jrn

Journal of Research in Nursing
0(0) 1–14

DOI: 10.1177/1744987113484737
jrn.sagepub.com
SAGE

Reducing interruptions during medication administration: the White Vest study

Jayne Craig
Clinical Nurse Researcher, CentraState Medical Center, USA

Fiesta Clanton
Director of Professional Development and Education, CentraState Medical Center, USA

Marylee Demeter
Research Consultant and Adjunct Professor, Middlesex County College, USA

Abstract

The well-established Institute of Medicine report entitled *To Err is Human: Building a Safer Health System* highlighted the importance of preventative errors in medicine, suggesting interruptions are a contributing factor. Patient safety organisations, such as The Joint Commission, acknowledge that interruptions contribute to preventable medical errors. The aim of this research is to examine the most frequently observed interruptions experienced by nurses administering medications and evaluate an intervention designed to reduce those interruptions. The primary intervention consisted of a White Vest worn during administration stating: 'Please do not interrupt while passing medications'. A quasi-experimental design was employed. Nurses were observed for 2 weeks during routine administration of morning medications. The vest was then introduced and worn during administration for 2 weeks for post-intervention data collection. The hospital unit, date, time, duration, and description of the interruption were recorded. Data collection was conducted in four hospital units sequentially. A content analysis revealed the most frequently observed interruptions were comments/questions by hospital staff, phone calls, and seeking supplies. As hypothesised, the overall number of interruptions during medication administration (MA) declined after implementation of the intervention. This study illustrates implications and policy changes with regards to nursing practices and MA.

Keywords

evaluation research, evidence-based practice, innovation and improvement, nursing practice, quasi-experimental research

Corresponding author:
Marylee Demeter, Rutgers, The State University of New Jersey, 115 College Avenue, Room 301, New Brunswick, NJ 08901-8544, USA.
Email: mdemeter@echo.rutgers.edu

Introduction

The well-established Institute of Medicine Report entitled *To Err Is Human: Building a Safer Health System* (Kohn et al., 2000) highlighted the importance of preventable errors in medicine and suggested interruptions as a contributing factor. Patient safety organisations, such as The Joint Commission, acknowledge that interruptions contribute to preventable medical errors. Specific analysis to medication errors (MEs) indicates that hospitals attribute 43% of MEs to workplace distractions (United States Pharmacopeia, 2000). MEs can occur at different stages of the medication process, which includes prescribing, dispensing, administering, and monitoring. Nurses generally administer medications, so they have the major responsibility in the process and are the last link in the medication cycle, performing the final safety check intended to identify and intercept errors and potential harm (Flanders and Clark, 2010). This includes administering the right medication to the right patient, at the right dosage, at the right time, with the right frequency, route, and technique, with no omissions and no unauthorised drugs. Medication administration (MA) is a high-risk procedure and is an area of opportunity to enhance patient safety by focusing on prevention of errors. Finding ways to prevent interruptions during MA to potentially reduce ME is a key factor.

Sources of MEs

Previous research demonstrates nurses perceive an increased risk of MEs when they are interrupted or distracted (Mayo and Duncan, 2004; Osborne et al., 1999; Palese et al., 2009; Tang et al., 2007) and cites interruptions as a significant contributor to MA errors (Biron et al., 2009). Medication preparation is a critical step in MA process that requires accurate matching of information found in the MA record with physician orders. Interruptions have been conceptualised as potentially dangerous for patients because nurses' attention is diverted from their concentrated task of MA, increasing the likelihood of MEs while decreasing workflow and efficiency (Palese et al., 2009). Furthermore, interruptions impact cognitive processes by interfering with working memory, causing lack of focus and invoking feelings of frustration and stress (Potter et al., 2005). When nurses are interrupted during the MA review process, they need to remember where they were when they resume the task. Omission errors are therefore likely because nurses may believe they were further along than they were and research suggests omissions linked to prospective memory failures may explain the relationship between interruptions and human error (Grundgeiger and Sanderson, 2009).

Sources of interruptions

Most MEs are usually attributed to general system failures; however, interruptions have also been cited as a major source (Armitage and Knapman, 2003; Bennett et al., 2010; Biron, 2009; Flanders and Clark, 2010; Tang et al., 2007; Thompson et al., 2003; Tucker and Spear, 2006; Ulrich, 2010). A number of studies conducted primarily in medical and surgical units observed staff interruptions, including nurse colleagues, as the most frequently occurring interruption (Biron et al., 2009; Coiera and Tombs, 1998; McGillis-Hall et al., 2010a, 2010b; Redding and Robinson, 2009; Trbovich et al., 2010) and cite patients, lack of equipment, phone calls, and missing medications as additional major sources of interruptions. Other studies have examined intensive care (Anthony et al., 2010; Stamp and Willis, 2010), nursing

homes (Dilles et al., 2011), post-partum (Stamp and Willis, 2010), orthopaedic/neurology (Potter et al., 2004), and chemotherapy infusion (Trbovich et al., 2010) units. These studies have also observed staff interruptions as most frequent; however, several studies relied on self-report measures. Furthermore, the majority of previous research is limited to the investigation of one or two nursing units during MA and research is lacking in oncology and orthopaedic/stroke settings.

