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ORIGINAL ARTICLE

**STUDY ON INCIDENT CAUSAL FACTORS ABOUT THE ORAL MEDICINE
BY NURSES: ANALYSIS FROM THE ADMINISTRATION PROCESSES**

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Abstract The aim of this study was to elucidate the differences in the causes of incidents at each stage of drug administration between nurses with different numbers of years of experience and current nursing unit tenure. We evaluated 510 reports involving medications taken after meals where medication charts were utilized. These reports were selected from 1,173 incident reports involving drug administration by hospital ward nurses in advanced treatment hospitals with 640 bed capacities in the northeastern area of Japan between fiscal 2012 and 2014. Approximately 40% of these were related to the drug preparation stage. There was no difference in the frequency of incidents between nurses with less than 2 years and those with 11 or more years of experience. As per the results of our correspondence analysis of the relation between the nursing unit tenure and the causal factors for each stage, “insufficient checking” at all stages was the most common factor. At the drug preparation and distribution stages, 11 or more years of experience were related to physical conditions. At all stages, nursing unit tenure of less than 2 years was related to psychological conditions. The findings indicated that nurse training and organized approach are required to minimize human factors involved in medical incidents.

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Key words: incident reporting; medical errors; nurse experience; risk factors; medication process.

Introduction

Since the US Institute of Medicine [IOM; currently “The Health and Medicine Division” (HMD)] declared that “anyone can make a mistake,” it has been working to advance its Patient Safety Policy. However, medical accidents and incidents continue to occur.¹⁾ The World Health Organization’s (WHO) “Framework for an Outline of an International Classification for Patient Safety” outlines the types and causes of incidents.²⁾ There is also an evidence-based handbook for nurses on patient safety.³⁾ In addition, the performance of double-checks and techniques, such as computerized physician order entry and bar code medication administration, in the clinical setting has been

reported to be effective.^{4,5)} However, these methods have not led to a significant reduction in the number of incidents, which continues to have a major impact on patients. In Japan, there were approximately 30,271 near-miss incidents during 2015,⁶⁾ approximately 40% of which were related to drug administration. Drug administration incidents that are related to insufficient attention to detail and subsequent harm to patients, such as a drug being administered to the wrong patient or a patient not being administered a prescribed drug, continue to occur in large numbers⁷⁾ and have not been reduced through the implementation of safety measures.⁸⁾

Nurses have the important role of preparing and administering drugs. Patients may suffer

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grave consequences if nurses neglect to perform the required checks, operate according to preconceptions, or forget to administer drugs. Therefore, nurses are often responsible for medical incidents.⁹⁾ A particularly high number of incidents are caused by inexperienced nurses.¹⁰⁾ On the other hand, highly experienced nurses who have accumulated a wealth of knowledge play a central role in the prevention of incidents.¹¹⁾ Nevertheless, even highly experienced nurses are sometimes responsible for incidents. Studies on medical errors made by inexperienced nurses or nurses in general have been conducted in the past.¹⁰⁾ However, almost no study has focused on the cause of these errors. Causes of medication errors include workload, interruption of work, and distractions¹²⁻¹⁶⁾ and are not related to years of experience. However, the causes of incidents may differ according to the relative durations of nursing experience and the extent to which highly experienced nurses and novice nurses are accustomed to their work environments. Therefore, elucidation of the causes of incidents that can be attributed to novice nurses and highly experienced nurses will allow for the creation of countermeasures to improve nursing work environments in accordance with the number of years of experience.

The process of drug administration comprises the following stages: the nurse receives instructions from the physician, makes preparations by setting up the medicine cart, etc., and administers the drug to the patient, who then takes the drug. However, analyses of the incident cause at each drug administration stage based on incident reports have not been performed. Medication errors occur during all stages of drug preparation and administration.¹⁷⁾ Analysis of each stage would help elucidate problems associated with each process. Analysis of the circumstances under which the responsible nurse administers a drug involved

in an incident, based on the number of years of experience and the nursing unit tenure, would allow the creation of detailed countermeasures tailored to each cause.

