



# Education program on medical error disclosure for emergency medicine residents using standardized patients

Chanwoong Kim<sup>1</sup>, Kyung Hye Park<sup>2,3</sup> and Eun Kyung Eo<sup>4</sup>

<sup>1</sup>Department of Emergency Medicine, Chung-Ang University College of Medicine, Seoul, <sup>2</sup>Department of Medical Education, Yonsei University Wonju College of Medicine, <sup>3</sup>Department of Emergency Medicine, Wonju Severance Christian Hospital, Wonju, and <sup>4</sup>Department of Emergency Medicine, Soonchunhyang University Bucheon Hospital, Bucheon, Korea

**Purpose:** We aimed to develop a program for error disclosure for emergency medicine (EM) residents to determine its effects.

**Methods:** Fifteen EM residents participated in 2020. The program included two-error disclosure sessions using standardized patients (SPs), a didactic lecture, and debriefing. The Kirkpatrick model was used to evaluate this program. Satisfaction scores and narrative reactions were collected (level 1). Residents were asked to choose their actions and explain reasons for the representative error cases before and after the program (level 2). After 2 months, they were asked to write their experiences of disclosing errors to real patients (level 3). The differences in the disclosing communication scores allocated by the SPs were compared between the senior and junior residents.

**Results:** The residents' satisfaction scores were high. Before the program, some residents chose not to disclose errors when there were no harmful sequelae at the time of the incident. After the program, opinions changed, and the residents thought that all errors should be disclosed. Before the program, most residents disclosed the errors to patients first; after the program, they would report to the hospital first to receive guidance. After 2 months, five residents reported disclosing errors to real patients. The senior residents' total scores and the scores for "prevention of future errors" were higher.

**Conclusion:** The residents showed confidence in error disclosure while maintaining rapport with the real patient, and some were satisfied with their disclosure approach. Our error disclosure program for EM residents had a positive effect on their behavior and attitude toward error disclosure.

**Key Words:** Error disclosure, Emergency medicine, Education, Simulation

## Introduction

Disclosing errors include acknowledging the facts in the event of a medical error, expressing regret or apology, investigating an incident, realistically explaining the occurrence, managing the incident, and

explaining the process of preventing recurrence [1]. With an increase in the importance of patient safety and the public awareness of patient safety and medical error, systematic and transparent error disclosure has become important. In general, patients and their family members expect to know what happened, why it happened, and how it will be handled in the future. However, doctors

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Corresponding Author: Kyung Hye Park (<https://orcid.org/0000-0002-5901-6088>)  
Department of Medical Education, Yonsei University Wonju College of Medicine, 20 Ilsan-ro, Wonju 26426, Korea  
Tel: +82.33.741.0242 Fax: +82.33.742.5034 email: [erdoc@yonsei.ac.kr](mailto:erdoc@yonsei.ac.kr)

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generally hesitate to disclose the error and discuss the solutions with patients [2]. This gap between the patients' and doctors' perspectives may reduce the patients' trust and satisfaction and may increase the likelihood of medical litigation [3]. Disclosing errors increases the trust in doctors and recommendations of doctors or hospitals to others, and the overall quality of care may improve [4]. In practice, both doctors and the general public acknowledge most known effects of error disclosure; however, from the doctors' perspective, there is a negative belief associated with the expectation that error disclosure would lead to fewer lawsuits filed by the general public and an increase in the credibility of the doctors [5].

In Korea, education and policies regarding patient safety and error disclosure are still in their early stages. In 2017, the Patient Safety Act was enacted, and in 2020, the reporting of sentinel events or serious adverse events was mandated under the Patient Safety Act [6]. However, no proper guidelines or education for error disclosure or support system has been put in place in Korea.

Obstacles to error disclosure include unrealistic expectations that doctors will not make mistakes, being unaware of useful approaches to communicate with patients about errors, and fear of further errors [7]. To overcome these obstacles, the American College of Emergency Physicians emphasizes the importance of protocols, policies, and apologies as responses to medical errors by medical institutions, the importance of recognition and prevention of medical errors for educators, and effective communication strategies of medical errors with patients [7]. A large survey of doctors in Canada and the United States showed that female doctors, American doctors, young doctors, and doctors working in training institutions believe that disclosure of errors reduces the likelihood of litigation, reporting the error will change the system when they experience error

disclosures, and that being trained to disclose previous errors would have a more positive attitude towards error disclosure [8].

