View metadata, citation and similar papers at core.ac.uk

brought to you by CORE

provided by Cronfa at Swansea University

Cronfa - Swansea University Open Access Repository

This is an author produced version of a paper published in:
Journal of Clinical Nursing

Cronfa URL for this paper:
http://cronfa.swan.ac.uk/Record/cronfa40736

Paper:
Alteren, J., Hermstad, M., White, J. & Jordan, S. (2018). Conflicting priorities: observation of medicines administration. *Journal of Clinical Nursing*
http://dx.doi.org/10.1111/jocn.14518

This item is brought to you by Swansea University. Any person downloading material is agreeing to abide by the terms of the repository licence. Copies of full text items may be used or reproduced in any format or medium, without prior permission for personal research or study, educational or non-commercial purposes only. The copyright for any work remains with the original author unless otherwise specified. The full-text must not be sold in any format or medium without the formal permission of the copyright holder.

Permission for multiple reproductions should be obtained from the original author.

Authors are personally responsible for adhering to copyright and publisher restrictions when uploading content to the repository.

http://www.swansea.ac.uk/library/researchsupport/ris-support/

DR. JOHANNE ALTEREN (Orcid ID : 0000-0002-3202-5048)

Accepted Article

Article type : Original Article

Conflicting priorities: observation of medicines administration

Johanne ALTEREN, PhD, CNSc, RN, Associate Professor, Nord University, Mo i Rana, Faculty of Nursing and Health Science, Norway

Marit HERMSTAD, Cand.Polit., RN, Adviser, Helgeland Hospital Trust, Sandnessjøen, Norway

Jo WHITE, Research Support Officer, Swansea University, Department of Public Health, Policy and Social Sciences, Wales, UK

Susan JORDAN, Professor of Medicines Management, Swansea University, Department of Nursing, Wales, UK

Corresponding author: Johanne Alteren: e-mail: Johanne.Alteren@nord.no

phone: +47 996 07 609

Authorship

All authors have confirmed:

That they have made substantial contributions to conception and design, or acquisition of data, or analysis and interpretation of data: JA, MH, JW, SJ

This article has been accepted for publication and undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the Version of Record. Please cite this article as doi: 10.1111/jocn.14518
This article is protected by copyright. All rights reserved.

Been involved in drafting the article or revising it critically for important intellectual content: JA, MH, JW, SJ

Given final approval of the version to be published: JA, MH, JW, SJ

Agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved: JA, MH, JW, SJ

Acknowledgements:
We would like to thank Lisbeth Nerdal, Cand.San., RN, Nord University, Mo i Rana, Susanne Herseth, Ronja Fredriksen, and Ingvild Olsen, RN's at Helgeland Hospital Trust for having contributed in data collection. Nord University and Helgeland Hospital Trust funded this study.

Conflict of Interest Statement:
No conflict of interest has been declared by the authors.

Abstract

Aims and objectives

To identify sources of interruptions and distractions to medicine administration rounds in hospitals.

This article is protected by copyright. All rights reserved.

Accepted Article

Background

Nurses are frequently interrupted during medicine administration. There is no systematic description of nurses' behaviours and interruptions during administration of medicines to patients.

Design

Exploratory non-participant observational study.

Methods

Three hundred and fifty-one episodes of medicines administration with 32 nurses from three hospitals in Norway were observed using paper-based observation grids between December 2013 and March 2014.

Results

Nurses were frequently interrupted and distracted, mainly by nurses and other health care professionals. One third of the nurses interrupted their medicines administration: they prioritized helping patients with direct patient care. When the nurses were interrupted, they left the round and re-entered the procedure. Even so, they managed to re-focus and continue to administer the medicines: interruptions and disturbances made little difference to most behaviours and actions, possibly because nurses double-checked more frequently. Some differences were seen in behaviours potentially affecting the safety of the medicines administration, such as leaving medicines at the bedside and not helping patients take their medicines. Some interruptions were avoidable, such as those by other nurses and professionals.

This article is protected by copyright. All rights reserved.

Accepted Article

Conclusions

This study offers insights into nurses' behaviours and actions when they are interrupted and distracted during medicines administration. The findings highlight a conflict for nurses administering medicines. Nurses are forced to prioritize between two important activities: direct patient care and medicine administration. Management and education providers need to recognise that nurses interrupting each other is a potential threat to patient safety.

Relevance to clinical practice

Our data indicate that nurses and other healthcare professionals should be warned not to interrupt colleague administering medicines and managers should ensure other staff are available to respond to patients' immediate needs during medicine rounds.

Keywords

Medication Administration, Medication Error, Nurses, Hospitals, Work Interruptions (WIs), Patient-Centred Care, Patient Safety

Introduction

Health care systems prioritize avoidance of harm emanating from treatment and care (Hippocrates, translated by Jones, 1923). The World Health Organization (WHO) (WHO, 2017, p. 4) has announced a global challenge on medication safety, aiming to reduce avoidable medication-related harm by 50% in 5 years and minimise medication errors (WHO, 2016). Administration of medicines is a complex, multidisciplinary process (Hewitt, 2010). Traditionally, doctors initiate the medication chain by prescribing, pharmacists dispense, and nurses have primary responsibility for administration of medicines, leaving nurses as the final link in the medication safety chain (Anthony *et al.* 2010, Choo *et al.* 2010, Jordan *et al.* 2016).

This article is protected by copyright. All rights reserved.

Accepted Article

Medicine management is one of the highest risk tasks in healthcare (Leufer & Clearly-Holdforth, 2013). However, nurses are often disturbed when they administer drugs (Elganzouri *et al.* 2009, Trbovich *et al.* 2010, Thomson *et al.* 2009). Interruptions lead to errors and threaten patient safety (Elganzouri *et al.* 2009). Interruptions during medicine administration may result in patient harm (Brady *et al.* 2009, Fogarty & McKeon, 2006, Hewitt, 2010). This paper reports on a non-participant observational study exploring interruptions and distraction during medicine administration in hospitals in Norway.