Research on interventions designed to reduce interruptions

In addition, researchers have evaluated interventions using a variety of apparel designed to alert others to the MA process, suggesting these types of interventions significantly reduced interruptions experienced by nurses engaged in the MA process (Relihan et al., 2010). Interventions focusing on providing ample personal space coupled with staff requests to hold interruptions have met with success (Nguyen et al., 2010), while others implementing specified protocols and signage have demonstrated reductions in interruptions (Anthony et al., 2010; Pape, 2003; Pape et al., 2005). However, few interventions combine apparel with behaviour modification techniques, staff education, and implementation checklists and most studies limit training designed to reduce interruptions to administering nurses and their immediate nurse colleagues. Finally, interventions have been used primarily in medical/surgical units; further research is needed to determine the impact of multifaceted approaches in multiple MA settings.

The purpose of this study is to expand on previous research by investigating the most frequently observed interruptions during morning MA in multiple hospital units, including expansion to oncology and orthopaedic/stroke units. The morning MA was chosen upon consideration of previous research demonstrating interruptions are more likely to occur during morning and afternoon MA rounds (Palese et al., 2009). We also sought to implement and evaluate a multi-faceted intervention designed to bring attention to nurses engaged in MA and reduce the most commonly cited interruptions. Our intervention is novel in that we included procedures for unit secretaries and transport specifically designed to reduce interruptions, particularly regarding non-emergent phone calls (excluding physicians), as research demonstrates this to be an effective strategy for reducing interruptions (Nguyen et al., 2010). Our first research question is exploratory in nature, specifically, what are the most frequently observed interruptions nurses experience while administering medications? Our second and third research questions investigated the effect of the White Vest (WV) Intervention on the number and duration of interruptions nurses experienced during the morning MA. We hypothesised the number and duration of interruptions during MA would decrease as a result of this multifaceted approach.

Methodology

Participants

Ethical approval was granted by the participating hospital's Institutional Review Board. The participating hospital is a 273-bed acute community hospital located in the North East United States, which offers full basic service to local residents. It has Magnet designation, which means it offers excellence in the delivery of nursing services to patients and residents, is supported by quality outcomes, and mechanisms for implementation of best practices are utilised. Nurse observers and administering nurses in each unit were systematically informed

of the objectives of study as well as the voluntary nature of participation. All volunteer nurse observers and administering nurses signed an informed consent form prior to data collection.

An observational study design was employed for the purpose of documenting the type and frequency of interruptions experienced during MA. Seventeen nurses from the participating hospital were voluntarily recruited during a professional development (PD) workshop offered by nursing administration and staff educators from the PD department to conduct observations during MA. Volunteer observers completed an online course offered by the National Institutes of Health for the purpose of obtaining human subjects research certification. All observers were then given an orientation to the study, including the purpose of the study and a detailed definition of what constitutes an interruption. Observers were then educated in systematic data collection procedures including where to stand during MA observation and how to record interruptions on the data collection sheet. Observers were also instructed to refrain from interrupting administering nurses except in cases of emergency. Observers conducted observations during MA for approximately 2 hours each day of data collection and did not perform other duties during the data collection process. Observers were paired with nurses based on work schedules and did not consistently observe the same nurses throughout the study.

Nurses were voluntarily recruited to participate in the intervention and undergo observation during MA following an announcement of the study at a routine nursing management meeting by the chief nursing officer. Nurse managers then announced a call for participants in their unit-based staff meetings. A convenience sample of 15 of 18 nurses (83.3%) from the Medical/Surgical Unit (MSU), 15 of 19 nurses (78.9%) from the Surgical Unit (SU), 6 of 8 nurses (75%) from the Oncology Unit (OU), and 6 of 13 (46.15%) nurses from the Orthopaedic/Stroke Unit (OSU) agreed to participate in the intervention and undergo observation during MA.

Procedure

All observational data were collected during the morning MA for approximately 2 hours, from 8:00 to 10:00 a.m., Monday through Friday. Baseline data were collected for a period of 2 weeks prior to implementing the intervention. Upon obtaining a baseline measure, data collection ceased for a period of 1 week, at which point the WV Intervention was introduced. Nurses who agreed to be observed in the study were provided with WVs with the following written in red on the back, 'Please do not interrupt while passing medications'. All administering nurses were instructed to wear them at all times during the post-intervention data collection phase.