Unlike the general medical care, the emergency physicians (EPs) provide quick judgment and problem-oriented treatment, and the emergency department (ED) is more complex than other medical environments and is a high-risk atmosphere in hospitals. The ER runs without breaks, and the EPs experience an irregular life cycle due to shifts, which causes a significant cognitive load [9]. In contrast to other medical departments, it is necessary to pay close attention to limited resources, transfer of patients, and different severity of diseases in the ER. Accordingly, the types and severity of errors in the ED vary. EPs must recognize, handle, and disclose medical errors in the midst of a constant unexpected flow of patients.

Doctors with error disclosure education are greater advocates of error disclosure. However, the complexity of the ED makes it difficult for EPs to learn while in service at the ED. Moreover, the availability of dedicated educational programs for medical error disclosure are lacking. Thus, the aim of this study was to develop a suitable education program for emergency medicine (EM) residents on disclosure of medical errors, and to evaluate the program based on the Kirkpatrick model. In addition, we investigated the difference in performance between the senior and junior residents to suggest the error disclosure education appropriate to the resident's grade.

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## Methods

### 1. Study design and setting

This quasi-experimental study was conducted from

October to November 2020 with 15 EM residents (four from each grade, three from the first grade) at Yonsei University Wonju Christian Severance Hospital. All residents voluntarily participated in this program. The same program was repeated 3 times because of the duty schedule of the residents. The program took about 3.5 hours, excluding the time taken to explain the study, obtain consent for the study, and prepare the initial pre-education survey before the session education. Before participating in the program, all residents responded to a preliminary survey on their experiences in disclosing treatment errors, who they received help from at that time, and whether they had received any prior education on the topic.

This study was approved by the Institutional Review Board of Yonsei University Wonju Christian Severance Hospital (CR320108). Written informed consent was obtained from all participants.

## 2. Development of cases

For cases using standardized patients (SPs), an overview and predicted scenarios of adverse events and near misses were developed after a discussion among authors (Appendix 1). In the case of a sentinel event, it is generally difficult for the SP to directly communicate with the resident, and it is difficult for the resident to disclose errors alone. Currently, there are no guidelines in Korea for disclosing medical errors. Therefore, the guidelines of New South Wales, Australia were used as a reference. In situations where SPs and residents talk one-to-one, it would be difficult to formulate an open disclosure; thus, the situation was developed up to the clinician disclosure stage [10]. The recruited SPs were actors having more than 10 years of experience in medical communication courses and clinical examination simulations for medical students. The outline of the developed cases was as follows:

**Adverse event:** Patient A told nurse A that she had an antacid allergy, and nurse A recorded 'antacid allergy' in the memo column in the electronic medical record. The resident was prescribed an antacid injection without checking the memo column. Following administration of the injection, the patient experienced shortness of breath and dizziness. The patient reported experiencing similar symptoms as an allergic reaction following administration of an antacid injection in the past.

**Near miss:** While collecting blood samples from a patient who needed a blood transfusion, the barcode was swapped with that of another patient. Packed red blood cells of a different blood type were sent from a blood bank, and during the process of checking the blood type, the patient stated that he was not that blood type. Thus, the transfusion did not begin; however, the patient was angry with the error in his blood type.

## 3. Error disclosure program using standardized patients

The SPs prepared an interview for one of the cases and waited for a resident in each room. After the resident read the case and instructions placed on the door of each room explaining the situation of the case for 2 minutes, he/she entered the room and had an 8-minute conversation with the SPs to disclose the error (Appendix 1). The SPs posed questions to the residents to progress through the error disclosing phase. After completing one conversation, they were allowed to enter another room. The SPs were scored on a checklist using a 5-point Likert scale after the medical interview was completed by each resident (Appendix 2). The checklist items were based on previous studies that have investigated patients' opinions on doctors' attitudes toward medical errors [11] and have been used in previous studies on error disclosure education [12-14]. The SPs were not informed in advance about the training grade of

the participants.

After the practice session with the SPs, one author (P.K.H.) gave a didactic lecture, which included the situation and obstacles associated with medical error disclosure in Korea, the meaning of apology law, and the established guidelines from Australia regarding communicating medical errors [9]. Subsequently, other authors (K.C.W., E.E.K.) debriefed the EM residents.

#### **4. Response to the program: Kirkpatrick level 1**

The residents' satisfaction and their feedback to the learning experiences were immediately evaluated after the program as the Kirkpatrick level 1 outcome [15]. The residents were asked to describe their satisfaction with the program using a 5-point Likert scale. They were also enquired about what they liked about the program, their opinions regarding improvements in the program, and what they could do based on what they had learned.