Aim

This study aimed to elucidate differences in incident cause for each drug administration stage based on differences in the number of years of nursing experience and the nursing unit tenure.

Methods

Subjects: The subjects were derived from 510 incident reports involving after meals from medication carts. These reports were selected from 1,173 incident reports between 2012 and 2014 involving drug administration by hospital ward nurses in a general Hospital. Our hospital is a tertiary hospital with 640 bed capacities in northeastern area of Japan. The incident level was classified by combination of continuity and a degree of the harm. Incident reports were collected from level 0 to 3a. The drug administration processes for after meals were analyzed. Administrations of narcotics that are securely stored and drug administration managed by the patients themselves were excluded from this study. The incident reports were put into computer terminals and reported by the responsible parties immediately after the incidents. The number of years of nursing experience and the number of years in the current nursing position were also recorded. The incident details were recorded in free description format and the causes were selected from 11 items (multiple answers were allowed).

Classification of subjects: The number of years of nursing experience was divided into less than 2 years, where nurses worked while

supervised and guided by other experienced nurses; 2–10 years, where nurses worked without supervision; and 11 or more years for mid-level or skilled nurse. The nursing unit tenure was divided into less than 2 years and 2 or more years. To allow comparison between novice nurses with little experience and highly experienced nurses, the nurses with unit tenure of less than 2 years were categorized as less than 2 years or 2 or more years of overall experience. In addition, nurses responsible for incidents included Deputy Head Nurses who were involved in drug administration. All the nurses were engaged in all types of procedures. The novice nurses practiced while supervised and guided by other experienced nurses.

Drug administration processes and number of incidents: The entire drug administration process was divided into the following processes: the first is instruction receipt stage. The second is drug preparation stage. The third is drug administration stage, and the fourth is drug confirmation stage. This division was confirmed by two joint researchers through careful examination of the incident reports. The number of incidents was compared statistically using chi square test based on the number of years of experience and the number of years in the current position. All data were analyzed statistically using R2.8.1.

Causal factors: The causal factors listed in the incident reports were freely reported by the responsible nurses from among the following 11 items: 1. Insufficient checking, 2. Insufficient observation, 3. Misjudgment, 4. Lack of knowledge, 5. Insufficient skills, 6. Physical condition (lack of sleep, poor physical condition, effect of sleeping pills), 7. Psychological condition (panicked, nervous, stressed, preoccupied with other concerns, preconceptions, acted without thinking), 8. Delayed reporting, 9. Inadequate

documentation, 10. Insufficient communication among staff, and 11. Lack of explanation to the patient. The frequency of these causal factors was calculated based on the number of years of experience of the responsible party for each stage. Correspondence analysis was then performed to analyze correlation with the number of years of experience and the nursing unit tenure. The related strength and weakness of the association between the causal factor and the number of years of experience are expressed as distance at the same time visually using the correspondence analysis.

Ethical considerations: This study was conducted with the approval of the Hirosaki University Graduate School of Medicine Institutional Review Board. The Director of the Medical Risk Management Office was provided with a description of the study details, and consent to utilize data was obtained. The names of the patients and responsible parties were removed before providing the data to the researchers. The nurses were informed of the theme, aim, subjects, and methods of this study. They were also informed that their identity would be concealed for the purpose of statistical processing, and that they could withdraw from this study at any point. All this information was communicated to the nurses in writing on a bulletin board.

