ORIGINAL ARTICLE

Medication administration errors by nurses: adherence to guidelines

Jeongeun Kim and David W Bates

Aims & objectives. Medication administration errors represent one of the major concerns in patient safety. We aimed to study the rate using more robust methods for the correct results.

Backgrounds. Very few studies have been carried out on medication administration error frequency. Previous studies of medication error frequency have used mainly surveys of clinical nurses, which may result in substantial undercounts.

Design & Methods. We developed a checklist using basic medication guidelines including the Five Rights, infection recommendations and medication recording rules. After validity and reliability were confirmed, we performed direct observation using a checklist to evaluate the medication activities of clinical nurses.

Results. We observed total 293 cases of medication activities, collected data and calculated adherence ratios per item. Only 45.6% of nurses verified the amount of medication indicated on the vial at least once for at least one-second. In addition, only 6.5% read the name of the patient from the wristband. Administering the medication at the correct time guideline was observed 41.0% of the time. The guideline regarding hand washing before external and oral medications was followed only 4.5% of the time, although this figure was much higher for intravenous medications at 96.6%. Overall, among 31 categories regarding drug administration, 17.2 (± 3.6) items per person were followed, whereas 5.7 (± 1.2) items per person were violated.

Conclusion. Thus, the results overall showed low rates of adherence to guidelines, suggesting that many medication administration guidelines are not strictly followed. We found key instances in which nurses did not follow the guidelines, including many from the Five Rights. About one in four elements were violated overall.

Relevance to clinical practice. The results of this study could be adopted to make guidelines of medication administration more practical for the clinical nurses to adhere.

Key words: five rights, medication administration error, medication safety, observation

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Introduction

Patients appear increasingly concerned about the safety and quality of the care they receive. However, measurement of patient safety on a routine basis has been elusive; one index which is generally available is the survival rate of patients in a hospital, although that is confounded by issues such as severity of illness (S.Y. Lee, Eulji University Graduate School of Advanced Practice Nursing, Daejeon, unpublished Master’s thesis). However, it is clear that patients at least in the United States are worried about the medication errors and in particular about being given the wrong drug (American Society of Hospital-System Pharmacists 2002). Thus, medication administration in hospitals is of major interest to patients because of the central role of medications in treating illness, and the important potential consequences to the patient if this is done incorrectly (Yoo et al. 1995).
As such, medication administration errors represent one of the major concerns in patient safety. However, many previous studies of medication administration errors in nursing have relied on survey methods such as questionnaires. The purpose of this article is to study the rate using more robust methods for the correct results.

Background

According to the National Coordinating Council for Medication Error Reporting and Prevention (NCCMERP), ‘A medication error refers to any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the healthcare professional, patient or consumer’ (NCCMERP, USA 2010). Medication errors harm 1·5 million people and kill several thousand each year in the United States, costing the nation at least $3·5 billion annually, the Institute of Medicine concluded in a report (Diamond 2006). Medication errors can occur at any stage of the medication use process and have the potential for substantial financial consequences, especially when they result in harm (Kim et al. 1998). Moreover, medication errors become a crucial source for general public’s distrust of the medical institution. Therefore, safe drug administration with accurate information is one of the primary responsibilities of healthcare professionals (E.K. Lee, Gachon University of Medicine and Science, College of Nursing, Incheon, unpublished Master’s thesis).

To begin reducing the frequency of medication errors, the U.S. government began to support the National Medication Error Reporting Program beginning in 1991. In Korea, Medication Error Preventive Guidelines were established in 1996 by the Ministry of Health and Welfare with the same objective (Kim et al. 1998). Medication errors can be prevented in many ways, with two of the keys for medication administration errors being through adherence to the Five Rights of Medication Safety and the Medication Error Preventive Guidelines (Levine et al. 2001). The principle of right patient, drug, dose, route and time when administering drugs is emphasised in nursing guidelines. An understanding of why nurses violate the ‘Five Rights’ and make mistakes is central to efforts to reduce medication errors (Tang et al. 2007).

