



## Major article

## Occupational exposure to infection risk and use of personal protective equipment by emergency medical personnel in the Republic of Korea

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## Key Words:

Infection control  
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Exposure  
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**Background:** Few studies of occupational exposure (OE) to infectious risk among emergency medical personnel (EMP) or their use of personal protective equipment (PPE) have been conducted in the Republic of Korea.

**Objective:** To determine the status of OE to infectious risks and use of PPE.

**Methods:** A convenience sample of 907 questionnaires (response rate, 88.5%) was collected from September 1, 2014, to January 31, 2015, in 5 metropolitan Korean cities.

**Results:** Respiratory diseases were significantly prevalent (44.5%) and influenza (29.5%) was the most frequently reported illness. An exposure report was only made in 19.5% of cases. The primary reason for OE report noncompletion was the complexity of the reporting process (23.9%). A total of 365 participants reported OE to body fluids and blood (40.2%) with needlestick injury being the most frequent OE type (17.6%). More than 5 years of job experience (47.8%) ( $P < .001$ ) and region (city) ( $P = .003$ ) significantly increased OE to body fluids and blood. Puncture-resistant containers (71.9%) and disposable gloves (68.9%) were used. Job training and education on infection risks and use of PPE were not uniformly conducted (77.5%). Anxiety about OE to risk of infection from patients was common among EMP (63.2%).

**Conclusions:** EMP experienced significant OE to infectious risk and use PPE inadequately. Surveillance and education programs regarding OE should be developed.

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Prehospital health care providers, particularly emergency medical personnel (EMP), including emergency medical technicians (EMTs) and nurses, are exposed through their occupation to bloodborne pathogens, including hepatitis B virus, hepatitis C virus, HIV, and various other infectious hazards.<sup>1,2</sup> Unlike the characteristics of occupational exposure among other hospital health care workers (HCWs),<sup>3,4</sup> EMP are exposed more frequently to respiratory diseases<sup>2</sup> and blood via skin exposure rather than percutaneous exposure such as needlestick injury.<sup>5-7</sup> Thus, standard precautions, including the adequate use of personal protective equipment (PPE), are strongly recommended for EMP.<sup>8,9</sup> Blood exposure risks are more than doubled (odds ratio, 2.4) when not using appropriate PPE.<sup>5</sup>

In the Republic of Korea (hereafter Korea), prehospital health care providers as EMPs were mainly EMTs and nurses. As providers of prehospital emergency medical services (EMS), EMTs have 2 levels of certification: basic emergency medical technician (EMT-B) and paramedic (EMT-P). There are college- or university-based education systems for EMT-P and special authorized training organizations for EMT-B accredited by the Ministry of Health and Welfare, in which individuals are required to pass both written and practical examinations for the national EMS certification. Most EMTs are stationed at fire stations as prehospital EMS providers, whereas others are often positioned in the emergency department of hospitals. The duties of EMT-P include invasive medical treatments (including endotracheal intubation, initiating intravenous access, and injecting intravenous glucose for hypoglycemic shock), administering medication (sublingual nitroglycerin and bronchodilator for asthma attack), and performing cardiopulmonary resuscitation and ventilator support. The duties of EMT-B are limited to noninvasive procedures and basic life support.<sup>10</sup>

Few studies of occupational exposure to infectious risk among EMP and prehospital HCWs providing EMS and their adherence to the use of PPE in prehospital environments have been conducted

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Statement

There is no about any presentation of the data or findings in a preliminary report or abstract.

Conflicts of Interest: None to report.

in Korea. Moreover, during the Middle East respiratory syndrome outbreak from May 20–July 28, 2015, it was reported that 2 Middle East respiratory syndrome cases were caused by occupational exposure among EMP.<sup>11</sup> EMP should be included in occupational exposure prevention systems and systematically protected from occupational infectious risks as are other HCWs.<sup>3</sup> To achieve this, the status of their occupational exposure to infectious risk and infection prevention measures should be investigated and quantified, providing basic information of the status of occupational exposures to develop effective occupational exposure prevention systems for EMP.

Therefore, this study was conducted to determine the current status of occupational exposures among EMP to infectious risks and their use of PPE in prehospital environments, and to provide basic information about the occupational exposures of EMPs for the development of occupational exposure prevention programs.

## METHODS

### Design

A survey was conducted in the 5 largest and most representative metropolitan cities in Korea (referred to as locations A–E). A self-report, anonymous questionnaire about occupational exposure to infectious risks, use of PPE, and job training was administered to EMPs. The questionnaire took approximately 15 minutes to complete. The study was approved by the Institutional Review Board at Daejeon University.

