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Medication Management Factors Associated With Medication Errors at Japanese Long-Term Care Facilities

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Abstract

To evaluate the quality of healthcare services provided at long-term care facilities (LTCFs), this study focused on medication management practice and performance. We measured the incidence of medication errors, and also aimed to clarify which structure and process indicators were associated with the incidence of such errors at LTCFs. We collected data on medication management practices and the incidence of medication errors in the fiscal year 2012–2013 at 865 LTCFs, sampled from among those registered with the Welfare, Health and Medical Care Information Network of the Welfare and Medical Service Agency in Japan. We assessed the incidence of medication errors over the course of a year and examined the relationships between medication management practices and incidence of errors, using a multiple regression analysis. The incidence of medication errors at LTCFs was 40.0 per 1,000 residents. Of these, the incidence of errors of severity level 3, defined as those resulting in some degree of harm, was 1.4 per 1,000 residents. Structure indicators relating to the incidence of medication errors were the number of residents, residents per nurse, and residents per care staff member; related process indicators were the practice of action to increase awareness and improve measures taken to prevent medication errors by staff, and double-checking of medications by staff before administration to residents. Overall, medication errors were associated with human resources and double-checking of medications. Our findings suggest that in order to prevent medication errors, LTCFs should increase their staffing levels and put in place systems for double-checking of medications.

Keywords: medication errors, medication management, long-term care facility

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1 Introduction

Long-term care facility (LTCF) residents are at a high risk of medication error because of their frequent need for multiple prescriptions due to chronic diseases and their decline in cognition. Therefore, it is important to provide a support system for the administration of medication that contributes to the prevention of medical accidents resulting from human error, such as administration of the wrong medication or incorrect administration of medication. The likelihood of medication errors in nursing homes is well recognised within the medical field. The Food and Drug Administration reports that medication errors are responsible for injuring approximately 1.3 million people in the United States annually [1].

In Japan, an increase in medication error rates at LTCFs has been reported, prompting the Japanese government to publish guidelines requiring appropriate patient safety measures and quality of healthcare at LTCFs [2]. Given that many elderly individuals commonly take many prescription medications to treat various ailments and conditions, it is imperative that these individuals are provided with the correct medications and dosages. However, there are relatively few doctors, pharmacists, nurses, and care staff per patient members working at LTCFs. For example, the practice of double-checking is indispensable in the prevention of misadministration of medication, but double-checking is often inadequately practised as a result of insufficient human resources.

Previous work has identified facility-related factors in medication error, including insufficient physician oversight of daily care activities [3] and a high turnover rate among nurses [4]. Additionally, another study has found that medication errors are primarily due to poor communication between care teams [5]. The number of residents per nurse is high in Japan, compared with other Organisation for Economic Co-operation and Development member countries [6]. However, there is no clear protocol for the development of specific strategies to manage risks relating to medication at LTCFs in Japan. To evaluate the quality of healthcare services provided at LTCFs, this study focuses on performance in medication management.

The aims of this study were (1) to investigate the incidence of medication errors and (2) to clarify the factors involved in medication errors by measuring structure and process indicators relating to medication management at LTCFs. An understanding of the causes of these errors and factors contributing to them is needed to better inform strategies for the avoidance of errors in medication management at LTCFs.

2 Methods

2.1 Setting

The sample consisted of welfare facilities for the elderly and healthcare facilities for the

elderly, as defined by the long-term care insurance system in Japan. Welfare facilities for the elderly are defined as facilities that provide care for elderly people for whom it would be more difficult to provide appropriate care in-home, as they will permanently require care as a result of significant physical or mental decline. In contrast, healthcare facilities for the elderly are defined as facilities that provide the care necessary for residents to return home, such as medical care and rehabilitation following acute care. The long-term care insurance system in Japan came into force in 2000, since which time the availability of long-term care services has increased. In 2012, there were approximately 11,000 LTCFs in Japan.

We randomly selected 2,000 facilities from a list of the LTCFs registered with the Welfare, Health and Medical Care Information Network of the Welfare and Medical Service Agency. A questionnaire was posted to those nurse managers or facilities officers who agreed to participate in the study.

2.2 Data collection

We collected information on healthcare services at the facilities during the fiscal year 2012–2013. The questionnaire consisted of three parts, in the Donabedian framework: structure indicators, process indicators, and outcome indicators [7]. The structure indicators consisted of 9 items, including facility organisation, the types of medication required by residents, and staffing levels at the facility. The process indicators consisted of 12 items, including the implementation of medication management practices and systems for ensuring patient safety and standards of care, such as analysis of medication errors, double-checking of medications, and provision of training. The outcome indicators consisted of 4 items, including the total number of medication errors occurring per 1,000 residents and number of errors involving each type of medication (oral, injection, and others, including eye-drops, ointments, inhalers, etc.) in the year preceding data collection.

2.3 Data analysis

We examined four outcomes: the total incidence of medication errors, the incidence of oral medication errors, the incidence of injection medication errors, and the incidence of other medication errors during the year preceding data collection. We constructed multivariate linear regression models using a stepwise selection method to examine the relationship of each of the four outcomes with the 9 structure indicators and the 12 process indicators. Analyses were carried out using SPSS for Windows, version 24.0J (IBM; Japan), with the threshold for significance set at $p < 0.05$.