#### **5. Learning after the program: Kirkpatrick level 2**

To assess the potential changes in behavior and attitude of the residents, the behavior and the reasons for the responses to the four case scenarios were surveyed before and after the program as the Kirkpatrick level 2 outcome [15].

Before the program, the residents were asked to choose one of six examples of action they would take for the four cases of medical errors and to write down the reasons for their choice. Using the same four cases used in the pre-survey, the residents were asked what they would do in these situations and to provide reasons for their choices after the program (Appendix 3). The four case scenarios of medical errors were developed by the authors.

#### **6. Behavior change in the workplace: Kirkpatrick level 3**

Two months after the program, the residents were asked to write a reflection essay about their error disclosure learning experience as the Kirkpatrick level 3 outcome [15].

#### **7. Data analysis**

The participants' responses (Kirkpatrick level 1) were analyzed using the satisfaction scores and questionnaire comments after the program. The participants' learning experiences (Kirkpatrick level 2) were analyzed using action plans and the underlying intentions before and after the survey based on four written cases. In addition, the participants' behaviors (Kirkpatrick level 3) were analyzed using reflection essays about their real experience on error disclosure in the workplace after 2 months. All qualitative data in the participants' responses, action plans and intentions, and reflection essays were described using content analysis by one author (K.H.P.).

We divided the residents into two groups: senior group (3rd- and 4th-grade residents) and junior group (1st- and 2nd-grade residents), and compared the scores in the checklist between the groups. The scores given by the SPs were analyzed using the Mann-Whitney U test. All continuous variables are presented as mean  $\pm$  standard deviation (SD). IBM SPSS ver. 23.0 (IBM Corp., Armonk, USA) software was used for the analyses, and significance was set at  $p < 0.05$ .

## Results

### 1. Participants

Seven residents had previously experienced error disclosure. Among them, one had asked the attending EP for help, two had asked senior residents for help. Three had attended lectures about medical errors, and one had attended a lecture and read a casebook about medical errors.

### 2. Reactions to the program

The satisfaction score (mean±SD) with the educational program was 4.77±0.44 out of 5 points. The aspects that were appreciated included sessions with the SPs, chance to enhance confidence in coping with medical errors, and learning how to disclose errors and apologize to patients. Regarding the suggestions on

program improvement, the residents expected to find various case scenarios based on the different situations of the ED and to address the subject of responsibility; moreover, the program duration and time spent talking with the SPs were considered to be too short. Many participants commented that they felt empowered to disclose errors and apologize to real patients immediately after the program, and they admitted they would improve their listening skills and empathize more with the patient. The residents responded that they were able to disclose the error while maintaining rapport (Table 1).

### 3. Learning after the program

In the sentinel event, “Report to the supervisor or superior authority, obtain consent, and disclose to the patient (family)” was the most common response before and after the educational program. The reason was that the patient had died, there had been an obvious error,

Table 1. Participants’ Reactions to the Error Disclosure Program

Questions	Answers	No. of answers
What they liked	Education experience through SP	4
	Confidence in coping with medical error	3
	Knowing how to disclose error and how to apologize	3
	Feedback after program	2
	Understanding the patient’s position when an error occurs	2
	No reluctance to apologize to the patient	2
	Comforting that medical error was not my own	1
	Sharing other residents’ experience	1
	Systematically learned what I experienced in the field	1
	What they thought could improve the program	Various cases (according to the whose responsibility, the type of emergency center)
Short education time and SP interview time		3
Detailed debriefing		1
Not completely realistic cases		1
What they can do based on what they learned	I can disclose medical error and apologize.	11
	I will listen to and empathize with the patient more.	3
	I can disclose medical error while maintaining rapport.	2
	I will figure out what to do when an error occurs and what to systematically solve.	1
	I found that apology could reduce medical disputes.	1

SP: Standardized patient.

and hospital assistance was needed in the process of disclosing the error. After the educational program, factors such as legal issues, compensation, identification of causes, and preventive measures to prevent recurrence were added as reasons (Table 2).

