing nursing staff tasks and multiple high acuity patients on the general wards (SEIPS: Task and Organisation of work components). Other direct issues included suboptimal medication preparation area (either the clean utility room or preparation by the baby's bedside), which were often too hot and crowded, conditions on the ward (SEIPS: Internal Environment component), poorly written medication cards and interruptions by other healthcare professionals, family and patients (SEIPS: Person component).

Issues identified by nurses which indirectly impacted the drug administration process included lack of management support, lack of training for staff returning after taking maternity leave/career breaks (SEIPS: Organisation of work component) and not addressing potential language barriers for nurses where English was not their first language (SEIPS: person component). Inadequate nursing breaks were commonplace (SEIPS: Organisation of Work component), with nurses often reporting there was not a suitable staff room, which increased nurses' fatigue and mental stress.

Barriers unique to the second nurse checker centred on the second nurse not challenging the primary nurse if there was a discrepancy in calculations, often due to confidence issues with the second nurse checker or, cultural differences where a junior second nurse checker would not challenge a senior colleague (SEIPS: Person component). The nurse second checker provides a safety check, if the above occurs then a safety component of the drug administration process has been breached. However, the second nurse check was perceived as a positive safety measure in the drug administration process, and it was recognised as an independent check.

A range of recommendations were made to address the different work system barriers identified. These included internal work environment considerations and included reviewing stock lists on each paediatric ward and neonatal areas to help try to optimise medication storage and aid selection of medication for nursing staff, along with temperature audits on clean utility rooms, so areas that were too hot could be targeted. Tools and technology recommendations included a range of interventions from increasing the number of handheld devices and chargers on Paediatric/Neonatal wards to the introduction of Electronic Prescribing and Medicines

Administration (EPMA) within paediatrics to circumvent issues identified around handwritten/unclear medication cards and the availability of medication cards on wards. Organisational considerations included increased training for new and returning staff, setting up a paediatric/neonatal working group with the aim of further exploring which medications could be made exempt from a second check and/ or two nurse administration with the long term objective of trialling a paediatric ward with any outcomes, and a review of patient acuity versus staff level ratios to determine the optimal staff level mix on each ward. Finally, to address the person component barriers identified, a recommendation to introduce cultural awareness courses for all nurses to try and increase understanding and confidence around challenging more senior nursing staff if second checker was made.

Discussion and Conclusion

This work aimed to gain an understanding of how errors occur from a systems perspective when undertaking medication administration requiring a two-person check, rather than just attributing blame onto individual staff. The SIEPS 2.0 model, provided a structure for exploring the role of wider system factors, gaining an improved understanding of the issues that nurses' face and how these interact and affect their day-to day role. The benefit of using an approach that moves away from individual staff blame and focuses on making improvements to the work system has been recognised, in that the new NHS England Patient Safety Incident Response Framework (PSIRF; NHS England, 2024) now adopts this model. It is acknowledged, that the themes identified are from a small number of participants and as such may not be representative of the complete population for this staff group, although every effort was made to get representatives from all the paediatric specialities, and this was largely achieved. A review of Datix incidences also identified similar work systems factors to those identified in the qualitative data, adding further robustness.

The work has also highlighted the implications of nurses' high workload on the drug administration and second check process. Nurses interviewed knew the correct two–person check procedure but did deviate from the recommended procedure to enable them to fulfil other tasks and highlights the everyday 'trade-offs' that nurses must decide to make, to enable them to complete all their patient related tasks. This is reflective of the Efficiency – Thoroughness Trade -Off (ETTO) Principle (Hollnagel, 2009), where nurses are consciously balancing thoroughness (following all checks) and efficiency (ensuring timely care). Whilst this is a conscious decision taken by nurses, a lack of time and high workload means they must apply their own risk assessments in day-to day tasks. These trade-offs staff make should not be seen as deviations from the SOP as a choice, but because of trying to balance the demands of the work system, the task requirements and potential risks. This further highlights the need to understand the wider system factors that influence this task.

A variety of sociotechnical barriers were identified that currently hinder both the primary nurse and second nurse checker in the drug administration process, with wide ranging recommendations arising from this work involving different work-based systems. This highlights that to try to resolve issues within a process, it is imperative that multiple areas are focused on, rather than just one area and that a systems approach is adopted. Interventions that solely focus on behaviour change will not be successful, as the causes for workarounds will not have been addressed. This is supported by the hierarchy of effectiveness model which illustrates which risk-mitigation strategies are more effective than others in addressing factors, with people focused interventions less effective than system-based interventions (McDaniel, 2024).

It was acknowledged that some of the recommendations would be more challenging and take longer to achieve and involve different divisions within the hospital, but a variety of work

system interventions have started to be implemented. These include setting up a working group of nurses and other healthcare professionals to look at the second check process. The second nurse check is still perceived as a positive safety measure in the drug administration process and will remain, but work remains ongoing around defining best practice in all clinical areas of the hospital and reviewing the current medication that requires a second check with the aim to reduce the number of medications that require second checks. Stock levels on all paediatric wards have been reviewed and rationalised. This has reduced excess stock, reduced waste and improved the working environment within the clean utility rooms, enabling nursing staff to locate medication more easily. A recruitment drive has improved nursing staff numbers within the paediatric setting and an increased amount of training and support from educational development nurses for ward-based staff has occurred, with the focus on reassuring junior nurses that it is acceptable to challenge and question calculations. It is imperative going forward that any improvements made, have nursing staff input to improve the likelihood of success and improve buy in. Regular reviews of the work system to identify any possible effects of the interventions (both positive and negative) will be required.

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