Background

Freedom from harm and adverse drug events

Patient safety is defined as freedom from harm and adverse events while receiving healthcare (WHO, 2017). Adverse drug events are a major threat to patient safety and remain a significant global health care issue (Cloete, 2015, Leufer & Clearly-Holdforth, 2013). In European Union Member States, health care related adverse events, including adverse drug events, occur in 8%-12% of hospitalizations (WHO, 2015). Adverse drug events affect nearly 5% of hospitalized patients in the USA (Agency for Healthcare Research and Quality, 2015), and 2%-3% in Australia (Australian Commission on Safety and Quality in Health Care, 2013). In Norway, 1866/9821 (19%) of all reports on adverse events from hospitals in four health regions were related to prescribed medicines (Norwegian Directorate for Health, 2017). Twenty-two of these reports involved unnatural deaths. In a content analysis of adverse events, nine patients' deaths (1.5%, n=585) were attributed to adverse drug events, 29 (5%) patients were seriously, and 64 (11%) moderately harmed (Björkstèn *et al.* 2016).

This article is protected by copyright. All rights reserved.

Accepted Article

Accepted Article

Medication errors

Medication errors are a major threat to patient safety and remain a significant global health care issue (Cloete, 2015, Leufer & Clearly-Holdforth, 2013). They are costly and injurious to health. A complex interplay between individual and system factors underlies many errors (Björkstèn *et al.* 2016).

Leading causes of medication errors include interruptions and distractions during medicine administration. The most common individual errors are wrong dose 241 (41%), wrong patient 76 (13%), and omission of drug 69 (12%). The most frequent system errors are role overload 212 (36%), unclear communication or orders 177 (30%), and inadequate access to guidelines on procedure for preparation of drugs or unclear organizational routines 176 (30%) (Björkstèn *et al.* 2016). The errors in mental health hospitals are very similar: dose omission 52 (37%), incorrect dose 25 (18%), formulation 16 (12%) or incorrect timing 12 (9%) (Cottney & Innes, 2015). Errors reported to Norwegian adverse events systems are: incorrect administration methods 119 (6%), incorrect drug or dose 280 (14%), prescribed drug not given 433 (22%), prescription errors 468 (23%), and wrong dose, strength, and frequency 676 (34%) (Norwegian Directorate for Health, 2017).

Medication errors are a leading cause of unintended harm to patients nationally and internationally, and there is now a concerted attempt to identify and reduce individual and system factors to maximize patient safety (Choo *et al.* 2010, Fogarty & McKeon, 2006, WHO, 2017). This awareness should help to reduce error rates and safer patient care (Brady *et al.* 2009, Elganzouri *et al.* 2009). However, despite increased attention, medication errors remain a serious concern (WHO, 2016), prompting the WHO to launch a global patient safety challenge to halve the harms caused by medicines (WHO, 2017).

This article is protected by copyright. All rights reserved.

Accepted Article

Work interruptions (WI) in nursing

Work interruptions (WIs) are potential precursors of errors (Biron *et al.* 2009b). WIs are a break in the activity being performed to carry out another task e.g. direct patient care or address system failures such as missing medicines. A distraction occurs when nurses do not have to leave the round, but concentration is interrupted. Nurses are interrupted during safety-critical stages of medicines administration in 141 (79%) of medication administration rounds, which decreases task efficiency and could lead to adverse drug events (Thomson *et al.* 2009).

Nurses are rarely able to complete nursing activities without being interrupted (Biron *et al.* 2009a), particularly when concentration is most needed to prevent errors (Elganzouri *et al.* 2009). A direct observational study indicates that nurses are interrupted 22% of their time, often while performing safety-critical tasks such as medicine verification or delivery, including entering rate and volume to be infused by intravenous or neuraxial routes (Trbovich *et al.* 2010). Trbovich *et al.* (2010) describe five types of interruptions: questions, complaints, statements, double-checks, and alarms, and six sources of interruptions: nursing colleagues (35.2%), patients (29.6%), patients' families (7.4%), pharmacists (3.7%), management (3.7%), and pumps (20.4%). However, few interruptions are related to medicines tasks, demonstrating considerable scope to reduce unnecessary interruptions (Westbrook *et al.* 2017).

Unstructured observational studies indicate that nurses are interrupted during medicine administration (Biron *et al.* 2009a, Elganzouri *et al.* 2009, Thomson *et al.* 2009, Trbovich *et al.* 2010). The goal of this structured observational study is to provide a systematic description of work interruptions and distraction during medicine administration, nurses'

This article is protected by copyright. All rights reserved.

behaviours when they are disturbed, and who or what interrupts and distracts nurses. The aim was to describe and explore nurses' work interruptions (WIs) and distractions during medicine rounds in surgical and medical wards. The prevalence of nurse-initiated interruptions and distractions, as a potentially modifiable risk, was tested by observation.

Methods

Design

This was an exploratory non-participant observational study with quantitative data collection using a structured observation grid (Biron *et al.* 2009b).

Data collection

The study was undertaken in the three hospitals linked with Nord University at Helgeland between December 2013 and March 2014. The hospitals are local hospitals for the population of 18 municipalities in Helgeland, serving approximately 77,000 inhabitants. Hospitals in Norway are organized in three levels: local, central, and regional. The researchers initially approached the nurses in charge of the only two surgical wards in these hospitals and the only medical ward from the third hospital (which has no surgical ward), verbally and in writing. The head nurses informed all 58 nurses employed on the wards working day and evening shifts on weekdays about the study's purpose and procedures, distributed the written information, discussed the relevant ethical issues, and asked for volunteers. When observations were scheduled, those on duty were opportunistically selected and asked to participate. Thirty-two nurses with responsibility for medicine administration rounds were invited to participate. All agreed to do so, signed informed consent, and completed the study: no-one withdrew.