2.4 Ethical approval

This study was conducted with the approval of the ethics committee of the Graduate School of Nursing of Nagoya City University (12024-2). Survey respondents were

provided with a written explanation of the purpose of the study, and informed that participation was voluntary, that the confidentiality of their personal information would be protected, and that the data from all participating facilities would be published collectively, so that individual facilities would not be identifiable. Return of the questionnaire was considered to represent implied consent to participate in this study.

3 Results

Questionnaires were returned by managers at 865 of the facilities (43.3% of those contacted). Of these, 541 (62.5%) were welfare facilities, and 324 (37.5%) were healthcare facilities. Table 1 displays the characteristics of participating facilities. The average number of residents per facility was 75.3, and their average age was 77.8 years. Facility residents may be classified according to the level of care they require, using the 5 categories laid out by the long-term care insurance system in Japan. On average, 4.2% of facility residents were Level 1 residents, who require partial care for some aspects of activities of daily living; 16.4% were Level 2 residents, who require a low level of care; 24.2% were Level 3 residents, who require a moderate level of care; 26.8% were Level 4 residents, who require a high level of care; and 28.4% were Level 5 residents, who require the highest level of care.

Table 1: Characteristics of participating LTCFs

		N (%)
Number of residents	< 50	91 (10.5)
	50–100	533 (61.6)
	> 101	241 (27.9)
Location	Rural	468 (54.1)
	Urban	397 (45.9)
Funding type	Private	822 (95.0)
	Public	43 (5.0)
Facility type	Welfare facility for the elderly	541 (62.5)
	Healthcare facility for the elderly	324 (37.5)

3.1 Incidence of medication errors

Table 2 shows the incidence of medication errors. The total number of medication errors per 1,000 residents was 40.0: 20.5 involving oral medication, 9.0 injection medication, and 10.5 other types of medication. The total number of errors at severity level 1, defined as cases in which an error was made and the medication was administered, but no harm was caused, was 12.0 per 1,000 residents. The total number of errors at level 2,

defined as cases in which an error was made that resulted in an increased frequency of monitoring of the resident, but no harm was caused, was 26.6 per 1,000 residents. The total number of errors at level 3, defined as cases in which some degree of harm was caused by an error and some additional treatment or examination became necessary, was 1.4 per 1,000 residents.

Table 2: Incidence of medication errors per 1,000 residents

	N
Total medication errors	40.0
Errors by medication type	
Oral	20.5
Injection	9.0
Other (eye-drops, ointment, inhalers, etc.)	10.5
Severity	
Level 1: an error was made and the medication was administered, but no harm was caused	12.0
Level 2: an error was made that resulted in an increased frequency of monitoring, but no harm was caused	26.6
Level 3: some harm was caused by an error and some additional treatment or examination became necessary	1.4
Error category (multiple answers possible per error)	
Omission (ordered medication not administered)	20.2
Unnecessary medication (an unordered medication administered)	2.6
Wrong dose	1.4
Wrong time	18.0
Wrong resident	2.0

Table 3: Medication management at LTCFs

Structure indicators	Median (range)
Number of residents in facility	80 (15–250)
Rate of capacity utilisation (%)	98.0 (88.0–106.2)
Proportion of residents requiring medication (%)	
Oral medication	74.3 (5.0–89.8)
Medication by injection	25.7 (10.2–59.6)
Other medications (eye-drops, ointment, inhalers, etc.)	36.1 (0–76.3)
Human resources	
Number of residents per doctor	98 (24–1860)
Number of residents per pharmacist	237 (27–980)
Number of residents per nurse	12 (3–145)
Number of residents per care staff member	2 (1–56)
Process indicators	***N*** **(%)**
Annual revision of manuals on measures for the prevention of medication management	685 (79.2)
Monthly summary and statistical analysis of medication-related incidents	610 (70.5)
Monthly analysis of background factors at time of medication errors	672 (77.7)
Quarterly rounds for identification of risks such as on-site dangers	621 (71.8)
Quarterly action to increase awareness and improve measures taken to prevent medication errors among staff	532 (61.5)
Quarterly review meetings and seminars relating to measures for the prevention of medication errors	437 (50.5)
Use of personalised medication containers	602 (69.6)
Individual packaging of medications with resident's name and time of administration clearly indicated	797 (92.1)
Individual indication of residents' medication history and drug allergies	294 (34.0)
Double-checking of medications at the time of dispensation	596 (68.9)
Double-checking of medications by staff before administration to residents	456 (52.7)
Confirmation of the name tag and face of a resident before administering medication	830 (96.0)

3.2 Medication management at LTCFs

Table 3 shows the data on facility organisation, medication management practices, and patient safety and standard of care systems. The median number of residents per care staff member during the day was 2.0; the median number of residents per nurse during the day was 12.0. Regarding specific safety measures, approximately 90% of facilities practised confirmation of the resident's name tag before administering medication and individual packaging of medications with the resident's name and time of administration. Approximately 70% of facilities conducted medication management activities, such as revising manuals, conducting rounds to identify risks, recording summaries and carrying out statistical analysis of incidents, and analysing medication errors. However, practice in only 50 to 70% of facilities included the following measures: action to increasing awareness and improve measures taken to prevent medication errors by staff; holding review meetings and seminars; use of personalised medication containers; double-checking of medications at the time of dispensation; and double-checking of medications by staff before administration to residents. Fewer than 50% of facilities had a practice of indicating when residents had drug allergies.