In addition to implementing the WV, unit secretaries and overnight nursing staff in each of the participating units attended in-service training designed to reduce interruptions. Each unit was systematically instructed to engage in the following procedures during implementation of the WV Intervention:

- Unit secretaries were educated in communicating with family/visitors, for example, upon receiving a phone call, unit secretaries were instructed to convey the following, 'the nurse is administering medication at the moment, may she/he call you back'? Secretaries were also taught to use discretion in holding phone calls for administering nurses during MA; however, due to the nature of physician needs (e.g. brief questions that need immediate answers), physician calls were always forwarded.

- Overnight nursing staff was instructed to indicate the method of transport (wheelchair, stretcher, bed) and any accompanying equipment (oxygen, IV, monitor) on a patient census list for the purpose of directing the transport team for safe transport of patients. This list was given to unit secretaries at the end of each shift for the purpose of reducing potential interruptions regarding patient transport during MA.

Coding

The Interruptions Coding Scheme (Table 1) was developed to analyse the most frequently observed interruptions experienced by administering nurses. For the purpose of our study, an interruption is defined as any emergent or non-emergent stimulus that 'halts the activity being performed for monitoring purposes or to carry out a secondary task' (Biron et al., 2009). We defined non-emergent interruptions as those that are not life threatening and can wait until the nurse completes MA. Emergent interruptions include those that are deemed life threatening and immediate. A preliminary coding scheme was provided by the principal investigator (Jayne Craig), where interruption categories were based on the most frequently observed types of interruptions documented in the literature (Biron, 2009; Dilles et al., 2011; Fry and Dacey, 2007a, 2007b; Kreckler et al., 2008; McGillis-Hall et al., 2010a, 2010b; Palese et al., 2009; Potter et al., 2004; Redding and Robinson, 2009; Relihan et al., 2010). The third author (Marylee Demeter) performed coding of all data and further refined the coding scheme using a Grounded Theory approach (Creswell, 1998; Hatch, 2002). Following this approach, additional categories were added and existing coding categories were

Table 1. Coding Scheme.

Code	Description	Example
1	Missing medications	'Looking for insulin, calling pharmacy'.
2	Narcotics key	'Another nurse asked for narcotics keys'.
3	Medication computers	'Couldn't log on to Medication Administration Cart, took three tries then logged on'.
4	Equipment	'Tech asked for equipment from med drawer'.
5	Med/utility/room	'Went to get syringes from med room'.
6	Staff interactions	'Medical Service Technician (MST) asked nurse if another patient could go to discharge'.
7	Phone calls	'Answered phone call from MRI about a patient'.
8	Educational interactions	'Answering questions from nursing student'.
9	Kitchen	'Nurse went to get fresh water for patient'.
10	Patients	'Went into another room to check patient'.
11	Visitors	'Family member of patient who passed asking questions'.
12	Personal comments	'MST telling nurse about newborn grandbaby'.
13	Unit desk	'To desk checking patient chart'.
14	Nursing assistant issues	'Set up patient breakfast'.
15	Other	'Nurse interrupted self to learn how to change phone from vibrate to ring'.

collapsed as appropriate to the dataset. All categories were discussed and agreed upon prior to final coding and data analysis. Observations with a recorded duration of '<1 min' were entered as 30 seconds.

Analysis

Statistical analyses were conducted using PASW Statistics, version 18. Independent sample two-sided *t*-tests were conducted to compare the number and duration of interruptions between the pre-and post-intervention period for the aggregate data set and in each unit, with observed interruptions as the unit of analysis. In cases where the homogeneity of variance assumption is violated, we report *t*-statistics for unequal variances. To reduce chances of committing a type I error, we applied the Bonferroni correction by setting $\alpha = 0.01$ for each of the comparisons. Due to the diverse nature of patient needs in each unit, *t*-tests were conducted to determine statistically significant reductions in the number of interruptions in each unit (Lewis, 1993). Interruptions were coded according to the Interruptions Coding Scheme. A content analysis was performed to determine the nature of the most frequently observed interruptions during MAs.

Results

Inter-rater reliability

A total of 3714 interruptions were observed in our study; each was coded according to the Interruptions Coding Scheme. A second rater independently coded 20.8% ($n = 774$) randomly selected observed interruptions for inter-rater reliability purposes (pre-intervention $n = 482$; post-intervention $n = 290$).

The number of agreements and disagreements was 628 and 146, respectively, indicating the two raters agreed on 81.1% of the categorised interruptions. An inter-rater reliability analysis using Cohen's Kappa statistic was performed to determine consistency among raters. Inter-rater reliability was 0.781 ($p < 0.01$), indicating the two raters are in 'substantial agreement' with the categorisation of observed interruptions (Landis and Koch, 1977).

We conducted a chi-square analysis of the types of interruptions observed by volunteers. There were significant differences among the nurses in types of interruptions recorded ($\chi^2 = 659.28$ (224), $p < 0.01$). This finding may be due to the fact that observers did not consistently observe the same nurses throughout the study. Further, observers did not consistently conduct observations throughout the course of the study.