In the case of falls among pediatric patients, “Report to the supervisor or superior authority, obtain consent, and disclose to the patient (family)” was the most commonly selected response before and after the education program. Most residents responded that the fall should be disclosed to the mother. However, there was one resident who responded that they would neither notify the mother nor report it, and two residents responded that they would notify the mother but would not report to the EM department or hospital. In addition, two residents would allow the fall to be disclosed after reporting the event to the EM department or hospital. However, after the education session, all residents said that they would disclose the fall to the mothers and report to the supervisor. The reason was that it was a mistake made by a nurse, and there might be possibilities of medical problems in the future. After the education program, the costs of further examination, compensation to the patient, and measures to prevent falls were included as reasons (Table 2).

In the case of falls among elderly patients, “Report to the supervisor or superior authority, obtain consent, and disclose to the patient (family)” was the most common response both before and after the program. Unlike in pediatric patients, all residents chose to disclose errors to the caregiver before the program. The reason was that additional examination, such as brain computed tomography, was needed, and the event was a fall accident. After the program, the residents added that they would seek help from the EM department or hospital in the process of explaining to the caregiver (Table 2).

In the case of a near miss, “Report to the supervisor

or superior authority, obtain consent, and disclose to the patient (family)” was the most commonly selected response before the educational program. However, “After reporting to the department of EM or hospital, it is left to the department of EM or hospital to decide whether or not to disclose to the patient (family)” was the most commonly selected response after the educational program. Before the program session, some residents responded that they would not inform anyone or would only disclose the error to the patient because there was no harm done to the patient. However, after the educational session, all the residents agreed to disclose and report. A greater number of residents selected that the disclosure to the patient after reporting should be left to the hospital than in other scenarios. Before education, it was believed that the cause of the medical error should be exposed to prevent future occurrences, and that it was necessary to notify the patient and caregivers to be cautious of side effects; thus, it was necessary to disclose the event to the patient. After the educational session, many residents mentioned that they felt that disclosing the event should be left to the EM department or hospital. Thus, it was considered necessary to report to the hospital to prevent recurrence, and although at the moment there might have been no problem with the patient, there was no need to notify the patient immediately (Table 2).

#### 4. Behavior change in the workplace

Five residents wrote a reflection essay about their experience of disclosing medical errors to patients. The remaining residents said that there was no incident to report, or they wrote about their experiences witnessing other doctors report errors. The cases described included adverse events, near misses, and no sentinel events. One resident was of the opinion that honesty was important and they felt the effect of the error disclosure, while one

Table 2. Comparison of Changes in Participants' Action Plan after the Error Disclosure Program

Cases	Behavior	Before		After	
		No. (%)	Summarized reasons	No. (%)	Summarized reasons
Sentinel event	C	2 (13.3)	(1) It was an obvious medical error and the patient died.	1 (6.7)	(1) If I do not apologize, I feel guilty and need to take precautions.
	E	9 (60.0)	(1) A fatal accident could be a legal issue, so I should consult with my supervisor and report it to the hospital for help in the disclosure process. (2) It is an obvious medical error, and if I do not apologize, I feel guilty. (3) It is necessary to understand the exact situation.	13 (86.7)	(1) It is a sentinel event due to an obvious mistake. (2) Legal/compensation issues may arise, so it is necessary to discuss with the supervisor before proceeding with disclosure.(3) To prevent recurrence, it is necessary to identify the cause and take precautions.
	F	4 (26.7)	(1) Disclosure is decided after consulting with the emergency department or hospital. (2) It is difficult to make a decision alone, and it is not right to decide on my own.	1 (6.7)	(1) Because it is a sentinel event, systematic disclosure and apology are required after consultation.
Adverse event (toddler)	A	1 (6.7)	(1) Only I know, and as a doctor, there is no fault.	0	-
	B	2 (13.3)	(1) If a medical problem occurs in the future, report it, and do not do it now. (2) Currently, the patient is fine, so it is adequate to explain it to the mother.	0	-
	C	4 (26.7)	(1) Medical problems may arise in the future, and additional tests are necessary. (2) It is a nurse's mistake and needs to be reported. (3) It is not a serious medical error, so explain to the mother first.	5 (33.3)	(1) The medical staff had some responsibilities. (2) Additional testing and compensation are required. (3) I have to apologize and explain so the mother will calm down. (4) Regardless of the consent of the hospital, the mother should know of the incident. (5) In order to prevent falls, it is necessary to share content and feedback at the level of hospitals and departments.
Adverse event (old patient)	E	6 (40.0)	(1) Additional testing may be required, and an accurate situation needs to be identified. (2) It is necessary to discuss countermeasures. (3) It cannot be hidden.	10 (66.7)	(1) After consulting with the supervisor and determining the content to be disclosed, explain and disclose the error. (2) I need to get help in the disclosure process. (3) Additional testing and compensation are required. (4) It was an accident in the hospital, so I need to check it. (5) It is a pediatric patient, so I will approach similar cases more carefully.
	F	2 (13.3)	(1) Reports are necessary, and decisions are made after consulting with the emergency medicine department or hospital.	0	-
	C	4 (26.7)	(1) Additional testing is required and should be explained first. (2) It is a fall accident, so it should be surely reported to the hospital.	3 (20.0)	(1) Additional testing is needed, so they should be explained first and preventive education. (2) The hospital is responsible for the fall.
Adverse event (new patient)	E	8 (53.3)	(1) Since additional testing is required, explain to the caregiver after consulting with a supervisor. (2) Report to the hospital to discussion precautions.	11 (73.3)	(1) The patient is harmed. (2) After consulting with the responsible department, the treatment policy is decided and summarized and explained. (3) Because patient may be harmed, additional testing and disclosure to the patient are necessary. (4) In case of an unexpected situation, in order to get help from emergency medicine department or hospital when disclosing error.