This article is protected by copyright. All rights reserved.

Accepted Article

Accepted Article

Current practice is for nurses to work shifts of eight hours with intense, concentrated work periods on weekdays, which include a wide range of duties as well as several medicine administration rounds.

The wards are organized into two teams. The total number of patients were twenty-two and seventeen in the surgical wards, and seventeen in the medical ward. On each team, one nurse has responsibility for administration of medicines for about ten patients. Medicines are kept in a medicine room, where nurses prepare medicines at designated times (8.00 am, 12.00, 3.00 pm, and 6.00 pm). At this stage, medicines are checked thoroughly: nurses not observed arranged the medicines for the next day, double checked and checked patient allergy status from notes. When double-checking, two nurses verify medicines in the dose distribution system against the prescription and sign the medicine journal. Medicines are administered to one patient at a time from a drug trolley using a unit dose distribution system.

Thirty five percent of interruptions during administration of medicines were from nursing colleagues (Trbovich *et al.* 2010), a prevalence, which, if confirmed, could be modified. A sample of 350 observations was required to estimate a prevalence of 35% with a 95% level of confidence and at a precision of +/- 5% (Uitenbroek, 1997).

Data were collected by four hospital nurses (the co-researchers), and two university researchers. Based on the nurse on duty, five to six medicine administration rounds were observed per nurse. Each individual nurse was observed on average a total of 5.4 times. A researcher followed the nurse when he or she prepared, controlled, and distributed the medicine. We recorded distractions, interruptions, and characterised the interruptions: source, tasks, location, origin of medicine, preparation and administration, and

This article is protected by copyright. All rights reserved.

administration time. We observed rounds at 8.00 am, at 12.00, and at 3.00 pm. We collected minimal demographic information on nurses observed, however, a parallel interview study with a sample of these nurses indicated that they are highly experienced.

Data analysis

The data analysis was conducted using IBM SPSS Statistics version 22.

Nurses' behaviours, interruptions and distractions were calculated for each episode of drug administration of approximately 5 minutes and dichotomized into binary categorical variables. We restricted the length of observation to avoid an increased risk of interruptions with prolonged administration. Descriptive statistics were prepared for interval and categorical variables. The unit of analysis was the episode of drug administration. Nurses' behaviours with and without interruption and distractions were compared using contingency tables and analysed by calculating odds ratios (ORs) with 95% confidence intervals and using the χ^2 statistic, taking Yates' continuity correction for 2x2 tables. Where the expected cell count was <5 for >20% cells, Fisher's exact test was substituted (Altman, 1991). Statistical significance was taken as 2-sided alpha <0.05.

Ethical considerations

The project was favourably reviewed by the Norwegian Social Science Data Service, project number 30223. Signed witnessed consent was taken. An information sheet describing the study was given to the participants. The nurses were informed that they could withdraw from the study whenever they wanted and without consequences. Anonymity of the participants was ensured.

This article is protected by copyright. All rights reserved.

Accepted Article

Results

We observed 173 medicine rounds with thirty-two nurses, 55% of the workforce. The nurses' (thirty women and two men), ages ranged from 22 to 68, mean 38. There were observed 351 episodes of care, each lasting around 5 minutes. In that time, the median number of medicines administered was 9 [interquartile range (IQR), 25th to 75th centile) 5-12, range 1 to 13]. The median number of distractions was 0 [IQR 0-0, range 0 to 5]. The median number of interruptions was 2 [IQR 1-5, range 0 to 13]. (Data were not normally distributed).

The medicines' dosage was ready when the nurses arrived on the wards. Then, nurses being observed repeated the checks undertaken and compared medicines in the dose distribution system against prescriptions and checked allergy status in patient notes as they prepared the medicine round. It was relatively rare for nurses to double check medicines and allergy status again on the medicine administration round or allow patients to take their medicines brought into hospital from home or primary care providers. Only rarely did the nurse not know the identity of the medicine in the dose distribution system (unlabelled in 2 of 351 episodes) or found the medicine missing from the dose distribution system (in 21/351 episodes).

A minority of episodes involved patients refusing one or more medicines (6.0%). Nurses helped patients to take medicines, and patients were invited to ask questions and verify medicines in a third of episodes. Information was given on at least one drug in 63.0% of episodes (Table 1).

Most, 264/351 (75.2%) drug administrations were interrupted. The main source of interruptions was nurses [41.6% (146/351) of episodes] or other health care professionals [23.6% (83/351) of episodes] seeking help, for example clarifying administrative tasks or

This article is protected by copyright. All rights reserved.

Accepted Article

answers to blood tests. More than a third of nurses interrupted their own tasks, by small talk or helping the patient with pillows or toilet (Table 2). Nurses could interrupt and be interrupted by small talk with patients and their families, and each other. In addition, they clarified and performed administrative tasks such as arranging discharge, prescriptions or hospital beds, and they assisted in medical administration by telling patients about surgical treatments, x-rays, and ultrasound scans. They shared observations and written documentation with nurses and other health care professionals.

Nurses also interrupted their own administration rounds by undertaking other nursing activities i.e. helping the patient out of bed or from bed to chair or to the toilet. If necessary, they checked urine, urinary catheters or bandages and repositioned bandages. They measured temperature, and intravenous infusion rates, and disconnected and flushed intravenous infusions. They asked patients how they were doing, and asked them about their pain, health problems, sleep, drinking, urination, defaecation, catheters, and stomata. They interrupted themselves when they supervised nursing students regarding nursing tasks and medicine administration. Nurses sometimes left the medicine administration round. When they left, the drug trolley was set aside. When they started administrating medicine again, they had to re-enter the procedure. Even if they left and re-entered the procedure, they managed to focus on and continue to administer medicine.