However, very few studies have been carried out on medication administration error frequency in Korea or other parts of Asia. Thus, frequency of medication errors is in this region is uncertain (Kim et al. 1998). Previous studies of medication error in Asia frequency have used mainly surveys of clinical nurses, which may result in substantial undercounts, in part because individuals are often unaware of errors they made themselves. A study on the perception and experiences regarding medication error identified the following approaches for medication error detection: anonymous self-report, accident report, investigation of main events, disguised observation and approaches to discover errors in medication preparations (Kim et al. 1998). Although each of the methods possesses advantages and disadvantages, the observation method has the highest accuracy and the least disadvantages, although it is more expensive than other approaches. Barker and McConnell compared incident report review and voluntary report review with direct observation in 1962 and projected that the errors observed represented 1422 times the number identified by incident report review (Barker & McConnell 1962). Shannon and De Muth compared a combination of chart and incident report reviews with direct observation in 30-long-term care facilities. Direct observation detected a mean medication error rate of 9·6%, while document review yielded an error rate of 0·2% (Flynn et al. 2002).

To assess the magnitude of the issue of medication administration errors, we carried out a study of medication administration error detection in one hospital in Korea. We elected to use the observation method to obtain the most robust estimate of medication error frequency. The observation technique for studying medication administration errors was originally developed in 1962, and it has since been used in more than 40 studies (Greengold et al. 2003). Research conducted since then has consistently demonstrated that the observation technique is the most accurate in detecting drug administration errors (Allan & Barker 1990, Flynn et al. 2002).

In addition to identifying the overall medication error rate, we characterised each error by type. Another goal was to provide data for developing improved medication error prevention strategies.

Methods

Study site and background information

The study was carried out in a 1700-bed university teaching hospital in Korea. This hospital implemented medication guidelines in 2006, which cover all the guidelines evaluated in this study, and has been very active in initiatives on achieving excellence in patient safety involving multiple quality improvement teams. The hospital assigned nurse champions for each ward, trained, monitored and gave feedback to their activities. The guidelines were developed after the analysis of electronic medical records including the time stamp of the real medication administrations,
self-monitoring and reporting about the nurse champion’s activities, conducting workshops for nurse champions, and surveying the outcomes of their activities. These activities have been recognised as one of the leading initiatives involving patient safety in Korean hospitals. Although the initiative was highly successful in general from the institutional perspective, we elected to evaluate guideline adherence in more detail in particular addressing nursing adherence.

**Terms and definitions**

Administration included all drug administration routes, such as PO (per os), intramuscular injection and IV (intravenous), by nurses from verbal or written order by doctors in a hospital.

As medication administration guidelines, the Five Rights are perhaps the most basic: Right Medication, Right Dose, Right Patient, Right Route and Right Time. There are many other guidelines that are revised to suit a number of drug administration settings, including the one suggested by Craven and Hirnle (Craven & Hirnle 2008): they have suggested: accurately interpret the prescription; accurately calculate the prescribed amount; using the Five Rights, develop a systematic and safe drug administration protocol; explain the purpose of drug administration to the patient; record the administration event according to the established protocol. On the basis of these guidelines, we defined the following drug administration guidelines for this research:

1. Adherence to the Five Rights of Medication Safety: Right Medication, Right Dose, Right Patient, Right Route and Right Time.
2. Adherence to basic infection regulation and safety regulation.
3. Adherence to accurate drug administration regulation to record.

**Subjects**

Two units from the Departments of Internal Medicine and General Surgery each studied, from 24 April to 16 June 2010. The research subjects were clinical nurses who administer drugs at a university hospital and were employed by the institution as of 2010. The sample selection followed a convenience sampling approach, which is one of non-probabilistic sampling methods. As the target population is relatively large and possibly dissimilar compared to that of the sample group, the sample was limited to one Internal Medicine and one General Surgery ward of a single university hospital to minimise the bias of convenience sampling. Because of practical limitations on time, place, approachability and other various factors, this research aimed for 300 cases. The study was approved by the Institutional Review Board of the hospital and did not use any personal information.

**Data collection**

A checklist was developed for how to measure the adherence to the medication guidelines. The content validity of the tool was checked by 3 experts who were the 1 head nurse, 1 charge nurse of the unit and 1 professor of the college of nursing. This included 13 items total; 4 for Right Medication, 3 for Right Dose, 3 for Right Patient, 1 for Right Route and 2 for Right Time (Table 1). Five items addressed adherence to basic infection and safety regulations: external and oral administration (Table 2), 9 items covered injections (Table 3) and 3 items aimed at adherence to drug administration record protocols (Table 4). They were checked according to the predefined level of adherence and judged whether the nurse’s adherence was satisfactory or not against the level.

