# OCCUPATIONAL RISK TOWARDS BLOOD-BORNE INFECTIONS AMONG AMBULANCE PERSONNEL IN A PROVINCIAL HOSPITAL NETWORK IN THAILAND

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**Abstract**. Health-care personnel working in an ambulance may be at risk for work-related infections, especially blood-borne infections. This cross-sectional study was conducted to assess occupational risks and their preventive practices for blood-borne infections among ambulance personnel working in a provincial hospital network. One hundred sixty-one personnel who voluntarily participated were interviewed using a structured questionnaire. The one-month history of risk exposures to blood-borne infections was collected. In order to cover the real situation of patient care practices among ambulance personnel during working, 30 ambulance runs were observed. Data from the questionnaire and field observation were analyzed and presented by descriptive statistics. The results indicated that 82% had a history of contact with jaundiced patients, and 95% had a history of contact with AIDS patients. Approximately, 63.4% had a history of contact with patients' blood through injuries; of these, 64.7% had needle stick injuries, and 24.5% had sharp injuries. Data for blood-borne preventive practices from interviews reported 82.6% wore disposable gloves when doing a blood puncture or giving intravenous fluid/blood. Only 54% broke off drug vials with a clean cloth or cotton wool to protect from an injury, in contradiction to recommended procedure. The mean score of preventive practices was 7.6±2.2; a score classified at a moderate level. However, data from field observations demonstrated only 30.3% of observed personnel (3/9) used aprons and goggles when contacting a large amount of blood, and only 11.1% (1/9) broke off drug vials with a clean cloths to protect from an injury. Continuous education and training, as well as the improvement of safety equipment are needed to better protect ambulance personnel from occupational risks.

**Keywords:** ambulance personnel, blood-borne infections, emergency medical service system, needle stick injury, occupational risks, universal precautions

## INTRODUCTION

An ambulance is an important part of an emergency medical service (EMS) system. It is designed to transport critically sick or injured people to a medical facility. Ambulance personnel must be well trained to take rapid action and provide medical care in unfamiliar and inconvenient circumstances (ACEP, 2008; Hignett *et al*, 2009). They may be at risk for some infectious diseases, because they may be exposed to droplet or air-borne, or

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body fluid or blood-borne infections from diagnosed or undiagnosed infectious patients (Rischitelli *et al*, 2001; CDC, 2003a; Speers, 2003).

A study in Botswana found that 55% of emergency nurses had exposure to AIDS patients and found that the most concern of emergency service is the risk of acquisition of blood-borne infections, such as HIV/AIDS, hepatitis B and hepatitis C (Chelenyane and Endacott, 2006). Another study in tertiary hospitals in Athens, Greece reported that the incidence of percutaneous injuries (needle stick and sharp injuries) alone, per 100 full-time employment-years, was 3.4 (Falagas *et al*, 2007). In West Algeria, a recent study reported that 81% of 108 exposures were needle stick injuries (Beghdadli *et al*, 2009). Additionally, a study in France suggested that among healthcare workers, there were 13,041 blood and body fluid exposures; 72.0% were needle stick injuries, of these, 22.6% occurred during an injection, 17.9% occurred during blood sample collection, and 16.6% occurred during surgery.

Fresh blood is the most communicable body fluid for hepatitis B, hepatitis C, and HIV/AIDS; whereas, other body fluids including saliva and vomit are lower risk modes of blood-borne transmission (Speers, 2003). Needle stick injury (NSI) from a contaminated needle is considered the highest risk compared to exposure of skin or mucous membrane (Betrami *et al*, 2000; Riddell and Sherrard, 2000; Phipps *et al*, 2002). A study in medical interns of Nepal reported that 12% of studied subjects had suffered from occupational accidents with needles (Janjua *et al*, 2007). Other studies documented that emergency service personnel received higher rate of NSIs (Rischitelli *et al*, 2001; Williams, 2004). Approximately 34%-58% of studied nurses often or always recapped needles after use, which was a common cause of NSIs among nurses (Henry *et al*, 1994; Phipps *et al*, 2002). A report from CDC suggested that the hepatitis B contraction from a significant NSI was up to 30%, 4%-10% for hepatitis C, and 0.32% for HIV (CDC, 2001).

Generally, the universal precaution (UP) practice would be useful for pre-exposure prevention of blood-borne infections (Gunson *et al*, 2003; Janjua *et al*, 2007; Dhaliwal *et al*, 2011), especially avoidance of exposure by not recapping the needles and disposing of them safely in puncture-resistance containers (Linnemann *et al*, 1991; Richard *et al*, 2001). A previous study in an Iowa Community Hospital reported that only 29%-70% of 3,223 hospital personnel avoided needle recapping, and 32%-54% washed their hands (Doebbeling *et al*, 2003). Additionally, a study in Nigeria showed that 63.8% of studied personnel regularly used personal protective equipment, and 94.6% regularly washed their hands after handling patients (Sadoh *et al*, 2006).