There were 107 reports of distractions, affecting 72/351 (20.5%) episodes of care. The majority of distractions came from nurses 32/351 (9.1%) or other health care professionals 37/351 (10.5%) – two very similar groups. Other sources were: orderly 1/351 (0.3%), alarms 6/351 (1.7%), patients 4/351 (1.1%), family 2/351 (0.6%), doctors 12/351 (3.4%), head

This article is protected by copyright. All rights reserved.

Accepted Article

nurses 1/351 (0.3%), self 5/351 (1.4%), and others such as cleaning assistants, secretaries, and office staff 7/351 (2.0%).

Interruptions disproportionately affected preparation of intravenous medicines (mainly antibiotics), the highest risk procedure observed (odds ratio OR 3.06, 95% confidence interval 1.54-6.06): this also raises questions of infection control. Lower risk tasks, such as crushing or shaking medicines or administering liquids were not disproportionately affected. Interruptions and distractions made little difference to nurses' behaviours. If nurses were interrupted, medicines were more likely to be left at the bedside 185/264 (70.1%), and the nurses were less likely to help the patients taking the medicines 170/264 (64.4%) (Table 3).

Medicines were more likely to be left at the bedside if nurses were distracted 170/264 (76.4%) (Table 4). Patients were more likely to refuse medicines if nurses were interrupted or distracted, but the differences did not reach statistical significance. Double-checking was more frequent if interruptions, but not distractions, occurred, but differences were not statistically significant.

Discussion

The purpose of this study was to describe nurses' behaviours during medicine administration rounds in surgical and medical wards. Nurses were frequently interrupted and distracted, mainly by nurses and other health care professionals, more so than in other studies (Trbovich *et al.* 2010). These findings resonate with previous research (Biron *et al.* 2009a, Cottney & Innes, 2015, Elganzouri *et al.* 2009, McGillis Hall *et al.* 2010, Palese *et al.* 2009, Thomson *et al.* 2009). Nurses were interrupted by nurses and other health care professionals seeking help, usually clarifying their administrative tasks and small talk. Such conversation can be

This article is protected by copyright. All rights reserved.

Accepted Article

Accepted Article

important in establishing rapport with patients, and are generally popular, but may be best undertaken after completion of medicine administration rounds. Interruptions disproportionately affected preparation of intravenous medicines, the highest risk task observed. Since 40% of drug administration episodes were interrupted by nurse colleagues, the extent of disruption might be amenable to change in education, ward procedure and culture.

The ward procedure concerning medicines administration includes more than mechanistic preparing, controlling, and distributing of medicine. It extends to collecting knowledge about the patient. The patient's medicine, observation of the patient's condition, and the exchange of knowledge between colleagues are sources of information relevant to the patient's further treatment and care. To get this knowledge, nurses had to interrupt themselves. More than a third of the nurses interrupted themselves by giving direct patient care such as helping the patient to the toilet or fetching a slice of bread for the patient, communicating with, and observing the patient. These findings resonate with research of Trbovich *et al.* (2010) where four of the five types of interruptions concerned observations and patients needing help. Biron *et al.* (2009a) found that direct patient care was the most frequent secondary task completed during medicine administration, without being explicit about definition and extent. To reduce avoidable interruptions, there needs to be a culture where nurses can set limits for involvement in patient care immediately. A discussion and awareness of the wards procedure and culture is therefore necessary.

When nurses interrupted themselves, they chose to suspend the medicine round. They prioritized helping patients with direct patient care, rather than administrating medicine. Sørensen & Brahe (2013) found nurses were confronted with a dilemma between maintaining

This article is protected by copyright. All rights reserved.

their focus on the task and their perceived need to be accessible. Nurses were conflicted by perceived needs to establish and maintain good relationships with patients whilst simultaneously complying with demands for efficiency and quality in healthcare services. In their work, nurses are not only responsible for medicines management, but also for the ward's high-quality nursing care, reputation and feedback from patients and other healthcare professionals. Nurses engage in maintaining an overview of the situation and being "in control" (Sørensen & Brahe, 2013). Whilst giving direct patient care, nurses acquire knowledge about the patient's condition and their needs. In these situations, nurses might consider interrupting themselves if necessary, because they have responsibility for patient. Nurses accept interruptions as a necessary component of their jobs (Sørensen & Brahe, 2013), precluding any questioning of the validity or necessity of the interruptions, and facilitating unnecessary interruptions.

Interruptions during administration of medicines decrease task efficiency and could lead to adverse drug events (Thomson *et al.* 2009, Trbovich *et al.* 2010). Continuous interruptions prolong medicine administration, decreasing efficiency. Increased time spent on medicines' administration has a "knock on" effect, particularly reduced time for other nursing work. Once nurses' reasoning process, focus and concentration are interrupted, the risk of error is increased. When nurses are interrupted, continuity of workflow is lost. When nurses interrupt themselves, and attend to other activities, the risk of error increased (Cottney & Innes, 2015). Nurses' decisions to interrupt their own or others' medicine rounds threaten patient safety (McGillis Hill *et al.* 2010).

This article is protected by copyright. All rights reserved.

Accepted Article

A "state-of-the-Science Review" examined work on interruptions experienced by nurses in the acute care sector, concluding that interruptions may promote safety and resilience by preventing errors (Hopkin & Jennings, 2013). Leaving the medication administration round to get medicines missing from the dose distribution system may be a safety critical task, without which the patient would remain unmedicated. Such interruptions are unavoidable in the immediate situation. Focusing on system failure can prevent unavoidable interruptions and medication errors (Björkstèn *et al.* 2016). Examples from this study include working systematically with patient safety routines, caring for patients' well-being, and continuing education of staff.