Results

Total number of incidents during the process based on number of years of experience and nursing unit tenure

Total number of incidents at each stage: The number of incidents at each stage were as follows: Instruction receipt stage, 53 (10.4%); drug preparation stage, 203 (39.8%); drug administration stage, 122 (23.9%); and drug confirmation stage, 132 (25.9%). There was sig-

Table 1. Total number of years of experience and number of years in the nursing unit tenure of the parties responsible for incidents at each stage

Years of nursing experience		Medication stage			
		Instruction	Preparation	Administration	Confirmation
<2 years	n = 22	12 (9.8)	48 (39.4)	27 (22.1)	35 (28.7)
2-10 years	n = 186	19 (10.2)	76 (40.9)	47 (25.3)	44 (23.6)
>11 years	n = 140	15 (10.7)	49 (35.0)	38 (27.2)	38 (27.1)

*No answer: No entry on the report, n = 62

Table 2. Total number of years of experience and number of incidents for responsible parties who have held their nursing unit tenure for under 2 years for each stage

Years of nursing experience		Medication stage			
		Instruction	Preparation	Administration	Confirmation
<2 years	n = 113	11 (9.7)	45 (39.8)	23 (20.4)	34 (30.1)
>2 years	n = 98	11 (11.2)	37 (37.8)	27 (27.6)	23 (23.4)

nificant deviation in the frequency of incidents at each stage, with a large percentage occurring at the preparation stage and a small percentage occurring at the instruction receipt stage ($\chi^2 = 88.6$, $df = 3$, $p < 0.01$).

Background characteristics of the responsible parties: The frequencies of incidents classified by the number of years of experience and the nursing unit tenure of the responsible parties are shown in Tables 1 and 2, respectively. Analysis of the entire process showed that there was significant deviation in the number of years of experience ($\chi^2 = 21.1$, $df = 2$, $p < 0.01$), with many nurses in the “2-10 years” group and few in the “less than 2 years” group. No significant deviations were observed in the nursing unit tenure ($\chi^2 = 1.1$, $df = 1$, n.s.). Likewise, there was no significant difference in the number of incidents based on the number of years of experience and the nursing unit tenure throughout the process.

Causal factors

Of the 510 reports, the numbers of incident reports in which the responsible parties selected the following causal factors were as follows: Insufficient checking, 463 reports (55.6%); psychological condition, 154 reports (18.5%); and misjudgment, 67 reports (8.1%). The numbers of causal factors for each stage are shown in Figure 1. At all stages, “insufficient checking” was most frequent. The results of correspondence analysis of the relationships between the causal factors at each stage are shown in Figure 2. Factors located at the central point of the graph were related to all stages. Insufficient checking was related to all stages. The factors located close to the stages were related to those stages. Lack of knowledge and inadequate documentation were related to the instruction receipt stage, psychological condition was related to the preparation stage, physical and psychological conditions were related to the administration stage, and insufficient observation and lack of explanation to the patient were related to the confirmation stage.