The observers were six student nurses in clinical training, and they were specially trained for this research study. To ensure the credibility and validity of the observation research, it was crucial to minimise the bias caused by the observation itself. Therefore, the observers were first chosen and educated in observation techniques and employed only after a reliability score was reached (based on the agreement within the observers) 90% after repeated practice of observing and recording drug administration, and investigated for their reliability. One student nurse observer had observed for the full time of one morning duty for one assigned acting nurse. We were very cautious about the Hawthorne effect, as it can cause an increased rate of adherence to guidelines, and potentially affect the outcome of the research. Therefore, to minimise the observation effect on the subjects, the research data were only collected in the afternoon duties when the observed nurses become more familiar with the observing student nurses through their regular duties during morning shifts. The IRB waived informed consent from the observed nurses, as it was felt to be implied and no nursing identification was retained.

**Results**

**Adherence to the five rights of medication safety**

Initially we aimed to observe 300 cases; however, we found missing data on seven cases after the completion of data
Table 1 The survey results of the adherence to the five rights of medication safety (n = 293)

<table>
<thead>
<tr>
<th>Items</th>
<th>Yes n (%)</th>
<th>No n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right Medication</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Read the name of the medication indicated on the label at least once for at least one-second.</td>
<td>289 (98.6)</td>
<td>4 (1.4)</td>
</tr>
<tr>
<td>2. Read the name of the medication indicated on the medication at least once for at least one-second.</td>
<td>289 (98.6)</td>
<td>4 (1.4)</td>
</tr>
<tr>
<td>3. Medication is prepared by the clinical nurse who will administer it.</td>
<td>211 (72.0)</td>
<td>82 (28.0)</td>
</tr>
<tr>
<td>4. Label the medication immediately after preparation.</td>
<td>199 (97.5)</td>
<td>5 (2.5)</td>
</tr>
<tr>
<td>Right Dose</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Verify the amount of medication indicated on the label of the medication at least once for at least one-second.</td>
<td>289 (98.6)</td>
<td>4 (1.4)</td>
</tr>
<tr>
<td>2. Verify the amount of medication indicated on the medication at least once for at least one-second.</td>
<td>289 (98.6)</td>
<td>4 (1.4)</td>
</tr>
<tr>
<td>3. When using a syringe, read the markings at the eye level.</td>
<td>93 (45.6)</td>
<td>111 (54.4)</td>
</tr>
<tr>
<td>Right Patient</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Read the name of the patient on the wristband worn by the patient.</td>
<td>19 (6.5)</td>
<td>274 (93.5)</td>
</tr>
<tr>
<td>2. Ask the patient to confirm the patient’s name.</td>
<td>10 (3.4)</td>
<td>283 (96.6)</td>
</tr>
<tr>
<td>3. Before the administration, read the name of the patient indicated on the label for at least one-second.</td>
<td>287 (98.0)</td>
<td>6 (2.0)</td>
</tr>
<tr>
<td>Right Route</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Read the medication route indicated on the label at least once for at least one-second.</td>
<td>289 (98.6)</td>
<td>4 (1.4)</td>
</tr>
<tr>
<td>Right Time</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Administer the medication at the correct time.</td>
<td>120 (41.0)</td>
<td>173 (59.0)</td>
</tr>
<tr>
<td>2. Prepare the medication right before the administration.</td>
<td>176 (85.4)</td>
<td>30 (14.6)</td>
</tr>
</tbody>
</table>

Regarding the Right Dose category, 98.6% ‘Verified the amount of medication indicated on the label of the medication at least once for at least one second’; however, only 45.6% ‘Verified the amount of medication indicated on the vial at least once for at least one second’ (excludes the observation cases for oral medication).

In the Right Patient category, adherence rate was high at 98.0% ‘Before the administration, read the name of the patient indicated on the label for at least one second’, but only 6.5% ‘Read the name of the patient on the wristband worn by the patient’. As for ‘Asking the patient to confirm the patient’s name’, only 3.4% followed this guideline.