Interruptions expose patients and nurses to risks of adverse events. We observed some changes in nurses' behaviours when they were interrupted: they were more likely to leave medicines at the bedside and less likely to help patients take medicines. When nurses were interrupted, they resumed administration of medicines. For most behaviours, interruptions and distractions made little difference to behaviours and actions, as nurses refocused, which suggests that they were accustomed to interruptions and, as expert nurses of considerable experience, had evolved coping mechanisms.

Nurses do not administer medicines in isolation. They are part of an organization and ward routines, where medicines management has its place and a set time for completion. Medicine administration accounts for a substantial portion of nursing time. Constantly being interrupted decreases task efficiency and add significantly to the time spent on the procedure (Thomson *et al.* 2009). Leaving medicine at the bedside and being less likely to help patients take their medicines might be an attempt to adjust the situation to ward routines and timelines. Initially, nurses might save time when they make these adjustments. Nevertheless, these adjustments

This article is protected by copyright. All rights reserved.

Accepted Article

potentially affect the efficiency, quality, and safety of medicine administration (Thomson *et al*. 2009). We do not know why nurses left medicines at bedsides or were less likely to help patients taking their medicines; however, such decisions could threaten patient safety. These behaviours are the final link of the medication administration chain, where nurses ensure that patients get and take their prescribed medicines.

Nurses double-checked more frequently if they were interrupted, but the finding was not statistically significant. At the same time as the nurses lowered their standards when they left medicines at the bedside and omitted to help patients take medicines, they took an additional precaution: double-checking. We suggest that this may have been experienced nurses compensating for the known risks of interruptions and break in concentration.

Regardless of whether the nurses were interrupted or not, some nursing behaviours that ensure patients get the right medicine such as allergy checks, verification and inviting questions were less frequent than expected.

Methodological considerations

Initially, the research group learned how to understand and use the paper-based observation grid independently. We discussed how to understand and define the different categories. To understand the observation grid, and enhance inter-rater consistency, the university researchers observed the nurse co-researchers administering medication, and the co-researchers observed each other. Observers needed to challenge their own focus during data collection, to avoid recording what the nurses did and did not do, and focus on the items on the paper-observation grid. Researchers exchanged experiences, clarified differences and agreed a common understanding of the observation grid.

This article is protected by copyright. All rights reserved.

Accepted Article

We completed thirteen pilot observations. A pilot observation was defined as "learning and understanding the paper-observation grid by observing, understanding what, and when cross off". At the start of the pilot, the researchers found that nurses being observed refrained from interfering in situations they would otherwise have disturbed, such as small talk or asking for help with the patient. During these thirteen pilot observations, the nurses and co-researchers became familiar with the observations, and behaviour of the nurse being observed normalised, that is the Hawthorne effect disappeared.

To our knowledge, this is one of the largest observation studies in the literature (Biron *et al.* 2009b): three wards are only a small proportion of the wards in Norway. Our experience suggests that our findings are likely to be generalizable throughout the acute sector in Norway, but we can only speculate regarding findings in less well-resourced healthcare systems. It is also possible that less experience or temporary nursing staff would have lacked the coping mechanism witnessed. Data were collected by researchers checking off forced choices on a paper-based observational grid, and we acknowledge the inherent risk of acquiescence biases in such observational research (Tranter *et al.* 2012). Manual processing of the paper-based observation grid was resource-intensive, but we made every effort to ensure consistency between observers and pilot observations. All those approached participated, eliminating volunteer bias. However, although our pilot work aimed to minimize the Hawthorne (Roethlisberger & Dickson, 1939), and Rosenthal effects (Rosenthal & Jacobsen, 1963), and entrapment by prior expectation (Sackett *et al.* 1991), which might have arisen from familiarity with ward routines, we acknowledge the inherent potential for biased reporting. The willingness of researchers to report suboptimal care, for example, leaving medicine at the bedside, not checking allergies, indicates that researchers were able to report

This article is protected by copyright. All rights reserved.

Accepted Article

unexpected events. The pilot work developed consistency, continuity and quality in data collection, allowing large scale data collection.

Conclusion

Nurses administer medicine in environments where they must relate to the wards daily operations and other people. They cannot avoid being interrupted. Some interruptions are unavoidable, but most are not. Whilst administering medicines, nurses have to take care of patients' immediate needs and urgent management tasks.

Ensuring safe medicine administration is an onerous and continuing task. This study raises the question: how can work be organized so that nurses can keep their attention on administration of medicine and not be diverted to other aspects of patient care, which are often equally important? We have identified that the high prevalence of nurses interrupting their colleagues undertaking medicine rounds represents a modifiable and avoidable risk to safe administration of medicine. Clarification of what nurses should deal with when administering medicine, and which tasks are safety critical, is needed to reduce interruptions, safeguard the patient, and improve working conditions to meet WHO's 2017 targets. Education, organizational and social change is needed to allow nurses to refuse to interrupt and to be interrupted during medicines administration and avoid exposing patients and themselves to adverse drug events.

Relevance to clinical practice

This study offers insights into nurses' working conditions during medicines administration rounds in hospitals. Nurses are frequently interrupted; some, not all, interruptions are unavoidable. To promote medication safety and reduce iatrogenic harm, ward teams and

This article is protected by copyright. All rights reserved.

Accepted Article

hospital management should develop quality assurance standards for medicines administration. Standards could usefully stipulate the minimisation of interruptions, for example by ensuring that other staff are available to meet patients' immediate needs. Actively discouraging interruptions by colleagues and prioritizing medication safety may require cultural changes at all levels of the service.