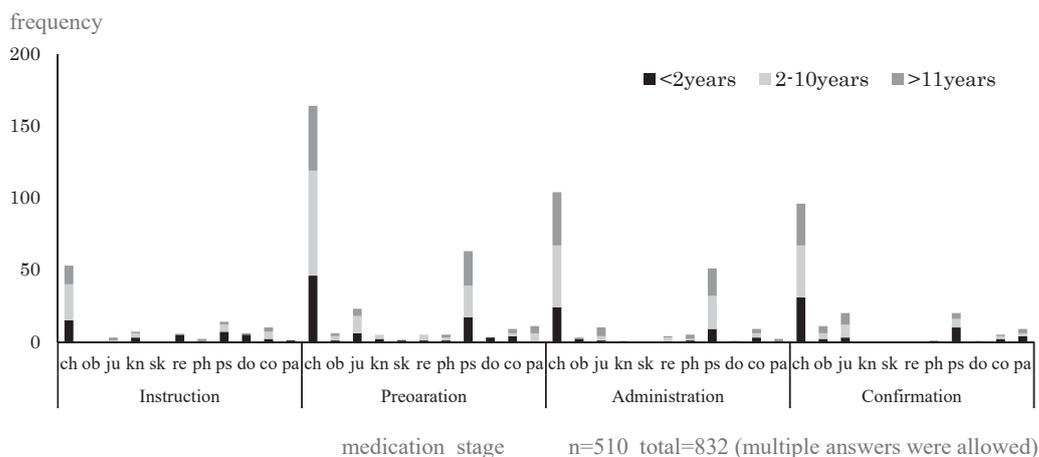


Figure 1 Frequency of causal factors selected by responsible parties based on years of experience for each stage
 ch: not enough checking, ob: not enough observation, ju: misjudgments, kn: lack of knowledge, sk: not enough skills, re: delayed reporting, ph: bad physical condition, ps: psychological condition, do: inadequate documentation, co: not enough communication among staff, pa: lack of explanation to patient

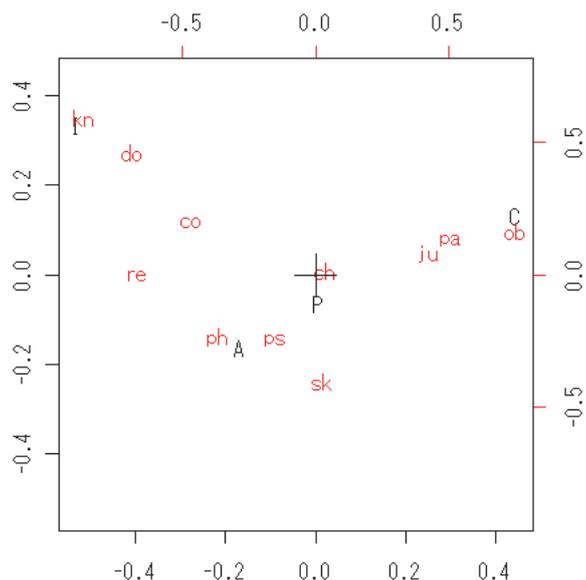


Figure 2 Relationship between causal factors at each stage
 The contribution ratio is 71.3% for the first component and 21.5% for the second component with a cumulative contribution ratio of 92.8%.
 I = receive instruction stage, P = medication preparation stage, A = administration stage, C = medication confirmation stage. ch: not enough checking, ob: not enough observation, ju: misjudgments, kn: lack of knowledge, sk: not enough skills, ph: bad physical condition, ps: psychological condition, re: delayed reporting, do: inadequate documentation, co: not enough communication among staff, pa: lack of explanation to patient.

The results of correspondence analysis of the relationship between the years of experience and the causal factors for each stage are shown in Figure 3. Throughout the process, the number of years of experience was related to

insufficient checking. At the instruction receipt stage, experience of less than 2 years was related to inadequate documentation, experience lengths of 2 to 10 years and 11 or more years were related to insufficient communication

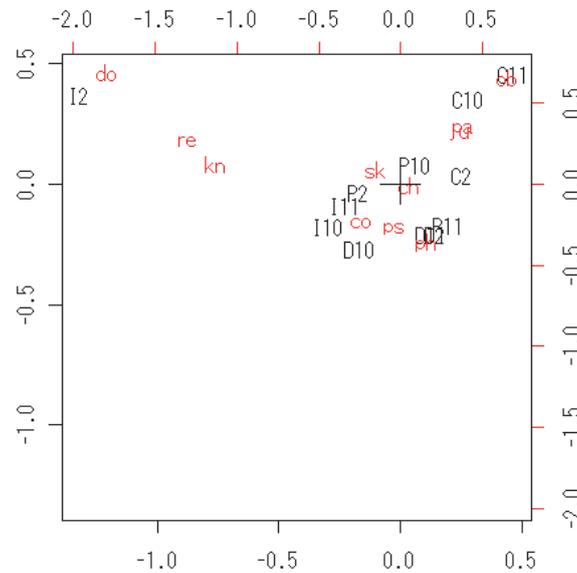


Figure 3 Relationship between causal factors and number of years of experience at each stage
The contribution ratio is 48.1 for the first component and 18.4 for the second component with a cumulative contribution ratio of 66.5%.