(Continued on next page)

Table 2. (Continued)

Cases	Before		After		
	Behavior	No. (%)	Summarized reasons	No. (%)	
Near miss	F	3 (20.0)	(1) Even if I did not do anything wrong, the hospital needs to know. (1) There are no associated medical problems or side effects.	1 (6.7)	After figuring out why the bed handle was lowered, an apology and compensation are decided.
	A	2 (13.3)	(1) There is no harm to the patient.	0	-
	B	1 (6.7)	(1) The patient's right to know is important. (2) There is a possibility of medical issues in the future. (3) Currently there is no problem with the patient.	0	-
	C	4 (26.7)	(1) Reports should be made to identify causes of medical errors and to discuss preventive measures, and patients should be informed of possible adverse drug reactions.	4 (26.7)	(1) Inform the patient first because problems may arise in the future. (2) Report to the hospital to prevent similar errors. (3) Inform early and apologize for keeping rapport. (4) When the medical records are checked later, the patients will discover the event; thus, inform them in advance.
	E	6 (40.0)	(1) It is a medical error, so I should report it.	3 (20.0)	(1) It is definitely the fault of the medical staff and needs to be reported regardless of whether there is any harm to the patient. (2) It should be recorded in the medical record, and if the patients read the medical record, problems such as lawsuits may arise. (3) Report errors to the superior authority for help in the case of disclosure. (4) Side effects may occur later in the patients.
	F	2 (13.3)	(1) It is a medical error, so I should report it.	8 (53.3)	(1) Recurrence can be prevented only by reporting to the hospital. (2) There is no current problem with the patients, so I do not need to notify the patients first, and leave the disclosure to the hospital. (3) The emergency medical department or hospital determines the possibility of future harm.

If the number of respondents was 0, it was not displayed. A: Do not report to the department of emergency medicine or hospital, keep it private. B: Do not report to the department of emergency medicine or hospital after disclosing to patient (family) only. C: Report to the department of emergency medicine or hospital after disclosing to patient (family) only. D: After reporting to the department of emergency medicine or hospital, disclose to the patient (family), despite opposition. E: Report to the supervisor or superior authority, obtain consent, and disclose to the patient (family). F: After reporting to the department of emergency medicine or hospital, it is left to the department of emergency medicine or hospital to decide whether or not to disclose to the patient (family).



**Table 3. Participants' Behavior Changed after 2 Months of the Error Disclosure Program**

Case summary	Reflection
Due to my misunderstanding, I explained to the patient the results of another patient's test. When the patient was discharged, the nurse informed me of the change in the patient. I was informed before the patient had left. The patient was informed of the correct results before discharge; I apologized, and the patient understood the situation and thanked me.	I realized that honesty and integrity are important to patient rapport. Without this education, I may have avoided responsibility.
The patient's central line was missing during the CT scan due to the carelessness of the radiological technologist, but the radiologist did not apologize to the patient. I apologized to the patient and informed the patient who was at fault. The patient did not raise any problems or complaints.	I was angry that I had to apologize as a representative, and I was worried that the situation would escalate and become my responsibility.
The first-grade resident missed the patient's elbow fracture, and the patient was discharged. Later, the fracture was found. I informed the patient over the phone, apologized, and made an appointment at an orthopedic outpatient clinic. I even informed the patient of how to file a formal complaint, and the patient thanked me.	I felt the effect of disclosing my error was good.
A fracture was missed due to CT images taken of the healthy arm. Immediately, the patient was notified and admitted to the hospital.	Being honest, by not avoiding error situations.
After explaining to the patient that the central line was inserted incorrectly, I re-inserted the central line into the patient. The patient tried to cooperate; however, he presented with symptoms.	I was sorry that the patient felt pain and empathized with the pain

Case summary and reflection are from the participants' reflection essay using content analysis.  
 CT: Computed tomography.