3.3 Factors associated with medication errors

Table 4 shows associations between indicators and incidence of medication errors. In the case of total medication errors, two of the associated factors were structure indicators (the number of residents in the facility and the number of residents per care staff member), while the other two were process indicators (action to increase awareness and improve measures taken to prevent medication errors by staff, and double-checking of medications by staff before administration to residents). The same factors were associated with the incidence of oral medication errors. In the case of injection medication errors, there was one significant structure indicator (the number of residents per nurse) and one significant process indicator (double-checking of medications at the time of dispensation). In the case of other medication errors, the same structural indicator was significant, and there was also one significant process indicator (double-checking of medications by staff before administration to residents).

Table 4: Factors associated with incidence of medication error

	β	*p*
Total incidence of medication errors		
Number of residents in facility	0.08	0.01
Number of residents per care staff member	0.12	0.02
Quarterly action to increase awareness and improve measures taken to prevent medication errors among staff	0.19	0.04
Double-checking of medications by staff before administration to residents	0.24	0.02
Incidence of oral medication errors		
Number of residents in facility	0.07	0.01
Number of residents per care staff member	0.12	0.02
Quarterly action to increasing awareness and improve measures taken to prevent medication errors among staff	0.20	0.03
Double-checking of medications by staff before administration to residents	0.24	0.02
Incidence of injection medication errors		
Number of residents per nurse	0.08	0.01
Double-checking of medications at the time of dispensation	0.19	0.03
Incidence of other medication errors		
Number of residents per care staff member	0.09	0.02
Double-checking of medications by staff before administration to residents	0.17	0.03

β values represent standardised coefficients resulting from a multiple linear regression analysis using a stepwise selection method.

4 Discussion

This study investigated two important issues. First, we examined the incidence of medication errors in LTCFs over a period of one year. Second, we determined which structure and process indicators relating to medication management at LTCFs functioned as independent predictors of the incidence of medication errors.

First, the total number of medication errors per 1,000 residents was 40.0. The number of errors of severity level 3 was 1.4 per 1,000 residents; an error reaches this level of severity if it causes some degree of harm and some additional treatment or examination becomes necessary. The incidence of medication errors with a harmful impact on patients in nursing homes is 0.95 in North Carolina [8] and 1.3 in Germany [9]. These rates are higher than in Japan. Provision of a support system for the administration of medication contributes to the prevention of medical accidents caused by human error,

such as administration of the wrong medication. In the present study, many facilities reported conducting medication management activities, such as revising manuals, conducting rounds to identify risks, and carrying out statistical analysis of incidents, but the frequency with which these activities were actually performed varied, as was particularly evident in the case of holding review meetings and seminars, use of personalised medication containers, double-checking of medications at the time of dispensation, and double-checking of medications before administration to residents. More tangible measures, such as double-checking of medications at the time of dispensation and before administration, were not practised widely, suggesting the need for further medication management.

Second, this study examined structure and process indicators in relation to medication management to clarify which functioned as independent predictors of medication errors. We showed that the incidence of oral medication errors was related to four factors: the number of residents in the facility, the number of residents per care staff member, action to increase awareness and improve measures taken to prevent medication errors by staff, and double-checking of medications by staff before administration to residents. Furthermore, we showed that the incidences of injection medication and other medication errors were also related to staffing levels and double-checking of medications. These results are in line with those of previous studies, which have found that the availability of human resources affects the incidence of medication errors [3] [4]. On the other hand, another study has found that medication errors are primarily due to poor communication between care teams [5]. If the availability of human resources remains restricted at care facilities, there is a limit to the extent to which medication errors can be prevented. It is necessary to put in place a support system for the administration of medication that contributes to the prevention of medication errors caused by human error, such as technology-based measures to prevent administration of the wrong medication.

This study may have been limited by the use of a retrospective design, which precludes conclusions on causality. In addition, these findings were based on a survey of only 865 LTCFs and may not be generalizable to all LTCFs.

5 Conclusion

This study found that the incidence of medication errors at LTCFs was 40.0 per 1,000 residents. Of these, the incidence of errors of severity level 3, defined as those resulting in some degree of harm, was 1.4 per 1,000 residents. Our findings showed that medication errors were related to staffing levels and double-checking of medications. Our findings suggest that to prevent medication errors in LTCFs, facilities must increase the availability of human resources and put in place systems for double-checking of medications.

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COMPETING INTERESTS. The authors declare that they have no competing interests.

AUTHORS' CONTRIBUTIONS. SK conceived the study, designed the questionnaire, collected the data, analysed the results, and wrote the manuscript. MO designed the questionnaire, collected the data, and analysed the results. Both authors read and approved the final manuscript.

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