Types of interruptions

Our first research question considered the most frequently observed types of interruptions experienced by nurses during MA. Frequencies for each type of interruption for aggregate data are shown in Table 2. The three most frequently observed interruptions were staff interruptions ($n = 1215$, 32.7%), phone calls ($n = 481$, 13.0%), and gathering supplies ($n = 303$, 8.2%). When comparing baseline data to the post-intervention, staff interruptions, phone calls, and seeking supplies remained the three most frequently observed interruptions.

Table 2. Types and frequencies of observed interruptions.

Interruption	Total	Baseline	Post-intervention
Staff	1215 (32.7%)	773 (32.8%)	442 (32.5%)
Phone call	481 (13.0%)	345 (14.6%)	136 (10.0%)
Medical/utility/narcotics	303 (8.2%)	174 (7.4%)	129 (9.5%)
Patient	282 (7.6%)	156 (6.6%)	126 (9.3%)
Narcotics keys	238 (6.4%)	121 (5.1%)	117 (8.6%)
Nursing assistant issue	190 (5.1%)	160 (6.8%)	30 (2.2%)
Educational	165 (4.4%)	153 (6.5%)	12 (0.9%)
Records/forms/rounds	135 (3.6%)	73 (3.1%)	62 (4.6%)
Missing medications	117 (3.2%)	51 (2.2%)	66 (4.9%)
Family/visitors	115 (3.1%)	78 (3.3%)	37 (2.7%)
Medication computers	105 (2.8%)	50 (2.1%)	55 (4.0%)
Personal comments	98 (2.6%)	58 (2.5%)	40 (2.9%)
Other	96 (2.6%)	53 (2.3%)	43 (3.2%)
Kitchen	91 (2.5%)	53 (2.3%	38 (2.8%)
Equipment issues	83 (2.2%)	57 (2.4%)	26 (1.9%)
Total	3714 (100%)	2355 (100%)	1359 (100%)

Table 3. Number of interruptions.

Unit	Observers (no vest)	Observers (vest)	Mean (no vest)	Mean (vest)	Mean difference	95% CI lower	95% CI upper	p
All	14	14	58.85	34	24.85	8.18	41.52	0
MSU	12	9	121.2	55.3	65.9	35.94	95.86	<0.01
SU	9	9	69.7	41.8	27.9	9.33	46.47	0.01
OU	5	3	29.8	15.8	14	−0.11	28.11	0.05

MSU: Medical/Surgical Unit; SU: Surgical Unit; OU: Oncology Unit.

Number of interruptions

Our second research question investigated whether the WV would have an effect on reducing the number of interruptions experienced by nurses during the morning MA. Due to lack of participation among administering nurses in the OSU (46.2% of unit nurses volunteered) during the baseline phase, data from the OSU are included in the aggregate analysis but are not considered in individual unit analyses.

Descriptive statistics are presented in Table 3. As hypothesised, administering nurses across all units experienced fewer interruptions during the morning MA when wearing the WV ($t = 2.967$ (57.54), $p = 0.004$). Individual unit analyses show a significant reduction in the number of interruptions in the MSU ($t = 4.621$ (18), $p < 0.01$) and the SU ($t = 3.156$ (18), $p = 0.005$). However, the vest did not have a significant effect on reducing interruptions in the OU ($t = 4.348$ (18), $p = 0.052$).

Duration of interruptions

Our third research question considered whether the vest would have an effect on reducing the duration of interruptions during the morning MA. A total of 627 interruptions are missing duration data and were therefore omitted from the analysis. Our results (Table 4) show the vest did not significantly reduce the duration of interruptions; rather, the duration of interruptions *increased* across all units ($t = -3.636$ (1481.313), $p < 0.01$), with individual unit analyses showing increases in the MSU ($t = -2.745$ (640.2), $p = 0.006$) and the OU ($t = -2.6667$ (125.5), $p = 0.009$).

Post hoc analyses

Due to the unexpected results obtained regarding our third research question, we ran additional analyses to more accurately assess the effect of the WV Intervention. Specifically, we considered non-emergent interruptions as social in nature, defined as staff interactions, phone calls, educational interactions, personal comments, and nursing assistant issues. Our rationale is that these are the interruptions that the vest could realistically affect. We predicted that the WV would have a significant effect in reducing both the number and duration of non-emergent social interruptions.

Descriptive statistics are shown in Tables 5 and 6. As hypothesised, administering nurses across all units experienced a decline in the number of non-emergent social interruptions during the morning MA ($t = 4.02$ (39.73), $p < 0.01$), as well as in each unit (MSU, $t = 4.630$ (18), $p < 0.01$; SU, $t = 4.659$ (18), $p < 0.01$; OU, $t = 2.412$ (180), $p = 0.027$). However, the vest

Table 4. Duration of interruptions.