I2 = less than 2 years of nursing experience, I10 = 2–10 years nursing experience, I11 = over 11 years of nursing experience in the receive instruction stage. P2 = less than 2 years of nursing experience, P10 = 2–10 years of nursing experience, P11 = over 11 years of nursing experience in the medication preparation stage. A2 = less than 2 years of nursing experience, A10 = 2–10 years of nursing experience, A11 = over 11 years of nursing experience in the administration stage. C2 = less than 2 years of nursing experience, C10 = 2–10 years of nursing experience, C11 = over 11 years of nursing experience in the medication confirmation stage.

among staff and insufficient skills, experience of 2 to 10 years was related to insufficient skills, and experience of 11 or more years was related to physical condition. At the administration stage, experience lengths of 2 or more years and 11 or more years were related to physical condition, and experience of 2 to 10 years was related to insufficient communication among staff and psychological condition. At the drug administration stage, experience of 2 to 10 years was related to misjudgment and lack of explanation to the patient, and experience of 11 or more years was related to insufficient observation.

The results of the correspondence analysis of the relationship between the nursing unit tenure and causal factors for each stage are shown in Figure 4. Throughout the process, the number of years of experience was related to the psychological condition and insufficient

checking. At the instruction receipt stage, experience of less than 2 years was related to inadequate documentation and experience of 2 or more years was related to physical condition. At the preparation stage, experience of less than 2 years was related to insufficient skills and insufficient communication among staff, and experience of 2 or more years was related to insufficient observation. At the administration stage, experience of less than 2 years was related to misjudgment. At the drug confirmation stage, experience of less than 2 years was related to insufficient observation.

Discussion

In this study, there was no difference in the frequency of incidents between nurses with less than 2 years and those with 11 or more years of experience. Although it is assumed that novice

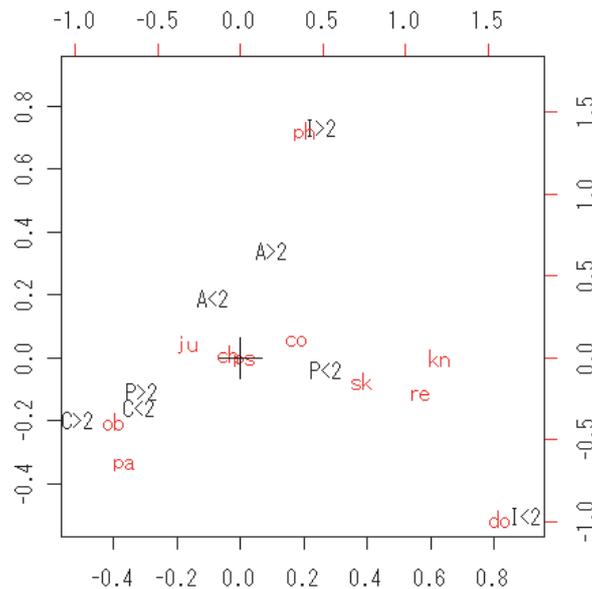


Figure 4 Relationship between causal factors and number of years of overall experience for a nursing unit tenure of less than 2 years at each stage
 The contribution factor is 46.4 for the first component and 24.8 for the second component with a cumulative contribution factor of 71.2%.
 I<2 = less than 2 years of nursing experience and I>2 = over 2 years of nursing experience in the receive instruction stage. P<2 = less than 2 years of nursing experience and P>2 = over 2 years of nursing experience in the medication preparation stage. A<2 = less than 2 years of nursing experience and A>2 = over 2 years of nursing experience in the administration stage. C<2 = less than 2 years of nursing experience and C>2 = over 2 years of nursing experience in the medication confirmation stage.

nurses are responsible for a high frequency of incidents,¹⁸⁾ we did not observe a significant statistical association between medication errors and years of experience. In addition, based on the fact that there were significant deviations in the number of years of experience at each stage, nurses may be responsible for an incident regardless of the years of experience, which indicates that countermeasures need to be created at each stage for not only novice nurses but also highly experienced nurses.