References

Agency for Healthcare Research and Quality: Advancing Excellence in Health Care. (2015). Medication Errors. Retrieved from https://psnet.ahrq.gov/primers/primer/23

Altman, D. G. (1991). *Practical Statistics for Medical Research*. Chapman & Hall, London.

Anthony, K., Wiencek, C., Bauer, C., Daly, B., & Anthony, M. K. (2010). No Interruptions Please: Impact of a No Interruption Zone on Medication Safety in Intensive Care Units. *Critical Care Nurse*, 30(3), 21-29. doi:10.4037/ccn2010473

Australian Commission on Safety and Quality in Health Care. (2013). Literature Review: Medication Safety in Australia. ACSQHC, Sydney, NSW. Australia. Retrieved from https://www.safetyandquality.gov.au/our-work/medication-safety/

Biron, A. D., Loiselle, C. G., & Lavoie-Tremblay, M. (2009a). Work Interruptions and Their Contribution to Medication Administration Errors: An Evidence Review. *Worldviews on Evidence-Based Nursing*, 2(6), 70-86.

This article is protected by copyright. All rights reserved.

Accepted Article

Accepted Article

Biron, A. D., Lavoie-Tremblay, M., & Loiselle, C. G. (2009b). Characteristics of Work Interruptions During Medication Administration. *Journal of Nursing Scholarship*, 41(4), 330-336.

Björkstèn, K. S., Bergqvist, M., Andersèn-Karlsson, E., Benson, L., & Ulfvarson, J. (2016). Medication errors as malpractice – a qualitative content analysis of 585 medication errors by nurses in Sweden. *BMC Health Services Research*, 16:431. doi:10.1186/s12913-016-1695-9

Brady, A-M., Malone, A-M., & Fleming, S. (2009). A literature review of the individual and systems factors that contribute to medication errors in nursing practice. *Journal of Nursing Management*, 17, 679-697. doi:10.1111/j.1365-2834.2009.00995.x

Choo, J., Hutchinson, A., & Bucknall, T. (2010). Nurses' role in medication safety. *Journal of Nursing Management*, 18, 853-861. doi:10.1111/j.1365-2834.2010.01164.x

Cloete, L. (2015). Reducing medication errors in nursing practice. *Nursing Standard*, 29(20), 50-59.

Cottney, A., & Innes, J. (2015). Medication-administration errors in an urban mental health hospital: A direct observation study. *International Journal of Mental Health Nursing*, 24, 65-74. doi:10.1111/inm.12096

Elganzouri, E. S., Standish, C. A., & Androwich, I. (2009). Medication Administration Time Study (MATS): Nursing Staff Performance of Medication Administration. *Journal of Nursing Administration*, 39(5), 204-210. doi:10.1097/NNA.0b013e3181a23d6d

This article is protected by copyright. All rights reserved.

Accepted Article

Fogarty, G. J., & McKeon, C. M. (2006). Patient safety during medication administration: The influence of organizational and individual variables on unsafe work practices and medication errors. *Ergonomics*, 49(5-6), 444-456. doi:10.1080/00140130600568410

Hewett, P. (2010). Nurses' Perceptions of the Causes of Medication Errors: An Integrative Literature Review. *MEDSURG Nursing*, 19(3), 159-167.

Hippocrates (translated by Jones, WHS). (1923). The Hippocratic Corpus, Epidemics, book I, sect. XI. Loeb Classical Library, Cambridge, UK and London, Heineman. Retrieved from https://ia902708.us.archive.org/8/items/hippocrates01hippuoft/hippocrates01hippuoft.pdf

Hopkinson, S. G., & Jennings, B. W. (2013). Interruptions During Nurses' Work: A State-of-the-Science Review. *Research in Nursing & Health*, 36, 38-53.

Jordan, S., Vaismoradi, M., & Griffiths, P. (2016). Adverse Drug Reactions, Nursing and Policy: A Narrative Review. *Ann Nurs Pract*, 3(3): 1050.

Leufer, T., & Clearly-Holdforth, J. (2013). Let`s do no harm: Medication errors in nursing: Part 1. *Nurse Education in Practice*, 13, 213-216. doi:10.1016/j.nepr2013.01.013

McGillis Hall, L., Pedersen, C., & Fairley, L. (2010). Losing the Moment: Understanding Interruptions to Nurses' Work. *The Journal of Nursing Administration*, 40(4), 169-176. doi:10.1097/NNA.0b013e3181d41162

This article is protected by copyright. All rights reserved.

Accepted Article

Norwegian Directorate for Health. (2017). Annual Report 2016 for notification of adverse events in the specialist health service IS-2617: Oslo, Norway. Retrieved from https://helsedirektoratet.no/English

Palese, A., Sartor, A., Costaperaria, G., & Bresadola, V. (2009). Interruptions during nurses' drug rounds in surgical wards: observational study. *Journal of Nursing Management*, 17, 185-192. doi:10.1111/j.1365-2934.2007.00835.x

Roethlisberger, F. S., & Dickson, W. J. (1939). *Management and the Worker*. Harvard University Press, Cambridge, Massachusetts.

Rosenthal, R., & Jacobsen, L. (1963). Teachers' expectancies: Determinants of pupils' IQ gains. *Psychological Reports*, 19, 115-118.

Sackett, D., Haynes, R. B., Guyatt, G., & Tuqwell, P. (1991). *Clinical Epidemiology: A Basic Science for Clinical Medicine*. (2nd ed.). Little, Brown, Boston, Massachusetts.