Unit	Observers (no vest)	Observers (vest)	Mean (no vest)	Mean (vest)	Mean difference	95% CI lower	95% CI upper	*p*
All	14	14	47.50	18.93	28.57	14.20	42.93	<0.01
MSU	12	9	85.70	32.50	53.20	29.06	77.34	<0.01
SU	9	9	41.00	17.80	23.20	12.74	33.66	<0.01
OU	5	3	15.80	6.50	9.30	1.20	17.40	0.027

MSU: Medical/Surgical Unit; SU: Surgical Unit; OU: Oncology Unit.

Table 5. Number of non-emergent social interruptions.

Unit	Observers (no vest)	Observers (vest)	Mean (no vest)	Mean (vest)	Mean difference	95% CI lower	95% CI upper	*p*
All	14	14	1.23	1.53	−0.29	−0.44	−0.13	<0.01
MSU	12	9	1.23	1.54	−0.31	−0.53	−0.09	0.006
SU	9	9	1.20	1.38	−0.18	−0.46	0.09	0.193
OU	5	3	1.23	1.94	−0.71	−1.24	−0.18	0.009

MSU: Medical/Surgical Unit; SU: Surgical Unit; OU: Oncology Unit.

did not have an effect on reducing the duration of these types of interruptions across units ($t = 0.111$ (1674), $p = 0.911$) or in any particular unit (MSU, $t = -0.882$ (1005), $p = 0.378$; SU $t = 1.939$ (544), $p = 0.053$; OU, $t = -1.524$ (38.32), $p = 0.136$).

We then ran a second set of post hoc analyses to examine the effect of the WV only on interruptions related to locating the narcotics keys, due to the urgent need for patient medication coupled with previous research suggesting this to be a significant source of interruptions (Biron et al., 2009; Mowinski-Jennings et al., 2011; Palese et al., 2009). We predicted the WV would not significantly reduce the number or duration of interruptions related to locating keys to the narcotics room due to the urgent nature of patient medication needs.

Descriptive statistics are presented in Tables 7 and 8. Results show the WV did not have a significant effect in reducing the number of interruptions specifically related to locating the narcotics keys ($t = 0.806$ (58), $p = 0.424$). This result was reflected in each individual unit as well (MSU, $t = -1.47$ (18), $p = 0.884$; SU, $t = 0.734$ (18), $p = 0.473$; OU, $t = 1.164$ (180), $p = 0.259$). Regarding the duration of interruptions related to searching for narcotics keys, the WV did not have a significant effect across all units ($t = 0.337$ (170), $p = 0.737$) or in each individual unit (MSU, $t = -0.331$ (89), $p = 0.741$; SU, $t = 1.011$ (57), $p = 0.316$; OU, $t = 0.619$ (20), $p = 0.543$).

Discussion

The results of this study illustrate the most frequently observed interruptions experienced during morning MA were staff interactions, phone calls, and seeking medical supplies.

Table 6. Duration of non-emergent social interruptions.

Unit	Observers (no vest)	Observers (vest)	Mean (no vest)	Mean (vest)	Mean difference	95% CI lower	95% CI upper	p
All	14	14	1.08	1.09	0.911	−0.16	0.14	0.911
MSU	12	9	1.13	1.23	−0.10	−0.32	0.12	0.378
SU	9	9	1.04	0.83	0.21	0.00	0.43	0.053
OU	5	3	0.92	1.28	−0.36	−0.84	0.12	0.136

MSU: Medical/Surgical Unit; SU: Surgical Unit; OU: Oncology Unit.

Table 7. Number of narcotics key interruptions.

Unit	Observers (no vest)	Observers (vest)	Mean (no vest)	Mean (vest)	Mean difference	95% CI lower	95% CI upper	p
All	14	14	3.57	2.97	0.60	−0.89	2.09	0.424
MSU	12	9	4.80	5.00	−0.20	−3.04	2.65	0.884
SU	9	9	3.70	2.90	0.80	−1.49	3.09	0.473
OU	5	3	2.20	1.00	1.20	−0.97	3.37	0.259

MSU: Medical/Surgical Unit; SU: Surgical Unit; OU: Oncology Unit.

Table 8. Duration of narcotics key interruptions.

Unit	Observers (no vest)	Observers (vest)	Mean (no vest)	Mean (vest)	Mean difference	95% CI lower	95% CI upper	*p*
All	14	14	1.23	1.15	0.08	−0.38	0.54	0.737
MSU	12	9	1.33	1.56	−0.10	−0.70	0.50	0.741
SU	9	9	1.14	0.92	0.29	−0.28	0.86	0.316
OU	5	3	3.08	0.092	0.70	−1.66	3.05	0.543

MSU: Medical/Surgical Unit; SU: Surgical Unit; OU: Oncology Unit.

