

Water and Health

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Water is essential for basic survival as it constitutes up to 60% of the human adult body. However, contaminated water can spread disease and cause poisoning. Pathogens such as bacteria, viruses, and parasites can spread by water and cause communicable diseases. Most of these are considered communicable because they can spread from one person to another via contaminated water or other vectors. So water is a vehicle for spread of the pathogens and other environmental health hazards. The most common diseases are diarrheal diseases, such as cholera, typhoid, paratyphoid, salmonella, giardiasis, and cryptosporidiosis. Other environmental health hazards may be chemical and radioactive constituents of water. Indeed, some chemical substances dissolved in water as a result of natural processes may be essential ingredients of dietary intake, and some may be harmful when they exceed certain concentrations. These are metals, synthetic organics and essential elements such as fluoride, iodine and selenium. This is why the quality of the drinking water is a universal health concern, more so in developing nations.

Infectious diseases caused by pathogenic bacteria, viruses and parasites are the most common and widespread health risk associated with drinking water. The elimination of all these agents from drinking water has to be a high priority. The provision of a safe supply of drinking water depends upon use of either a protected high-quality ground water, surface water, or a properly selected and operated series of treatments capable to reduce pathogens and other contaminants to the negligible health risk [1]. These diseases are usually classified according to the nature of the pathogen. However, a more useful way of classifying these diseases is according to the various aspects of the environment that human intervention can alter [2].

The suggested classification is the following:

1) Waterborne diseases arise from the contamination of water by human or animal feces or urine infected by pathogenic viruses or bacteria, which are directly transmitted when the water is drunk or used in the preparation of food. Examples are cholera, typhoid, and cryptosporidiosis.

2) Water-privation diseases are a category that is affected more by the quantity of water rather than by quality. These diseases spread through direct contact with infected people or materials contaminated with the infectious agent. Infrequent washing and inadequate personal hygiene are the main factors in these types of diseases, such as certain types of diarrheal diseases, helminthes, and skin and eye infections.

3) Water-based diseases are a category for which water provides the habitat for intermediate host organisms in which some parasites pass part of their life cycle. These are later the cause of disease in people as their infective larval forms in fresh water find their way back to humans, either by boring through wet skin or by being ingested with water plants, minute water crustacea, or raw or inadequately cooked fish. Schistosomiasis is an example of a water-based disease.

4) Water-related diseases are a category for which water may provide a habitat for insect vectors of water-related diseases. Mosquitoes breed in water and the adult mosquitoes may transmit parasite diseases,

such as malaria, and virus infections, such as dengue, yellow fever, and Japanese encephalitis.

5) Water-dispersed infections are the fifth category of diseases associated with water that is emerging in developed countries - infections whose pathogens can proliferate in freshwater and enter the body through the respiratory tract. Some freshwater amoebae that are not usually pathogenic can proliferate in warm water, and if they enter the host in large numbers, they can invade the body along the olfactory tracts and cause fatal meningitis. These bacteria can be dispersed as aerosols from air-conditioning systems; an example of this type of disease is Legionella.

The chemical substances and constituents of drinking water are classified by UNEP (United Nations Environment Program) GEMS (Global Environment Monitoring System) [3] into three categories which are the following:

1) Substances (various metals, nitrates, cyanides) that exert an acute and/or chronic toxicity when consumed. As the concentration of these substances in the drinking water increases, so does the severity of the health problem; below a certain threshold concentration, however, there are no observable health effects.

2) Genotoxic substances (synthetic organics, many chlorinated micro organics, some pesticides, and arsenic) that cause adverse health effects such as carcinogenicity, mutagenicity, and birth defects. There is no threshold level for these substances that would be considered safe, since any amount ingested contributes to an increase in risk.

3) Essential elements (fluoride, iodine, selenium) that are a mandatory part of dietary intake to sustain human health. Deficiencies or high concentrations of these elements cause a variety of adverse health effects [4].

Some chemicals present in water are of particular importance with regard to their effect on human health. These include arsenic, fluoride, iodine, and nitrates [2] that are briefly described as follows:

1) Arsenic is naturally present in all lead, copper, and gold ores. Several geographical areas in Asia, North America, and Latin America were affected by arsenic-associated health conditions including dermatological effects that were the first manifestation of groundwater enrichment of arsenic. At chronic poisoning levels, various effects are observed, such as vascular disease, liver disease, skin lesions, skin cancer, and neurological disorders.