In the Right Route category, 98.6% ‘Read the medication route indicated on the label at least once for at least one second’.

In the Right Time category, ‘Administer the medication at the correct time’ guideline was observed 41.0% of the time, and ‘Prepare the medication right before the administration’ guideline was observed 85.4% of the time.

### Table 2 Adherence to basic infection regulation and safety regulation: external and oral administration (n = 89)

<table>
<thead>
<tr>
<th>Items</th>
<th>Yes n (%)</th>
<th>No n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Wash the hands before administering medication.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. The use of antiseptic.</td>
<td>4 (4.5)</td>
<td>85 (95.5)</td>
</tr>
<tr>
<td>2. The duration of washing (15–30 seconds).</td>
<td>4 (4.5)</td>
<td>85 (95.5)</td>
</tr>
<tr>
<td>3. The area of washing (palm, wrist, back of hands, between fingers and all fingernails).</td>
<td>4 (4.5)</td>
<td>85 (95.5)</td>
</tr>
<tr>
<td>2. Verbal confirmation of drug ingestion.</td>
<td>43 (48.3)</td>
<td>46 (51.7)</td>
</tr>
</tbody>
</table>

collection, so those were excluded. A total of 293 observations of drug administration were analysed regarding the Five Rights: Right Medication, Right Dose, Right Patient, Right Route and Right Time (Table 1).

The observations show that for the Right Medication category, 98.6% ‘Read the name of the medication indicated on the label at least once for at least one second’ and 97.5% ‘Labelled the medication immediately after preparation’ (this percentage excludes the observation cases where no labels are required, for drugs which are oral medications). However, a relatively lower adherence rate of 72.0% was observed for ‘Medication is prepared by the clinical nurse who will administer it’, being the least followed guideline. This was because the medication was prepared by another nurse who will not do the actual administration for the convenience of sharing workload.

Adherence to basic infection regulation and safety regulation

A total of 293 observations, consisting of 89 external and oral administration cases and 204 injection cases, were made regarding the adherence to basic infection regulation and safety regulation. However, in only 4.5% of the external and oral administration cases did nurses follow the ‘Wash the hands before administering medication’
Adherence to drug administration record guidelines

A total of 293 observations were made with regard to drug administration recording practice. In 100% of the cases, ‘The nurse who administered the drug recorded the event’, but only in 52.8% of the cases, ‘The actual time of the administration is accurately recorded’ showing the lowest adherence rate in this category. In 98.6% of the cases, ‘The event is recorded only after the administration is completed’ (Table 4).

Non-compliance rate per person

Among the 31 categories regarding drug administration, 17.2 (± 3.6) items per person were successfully followed, whereas 5.7 (± 1.2) items per person were violated. Factors contributing to such high level of non-compliance are because of the failure to follow the ‘Read the name of the patient on the wristband worn by the patient, Ask the patient to confirm the patient’s name’ items among the Right Patient category, as well as the failure to follow the ‘The use of antiseptic, The duration of washing, The area of washing’ items among the ‘Wash the hands before administering medication’ category. Among all items, these guidelines only had 10% adherence rate.

Discussion

According to the clinical risk management theory, risk identification is the first step and fundamental to manage as otherwise any strategy to reduce risk may be inappropriate (Sandars 2005). We used a direct observation approach to assess the medication error rate and found high rates of medication errors and non-adherence to

