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## Perceptions of hospital emergency color codes among hospital employees in Korea

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## ABSTRACT

**Introduction:** Hospital emergency codes frequently comprise of colors to prevent confusion and enhance prompt response to emergency situations. The purpose of this study was to identify perceptions of emergency color codes among hospital employees in Korea.

**Methods:** A 12-color spectrum and emergency situations were selected from the standardized emergency color codes used in the US and Canada. Participants were selected via convenience sampling from four general hospitals in Seoul and Gyeonggi-Do. Between October 25 and November 30, 2016, 295 questionnaires were distributed and 266 of them were analyzed.

**Results:** The participants showed the highest consistency in the association between emergency images related to colors and emergency code color images associated with emergency situations in the following cases: “red for fire,” “blue for adult cardiopulmonary resuscitation (CPR),” “yellow for pediatric CPR,” “orange for external disaster,” “pink for infant/child abduction,” “white for deactivation,” and “black for violent/combatative person.” Meanwhile, the most confusing colors were purple, gray, and silver. Hospital employees tended to select colors that matched the emergency codes used in their respective hospitals.

**Conclusions:** The four colors of “red,” “blue,” “pink,” and “white,” were strongly associated with “fire,” “cardiac arrest,” “infant/child abduction,” and “emergency deactivation,” respectively. The use of four colors for hospital emergency code standardization domestically in Korea is recommended.

### 1. Introduction

A hospital emergency code refers to the sign used by hospital staff, in the hospital or community, to prevent confusion and enhance prompt response with respect to emergency patients who require cardiopulmonary resuscitation (CPR) or to address mass casualties caused by disasters [1–3]. Emergency codes are often color-coded because it is easier to quickly identify their meaning than that of characters [4]. Therefore, color codes are considered as a visual language that many people can understand without language barriers [5–7].

However, different emergency color codes are used in different countries, regions, and hospitals, which can cause confusion and secondary accidents when healthcare workers in neighboring hospitals work together, or when firefighters or police personnel work together [4,8–11]. To minimize these concerns, more than 25 hospital associations in the US have established a standardized emergency code, and the Federal Emergency Management Agency (FEMA) [12], under the US Department of Homeland Security, has recommended the standardization of emergency codes into plain language. The use of plain

language codes is recommended to aid patients’ health decision making in emergency situations by ensuring hospital transparency and considering the level of health literacy of the patient [4,12]. Missouri State, Iowa State, and others have transitioned to using Plain Language Emergency Codes [13,14]. Meanwhile, in Scandinavian countries hospitals do not denote color codes for emergency situations, but sometimes in-hospital preparedness are color coded based on the Medical Emergency Triage and Treatment System (METTS) to improve patient flow [15]. However, despite various strategies, the application of emergency color codes only in color, or color based emergency codes including some plain language, is still a common practice worldwide [16].

Emergency Color Codes are paged in English, such as “Code Red,” rather than using colored flags or flashing lights [10,17]. Most hospital employees around the world, irrespective of whether English is their second language, may listen to the code in English. This requires them to interpret such messages into their first language. Therefore, it is important to consider if Korean hospital employees, whose native tongue is not English, can immediately recall the color on hearing the

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code in English, or reflectively think of a certain emergency without linking it to color.

The images associated with color vary depending on the internal factors of the individual, as well as external factors such as education, lifestyle, culture, and tradition [6,18]. The symbolism of color may vary depending on the age and area in which the individual lives [7,19–21]. “Color image” refers to the visual sensation perceived by the eye as a specific object or adjective based on personal experiences or the environment [22]. “Association” is something linked in memory or imagination with a thing or person [23].

In Korea, the hospital accreditation guidelines of the Korea Institute of Healthcare Accreditation (KIHA) [24] require the use of emergency codes only for CPR. Therefore, the number and the meaning of emergency codes differ across hospitals, and often, these codes do not consider the color image and possibility of recall of hospital employees.

The purpose of this study was to identify perceptions of emergency color codes among hospital employees in Korea.

## 2. Methods

### 2.1. Design

A descriptive study was designed to identify color images associated with the emergency codes used by hospital employees. Permission was obtained from the Chung-Ang University Review Board (1041078-201609-HR-177-01).