Considering the limited data about occupational risks among health personnel working in EMS, especially in ambulances in Thailand, this study aimed to explore occupational risks for blood-borne infections and their preventive practices among Thai ambulance personnel working in a provincial hospital network.

## MATERIALS AND METHODS

### Study design and study samples

A cross sectional study was conducted between September 2009 and March 2010 to investigate occupational risk for blood-borne infections among ambulance personnel in a northeastern provincial hospital network in Thailand. One hun-

dred sixty-one personnel (28 from a provincial hospital and 133 from community hospitals) were included. All personnel who voluntarily participated were interviewed using a structured questionnaire.

Data about socio-demographic characteristics, personal health history, and the 1-month history of occupational risk exposures to blood-borne infections were collected. A checklist of preventive practices towards blood-borne infections consisting of 10 questions (total score = 10) was used as an interview guideline. For practice scoring, if the subject personnel regularly practiced, the score for that item was equal to '1'. If the subject personnel occasionally or never practiced, the score for that item was equal to '0'. The score level of the preventive practices was classified into three levels: the first group was the high level (score >80% of total score), the second was the moderate level (score 60%-80%), and the third was the low level (score <60%). In order to cover the real situation of patient care practices among ambulance personnel during working, 30 ambulance runs were observed by the researcher.

**Ethical approval**

This study is a part of the study protocol entitled "Risk assessment towards work-related infections among ambulance personnel in a provincial hospital network", which was reviewed and approved by the ethics committee of the Faculty of Public Health, Mahidol University (Ref No. MUPH 2009-184; 2009 Oct 05).

**Data analysis**

Data from the questionnaire and field observation were analyzed and presented by descriptive statistics, including percentage, mean, and standard deviation using SPSS Statistics for Windows® version 17.0 (SPSS, Chicago, IL).

## RESULTS

Of 161 ambulance personnel in emergency medical services of a provincial hospital network, 17.4% had worked at a provincial hospital, and 82.6% had worked at community hospitals. Most of them were female (70.8%), and only 29.2% were male. Forty-six point six percent were 31-40 years of age, 44.1% were 21-30 years, and the rest were over 40 years old. The majority (81.3%) graduated with a bachelor's degree or higher, and 18.7% finished at a diploma or lower. Seventy-seven point six percent were registered nurses, and 22.4% were emergency medical technicians. Reported work experience in the emergency medical service indicated that 28% had worked more than 5 years, 34.2% had worked 3-5 years, and the rest had only worked ≤2 years (range: <1-to-23 years).

For personal health history, 92.5% had a health check-up every year, 58.4% received HBV vaccine, 6.8% smoked, and 23.0% had underlying diseases. Four point three percent had been sick with viral hepatitis, and 3.1% had been sick with TB. For blood-borne diseases and blood or body fluid exposures during the previous 1-month of work, respondents reported that 82% had a history of contact with jaundiced patients, 95% had a history of contact with AIDS patients, and 63.4% (102 personnel) had a history of contact with patients' blood through some injury. Details are shown in Table 1.

Among 102 ambulance personnel who had a history of contact with patients' blood by injury, 64.7% had needle stick injuries, 24.5% had sharp injuries, and the rest had 'others'. For which step in the procedure did an injury occur, 43.1% answered that the injury occurred while taking intra-

Table 1
Personal health history and history of blood-borne disease exposures in ambulances ($N$ = 161).

| Personal health history and history of blood-borne disease exposures | No. (%) |
|---|---|
| Personal health history | |
| Regular annual health check-up | 149 (92.5) |
| Receiving HBV vaccine | 94 (58.4) |
| Current smoking | 11 (6.8) |
| Having underlying disease | 37 (23.0) |
| Having history of illness with viral hepatitis | 7 (4.3) |
| Having history of illness with TB disease | 5 (3.1) |
| History of blood-borne disease exposures | |
| Contact with AIDS patients | 153 (95.0) |
| Contact with jaundiced patients | 132 (82.0) |
| Contact with patients' blood by injuries | 102 (63.4) |
| Clean the injured area with soap | 18 (17.7) |
| Clean the injured area with soap and wipe with 70% alcohol | 76 (74.5) |
| Clean the injured area with water | 8 (7.8) |

Table 2
Details of sharp and /or needle stick injury history ($N$ = 102).