Our results are in agreement with previous research investigating the types of interruptions occurring during typical day shifts and MA (Biron, 2009; Dilles et al. 2011; Fry and Dacey, 2007a, 2007b; Kreckler et al., 2008; McGillis-Hall et al., 2010a, 2010b; Palese et al., 2009; Potter et al., 2004; Redding and Robinson, 2009; Relihan et al., 2010). With staff interruptions occurring 2.5 times more often than any other interruption, future research is needed to examine the nature of legitimate work-related and non-work related staff interruptions to develop proactive procedures to reduce staff interruptions in the future. Despite intervention procedures targeting non-emergent phone calls (excluding physicians), phone calls remained the second-most frequently observed interruption during the morning MA. More research is needed to determine the nature and urgency of phone calls and ways to reduce phone-related interruptions during MA.

The results of our statistical analysis suggest the WV Intervention, requiring nurses to wear a vest stating, 'Please do not interrupt while passing medications', coupled with staff education, significantly reduces the number of interruptions experienced by nurses during MA. While our hypothesis was confirmed across units and the MSU and SU, a significant effect was not found in the OU. Several factors may explain this finding. It may be that the nature of patient and staff needs in oncology may require urgent attention, thus leading to an increase in interruptions experienced by administering nurses. One alternative explanation may be related to the smaller size of the unit, as the OU consists of 16 beds, compared with 42 beds in both the MSU and SU. Another possible explanation may be that the number of nurse observers collecting data may be too small to detect a statistically significant difference. Future research should consider the unique needs of OUs and consider several units ranging in size.

Our analysis failed to provide support for our prediction that the WV Intervention would be effective in reducing the duration of interruptions. Surprisingly, we found quite the opposite: duration of interruptions *increased* after the intervention was implemented. As a result, we ran additional analyses investigating social interruptions that are non-emergent in nature, defined as staff interactions, phone calls, educational interactions, personal comments, and nursing assistant issues that are not life-threatening. We found the WV did not reduce the duration of such interruptions. One explanation may be that nurses might persist with the interruption until the problem is solved, thus reducing the possibility of having to subsequently interrupt the administer nurse for the same issue. Further research is needed to determine the nature of these results.

We also investigated the effect of the WV Intervention on the number and duration of interruptions with regards to locating narcotics keys; our results show our intervention did not have a significant effect. These findings lend support for the installation of a keypad for entry to the narcotics room or implementing a 'key-holder' system where a

non-administering nurse is designated as the sole individual in charge of keys (Kreckler et al., 2008; Relihan et al., 2010). Similar results have been reported in previous studies conducted in nursing units where a key is required for access to the narcotics room (Kreckler et al., 2008; Palese et al., 2009; Tucker, 2004; Tucker and Spear, 2006). In particular, Kreckler et al. (2008) found gaining access to controlled drugs was a significant source of interruptions due to the fact there was one set of keys available while several nurses are responsible for simultaneous MA. There is only one set of narcotics keys in each unit and the keys must be in a nurse's possession at all times. Looking for the narcotic keys requires interrupting other nurses to locate them. Regardless whether the nurse is administering medications, the need for the keys is urgent. Co-workers have no option but to interrupt because they need to administer the medication to a patient immediately (Bennett et al., 2010). Furthermore, it may be the case that nurses must continue to look for keys until they are found due to the emergent nature of patient medications. Installation of a keypad entry system may significantly reduce both the number and duration of interruptions related to locating narcotics room keys.

Several limitations to this research should be considered. Since nurse observers and administering nurses were aware of nature the study, results should be read with caution due to the potential for measurement bias and research reactivity (Cook and Campbell, 1979). A second limitation concerns data collection issues. In some instances, recorded durations are ambiguous, i.e. a number of entries omit the duration of interruptions and several interruptions fewer than 1 minute are not noted in a standardised manner. For example, some nurses wrote the time in seconds, whereas others wrote '<1 min'. Future studies should take care in providing specific, detailed data collection instructions for observers to ensure accuracy and quality of data related to this variable. Furthermore, due to the lack of voluntary participation among administering nurses in the OSU, a selection bias may threaten the validity of our results and should therefore be considered with caution (Cook and Campbell, 1979).

Previous research suggests a possible relationship between interruptions experienced by administering nurses and time of the day at which they occur (Kreckler et al., 2008). Our observations were conducted during the morning MA, limiting generalisability of our results to other MAs. Future research is needed to investigate the effect of the vest at different times, particularly in the evening when there is more activity in the units. The nature of interruptions in the evening hours may show an increase in interruption types, particularly those initiated by visitors. In addition, we would be able to determine if interruptions are more likely to occur during a particular medication pass. Second, our study was limited to the MSU, SU, OU, and the OSU. Future research is needed to determine if the intervention will be effective in other types of patient units. Finally, our results may not extend beyond the scope of this hospital; research is needed to assess the nature and duration of interruptions in a variety of hospital settings.