### 2.2. Measurements

The sociodemographic characteristics of the participants included gender, age, career, occupation, type of emergency code used at work, education about emergency codes, training experience in using emergency codes, and involvement in activating an emergency code.

By referring to the standardized codes of the British Columbia Ministry of Health [2] and the Hospital Association of Southern California [25], emergency color codes were selected by researchers, which were reviewed by 2 senior medical doctors and 2 nursing managers. Finally, we created a 12-color spectrum, excluding amber, which is not commonly used in Korea, and selected 12 emergency situations. The pilot test was done for its readability and understanding with 20 hospital workers of Hospital A.

### 2.3. Emergency situations associated with colors

The participants were asked to choose one emergency situation associated with each color according to Korean Industrial Standards [26]. These colors included red, orange, yellow, green, blue, purple, pink, brown, white, silver, gray, and black.

Emergency situations were based on the emergency codes of the participating hospitals in this survey and other major hospitals in Korea. These included fire, external disaster, evacuation, adult CPR, infant/child CPR, infant/child abduction, hazardous materials (pollution/spraying), violent/combatative person, severe weather, mass casualties, energy cutoff, and deactivation. Participants were allowed to choose duplicates and to create their own images if they associated the color with any emergency situation that was not listed in the questionnaire.

### 2.4. Emergency color codes associated with critical events

Participants were instructed to connect the emergency color code to 12 emergency situations. The emergency color codes were Code Red, Code Orange, Code Yellow, Code Green, Code Blue, Code Purple, Code Pink, Code Brown, Code White, Code Silver, Code Gray, and Code Black.

### 2.5. Data collection and analysis

For patient safety, all the hospital employees should respond promptly and cooperate in case of critical incidents. Participants including doctors, nurses, administrative staff, and technicians were selected via convenience sampling, from four general hospitals in Seoul and Gyeonggi-do; two private facilities with about 2700 beds and 450 beds, respectively; two public facilities with about 830 beds and 300 beds, respectively. Data were collected from October 25, 2016 to November 30, 2016, and researchers contacted participants individually during the breaks of each department. All participants submitted written informed consent and the self-reported questionnaires were completed anonymously. The questionnaire was evenly distributed in 4 hospitals (295 copies) and 283 copies were collected (response rate: 95.9%). Finally, 266 copies were used for the analysis, since 17 copies had missing values. The distribution of participants by hospitals was as follows: 99 from Hospital A, 57 from Hospital B, 50 from Hospital C, and 60 from Hospital D. The collected data were analyzed using frequencies, percentages, and averages.

## 3. Results

### 3.1. Sociodemographic characteristics

In total, 73.7% of the 266 participants were female and 26.3% were male (Table 1). Their age ranged from 20 to 47 years, and the mean age was 32.4 years. With reference to job types, nurses accounted for 42.9%, followed by doctors (18.8%), administration staff (18.0%), and others (20.3%). More than half (55.3%) of the participants had less than 5 years of work experience.

Most of the participants (73.7%) reported that they used color codes in their workplace, 9.4% of them said that they used plain language codes, and 16.9% of them did not know about the emergency codes used in their hospital. Two thirds of them (64.3%) had experience in participating in education or training related to emergency codes, and 35.7% had no such experience. Less than half of the participants (47.0%) had experience in activating the emergency code in their

**Table 1**  
Socio-demographic Characteristics of Participants ( $n = 266$ ).

Characteristics		N (%)
Gender	Male	70 (26.3)
	Female	196 (73.7)
Age	20–29	12 (47.0)
	30–39	80 (30.1)
	≥ 40	61 (22.9)
Job classification	Doctor	50 (18.8)
	Nurse	114 (42.9)
	Administrative	48 (18.0)
	Technician, others	54 (20.3)
Experiences (years)	< 5	147 (55.3)
	5– < 10	44 (16.5)
	10– < 15	26 (9.8)
	15– < 20	20 (7.5)
	≥ 20	29 (10.9)
Types of emergency code at my hospital	Color	196 (73.7)
	Plain language	25 (9.4)
	I don't know	45 (16.9)
Have joined to an education/training of emergency codes	Yes	171 (64.3)
	No	95 (35.7)
Have joined to an emergency codes activation	Yes	125 (47.0)
	No	141 (53.0)
Have read guidelines for emergency codes	Yes	131 (49.2)
	No	135 (50.8)

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