Sørensen, E., & Brahe, L. (2013). Interruptions in clinical nursing practice. *Journal of Clinical Nursing*, 23, 1274-1282. doi:10.1111/jocn.12329

Thomson, M. S., Gruneir, A., Lee, M., Baril, J., Field, T. S., Gurwitz, J. H., & Rochon, P. A. (2009). Nursing Time Devoted to Medication Administration in Long-Term Care: Clinical, Safety, and Resource Implications. *Journal of the American Geriatrics Society*, 57, 266-272.

Tranter, S., Irvine, F., & Collins, E. (2012). Innovations aimed at improving the physical

This article is protected by copyright. All rights reserved.

health of the seriously mentally ill: an integrative review. *Journal of Clinical Nursing*, 21, 1199-1214. doi:10.1111/j.1365-2702.2011.04020.x

Trbovich, P., Prakash, V., Stewart, J., Trip, K., & Savage, P. (2010). Interruptions During the Delivery of High-Risk Medications. *Journal of Nursing Administration*, 40(5), 211-218. doi:10.1097/NNA.0b013e3181da4047

Uitenbroek, D. G. (1997). SISA Binomial. Southampton: D.G. Uitenbroek. Retrieved from http://www.quantitativeskills.com/sisa/distributions/binomial.htm

Westbrook, J.I., Li, L., Hooper, T., Raban, M. Z., Middleton, S., & Lehnbom, E. C. (2017). Effectiveness of a "Do not interrupt" bundled intervention to reduce interruptions during medication administration: a cluster randomised controlled feasibility study. *BMJ Qual Saf*. 2017 Feb 23. pii: bmjqs-2016-006123. doi:10.1136/bmjqs-2016-006123 [Epub ahead of print] PubMed PMID: 28232390

World Health Organization, WHO. (2015). Data and statistics. Retrieved from http://www.euro.who.int/en/health-topics/Health-systems/patient-safety

World Health Organization, WHO. (2016). Medication Errors. Retrieved from http://apps.who.int/iris/bitstream/10665/252274/1/9789241511643-eng.pdf?ua=1&ua=1

World Health Organization, WHO. (2017). Patient safety. Retrieved from http://who.int/patientsafety/medication-safety/en/

This article is protected by copyright. All rights reserved.

Accepted Article

Accepted Article

Table 1: Frequencies of selected behaviours during medicine administration, n=351

	No / Not done n (%)	**Yes / Done for 1 or more medicine n (%)**
Patient refused medicine	330 (94.0)	21 (6.0%)
Nurse helped patient taking medicine	244 (69.5)	107 (30.5%)
Medicine left at bedside	119 (33.9)	232 (66.1%)
Verified medicine with the patient	211 (60.1)	140 (39.9%)
Invited questions from the patient	224 (63.8)	127 (36.2%)
Informed patient about the medicine	130 (37.0)	221 (63.0%)

This article is protected by copyright. All rights reserved.

Accepted Article

Table 2: Interruptions of medicine administration by source, n=351

Source	**None n (%)**	**Affected 1 or more medicine administered n (%)**
Nurse colleagues e.g. seeking information about the ward	205 (58.4%)	146 (41.6%)
Ward orderly e.g. adjusting bedside table, clothes	341 (97.2%)	10 (2.8%)
Nurse call buzzer	312 (88.9%)	39 (11.1%)
Patient e.g. asking for the toilet	251 (71.5%)	100 (28.5%)
Family e.g. husband, wife, son, daughter	333 (94.9%)	18 (5.1%)
Health Care Professional e.g. phlebotomist, physiotherapist, students	268 (76.4%)	83 (23.6%)
Medical Doctor e.g. seeking information from the medication chart	323 (92.0%)	28 (8.0%)
Manager from other wards or administration	341 (97.2%)	10 (2.8%)
Head Nurse at ward	348 (99.1%)	3 (0.9%)
Self-e.g. to speak with or help the patient	232 (66.1%)	119 (33.9%)
Other e.g. office and cleaning staff	321 (91.5%)	30 (8.5%)

This article is protected by copyright. All rights reserved.

Table 3 Comparison between interrupted and uninterrupted administrations

Interruptions and behaviours

Actions	Administration Interrupted N=264	Administration Not interrupted N=87	OR, 95% CI	P value
Tablet crushed				
Yes	8 (3.0%)	2 (2.3%)	1.33 (0.28-6.38)	1 .00[F]
No	256 (97.0%)	85 (97.7%)		
Preparing medicine for intravenous administration, usually antibiotics*				
Yes	81 (30.7%)	11 (12.6%)	3.06 (1.54 – 6.06)	0 .001
No	183 (69.3%)	76 (87.4%)		
Medicine in liquid form e.g. lactulose*				
Yes	57 (21.6%)	18 (20.7%)	1.01 (0.58 – 1.92)	0 .98
No	207 (78.4%)	69 (79.3%)		
Medicine shaken e.g. soda tablets for indigestion				
Yes	14 (5.3%)	6 (6.9%)	0.76 (0.28 – 2.03)	0 .77
No	250 (94.7%)	81 (93.1%)		
Double checking of medicine with nurse colleagues				
Yes	50 (18.9%)	9 (10.3%)	2.03 (0.95 – 4.31)	0 .09
No	214 (81.1%)	78 (89.7%)		
Allergies checked against notes				
Yes	4 (1.5%)	0 (0.0%)	NA	0 .32 [F]
No	260 (98.5%)	87 (100%)		
Compared medicine against prescription				
Yes	234 (88.7%)	77 (88.5%)	1.01 (0.47 – 2.17)	1.00
No	30 (11.4)	10 (11.5%)		
Patient may take medicine brought from home				
Yes	42 (15.9%)	13 (14.9%)	1.08 (0.55 – 2.12)	0 .96
No	222 (84.1%)	74 (85.1%)		
Unlabelled medicine in the trolley**				

This article is protected by copyright. All rights reserved.