<table>
<thead>
<tr>
<th>Items</th>
<th>Yes n (%)</th>
<th>No n (%)</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Wash the hands before administering medication.</td>
<td>197 (96.6)</td>
<td>7 (3.4)</td>
<td></td>
</tr>
<tr>
<td>2. The use of antiseptic.</td>
<td>197 (96.6)</td>
<td>7 (3.4)</td>
<td></td>
</tr>
<tr>
<td>3. When not all medications are used, the last date of use is recorded.</td>
<td>3 (50.0)</td>
<td>3 (50.0)</td>
<td>198</td>
</tr>
<tr>
<td>4. Disinfected the injection site before administering drugs.</td>
<td>145 (71.1)</td>
<td>59 (28.9)</td>
<td></td>
</tr>
<tr>
<td>5. Use of aseptic techniques.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Disinfected the IV fluid bottles, bags and vials are disinfected before use.</td>
<td>186 (91.2)</td>
<td>18 (8.8)</td>
<td></td>
</tr>
<tr>
<td>2. The syringe needles and IV set needles are not placed in areas that are not disinfected.</td>
<td>202 (99.)</td>
<td>2 (1.0)</td>
<td></td>
</tr>
<tr>
<td>3. The area of washing (palm, wrist, back of hands, between fingers, fingernails and all).</td>
<td>190 (93.1)</td>
<td>14 (6.9)</td>
<td></td>
</tr>
<tr>
<td>2. Follow the infection regulation when preparing the medication.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. IV fluid bottles, bags and vials are disinfected before use.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. The syringe needles and IV set needles are not placed in areas that are not disinfected.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Disinfected the IV fluid bottles, bags and vials.</td>
<td>203 (99.5)</td>
<td>1 (0.5)</td>
<td></td>
</tr>
<tr>
<td>2. The duration of washing (15–30 seconds).</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. The area of washing</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3 Adherence to basic infection regulation and safety regulation: injection (n = 204)

<table>
<thead>
<tr>
<th>Items</th>
<th>Yes n (%)</th>
<th>No n (%)</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The nurse who administered the drug recorded the event.</td>
<td>293 (100.0)</td>
<td>0 (0.0)</td>
<td></td>
</tr>
<tr>
<td>2. The actual time of the administration is accurately recorded.</td>
<td>155 (52.9)</td>
<td>138 (47.1)</td>
<td></td>
</tr>
<tr>
<td>3. The event is recorded only after the administration is completed.</td>
<td>289 (98.6)</td>
<td>4 (1.4)</td>
<td></td>
</tr>
</tbody>
</table>

Table 4 Adherence to drug administration record protocol (n = 293)

In only 48.3% was the ‘Verbal confirmation of drug ingestion’ guideline followed (Table 2).

In cases of injection, 96.6% followed the ‘Wash the hands before administering medication’. The subcategories of the guideline had adherence rates of 96.6, 96.6 and 93.1% for ‘The use of antiseptic’, ‘The duration of washing’, and ‘The area of washing’, respectively. In the Infection during Preparation category, 91.2% ‘Disinfected the IV fluid bottles, bags and vials’ and 99.0% ‘Did not place syringe needles and IV set needles in areas that are not disinfected’. Fifty per cent adhered to the ‘Recorded the last date of use when not all medications are used’ recommendation. However, in 198 cases, the drug vials were discarded, regardless of any drug remaining, which made the number of cases observed small. Seventy-one per cent ‘Disinfected their hands before administering drugs’. In the category of determining whether aseptic technique is used, 79.9% of nurses followed the ‘Disinfected the injection site before administering drugs’ guideline and 99.5% ‘Did not place the syringe needles in areas that are not disinfected’. Overall, the basic infection guidelines were adhered to more frequently in the case of injection drugs compared to external and oral drugs (Table 3).
guidelines, with violations occurring in about one of four items overall. The direct observation method identified the greatest number of drug-related problems (DRPs), while incident report review identified the fewest (Meyer-Massertti et al. 2011).

Different types of errors have quite different risks of resulting in harm, so that some errors that occur relatively often probably have less potential for harm – and may not even be errors at all if the evidence behind the practice were examined – than others that occur much less often but carry high risk of injury. In the past, error prevention efforts have focused on examining the root causes of errors that resulted in serious harm, such as the death of the patient (Aspden et al. 2003). This approach ignores all the information related to errors that did not result in harm, but had the potential to cause serious harm, referred to as near misses. Near misses occur much more frequently than harmful errors and, therefore, may be useful for informing prevention strategies.

For example, categories that had low rates of adherence included preparation of the drug by the nurse who was going to administer it (adherence of only seven in ten) and hand washing before oral medication administration (adherence of only one in 25). Both of these are undesirable but the absolute risk of harm to the patient per instance is probably fairly low. In contrast, the rate of errors in right patient and right route was only 1–2%, but these types of errors carry a much higher risk of harm and given the large number of medications administered across an institution, the aggregate number of errors involved and potential of harm to patients can be substantial.