Negative effects of the WV Intervention must be considered as well. It is questionable whether the vest would have a lasting effect on reducing interruptions. It is possible staff may become habituated (Rankin et al., 2009) to the WV over time, resulting in a decline in effectiveness. Another possible negative outcome may be the WV may produce a change in culture where nurses become habituated to avoid interrupting nurses during MA, even when the interruption is warranted. Follow up studies would be effective in answering this question. Another concern relates to infection control issues; while nurses are provided with two vests, there is no oversight ensuring proper laundering to avoid the spread of infection.

Furthermore, vests may produce clutter in work areas, leading to more interruptions, e.g. nurses may be too busy to return vests to lockers and leave them in inappropriate areas. Finally, implementing the WV Intervention may present financial issues for hospitals with inadequate funding to purchase enough vests for administering nurses.

Conclusion

Overall, our study lends support for implementing an intervention that combines staff education with a systematic protocol coupled with the condition that nurses wear a WV that indicates to others one is concentrating on administering patient medication. While interruptions social in nature, such as staff interactions, and phone calls may inevitably continue, such is the nature of hospitals where emergencies are commonplace. Nonetheless, our results suggest the WV Intervention may significantly reduce interruptions during MA, possibly resulting in fewer MA errors.

Key points for policy, practice and research

- The most frequently observed types of interruptions in this study were staff interactions, phone calls, and seeking necessary supplies.
- Staff education coupled with the requirement administering nurses wear a WV with the statement, 'Please do not interrupt while passing medications' may significantly reduce the number of interruptions experienced by nurses administering medications, which may lead to a reduction in MA errors.
- While the WV Intervention significantly reduced the number of interruptions, it did not significantly reduce the duration of such interruptions. It may be the WV has an effect where nurses may persist in resolving an issue once they have interrupted, therefore reducing the need for a second interruption.
- The WV Intervention was not effective when nurses were confronted with locating the narcotics keys. Our findings lend support for installing a keypad entry system allowing nurses access the medication room without having to interrupt administering nurses.

Funding

This research was supported by a grant from the Cardinal Foundation.

Conflict of interest statement

None declared.

References

Anthony K, Wiencek C, Bauer C, et al. (2010) No interruptions please: Impact of a no interruption zone on medication safety in intensive care units. *Critical Care Nurse* 30(3): 21–29.

Armitage G and Knapman H (2003) Adverse events in drug administration: A literature review. *Journal of Nursing Management* 11: 130–140.

Bennett J, Dawoud D and Maben J (2010) Effects of interruptions to nurses during medication administration. *Nursing Management* 16(9): 22–23.

Biron AD (2009) *Medication administration complexity work interruptions and nurses' workload as predictors of medication administration errors*. PhD Thesis, McGill University, USA.

Biron AD, Loisell CG and Lavoie-Tremblay M (2009) Work interruptions and their contribution to medication administration errors: An evaluation study. *Worldviews on Evidence-Based Nursing* 2: 70–86.

Coiera EW and Tombs V (1998) Communication behaviours in a hospital setting: An observational study. *British Medical Journal* 316: 673–677.

Cook TD and Campbell DT (1979) *Quasi-Experimentation: Design and Analysis Issues for Field Settings*. Boston, MA: Houghton Mifflin Company.

Creswell JW (1998) *Qualitative Inquiry and Research Design: Choosing Among Five Traditions*. Thousand Oaks, CA: Sage Publications.

Dilles T, Elseviers M, Van Rompaey B, et al. (2011) Barriers for nurses to safe medication management in nursing homes. *Journal of Nursing Scholarship* 43(2): 171–180.

Flanders S and Clark AP (2010) Interruptions and medication errors. *Clinical Nurse Specialist* 24(6): 281–285.

Fry MM and Dacey C (2007a) Factors contributing to incidents in medicine administration. *Part 1*. British Journal of Nursing 16(9): 556–559.

Fry MM and Dacey C (2007b) Factors contributing to incidents in medicine administration. *Part 2*. British Journal of Nursing 16(11): 676–681.

Grundgeiger T and Sanderson P (2009) Interruptions in healthcare: Theoretical views. *International Journal of Medical Informatics* 78(5): 293–307.

Hatch JA (2002) *Analyzing Qualitative Data: Doing Qualitative Research in Education Settings*. Albany, NY: State University of New York Press.

Kohn LT, Corrigan JM and Donaldson MS (2000) *To Err is Human: Building a Safer Health System*. Washington DC: National Academy Press.

Kreckler S, Catchpole K, Bottomley M, et al. (2008) Interruptions during drug rounds: An observational study. *British Journal of Nursing* 17(21): 1326–1330.

Landis JR and Koch GG (1977) The measurement of observer agreement for categorical data. *Biometrics* 33: 159–174.