**Table 4. Comparison of Performance Scores Given by Standardized Patients between Resident Grades**

Variable	Junior residents (N=7)	Senior residents (N=8)	p-value
<b>Adverse event</b>			
Explanation of medical facts regarding error	2.14 ± 0.38	2.25 ± 0.46	0.617
Honesty and truthfulness	1.57 ± 0.53	2.13 ± 0.64	0.098
Empathy	1.00 ± 0.58	1.38 ± 0.52	0.209
Prevention of future errors	1.14 ± 0.38	1.75 ± 0.46	0.023
General communication skills	1.71 ± 0.49	2.13 ± 0.35	0.082
Total score <sup>a)</sup>	7.57 ± 1.40	9.63 ± 1.41	0.018
<b>Near miss</b>			
Explanation of medical facts regarding error	2.29 ± 0.49	2.50 ± 0.53	0.414
Honesty and truthfulness	2.00 ± 0.00	2.25 ± 0.46	0.170
Empathy	1.57 ± 0.53	1.63 ± 0.52	0.838
Prevention of future errors	1.43 ± 0.53	2.25 ± 0.71	0.034
General communication skills	1.86 ± 0.69	1.88 ± 0.35	0.881
Total score <sup>a)</sup>	9.14 ± 1.07	10.50 ± 1.31	0.035

Data are presented as mean ± standard deviation. Mann-Whitney test was used for comparison between grades.  
<sup>a)</sup>Minimum score, 0; maximum score, 3; maximum total score, 15.

resident disclosed and apologized for the errors made by a radiological technologist, which made him angry. There was also a resident who reported feeling more empathic towards a patient's pain (Table 3).

### 5. Comparisons of the SPs' performance scores between resident grades

In both cases, the senior residents' total scores were significantly higher. In addition, the senior residents' scores were higher for the prevention of future errors (Table 4).

## Discussion

We developed a medical error-disclosing education program using SPs and educated EM residents. The residents were satisfied with the program, and the participants' knowledge and action plan about error disclosure changed immediately after the program, and 2 months later, some of them even converted their action plans into behaviors in the workplace.

After the program, the residents believed it was necessary to disclose the errors following reporting of the incident to a superior authority, to provide compensation for patients, and to ensure measures were enacted to prevent similar errors. Five residents apologized to the patients and reported disclosing errors within 2 months after the program, and it seems that they benefitted the most from this program.

In our study, the residents were particularly satisfied with the learning experience involving SPs and the practical sessions for apologizing to patients. Confidence and satisfaction were sufficiently high such that 11 residents felt that they could practice what they had learned in the emergency room immediately after the program. In previous studies, the practice of disclosing errors using SPs has shown a high level of satisfaction among participants, and it increased confidence in disclosing errors [12,16]. From the standpoint of suggestions for improvement of the program, the residents recommended additional case scenarios according to different levels of responsibility for the error and the level of the emergency medical center. The residents state that the type of error and the method of disclosure would differ depending on the level of responsibility and emergency medical center.

Examples of change action plans involving error disclosure before and after the program included

unexpected and preventable deaths, falls, and medication errors. These were the error types that most EM doctors agreed to disclose to others [17]. Before the program, some residents responded that when there were no harmful sequelae to the patient at the time of the incident, for example, in situations where there were no evident symptoms presented immediately after a fall, or when there were no evident symptoms associated with a medication error, they would not disclose the error to the patients immediately. However, as a result of the program, the residents developed action plans, which indicated that they would now report the incident. In addition, some residents responded that they would disclose to the patient first and then report to a superior authority, although following the program, most residents chose "Report to the supervisor or superior authority, obtain consent, and disclose to the patient (family)," or "After reporting to the department of EM or hospital, it is left to the department of EM or hospital, to decide whether or not to disclose to the patient (family)." In a previous study, doctors were skeptical about whether disclosure of a near miss would negatively impact patient trust; however, most patients responded that disclosure would serve to prevent recurrence [5]. In our study, some residents thought that it was not necessary to disclose near misses to the patient, although their opinion changed after the program. It was revealed that they would disclose when given consent by a superior authority, or they believed disclosure should be left to the superior authority. These were interpreted as willingness by the resident to passively disclose the error. In addition, it seems that the decision to disclose the error was made after being assured that there was no need to disclose a near miss unless the patient would face a subsequent risk.

