



Review Article

Biologically Hazardous Agents at Work and Efforts to Protect Workers' Health: A Review of Recent Reports



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ABSTRACT

Because information on biological agents in the workplace is lacking, biological hazard analyses at the workplace to securely recognize the harmful factors with biological basis are desperately needed. This review concentrates on literatures published after 2010 that attempted to detect biological hazards to humans, especially workers, and the efforts to protect them against these factors. It is important to improve the current understanding of the health hazards caused by biological factors at the workplace. In addition, this review briefly describes these factors and provides some examples of their adverse health effects. It also reviews risk assessments, protection with personal protective equipment, prevention with training of workers, regulations, as well as vaccinations.

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1. Introduction

Recently, infectious diseases have been found to be most frequent among occupational diseases. Discovery of occupational infectious diseases had a lot of ripple effects in the field of occupational medicine and industrial hygiene. Occupational infections, including parasitic diseases, can limit the range of applied diagnostic and certification procedures only to diseases induced by pathogenic agents or by exposures occurring in the occupational environment [1]. In some cases, it becomes difficult or even impossible to identify the real cause of patients' complaints. Occupational biohazards are infectious agents or hazardous biological materials that exert harmful effects on workers' health, either directly thorough infection or indirectly through damage to the working environment, and it can also include medical waste or samples of a microorganism, virus, or toxin from a biological source [2].

The occupational infectious diseases are commonly found as part of a systemic infection involving the respiratory organs in immunocompromised workers. There has been a lot of discussion on biological hazards at work, their diagnosis, and treatment. Known

etiologically causes of the disease are increasing and include occupational factors [3]. Two main groups of biological agents are regarded as occupational biohazards: (1) allergenic and/or toxic agents forming bioaerosols, causing occupational diseases of the respiratory tract and skin, primarily in agricultural workers; and (2) agents causing zoonoses and other infectious diseases that could be spread by tick or insect vectors, through various exposure routes. Bioaerosols are biological particles of organic dust and/or droplets suspended in the air, such as viruses, bacteria, endotoxin, fungi, secondary metabolites of fungi, particles of feces, bodies of mites and insects, and feather, hair, feces, and urine of birds and mammals. They often induce disorders of the respiratory system or skin [4]. Bioaerosols are a main health problem in agriculture, medical or veterinary facilities, diagnostic laboratories, plants producing biofuel from rape blossoms, the metallurgical industry, libraries, and even art conservation [5].

This review discusses occupational exposure to biologically hazardous agents and various efforts to protect workers' health; we also provide brief commentaries on effective measures for the control and prevention of occupational infectious diseases through their systematic classifications.

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Table 1
First category of biological hazards at the workplace-contact with infected living animals

Occupations	Contact with infected living animals	Diseases
Animal breeder, animal caretaker, animal scientist, farmer and rancher, farmworker, laboratory animal worker, veterinarian	Handling of infected domestic animals (inhalation or percutaneous exposure)	Brucellosis, influenza, Hendra and Nipah virus diseases; leptospirosis; Q fever
Animal breeder, animal caretaker, animal scientist, laboratory animal worker, poultry farmer, poultry handler, veterinarian	Handling of infected chickens or birds	<i>Campylobacter</i> enteritis, influenza, Newcastle disease, psittacosis
Animal breeder, animal caretaker, animal scientist, farmer and rancher, farmworker, laboratory animal worker, veterinarian	Bite or scratch by infected dogs or cats	Brucellosis, cat scratch fever, <i>Capnocytophaga</i> infection, pasteurellosis, plague, rabies, tularemia
Farmer and rancher, farmworker, game warden, hunter and trapper, veterinarian, wildlife biologist	Bite by skunk, raccoon, bat, fox, other carnivore, or woodchuck	Rabies
Farmer and rancher, farmworker, game warden, hunter and trapper, veterinarian, wildlife biologist	Bite by rodents	Monkeypox, plague, rat bite fever
Farmer and rancher, farmworker, game warden, hunter and trapper, veterinarian, wildlife biologist	Handling of infected rodents (inhalation or percutaneous exposure)	Arenaviral infection, Hantavirus infection, Lassa fever, leptospirosis, LCM, monkeypox, Omsk hemorrhagic fever, plague
Laboratory animal worker, veterinarian	Handling of infected laboratory rats or mice	Hantavirus infection, LCM, rat bite fever
Laboratory animal worker, veterinarian	Handling of infected macaque monkeys	B-virus infection

Note. Haz-Map. Control of communicable diseases manual; "Occupational Infections" in Rom; "Occupational Infections" in LaDou. p. 280-1 [Internet]. 2012 [cited 2014 Mar 25]. Available from: <http://www.haz-map.com/infect.htm>. LCM, lymphocytic choriomeningitis.