Yes	1 (0.4%)	1 (1.1%)	0.33 (.020 – 5.30)	0 .44 [F]
No	262 (99.6%)	86 (98.9%)		
Medicine missing in the trolley				
Yes	17 (6.4%)	4 (4.6%)	1.43 (0.47 – 4.37)	0.71
No	247 (93.6%)	83 (95.4%)		
Patient refused medicine				
Yes	18 (6.8)	3 (3.4%)	2.05 (0.59 – 7.13)	0 .37
No	246 (93.2%)	84 (96.6%)		
Nurse helped patient taking medicine				
Yes	94 (35.6%)	13 (14.9%)	3.15 (1.66 – 5.98)	<0 .001
No	170 (64.4%)	74 (85.1%)		
Medicines (any) left at bedside	185 (70.1%)	47 (54.0%)	1.99 (1.21 – 3.28)	0 .01
Medicines not left at bedside	79 (29.9%)	40 (46.0%)		
Verified medicines with patient				
Yes	105 (39.8%)	35 (40.2%)	0.98 (0.60 – 1.61)	1 .00
No	159 (60.2%)	52 (59.8%)		
Invited questions	95 (36.0%)	32 (36.8%)	0.97 (0.58 – 1.60)	0.97
Did not invite questions	169 (64.0%)	55 (63.2%)		
Informed patient about medicine				
Yes	172 (65.2%)	49 (56.3%)	1.45 (0.89-2.38)	0 .18
No	92 (34.8%)	38 (43.7%)		

Notes: continuity correction taken for 2x2 tables

[F] indicates value from Fisher's exact test, 2 sided

Actions are as listed on the observation grid.

* The medicine for intravenous administration is in powder form. It must be dissolved in saline. This preparation takes time, allowing interruptions. The same applies to medicine in liquid form, here lactulose, which the nurse must pour into small cups before they can give it to the patient.

** Nurses needed to return to the medicines' room to ascertain the identity of the medicines in the trolley

This article is protected by copyright. All rights reserved.

Table 4 Administrations with and without distractions: behaviour and distractions

Actions	Distracted N=72	Not distracted N=279	OR, 95% CI	P value
Tablet crushed				
Yes	1 (1.4%)	9 (3.2%)	0.42 (0.05 – 3.39)	0 .66 [F]
No	71 (98.6%)	270 (96.8%)		
Preparing medicine for intravenous administration, usually antibiotics*				
Yes	16 (22.2%)	76 (27.2%)	0.76 (0.41 – 1.41)	0.48
No	56 (77.8%)	203 (72.8%)		
Medicine in liquid form e.g. lactulose*				
Yes	17 (23.6%)	58 (20.8%)	1.18 (0.64 – 2.18)	0.72
No	55 (76.4%)	221 (79.2%)		
Medicine shaken e.g. soda tablets for indigestion				
Yes	6 (8.3%)	14 (5.0%)	1.72 (0.64 – 4.65)	0 .43 [F]
No	66 (91.7%)	265 (95.0%)		
Double checking of medicine with nurse colleagues				
Yes	8 (11.1%)	51 (18.3%)	0.56 (0.25 – 1.24)	0 .20
No	64 (88.9%)	228 (81.7)		
Allergies checked against notes				
Yes	1 (1.4%)	3 (1.1%)	1.30 (0.13 – 12.65)	1.00 [F]
No	71 (98.6%)	276 (98.9%)		
Compared medicine against prescription				
Yes	68 (94.4%)	243 (87.1%)	2.52 (0.87 – 7.32)	0.12
No	4 (5.6%)	36 (12.9%)		
Patient may take medicine brought from home				
Yes	14 (19.4%)	41 (14.7%)	1.40 (0.72 – 2.74)	0.42
No	58 (80.6%)	238 (85.3%)		

This article is protected by copyright. All rights reserved.

Unlabelled medicine in the trolley*				
Yes	0 (0.0%)	2 (0.7%)	NA	1 .00 [F]
No	72 (100%)	276 (99.3%)		
Medicine missing in the trolley				
Yes	4 (5.6%)	17 (6.1%)	0.91 (0.30 – 2.78)	1.00 [F]
No	68 (94.4%)	262 (93.9%)		
Patient refused medicine				
Yes	7 (9.7%)	14 (5.0%)	2.04 (0.79 – 5.26)	0 .16 [F]
No	65 (90.3%)	265 (95.0%)		
Nurse helped patient taking medicine				
Yes	22 (30.6%)	85 (30.5%)	1.00 (0.57 – 1.76)	1.00
No	50 (69.4%)	194 (69.5%)		
Medicines (any) left at bedside	55 (76.4%)	177 (63.4%)	1.86 (1.03 – 3.38)	0 .05
Medicines not left at bedside	17 (23.6%)	102 (36.6%)		
Verified medicine with patient				
Yes	31 (43.1%)	109 (39.1%)	1.18 (0.70 – 1.99)	0 .63
No	41 (56.9%)	170 (60.9%)		
Invited questions	29 (40.3%)	98 (35.1)	1.25 (0.73 – 2.12)	0 .50
Did not invited questions	43 (59.7%)	181 (64.9%)		
Informed patient about medicine				
Yes	48 (66.7%)	173 (62.0%)	1.23 (0.71 – 2.12)	0 .55
No	24 (33.3%)	106 (38.0%)		

Notes: continuity correction taken for 2x2 tables

[F] indicates value from Fisher's exact test

Actions are as listed on the observation grid.

* The medicine for intravenous administration is in powder form. It must be dissolved in saline. This preparation takes time, allowing interruptions. The same applies to medicine in liquid form, here lactulose, which the nurse must pour into small cups before they can give it to the patient.

** Nurses needed to return to the medicines' room to ascertain the identity of the medicines in the trolley

This article is protected by copyright. All rights reserved.