Before the program, the residents did not mention compensation to the patient nor efforts by the hospital

or system to enact preventative measures to avoid recurrence following their decision to disclose the error. However, after the program, they thought that compensation and preventative measure should be considered as early as possible. In prior studies, clinicians did not apologize to patients in cases of a near miss or adverse events, although no immediate medical sequelae were identified. However, in the case of sentinel events, a higher tendency to apologize has been reported [12]. It seems that residents based their decisions on how to act based on the immediate results of the error to the patient rather than the type of medical error that had occurred. Nonetheless, residents seemed to increase their consideration of potential harms to the patient in the future and prevention of recurrence after attending the programs.

Two months after the program, five residents who disclosed medical errors thought that the effectiveness of the disclosure of medical errors was positive and that the programs were helpful.

In our study, senior residents achieved higher overall scores and scores about future error prevention than junior residents. In one study in which the SPs gave scores to the residents, the scores were higher for items such as explanation of medical factors and responsibility for incidents; however, the scores were lower for future error prevention, continued updates on the situation, continued communication with the family, and providing an accurate plan for follow-up [14,18,19]. In another study, 75% of EPs did not discuss methods to prevent the recurrence of errors in patients, and senior residents performed better than junior residents in terms of apology, explanation, and prevention [20]. This may be attributed to the fact that senior residents have more clinical experience.

Our study presents a few limitations. The first was the small number of participants. Opportunities for offline

programs were limited due to coronavirus disease 2019. The research was conducted at only one institution; therefore, our results might reflect a cultural bias. It will be necessary to expand the program and target residents from other institutions to validate the effectiveness of the program and evaluate the cultural and personal differences in the residents' error disclosure. Second, the same scenarios were used for all the residents. Sessions were split into three sessions distanced over several weeks apart; thus, the content of the scenarios might have been shared among the participants.

After the program, the EM residents reported that even near misses should be disclosed to the patients and showed intentions to systematically proceed with the disclosure procedure. Further, instead of attempting to resolve medical errors alone, residents now took into consideration disclosure to patients, need for compensation, and enactment of preventative measures as hospital-level issues. The residents were confident that they could disclose and apologize for errors while maintaining rapport with the patient, and some felt satisfied with their disclosure to actual patients. EM residents are exposed to medical errors early in their residency. Thus, they should be prepared on how to disclose errors and how to discuss them with patients and supervisors. Our education program for EM residents has changed their behavior and attitudes and has contributed to improved handling of error disclosure in the ED.

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#### ORCID:

Chanwoong Kim: <https://orcid.org/0000-0001-7821-8980>;

Kyung Hye Park: <https://orcid.org/0000-0002-5901-6088>;

Eun Kyung Eo: <https://orcid.org/0000-0002-6615-5043>

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## Appendix 1. Door Signs for Error Disclosure Exercise with Standardized Patients

### A. Adverse event

Ms. Kim (45/F) came to the emergency room due to heartburn and nausea after drinking too much the previous day. At the triage, she told nurse A that she had an antacid allergy, although she was not sure of the name of the drug. Nurse A recorded "antacid allergy" in the memo column in the Electric Medical Record (EMR). I went to the patient to check the medical history and perform abdominal examination, and explained that I would prescribe an injection to relieve symptoms; I then prescribed Urantac® (Ranitidine HCl) and Macperan® (Metoclopramide HCl) injections. I did not check "antacid allergy" in the memo column in the EMR.

After the two injections, the patient experienced shortness of breath and dizziness. Nurse B asked me to look at the patient. Nurse B said that the patient had a history of receiving an injection of antacid and experiencing shortness of breath and dizziness and was now experiencing the same symptoms. Nurse B checked and found that the patient had been injected with Urantac.

Understand the patient's situation as the doctor-in-charge and explain to the patient the process of the error and the future steps.

### B. Near-miss

Mr. Lee (39/M) visited the emergency room with dizziness. He habitually drinks alcohol, and he did not consider it a major problem. He had tarry stools or melena for several days, and he felt dizzy. He was brought to the emergency room, and he appeared tired enough to collapse.