The Five Rights of Medical Safety

Within the observation criteria of Right Medication, about 3 of ten times a drug was administered by a nurse other than the one who had prepared it. In general, there is a significant overlap in drug administration duties, and in many cases of departments with large drug administration duties, the nurses in previous shifts will prepare the drugs that are to be administered by the nurses in following shifts. This has the advantage of increasing the efficiency of workflow, but results in administration of drugs by nurses other than those who prepared them. This kind of situation was found in the study conducted in Taiwan (Tang et al. 2007). They found that ‘advanced drug preparation without rechecking’ was another major condition involved in medication errors, which has seldom been reported. Upon interviewing hospital nurses, they found that it is common, although against hospital policy, for a ‘task-oriented’ nurse to work on the busy wards. Some nurses on the day shift even confided that they prepare medications for evening shift nurses out of friendship during understaffing situations. Although nurses are encouraged to use standard protocols in administering drugs and to avoid interruptions (Ashton & Iyer 2003), the reality of time pressures and excessive workloads causes them to modify protocols, resulting in error-prone situations.

Therefore, it is preferable that nurses only prepare the medication that is to be used directly in their own time shifts, or better yet, that preparation be performed in the pharmacy. The hospitals should be encouraged to adopt the unit-dose system to alleviate the burden of nurses preparing drugs. The unit-dose is a system of drug distribution in which a portable cart containing a drawer for each patient’s medications is prepared by the hospital pharmacy with a 24-hour supply of the medications (Mosby 2009).

In the observation criteria of Right Dose, 54-4% scored negative to the criterion on reading the markings at the eye level. It was observed that the syringe markings were read at the eye level in the case of complex combination of medication or insulin that requires the greatest care in the volume, but in the case of medications with relatively low level of risk, the adherence rate to this requirement was comparatively low. Such observations had the following characteristic: less experienced nurses, although slow at completing their tasks, showed higher adherence to guidelines, whereas more experienced nurses were faster in completing their tasks, but were less careful in ensuring the correct volume of medications. This kind of behaviour is attributed to work-related adaptations, and to address such behaviour, awareness improvement training of the nurses is required.

In the observation criteria of Right Patient, 94% scored negative on reading the name of the patient wristband, and 97% scored negative on asking the patient to confirm their name. The reason why nurses neither confirm the names of the patients on their wristband nor asking for their names is because they think that they are already familiar with the names of the patients and the need for repeated confirmation unnecessary. Certainly the nurses must be familiar with patients who have had extended stays at the hospital, but to prevent medication error, it is important to adhere to medication guidelines in all circumstances. Therefore, patients and nurses both must alter their attitude towards what are seemingly overly careful guidelines, such that their safety is at risk when these guidelines are not met, or alternative strategies ensuring identification should be used. It is crucial to improve the hospital culture among the nurses that confirming the identity of patients in drug administration is a very important part of their duties. Another more technical solution is bar coding with links to the medication
administration record, which can automate checks of right patient, right drug and right dosage.

In the observation criteria of Right Time, 59% scored negative on administering the medication at the correct time and 15% scored negative on preparing the medication right before the administration. The hospital work environment may be considered as a major part of the cause of why drugs are not administered at the right time. In this study, the average number of patients under the care of one nurse was 18. And since majority of the drug administration timeline is synchronised among the ward, it is practically impossible to administer the drugs to all patients at the correct time. Additionally, because of the heavy workload on the nurses, the correct administration time cannot be met, and the drugs need to be prepared beforehand. This problem cannot be alleviated unless the workload per nurse is reduced. Thus, the responsibility lies not on an individual nurse, but on the hospital administration and requires a more systematic solution.

Traditionally, nurses blame themselves for making an error when hospital systems should take the responsibility for failing to establish a safe working environment (Beyea et al. 2003). It was reported that the linkage between nursing work environment and medication safety is noticeable (Chiang & Pepper 2006). Nurses can provide safer patient care through quality management and work environment transformation (Institute of Medicine 2004). Redesigned work processes such as workflow, documentation, standardised procedures and interdisciplinary communication have decreased medication errors and increased error reporting (Karow 2002). Researchers have indicated that heavier workload, inadequate staffing, non-supportive physical environment, poor colleague relations, impaired quality improvement orientation and insufficient physical resources could hamper nurses’ and physicians’ willingness to report errors because of lack of time, extra workload and complexity of the reporting process (Jones & Arana 1996, Uribe et al. 2002).

