

# Study of Factors Affecting Medical Incident: 3. Medicine Inspection

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## Abstract

It is the responsibility of pharmacists to ensure the safety of patients as pharmacist's professional duties expand into diverse directions. In recent years, the use of automated dispensing systems has increased; however, the inspection by pharmacists is the most important step in the prevention of medical errors. Comparing the inspection of hospital and community pharmacists may lead to an increased awareness of incident countermeasures. Therefore, eye tracking was performed for hospital and community pharmacists who conduct inspection, and the results revealed the factors that affect dispensing errors. One of the factors was the size of the dispensing space, especially if the space was small and the items needed were not easily accessible. In addition, differences in the inspection procedures among pharmacists were presumed to lead to possible dispensing errors due to oversights. Moreover, it was suggested that any subsequent work would flow more smoothly if a pharmacist checked the prescription and medication history management records at the beginning. Furthermore, it was thought that keeping a history of checks, such as recording any prescription checks in writing, would speed up finding the cause in the unlikely event that a dispensing error occurred. Accordingly, creating an environment in which one can concentrate without distractions during the inspections can lead to the prevention of dispensing error.

## Keywords

Medicine Inspection, Dispensing Error, Eye Tracking, Pharmacist

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## 1. Introduction

In recent years, hospitals and community pharmacy have become more aware of medical safety, and various medical accident prevention measures have been devised. According to a report by the Japan Council for Quality Health Care, ap-

proximately 37.9% of errors involved medicines [1]. In 2016, the Ministry of Health, Labour and Welfare issued a notice regarding changes to barcode labeling for medicines. The new barcode incorporates the product code, expiry date, and serial number or code. Yamakita *et al.* reported that the implementation of the new barcode system contributed to decrease the number of error [2]. Moreover, according to a study by Sato *et al.* on how hospital pharmacists actually work, 1) Prescription checks based on patient information and the sharing of such information within a hospital contributed to accident prevention, 2) Preciseness in writing on envelope for medicines and labels can lead to accident prevention, 3) Timely provision of medicine information is useful for ensuring medical safety, and the involvement of hospital pharmacists leads to medical safety [3]. In recent years, various manufacturers have developed several dispensing devices as automated dispensing. New devices include a wide range of liquid medication dispensing machines, medicinal powder dispensing robots, packaged tablet checking support devices, and so on. However, it is financially and physically impossible to introduce such devices to all medical institutions. Further, even if one follows various medical accident prevention measures, it ultimately comes down to the pharmacist's eyes being indispensable.

Our laboratory has been using eye trackers in the picking and the inspection as well as the powder medication dispensing by hospital pharmacists to study factors affecting medical error [4] [5] [6] [7]. Eye tracking makes it possible to visualize and measure "what people are looking at", with eye tracking systems being widely used in the fields of ergonomics and psychology [8]. Eye tracking systems are also often used in medical settings, such as in studies on barrier-free of the elderly, and educational feedback comparing clinical nurses and nursing students [8] [9]. In this study, we considered the factors leading to medical incident using an eye tracking technology, capable of measuring a person's eye movement.

## 2. Method

### 2.1. Subjects

The subjects were 5 pharmacists working at Aichi Medical University Hospital (HpP), and 5 pharmacists working at Suzuka Center Pharmacy or Suzuka Minami Pharmacy (PhP). The average number of years of working for HpP was  $21.6 \pm 5.2$  years, and for PhP was  $15.6 \pm 4.4$  years. The candidate chose at random from pharmacists who are working during more 5 years in hospital or pharmacy.

### 2.2. Measurement Methods

An eye tracking measurement experiment was conducted during inspection. Five prescriptions were checked at the hospital, and three prescriptions were checked at each pharmacy. Pharmacists in the same facility used the same prescriptions, envelope for medicines, and medicines during inspection. Gaze mea-

surement device used was an eye mark recorder EMR-9 (NAC Image Technology Inc.). An example of the eye tracking video is shown in **Figure 1**.

### 2.3. Gaze Points

From the data collected, the gaze point during inspection was individually categorized. The gaze points used “Prescription (prescription check)” when the prescription looked during check the prescription, “Prescription (medicine check)” when the prescription looked during check the medicine, “Prescription (other)”, “Medicine (name)”, “Medicine (number)”, “Medicine (other)”, “Packaging (code/number)” the packaged medicine’s the identification code/the packaged medicine’s the number of tablets and capsules, “Packaging (number)” the total number of packages, and “Envelope for medicines”.

### 2.4. Pupil Diameter

The left and right pupil diameters were averaged, and the mean pupil diameter for each the gaze category as divided was computed. The formula for obtaining the rate of change was as follows.

$$\text{The rate of change (\%)} = \frac{(\text{Mean pupil diameter for each category} - \text{Mean pupil diameter for all categories})}{(\text{Mean pupil diameter for all categories})} \times 100$$

### 2.5. Statistical Analysis

Differences in each parameter were statistically evaluated by the Mann-Whitney U test. All differences were considered significant when  $p < 0.05$ .