You confirmed that the hemoglobin level was 6.0 on a blood test, and you decided to do a blood transfusion. The nurse connected the blood (A+) from the blood bank for the infusion line for transfusion and checked the patient's name, hospital number, and blood type. However, the patient said that his blood type was B+, and it was confirmed that it was different from the patient's recorded blood type. Preparation for blood transfusion was immediately stopped, and the nurse informed you of this situation. In addition, we investigated the process of how the error occurred and determined where the error occurred. Blood samples were collected from interns to check the blood type, and another intern had attached the patient barcode to a different patient's sample. Finally, the blood samples were collected. Now, the patient is receiving fluid therapy.

Understand the patient's situation as the doctor-in-charge and explain to the patient the process of how the error occurred and the future process.

Appendix 2. Checklist Used by the Standardized Patients

Category	Details
Explanation of medical facts regarding error	<ul style="list-style-type: none"> <li>- Told me what the error was in my care</li> <li>- Explained to me why the error occurred</li> <li>- Told me how the error impacted my health care</li> <li>- Told me how the consequences of the error will be corrected</li> </ul>
Honesty and truthfulness	<ul style="list-style-type: none"> <li>- Took responsibility for the error</li> <li>- Explained the error to me freely and directly, without me having to ask a litany of probing questions to get the details of the error</li> <li>- Did not keep things from me that I should know</li> <li>- Did not avoid my questions (not evasive)</li> </ul>
Empathy	<ul style="list-style-type: none"> <li>- Said he/she was sorry and apologized in a sincere manner</li> <li>- Allowed me to express my emotions regarding the error</li> <li>- Told me that my emotional reaction was understandable</li> </ul>
Prevention of future errors	<ul style="list-style-type: none"> <li>- Told me that an effort will be made to prevent a similar error in the future</li> <li>- Told me what he/she would have done differently</li> </ul>
General communication skills	<ul style="list-style-type: none"> <li>- Verbal expression (smooth beginning and end of the conversation)</li> <li>- Non-verbal expression (voice tone, speech rate, facial expression, eye contact, etc.)</li> <li>- Responded to my needs</li> <li>- Checked for my understanding of the information he/she provided</li> </ul>

### Appendix 3. Description of Error Scenarios Used to Investigate Action Plans before and after the Program

#### Case 1. Sentinel events

Patient A was admitted to the ER due to dyspnea. After taking a portable X-ray, a pneumothorax was observed, and I (resident) inserted a chest tube in the patient. The patient's symptoms did not improve, and X-rays were taken again to check the results of the procedure. When I checked the X-ray, I noticed that the chest tube had entered the contralateral side of the chest. The pneumothorax was severe, and the patient experienced respiratory arrest.

#### Case 2. Adverse events, toddler

A mother brought her 15-month-old boy to the ER due to a fever. She said she had left her phone in the car, so she asked the nurse if she could leave the child in her care for a while. After checking the fever and respiration rate, the nurse went to the nurse station to answer the phone without raising the handle by the bed. In the meantime, the child cried and then fell from the bed. Immediately, the nurse and I (resident) put the child on the bed and had a physical examination; there were no special trauma or abnormal findings. The state of consciousness was also the same as when he first came to the ER.

#### Case 3. Adverse events, old age

A 92-year-old woman developed a high fever and was transferred from a nursing home to the ER. Due to pre-existing dementia, her consciousness was not clear. She screamed intermittently in the ER and normal communication was impossible. While the caregiver went to the bathroom, she fell from the bed. After the fall, I (resident) went to check on her, and after lifting her to the bed, I noted that the handle by the bed was lowered. She had no special trauma, her consciousness was the same as when she first arrived at the ER, and there was no evidence of abnormal findings on the neurological examination.

#### Case 4. Near miss

The antacid Gaster injection to be administered to patient A and the antispasmodic Buscopan injection to be administered to patient B were reversed. However, neither patient experienced any notable side effects.

#### Choose your own behavior for each case from the options below, and write the reason.

- (1) Do not report to the department of emergency medicine or hospital, keep it private.
- (2) Do not report to the department of emergency medicine or hospital after disclosing to patient (family) only.
- (3) Report to the department of emergency medicine or hospital after disclosing to patient (family) only.
- (4) After reporting to the department of emergency medicine or hospital, disclose to the patient (family), despite opposition.
- (5) Report to the department of emergency medicine or hospital, obtain consent, and disclose to the patient (family).
- (6) After reporting to the department of emergency medicine or hospital, it is left to the department of emergency medicine or hospital to decide whether or not to disclose to the patient (family).