2. Materials and methods

In this review, relevant articles in the fields of biological hazards, industrial hygiene, and epidemiology were found using PubMed (<http://www.ncbi.nlm.nih.gov/pubmed/>), Google Scholar (<http://scholar.google.com>), and ScienceDirect (www.sciencedirect.com). Keywords were used to locate relevant articles, and the following is an example of a typical search: biohazard AND workplace AND worker OR environment OR occupation AND health OR industry.

These searches yielded more than 150 articles, which were further reviewed for occupational content. At the end of this selection process, 83 articles were deemed relevant to this review, and they were examined with particular emphasis on three topics: biological hazards, biological hazards associated with industries, and protection of workers against biological factors or their prevention. Prospects of industries that depend on biohazards and the significance of preventive health and safety measures in these industries have also been discussed here.

3. Results

3.1. Basic concept of biological hazards at the workplace and their research trends in Korea

Work-related accidents involving biological fluids in health care workers (HCWs) are among the most frequent and most serious accidents, which can lead to the development of various diseases. Occupational exposure among these workers, more specifically among nurses, can be attributed to several direct or indirect factors, such as integral and direct care to patients, administering medication and dressing wounds, cleaning and sterilization of surgical materials and diverse instruments, excessive workload [6], and inappropriate conditions for carrying out the work process.

In Korea, two main groups of biological agents are regarded as occupational hazards: allergenic and/or toxic agents forming bio-aerosols, and agents causing zoonoses and other infectious diseases. Bioaerosols occurring in the agricultural work environments comprise bacteria, fungi, high-molecular-weight polymers produced by bacteria (endotoxin) or fungi (β -glucans), and low-molecular-weight secondary metabolites of fungi (mycotoxins and

volatile organic compounds). It also includes various particles of plant and animal origins. All these agents can cause allergic and/or immunotoxic occupational diseases of respiratory organs (airways inflammation, rhinitis, toxic pneumonitis, hypersensitivity pneumonitis, and asthma), conjunctivitis, and dermatitis in exposed workers [7]. Very important among zoonotic agents causing occupational diseases are those causing tick-borne diseases. Recently, severe fever with thrombocytopenia syndrome (SFTS) caused by Phlebovirus (SFTS virus) and Tsutsugamushi disease caused by *Orientia tsutsugamushi* [8] have become serious social problems. Among other infectious, nonzoonotic agents, bloodborne human hepatitis and immunodeficiency viruses [human immunodeficiency virus (HIV), hepatitis B virus (HBV), and hepatitis C virus (HCV)] pose the greatest hazard to HCWs. Of interest are also bacteria causing legionellosis in people occupationally exposed to droplet aerosols, mainly from warm water [9].

Occupational infectious diseases in Korea occur mostly in people associated with industries of construction, forestry, agriculture,

Table 2

Second category of biological hazards at the workplace-contact with contaminated animal products

Occupations	Contact with contaminated animal products	Diseases
Animal Breeder, animal caretaker, animal scientist, butcher, farmer and rancher, farmworker, hunter and trapper, laboratory animal worker, meat packer, slaughterer, veterinarian	Handling of infected animal carcasses or placental tissues	Anthrax, brucellosis, Crimean Congo hemorrhagic fever, glanders, Hendra and Nipah virus infection, leptospirosis, Newcastle disease, plague, psittacosis, Q fever, Rift valley fever, <i>S. suis</i> infection, tularemia
Grader and sorter, freight handler, packer	Handling of raw goat hair, wool, or hides from endemic areas	Anthrax

Note. From the webpage of Haz-map: <http://www.haz-map.com/infect.htm>. Reproduced with permission.

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