



SMU
Sikkim Manipal University



SMU Medical Journal



ISSN : 2349 – 1604 (Volume – 2, No. 2, July 2015) Review article

Indexed in SIS (USA), ASI (Germany), I2OR (India) and SJIF
(Morocco) databases
Impact Factor: 3.835 (SJIF)

Environmental Pathogens related to Human Infections

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Manuscript received: 18.04.15

Manuscript accepted: 28.05.15

Abstract

Environmental pathogens are microorganisms that normally spend a substantial part of their lifecycle outside human hosts, but when introduced to humans cause diseases. They are borne in the water, soil, air, food, and other elements of our surroundings. Their adverse effects on human health cannot be controlled without first obtaining a thorough understanding of their environmental habitats and the epidemiology of the diseases they cause. To achieve this understanding, surveillance of the environment to determine the numbers and distribution of environmental

pathogens is needed. The impacts of environmental pathogens can be felt by almost every person, So the public needs to be made better aware of their presence and risks. More study and research is needed on these environmental microbes for appropriate drug and vaccine development for the control of these infections. This review article highlights some of important environmental microbes associated with human infections.

Keywords: Environmental pathogens, fomites, biofilms, aerosols

Introduction

The world around us has a complex and dense content of microbes. The vast majority of these microbes are not capable of causing human disease, but the few microorganisms referred to as "environmental pathogens" pose significant threat to human beings. Environmental pathogens are defined as microorganisms that normally spend a substantial part of their lifecycle outside human hosts, but when introduced to humans cause disease with measurable frequency. They are borne in the water, soil, air, food, and other elements of our surroundings, and they affect almost every individual on the planet. These environmental pathogens cause disease in normal or immuno compromised humans when acquired from the above said fomites (objects on which microbes are deposited and transmitted to humans) and vectors. Environmental pathogens can infect large number of individuals from a single source. They do not rely on mode of infection by person-to-person as is the case with other pathogens.

Better information on environmental pathogens is needed to rapidly determine whether a given outbreak is the result of a natural occurrence or an intentional release (bioterrorism) and to allow public health and emergency officials to respond appropriately. For eg. *Bacillus anthracis*

Unlike pathogens that are passed by person-to-person contact or by animal-to-person contact, environmental pathogens find ways to survive, and to reproduce, in the soil, water, air, and other materials that surround us. They accomplish this by formation of spores, cysts, biofilms, etc. The mechanisms of environmental persistence of environmental pathogens are understudied and deserve

more research attention So that general public may be made aware of the environmental reservoirs and vehicles of these microbes. This is necessary for the management of complex diseases caused by these microbes by appropriate drugs and vaccine development.

Some of the important environmental pathogens associated with human diseases are discussed as follows:

1)Mycobacterium avium complex:

Mycobacterium avium complex (MAC) represent a group of opportunistic human pathogens of potential public health concern [1,2]. MAC is naturally found not only in freshwaters and humid environments but also in engineered water systems[1]. Transmission of MAC is likely to occur from the environment to mammals through inhalation of aerosols, and through ingestion of contaminated soil and water [3]. Bukh and Roslev [4] in their study showed that the public hot water systems served as reservoirs for the opportunistic pathogen MAC as they were detected in hot water and/or biofilms in all of the 9 day care centers examined. MAC can grow in water samples to which no additional nutrients have been added in temperatures ranging from 15 to 45⁰C and salinities from 0 to 2% sodium chloride [5]. DNA fingerprinting studies have shown that single unique strains of MAC can persist for up to 41 months in a water distribution system[6].

MAC hypersensitivity pneumonitis (inflammation of the alveoli within the lung caused by the body's immune response) has also been observed after inhalation of MAC contaminated aerosol, primarily from hot tubs.[7]. Sugita [8] describes a healthy family of five in Japan, suffering inflammatory subcutaneous nodules and ulcerations as a result of MAC skin infections acquired from the family spa bath.