### 2.6. Ethics Statements

This study is approved by the Kinjo Gakuin University Ethical Review Board (No. H17015, January 31 2018).



**Figure 1.** The eye tracking video (the white circles represent the gaze point).

### 3. Result

#### 3.1. Eye Tracking Measurement Experiment

**Table 1** shows the prescriptions checked by HpP and PhP. There were no significant differences in these prescriptions except for the dosage days.

**Figure 2** shows the gaze rate during inspection per prescription. The gaze rate of “Prescription (medicine check)” of HpP ( $19.7\% \pm 7.2\%$ ) was significantly higher than PhP ( $10.5\% \pm 7.2\%$ ) ( $p < 0.05$ ). The gaze rate of “Packaging (number)” of PhP ( $14.3\% \pm 5.9\%$ ) was significantly higher than HpP ( $8.1\% \pm 4.2\%$ ) ( $p < 0.05$ ). The gaze rate of “Prescription (medicine check)” of HpP ( $9.8\% \pm 8.9\%$ ) was tended to be higher than PhP ( $6.2\% \pm 3.4\%$ ). The gaze rate of “Packaging (code/number)” of HpP ( $29.9\% \pm 10.1\%$ ) and PhP ( $35.5\% \pm 12.4\%$ ) was the highest gaze rate of all the items.

#### 3.2. Changes in Pupil Diameter

**Figure 3** shows the rate of change in pupil diameter for HpP and PhP. The rate of change of pupil diameter of “Prescription (prescription check)” was  $2.1\% \pm 5.0\%$  and  $-4.3\% \pm 4.0\%$  for HpP and PhP, respectively. The pupil diameter of “Prescription (medicine check)”, “Prescription (other)”, “Medicine (name)”, “Medicine (number)”, “Medicine (other)”, and “Envelope for medicines” for HpP and PhP were tended to mydriasis. The rate of change of pupil diameter of “Packaging (code/number)”, was  $-9.5\% \pm 4.6\%$  and  $-5.7\% \pm 4.1\%$  for HpP and PhP, both of which the miosis. The pupil diameter of “Packaging (number)” of PhP ( $3.3\% \pm 2.7\%$ ) was a significantly greater than HpP ( $-2.6\% \pm 2.2\%$ ) ( $p < 0.05$ ).

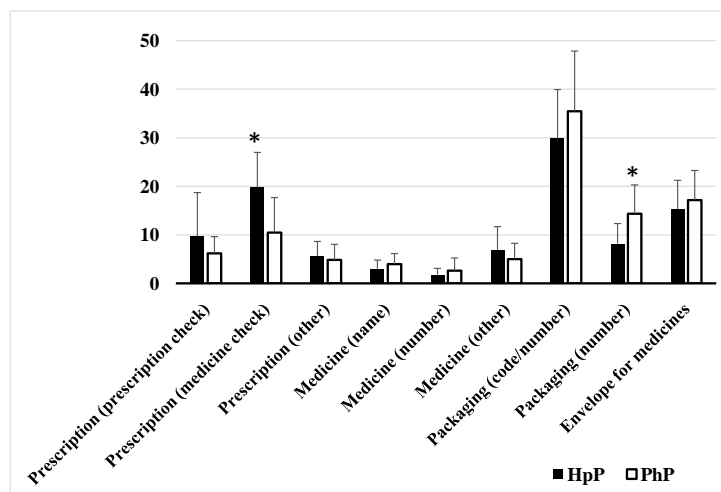
### 4. Discussion

In recent years, pharmacists’ professional duties have expanded, and dispensing errors have become various types. For example, patients can become mentally stressed when they are given the wrong medicine, even before taking it. Since this type of stress may reduce adherence, it is important to consider multifaceted improvement measures. In this study, we conducted eye tracking measurements of inspections by HpP and PhP to find factors that affect dispensing errors, and consider human error countermeasures.

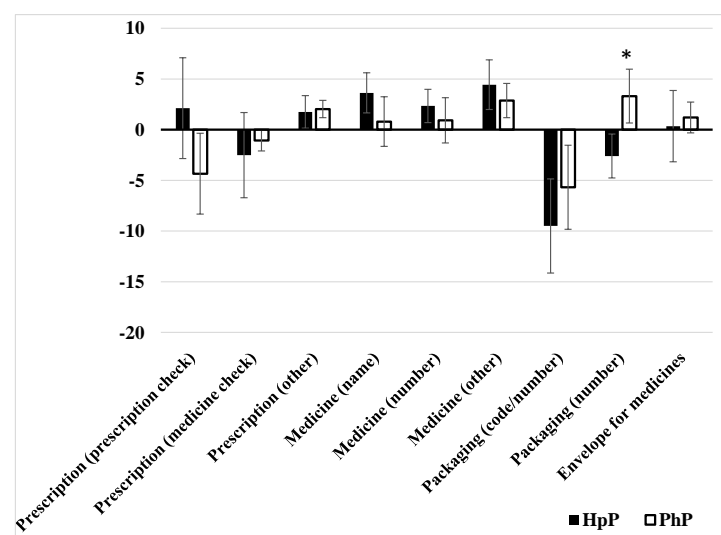
**Table 1.** The prescriptions.