### Questionnaire

The 2-part questionnaire was developed based on literature reviews.<sup>4,6,12,13</sup> Part I consisted of 12 questions assessing participants' demographic characteristics and the general characteristics of their workplaces, a majority of which were emergency fire stations. Part II included 18 questions measuring the extent of occupational exposure to infectious risks, job training and education, the use of PPE, and their concerns and suggestions. Detailed follow-up questions were used in several categories. Specific occupational exposure information included exposure experiences, types of occupational exposure, types of infectious diseases to which they were exposed, and previous reports of occupational exposure (if occupational exposure was not reported, the reasons for this were also collected). Specific PPE use information included use of PPE as a standard precaution (ie, wearing gloves and other PPE), manipulation of needles, use of sharps containers, types of PPE used during the transfer of patients with respiratory symptoms, and types of PPE used during transfer of patients with bleeding. Specific information about job training and educational experiences within the past year was collected, including the status of their training in occupational exposure to infection risks, use of PPE, and postexposure management (PEM). Information about participants' major concerns and suggestions about occupational exposure and prevention was also collected. The questionnaire was revised to increase validity following a pilot study of expert EMPs. The final questionnaire included 30 questions.

The Cronbach's alpha value of the final questionnaire was 0.788 (Cronbach's alpha based on standardized items, 0.782), indicating a good internal consistency.

### Data collection and participants

The sample size required for a statistical power of 0.80, an effect size of 0.15, and an  $\alpha < 0.05$  was  $N = 277$ . A total of 1,025 questionnaires were mailed to prehospital EMPs working at fire stations

(questionnaire packages with cover letters were distributed with a return envelope). Participation was both voluntary and anonymous. Between the study period September 1, 2014–January 31, 2015, a total of 907 questionnaires (response rate, 88.5%) were collected via mail. Only EMPs indicating that they provide EMS as prehospital workers were enrolled in the study, excluding EMP working in hospital emergency departments.

### Statistical analyses

The Kolmogorov–Smirnov test was used to analyze data distribution and normality. Descriptive statistics and multiple response analysis were used. Categorical variables were compared using the  $\chi^2$  test. Statistical analyses were performed using SPSS version 20.0 for windows (IBM-SPSS Inc, Armonk, NY).  $P < .05$  was considered statistically significant.

## RESULTS

### General characteristics of participants (N = 907)

The average age of EMPs was  $34.8 \pm 15.0$  years. Men ( $n = 795$ ; 87.7%) were dominant in this sample. The job categories of the study population included EMTs ( $n = 646$ ; 71.3%), nurses ( $n = 60$ ; 6.6%), and nonspecified EMPs ( $n = 201$ ; 22.1%). The educational attainment among the study population was college (or university) education ( $n = 808$ ; 89.1%), followed by high school diploma ( $n = 87$ ; 9.6%) and master's degree ( $n = 12$ ; 1.3%). The median years at current workplace was  $\leq 5$  years ( $n = 551$ ; 60.7%), followed by 6–10 years ( $n = 211$ ; 23.3%) and  $\geq 11$  years ( $n = 145$ ; 16.0%). Participation according to national representation was 181 from location A (20.0%), 241 from location B (26.6%), 134 from location C (14.8%), 108 from location D (11.9%), and 243 from location E (26.8%).

### Occupational exposure to infections

Types of occupational exposure to infectious risks and management of sharps are listed in Table 1. Respiratory diseases were the most common occupational exposure (44.5%); influenza (29.5%), specifically, was the illness to which participants were most frequently exposed, followed by diarrhea, hepatitis, and HIV/AIDS. An exposure report was completed in only 19.5% of occupational exposure cases. The reasons for unreported exposure were the complexity of the process (23.9%), followed by being too busy, finding report completion annoying, and concerns regarding promotion and salary consequences.

A total of 365 participants reported occupational exposure to body fluids and blood (40.2%). Percutaneous exposures (ie, needlestick injury) were the most frequent route of exposure (17.6%), followed by mucocutaneous exposure and nonspecified. Needle and sharps manipulation were practiced by 34.9% of subjects. In particular, recapping (22.6%) and needle manipulation (10.9%) were the most frequently used procedures. Puncture-resistant containers for the disposal of needles and sharps were used by 71.9% (Table 1).

Length of experience on the job and city of employment had a statistically significant association with occupational exposure to body fluids and blood. Those with more than 5 years of job experience (170 out of 356; 47.8%) had significantly higher ( $P < .001$ ) occupational exposure to body fluids and blood than those with 5 years or less (195 out of 551; 35.4%) experience. The rate of occupational exposures to body fluids and blood were 39.8% at location A (72 out of 181), 32.8% at location B (79 out of 241), 53.7% at location C (72 out of 134), 41.7% at location D (45 out of 108), and 39.9% at location E (97 out of 243). The differences among the cities were statistically significant ( $P < .003$ ).

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