Lewis C (1993) Analyzing means from repeated measures data. In: Keren G and Lewis C (eds) *A Handbook for Data Analysis in the Behavioral Sciences: Statisical Issues*. Hillsdale, NJ: Lawrence Erlbaum Associates Inc, pp. 73–94.

Mayo AM and Duncan D (2004) Nurse perceptions of medication errors: What we need to know for patient safety. *Journal of Nursing Care Quality* 19(3): 209–217.

McGillis-Hall L, Ferguson-Pare M, Peter E, et al. (2010a) Going blank: Factors contributing to interruptions to nurses' work and related outcomes. *Journal of Nursing Management* 18: 1040–1047.

McGillis-Hall L, Pedersen C and Fairley L (2010b) Losing the moment. *The Journal of Nursing Administration* 40(4): 169–176.

Mowinski-Jennings B, Sandelowski M and Mark B (2011) The nurse's medication day. *Qualitative Health Research* 20(10): 1–11.

Nguyen EE, Connolly PM and Wong V (2010) Medication safety initiative in reducing medication errors. *Journal of Nursing Care Quality* 25(3): 224–230.

Osborne J, Blais K and Hayes J (1999) Nurses' perceptions: When is it a medication error? *The Journal of Nursing Administration* 29(4): 33–38.

Palese A, Sartor A, Costaperaria G, et al. (2009) Interruptions during nurses' drug rounds in surgical wards: Observational study. *Journal of Nursing Management* 17: 185–192.

Pape TM (2003) Applying airline safety practices to medication administration. *Medsurg Nursing* 12(2): 77–93.

Pape TM, Guerra DM, Muzquiz M, et al. (2005) Innovative approaches to reducing nurses' distractions during medication administration. *The Journal of Continuing Education in Nursing* 36(3): 108–116.

Potter P, Boxerman S, Wolf L, et al. (2004) Mapping the nursing process. *Journal of Nursing Administration* 34(2): 101–109.

Potter P, Wolf L, Boxerman S, et al. (2005) Understanding the cognitive work of nursing in the acute care environment. *Journal of Nursing Administration* 35(7/8): 327–335.

Rankin CH, Abrams T, Barry RJ, et al. (2009) Habituation revisited: An updated and revised description of the behavioral characteristics of habituation. *Neurobiology of Learning and Memory* 92(2): 135–138.

Redding DA and Robinson S (2009) Interruptions and geographic challenges to nurses' cognitive workload. *Journal of Nursing Care Quality* 24(3): 194–199.

Relihan E, O'Brien V, O'Hara S, et al. (2010) The impact of a set of interventions to reduce interruptions and distractions to nurses during medication administration. *Quality and Safety in Health Care* 19: 1–6.

Stamp KD and Willis DG (2010) Nurse interruptions pre- and post-implementation of a point-of-care medication administration system. *Journal of Nursing Care Quality* 25(3): 231–239.

Tang FI, Sheu SJ, Yu S, et al. (2007) Nurses relate to contributing factors involved in medication errors. *Journal of Clinical Nursing* 16: 447–457.

Thompson D, Wolf GA and Spear SJ (2003) Driving improvement in patient care. *Journal of Nursing Administration* 33(11): 585–595.

Trbovich P, Prakash V and Stewart J (2010) Interruptions during the delivery of high-risk medications. *Journal of Nursing Administration* 40(5): 211–218.

Tucker A (2004) The impact of operational failures on hospital nurses and their patients. *Journal of Operations Management* 22: 151–169.

Tucker AL and Spear SJ (2006) Operational failures and interruptions in hospital nursing. *Health Services Research* 41(3): 643–662.

Ulrich B (2010) Interruptions: A danger to quality patient care. *Nephrology Nursing Journal* 37(3): 225.

United States Pharmacopeia (2000) *Summary of 1999 information submitted to MedMarx: A national database for hospital medication error reporting*. Rockville, MD: USP.

Jayne Craig (PhD, RN) is a nurse researcher at CentraState Medical Center in Freehold, NJ. She attained her PhD in nursing in 2005 and an MS in nursing in 1995, both from Rutgers,

The State University of New Jersey. She earned her BSN from Kean College of New Jersey in 1990 and an Associate's Degree in nursing from Middlesex County College in 1976.

Fiesta Clanton (RN, DNSc(c), ACNS-BC) is the director of professional development and education at CentraState Medical Center, Freehold, NJ.

Marylee Demeter (EdM, MA) is the coordinator of student affairs assessment and research for Rutgers, The State University of New Jersey. She graduated with a BA in psychology and sociology in 1997, an EdM in measurement, statistics and program evaluation in 2005, and an MA in educational psychology in 2009, all from Rutgers, The State University of New Jersey. She currently consults with educational, medical, and state organisations in New Jersey on a variety of research projects and program evaluations.