		HpP (n = 5)	PhP (n = 5)
Per prescription	Working experience (year)	21.6 ± 5.2	15.6 ± 4.4
	Number of picking medicines	2.0 ± 1.3	3.7 ± 0.9
	Number of medicines in one dose package	6.4 ± 2.1	8.2 ± 2.2
	Number of total medicines	8.4 ± 2.7	11.8 ± 2.7
	Dosage days	7	32.7 ± 6.6*

Mesn ± SD (n = 5); \* $p < 0.05$ .



**Figure 2.** The gaze rate per prescription (%). Mean  $\pm$  SD (n = 15 - 25); \* $p$  < 0.05.



**Figure 3.** The rate of change in pupil diameter (%). Mean  $\pm$  SD (n = 5); \* $p$  < 0.05.

The incidence of errors at the institutions in which we conducted the research in 2018 was approximately 1.6% at the HpP and approximately 0.94% at the PhP. However, accidents were approximately 0.004% at the HpP and approximately 0.03% at the PhP. Therefore, it was shown that, errors were discovered by the inspection of the PhP which was less than the HpP.

In the results of the eye tracking, we indicated that PhP tended to have lower gaze rate compared to HpP in “Prescription (prescription check)”, and there was a significant difference in “Prescription (medicine check)”. Further, the rate of change in pupil diameter of “Prescription (prescription check)” resulted in a significant toward contraction for PhP. In addition to prescription checks, pharmacy pharmacist’s work involves checking the medication history management records, medical fees, receipts, and so on [10]. These results are inferred to

be the attention points which were dispersed; it was deduced that the gaze rate was low and the pupil diameter was also reduced. Moreover, it was considered that the resulting number of accidents mentioned above was also affected. It was necessary to prepare a working environment so that I could concentrate on the inspection. For example, confirmer of the medical fees can do by the medical clerk; thus, it is thought that inspection's pharmacist could concentrate on "confirm prescription".

The gaze rate of "Packaging (number)" was significantly higher in PhP. Further, the rate of change of pupil diameter on "Packaging (number)" was significantly higher for PhP than HpP. It was affected that the prescriptions inspected by PhP had significantly longer dosage days in this study.

It was considered that the pupil diameter in "Packaging (code/number)" exhibited a changed toward contraction for both HpP and PhP, because contraction occurs due to short-sighted work when checking the code and number [11].

Moreover, at the institutions in which we conducted the research, the inner bags and rubber bands required for inspection were not easily accessible. As a result, the pharmacists had to move every time they need those extra work. It has been reported that interruptions during work cause incidents [12] [13] [14]. It was thought that looking away from the prescription or medicine during inspection is presumed to result in loss of concentration and reduced attention. There were also cases in which the space for inspecting was small, and the prescription and envelope for medicines were inspected on top of a computer keyboard. Inspecting on uneven surfaces may lead to serious mistakes such as dropping or loss of medicines, picking up the wrong prescriptions, and so on. One of the measures for preventing dispensing errors and accidents caused by human error is organizing the dispensing room [15]. Therefore, it was suggested that it's necessary to maintain a well-organized inspecting space and dispensing room.

Moreover, there were differences in the working procedures; for example there were pharmacists who did not check prescriptions first and others did not check the medication history records during prescription checks, and so on. It was thought that the subsequent work will flow more smoothly if items such as prescription and medication history management record checks are performed first. Moreover, it has been reported that standardizing the series of work procedures could prevent mistakes and oversights [16]. Consequently, reconsideration of the work procedures during inspection should be considered as an incident countermeasure.

Furthermore, some pharmacists record the checked content by writing it down to prescriptions. In the unlikely event that a dispensing error occurs, it is important to discover medicine before the medicine is actually taken [17] [18]; thus, having a record at the inspection may be an important key in any subsequent investigation of the cause.

According to the Japan Council for Quality Health, the most common cause of near-miss incidents in pharmacies is reported to be "failure to check", as well as human factors such as "busy working conditions"; thus, the causes of medical

error may be complicated [19]. Our study using eye trackers, can help to elucidate each institution's idiosyncrasies, and lead to clarification of the causes of incidents as well as prevention of medical errors in the future.

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## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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