Ascertaining causal factors for incidents is an important part of countermeasures for highly experienced nurses. Throughout the process of administering drugs to patients, medication errors are related to factors, such as stress, fatigue, and workload, on part of the nurses.¹⁹⁾ In this study, the psychological condition of the nurses was a causal factor at the instruction receipt stage and the drug

administration stage, even among nurses with 2–10 years of experience. In addition, during preparation and administration of drugs, factors related to physical condition, such as insufficient sleep and poor physical condition, were causal factors of incidents, even among nurses with 11 or more years of experience. The relationship between medication errors and fatigue was particularly pronounced among older nurses. Many of these nurses worked night shifts and off-hours and underwent training during off-hours, which presumably led to sleepiness and fatigue. Adjustment of work schedules is a necessary part of relieving the physical burden of nurses, which would be impossible without the involvement of the nursing labor union.

In addition, we found that when a nurse has just attained a new position, her psychological condition, such as panicking, preconceptions, and being distracted by other concerns, was

related to incidents, regardless of the total number of years of experience. Panicking due to workload in new and unfamiliar work environments makes it difficult to complete each task smoothly. Although improving the work environment of nurses who handle drugs to facilitate better concentration on the job at hand will prevent medication errors,¹⁹⁾ it is difficult to maintain ideal conditions. Nurses have to respond to patient call buttons and requests to discuss issues with patients, which means that work interruptions are a daily occurrence¹⁴⁾ and cause medication errors.¹⁶⁾ The psychological burden of having to set up and administer drugs accurately for all patients under a particular nurse's care while constantly being interrupted is large. Because nurses work in an environment in which they are prone to panic and distraction due to others' concerns, we believe that it is necessary to make all nursing work tasks, including drug-related tasks, simpler and more efficient to relieve nurse burden. Although errors are committed by individuals, they are caused by various environmental factors.²⁰⁾ Recently, medical accident prevention due to reviews of various systems are becoming more prominent.²¹⁾ The causes of medical accidents are not simply individual errors or rule infractions. It is also necessary to improve the background conditions that lead to errors and rule infractions (e.g., problems and environment) and the organization that creates those problems and environments.²²⁾ In particular, it is necessary to move away from the tendency to regard lack of awareness, mistaken preconceptions, and forgetfulness on the part of nurses as the causes of incidents and to investigate various work environments that lead the responsible parties into those situations. Important components of human error in the human cognitive process include reduced ability to concentrate, stress, increased burden, and lack of sufficient knowledge to

perform tasks correctly.²³⁾ We believe that it is necessary for organizations which create work environments wherein workers fall victim to such circumstances to take initiatives to improve these work environments. For example, organizations need to take initiatives to achieve the following goals: design systems that take into consideration people's limits, set tasks that take safety into consideration, stop dependence on memory, utilize regulatory and compulsive functions, stop dependency on human supervision, simplify important processes, and standardize work processes.¹⁾ These systems should not be left to individual nurses but rather taken on by organizations, because if comprehensive improvement is not achieved, errors cannot be prevented. In addition, nursing experience of less than 2 years is related to incidents, insufficient skills, poor judgment, and insufficient explanation to patients. Because novice nurses are not used to any aspects of their work, we believe that the safety of drug administration can be improved by novice nurse participation in repeated simulations resembling actual circumstances based on the causal factors identified in this study.^{24),25)}

The subjects of this study were derived from the incident reports obtained from a single institution. Moreover, the reports were limited to the selection of causal factors of the incidents. To extract more diversified causal factors, reports from multiple institutions and free descriptions of the causal factors are needed. We also believe that extraction of the causal factors that are most useful in improving work environments is needed. However, the causal factors identified in this study suggest that it is necessary for organizations to investigate and take initiatives to improve the current work environments that lead to incidents.

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