2) Bacillus anthracis:

Bacillus anthracis, is a soil-borne, Gram positive bacterium, which primarily infects herbivores and

secondarily afflicts humans. The bacterium is able to persist in the environment for years, possibly even decades, in alkaline soils with high calcium and organic matter [9]. Human transmission is often a result of coming into contact with infected animals or contaminated animal materials during agricultural activities including the butchering of livestock or industrial exposures through the processing of hair and bone [10,11,12]. According to Christie, [13] Persons are not aware of proper disposal practices, so, anthrax-infected dead animals are frequently disposed in open fields and rivers, which can contaminate grazing land with anthrax bacilli that can sporulate rapidly on exposure to air and high temperatures. Therefore, unvaccinated animals might acquire anthrax by ingestion of spores while grazing which can further transmit the disease to humans.

3) *Campylobacter jejuni*:

Thermophilic *Campylobacter* species are one of the most frequent causes of bacterial food-borne gastrointestinal infection worldwide. [14]

The symptoms of campylobacteriosis generally entail diarrhea, fever, and abdominal pain.[15]

Ruminants constantly shed *Campylobacter* into the environment, which acts as a reservoir for human infection which occurs by ingestion of contaminated food or direct or indirect contact with ruminants or their feces [16]. The most frequent food vehicles reported in outbreaks of campylobacteriosis are raw unpasteurized milk and poultry [17].

The properties of *C. jejuni* like susceptibility to elevated temperature, osmotic stress and pH theoretically make *C. jejuni* unsuitable for survival outside the host in natural aerobic environments or in the food chain [14, 18]. In reality, however, *C. jejuni* is widely spread in the environment and can be readily isolated from food, water, and other sources [19, 20]. But *C. jejuni* overcomes these apparent disadvantages to survive in the environment and the food chain and then goes on to cause disease. Reports on research undertaken on this aspect suggest that biofilm formation may play a significant role in survival of *C. jejuni* in the environment[21]

4) Legionella species:

Legionnaires' disease is a systemic infection caused by gram-negative bacteria belonging to the genus *Legionella*. The primary clinical manifestation is pneumonia. *Legionella* spp. are typically found in natural and artificially hydrated environments. [22]

In July 1976, *Legionella pneumophila*, often found in natural aquatic systems, Somehow, had found its way into the air conditioning cooling towers at the Bellevue Stratford, enabling it to be spread as an aerosol throughout the hotel. A total of 221 hotel visitors eventually developed the same symptoms like chest pain, fever, lung congestion, and pneumonia. Influenza was ruled out. After months of investigation, the cause of the disease was found to be a common bacterium, *Legionella pneumophila*. Every year in U.S this disease kills about 5% -30% of people affected.[23]

Utilization of public facilities has increased with time, leading to increased sharing of space by a large number of randomly gathered people. *Legionella* spp., the causative organism of legionellosis, is frequently isolated from public facilities like Cooling towers, Public baths and hospitals.[24]

5) Listeria monocytogenes:

Listeria monocytogenes is a frequent causal agent of meningitis, and may cause severe septicemia, particularly in pregnant women and immunocompromised patients.[25] *L. monocytogenes* is widely distributed in nature and can be isolated from several natural sources, such as soil and vegetables as well as river, channel, estuarine, and residual waters. [26] Cows, sheep, as well as wild and domestic bird species are known reservoirs of this organism[27]. Foodborne listeriosis outbreaks have been associated with intake of contaminated cheese, meat, vegetables, and fish as well as with several dairy products, such as raw and pasteurized milk, fresh swiss cheese, chocolate milk and butter [28, 29] may be due to postprocessing cross contamination, frequently caused by improper sanitation conditions or postproduction exposure during packaging.[30] Moreover it is relatively less sensitive to pasteurization temperatures compared with vegetative forms of other microbial foodborne pathogens. It is known to survive refrigeration and dry environments [31]. It is also able

to survive in milk processing plants for up to seven years.[32].

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