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2) Fluoride is naturally present in some foods as well as in water, but for most part, it is the amount provided by drinking water that determines the daily intake. Since fluoride is an important component in bone and tooth structure, it is considered an essential element. It is also a toxic chemical. Only a relatively narrow range of fluoride concentrations in drinking water provides optimal conditions. Too-low levels of fluoride increase the incidence of dental caries whereas elevated levels cause mottling of the teeth as well as skeletal fluorosis. Fluoride is added to drinking water in some countries in improve dental health.

3) Iodine has water as one of its main sources of dietary intake. In areas where there is very low concentration of groundwater iodine, resident populations suffer from iodine deficiencies resulting in an enlargement of the thyroid gland (goiter) and, in sever cases, mental retardation and cretinism.

4) Nitrates that result from the excessive and widespread application of nitrogenous fertilizers and manure spraying are the main sources of elevated nitrate concentrations in groundwater. High levels of nitrates in drinking water are of concern because they may lead to serious, even fatal consequences in infants below 6 months of age. Nitrates are reduced to nitrites and, one absorbed, combine with hemoglobin to form methaemoglobin, which is unable to bind with oxygen and therefore transport it from the lungs to the tissues [4].

According to the World Health Organization (WHO) and the U.S. Centers for Disease Control and Prevention (CDC), nearly 2.4 billion people in the world do not have access to clean water or waste management facilities [5]. This figure represents almost 40% of the Earth's population. This lack of access to clean drinking water may expose people to numerous infectious, possibly life-threatening, diseases. Despite global efforts to improve sanitation, some developing countries do not follow safe personal hygiene techniques due to a lack of knowledge of personal hygiene principles or lack of proper resources.

In the past, governments, communities, and outreach organizations have focused solely on water access, without consideration of the waste/water interrelationship of many communicable diseases [5]. CDC defines personal hygiene as a population having facilities for the safe disposal of human feces and urine, and the ability to maintain personal cleanliness by such techniques as hand washing and bathing. WHO's objectives for safe water include: preventing fecal contamination of drinking water, treating water with an appropriate method to reduce or remove existing contaminants, and maintaining safe storage and handling of drinking water.

WHO estimated that every 8 seconds a child died from a water-related disease and that each year 5,000,000 people died from illnesses linked to unsafe drinking water or inadequate sanitation [6]. Water-related diseases outbreaks are due to bacterial, viral, and parasitic microorganisms associated with the consumption of untreated or improperly treated drinking water.

Organizations such as UNICEF, CDC and WHO have added a focus on personal hygiene behavior to their water and sanitation efforts for both residents and travelers [5]. Epidemiologists agree that hand washing is the primary action used to prevent fecal-oral transmission of numerous diseases and parasites. Hands should be washed before preparing or consuming food or drinks. They should also be washed after defecating or urinating; changing diapers or bathing a child; assisting anyone who is ill; handling uncooked meat, poultry, or fish; coughing, sneezing, or blowing the nose; handling an animal or its waste; or handling any object touched by flood water or sewage. The hands should also be washed before and after dressing a wound. To

properly cleanse the hands with water, wet the hands with clean water; rub the hands together for at least 20 seconds with soap; include the wrists, fingers, back of hands, and under the fingernails in the process.

Groundwater contamination is nearly always the result of human activity [7]. In areas where population density is high and human use of the land is intensive, ground water is especially vulnerable. Virtually any activity whereby chemicals or wastes may be released to the environment, either intentionally or accidentally, has the potential to pollute ground water. When ground water becomes contaminated, it is difficult and expensive to clean up. Ground water can become contaminated from natural sources or numerous types of human activities. Residential, municipal, commercial, industrial and agricultural activities can all affect ground water quality. Contaminants may reach ground water from activities on the land surface, such as releases or spills from stored industrial wastes; from sources below the land surface but above the water table, such as septic systems or leaking underground petroleum storage systems; from structures beneath the water table, such as wells; or from contaminated recharge water. Some substances found naturally in rocks or soils, such as iron, manganese, arsenic, chlorides, fluorides, sulfates, or radionuclides, can become dissolved in ground water. Other naturally occurring substances, such as decaying organic matter, can move in ground water as particles. Whether any of these substances appears in ground water depends on local conditions. Some substances may pose a health threat if consumed in excessive quantities; others may produce an undesirable odor, taste, or color. Ground water that contains unacceptable concentrations of these substances are not used for drinking water or other domestic water uses unless it is treated to remove these contaminants.

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