| Sharp and/or needle stick injuries | No. (%) |
|---|---|
| Type of injuries/blood exposure | |
| Needle stick injuries | 66 (64.7) |
| Sharp injuries | 25 (24.5) |
| Other (such as splashing to eyes, mouth and nose) | 11 (10.8) |
| Steps of work when an injury occurred | |
| Taking intravenous blood or fluid | 44 (43.1) |
| Doing surgical wound | 16 (15.7) |
| Taking respiratory care and suction | 13 (12.8) |
| Throwing instrument into a container | 7 (6.9) |
| Stabbing sharp object through the container | 5 (4.9) |
| Removing instrument/equipment | 3 (2.9) |
| Cleaning equipment | 1 (1.0) |
| Other | 13 (12.7) |
| Cleaning the injured area with: | |
| Soap and 70% alcohol | 76 (74.5) |
| Soap and water | 18 (17.7) |
| Other | 8 (7.8) |

venous blood or fluid, and 15.7% occurred during treating surgical wounds. Most of them (74.5%) cleaned the injured area with soap and 70% alcohol. Details are shown in Table 2.

**Preventive practices towards blood-borne infections among studied ambulance personnel**

Data from interviews found that 95% of the respondents wore disposable gloves

Table 3
Preventive practices towards blood-borne infections among studied ambulance personnel from questionnaires ($N$ = 161).

| Activities | Regular practices No. (%) |
|---|---|
| Hand-washing before and after contacting with blood, body fluids or contaminated materials. | 136 (84.5) |
| Wearing disposable gloves when contacting with blood/body fluids or potentially infectious materials. | 153 (95.0) |
| Wearing disposable gloves when blood puncture or giving intravenous fluid / blood. | 133 (82.6) |
| Wearing sterile gloves, surgical mask when dressing wound. | 90 (55.9) |
| Wearing apron while practice activities that contact a large amount of blood and body fluids. | 128 (79.5) |
| Wearing surgical mask, goggle to protect mucous membranes of the eyes, nose and mouth during practices generating splashes or sprays of blood and body fluids, or secretions. | 116 (72.0 |
| Non-recapping needle, and throwing out in special container. | 96 (59.6) |
| Breaking-off drug vials with a clean cloth or using cotton wool to protect an injury. | 87 (54.0) |
| Blood contaminated gauze, wool and cloths are thrown in the infectious waste container. | 156 (96.9) |
| Using paper or cloth to wipe for removing mostly contaminated substances and spraying with 70% alcohol to get rid of infected waste, blood, and other secretions contaminated on ground. | 117 (72.7) |
| $\overline{X} \pm SD$ | 7.6 ± 2.2 |

Low level (<6.0) = 21.7%; moderate level (6.0-8.0) = 31.1%; high level (>8.0 scores) = 47.2%.

regularly when contacting blood/body fluids or potentially infectious materials. Approximately 84.5% regularly washed their hands before and after making contact with blood, body fluids, or contaminated materials. About 82.6% wore disposable gloves when doing blood punctures or giving intravenous fluid/blood. Only 54% broke off drug vials using a clean cloth or cotton wool as recommended to protect from injury. The mean score for preventive practices was 7.6 ± 2.2 (total score = 10); this was classified as a moderate level. Details are shown in Table 3.

Additional data from field observation among 30 ambulance runs demonstrated that 90.6% of observed personnel regularly washed their hands with antimicrobial soap before and after contact with blood, body fluids, or contaminated materials. All wore disposable gloves when contacting blood/body fluids or potentially infectious materials, and when blood puncture or giving intravenous fluid/blood. However, when contacting a large amount of blood and body fluids, only 33.3% (3/9) used an apron and goggles, and only 11.1% (1/9) broke off drug vials with a clean cloth or cotton wool to protect from injury (Table 4). During the period of observation, nine out of 30 ambulance runs (30%) the researcher

Table 4
Field observations of preventive practices towards blood-borne infections among studied ambulance personnel (30 ambulance runs).

| Activities | Practices[a] % (*n*/*N*) |
|---|---|
| Hand-washing before and after contacting with blood, body fluids or contaminated materials. | 90.6 (29/32) |
| Wearing disposable gloves when contacting with blood/body fluids or potentially infectious materials. | 100.0 (55/55) |
| Wearing disposable gloves when blood puncture or giving intravenous fluid / blood. | 100.0 (43/43) |
| Wearing sterile gloves, surgical mask when dressing wound. | 100.0 (1/1) |
| Wearing apron while practice activities that contact a large amount of blood and body fluids. | 33.3 (3/9) |
| Wearing surgical mask, goggle to protect mucous membranes of the eyes, nose and mouth during practices generating splashes or sprays of blood and body fluids, or secretions. | 42.9 (3/7) |
| Non -recapping needle, and throwing out in special container. | 81.3 (13/16) |
| Breaking-off drug vials with a clean cloth or using cotton wool to protect an injury. | 11.1 (1/9) |
| Blood contaminated gauze, wool, and cloths are thrown in the infectious waste container. | 89.1 (49/55) |
| Using paper or cloth to wipe for removing mostly contaminated substances and spraying with 70% alcohol to get rid of infected waste, blood, and other secretions contaminated on ground. | 61.8 (34/55) |

[a] One personnel possibly practiced more than once.

observed personnel exposed to a large amount of blood while caring for patients, and three ambulance runs (10%) were observed where personnel were exposed to HIV/AIDS patients. Details are shown in Table 5.