Basic infection regulation and safety regulation

In the observation criteria of External and Oral Administration, only 4% of nurses washed their hands. In contrast, nurses washed their hands 93% of the time before giving an injection. This suggests that nurses believe they do not need to wash their hands before administering oral and external drugs. Many nurses consider that because external and oral medications tend to be individually wrapped, there is less risk of direct infection. However, not much evidence was revealed on this common notion, researches should be conducted to determine the relationship between hand washing and individually wrapped oral medication (the effectiveness of unit-dose system) for the hospital infection. If this behaviour is to be addressed, education regarding hand-washing practice when administering external and/or oral drugs and a surveillance system must be established. For example, a Children’s hospital in Miami, United States, adopted wireless surveillance system in regard to hand-washing practice (Infection Control Today 2010). It uses RFID (Radio Frequency Identification) to continually monitor the hand-washing behaviour of medical staff, and sounds an alarm if a medical staff who has not washed his or her hands approaches a patient. This system was expected to be effective for decreasing the frequency of infections occurring in hospital settings. In Asia, following the increase in the rate of hospital information system implementation, many hospitals are adopting various other technologies – such technological solutions regarding hand washing may be helpful.

About half of observations scored negative on verbal confirmation of drug ingestion. When there is no verbal confirmation as to whether the correct drug in correct amount was ingested by the patient, the risk of medication error increases. The primary cause of this problem is the high workload and number of patients under the care of a single nurse, and the lack of awareness in clinical nurses regarding the task of verbal confirmation with the patients. To address this problem, the nurses need continuous training in the importance of confirming with the patients whether the drug was ingested, and a strict guideline regarding this practice must be established within each hospital ward.

In the observation criteria of Basic Infection Regulation and Safety Guidelines for Injection Drugs, 3 of 6 case studies scored negative to ‘When not all medications are used, the last date of use is recorded’ guideline. But because drug vials are discarded after use, regardless of any remaining drugs, the actual state of drug discarding practice is unclear. Nonetheless, the date of last drug use must be recorded in each drug vial to avoid medication error, and nurses should receive additional training on this issue.

Drug administration record

In the observation criteria of the drug administration record roughly half of cases scored negative to ‘The actual time of the administration is accurately recorded’ guideline. This means that even though the time of drug administration is different from what is ordered, the record indicates that the right time of drug administration was met. This not only causes medication error, but goes against the general nursing ethics. Therefore, it is important not only to administer the drugs at the correct ordered time, but to keep an honest record of the
actual time of the administration. It is recommended that in addition to nurse education, systematic and environmental improvements, such as placing bar codes on drugs, patients and providers, may be helpful for recording real-time data and improving the safety of the process (Poon et al. 2010).

Limitations
This study has several limitations. It was carried out at a single hospital in Korea, which may not be representative of other hospitals in Korea or elsewhere in Asia or other regions. In addition, sampling was not random from all units on the hospital.

Another limitation and some kind of ethical issue concerning about the situation could be what the observers did when they notice the error. As the objective of this research was to find out and describe the natural situation as it is, the observers did not intercept or try to give any feedback when they notice those errors. The only goal of the observation was to see whether any variation from the guideline occurs, and the observers were trained and told to do that task only. Even though it could incur some ethical controversies, the author opted not to reach more than the scope of this study, and fortunately no serious errors happened during the course of the observation. And also this study did not intend to analyse the results or the cause-and-effect of the error. This kind of issue could be another topic of investigation.

Conclusions
We conclude that medication administration errors were common in this hospital. Nurses often gave drugs that they did not prepare themselves and rarely washed their hands before giving oral or external medications. Other types of errors such as wrong patient and wrong dose errors were much less frequent, but may have more potential for harm. These data suggest that both implementation of educational strategies, and tracking of performance will be helpful. In the longer term, technological solutions such as bar coding and implementation of electronic medication administration records may also be helpful.

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Contributions
Study design: JK, DWB; data analysis: JK, DWB and manuscript preparation: JK.

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Conflict of interest
The material has not been published previously and will not be submitted for publication elsewhere, and the authors declare no conflicts of interest.

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