## DISCUSSION

Ambulance personnel frequently have to give medical care under life-and-death circumstances in unfamiliar and inconvenient circumstances (Hignett *et al*, 2009). They are most likely exposed to diseases spread through the respiratory system, such as meningococcal disease and tuberculosis; and blood-borne diseases, such as hepatitis B, hepatitis C, and HIV/AIDS (Speers, 2003; Mahomed *et al*, 2007). Ambulance officers and other emergency service personnel may be exposed to diagnosed or undiagnosed transmissible infectious patients with whom they contact (ACEP, 2008).

Guideline for infection control of health care personnel (1998) suggested that before personnel begin a new work assignment, health inventories including immunization status for vaccine-preventable diseases (for example, influenza, BCG, hepatitis B, chickenpox, measles, mumps, rubella) and a history of any conditions that may predispose towards acquiring or transmitting infectious diseases should be known and an

Table 5
Field observations of exposures in 30 studied ambulance runs.

| Exposures in studied ambulance runs | Occurrence [a] No. (%) |
|---|---|
| Exposure to a large amount of blood and body fluids | 9 (30.0) |
| Exposure to HIV/AIDS patients | 3 (10.0) |
| Exposure to respiratory infection patients (*eg*, TB, pneumonia) | 6 (20.0) |
| Exposure to sepsis patients | 2 (6.7) |
| Exposure to patients with accidents | 4 (13.3) |
| Exposure to patients with cardio-vascular diseases and other chronic diseases | 14 (46.6) |

[a]Some exposures occurred during the same ambulance run.

appropriate vaccine should be provided (Luksamijarulkul *et al*, 2001; ACEP, 2008; Hignett *et al*, 2009).

The present study revealed that most ambulance personnel had received appropriate immunizations, such as 84.5% had received influenza vaccine, and 58.4% had received hepatitis B vaccine. A report of Dinelli *et al* (2009) stated 94.1% of hepatitis B vaccination coverage among studied health-care personnel that were higher than this present study.

This study found that 95% of studied personnel were exposed to HIV/AIDS patients, and 82% were exposed to jaundiced patients. About 63.4% were exposed to patients' blood by injury, and of these, almost 65% had needle stick, and 24.5% had sharp injuries. For the step in the procedure when an injury occurred, 43.1% occurred during the taking of intravenous blood or fluid, 15.7% were exposed during dressing surgical wound, and 12.8% were exposed during doing respiratory care and suction.

Over 80% of the ambulance personnel in this study usually wore disposable gloves when contacting blood, body fluids, or potentially infectious materials (95%); regularly washed their hands before and after contacting with blood, body fluids or contaminated materials (84.5%); and usually wore disposable gloves when doing blood punctures, or giving intravenous fluid or blood transfusion (82.6%). However, only 59.6% usually did non-recapped needle, and 54% broke off drug vials with a clean cloth or cotton wool to protect from injury.

Data from field observation of 30 ambulance runs also supported data from the questionnaires; for example, all the observed ambulance personnel wore disposable gloves while contacting with blood or body fluids, and placement or removal of an intravenous line. However, when they had to contact a large amount of blood or body fluids, most of them rarely used aprons or goggles, and few broke off drug vials with a clean cloth or used cotton wool to protect from injury.

Many needle sticks and other cuts can be prevented by using safer techniques; for example, not recapping needles by hand, disposing of used needles in appropriate sharps-disposal containers, and using medical devices with safety features designed to prevent injuries. Using appropriate barriers, such as gloves, eye and face protection, or gowns when contact-

ing with blood are expected to prevent exposure to the eyes, nose, mouth, or skin (NIOSH, 2012). To decrease occupational risks, continuous education and training, and an improvement of safety equipment are needed to better protect ambulance personnel from blood exposure and other communicable diseases (Mahomed *et al*, 2007; Mathews *et al*, 2008). The cleaning and disinfection of all patient-care areas is important for frequently touched surfaces, especially those closest to the patient, that are most likely to be contaminated. Medical equipment and instruments/devices must be cleaned to remove organic materials, and routine surface cleaning is recommended to control the spread of pathogens in an ambulance environment (CDC, 2003b; Andersen *et al*, 2009).

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