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THE INFLUENCE OF DRINKING WATER QUALITY ON POPULATION HEALTH IN THE MOLDAVIAN AREA

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Abstract. This paper is beginning by describing the main water related diseases that affect people all over the world. The illnesses are divided into two main categories: infectious and non-contagious. Water related diseases that affect the Moldavian population from rural areas are mostly non-contagious and are related to the contamination of water wells with nitrates. So this paper will treat in detail methemoglobinemia's causes, symptoms, vulnerable people and the zones from Moldavian area that are mostly affected by this disease. Because the most efficient way to prevent the apparition of methemoglobinemia is to supply the population with water from the centralized water supply systems, the status of water distribution infrastructure from the mentioned area will be analyzed.

Introduction

Clean and sufficient water is essential to health protection and improvement. In order to evaluate the quality of water supply services the following parameters must be taken into consideration: quality, quantity, accessibility, affordability and continuity (WHO, 2011).

This *paper* analyses a variety of factors that can alter the quality of drinking water, the main water-related diseases, and the status of water-related illnesses occurring in the Moldavian area. Also, we will discuss some possible solutions to prevent the health problems caused by contaminated water from the wells situated in the mentioned area.

Contaminated water *exposes human health at numerous risks. There are many* water related diseases. *Most of the diseases arise because of the lack of clean water for drinking and preparing food. Others are caused by inadequate sanitation facilities and poor personal hygiene practices. Access to clean drinking water and sanitation facilities is still limited in many parts of the world.*

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According to WHO, 2011, safe drinking water "does not represent any significant risk to health over a lifetime of consumption". Every year, diseases from unsafe water and lack of basic sanitation kill at least 1.6 million children under the age of five (WHO and UNICEF, 2006).

Water related diseases can be divided in two main categories: infectious diseases and non-contagious diseases, which will be detailed into the further sections.

1. Water-related infectious diseases

Many of the diseases related to water can be infectious. These illnesses can be caused by parasites, bacteria, mites, worms found in water, and insects that live near water. There are the five main types of water-related infectious diseases (MDH, 2012): water-borne, water-washed, water-based, water-related insect vector and diseases caused by defective sanitation.

Common **water-borne diseases** include cholera, typhoid, dysentery and hepatitis. These illnesses result when human and animal wastes enter and contaminate water supplies. Many of these are diarrheal diseases. These intestinal disorders are caused by Cryptosporidium and Giardia, microscopic parasites which live in water. In addition to severe diarrhea, they may also cause cramps, fever, nausea, and dehydration. These diseases can lead to the death of people who are already sick or of children and elderly who may have compromised immune systems.

Approximately one in five child deaths is caused by diarrhea. This disease kills more children than AIDS, malaria and measles combined. It has been estimated that 88 per cent of diarrheal deaths worldwide are due to unsafe water, inadequate sanitation and poor hygiene (UNICEF and WHO, 2009).

Water-washed diseases are caused by poor personal hygiene resulting from inadequate water availability. These may be prevented if people have adequate supplies of clean water available for personal hygiene. Typical water-washed diseases include Shigella, which causes dysentery, scabies, trachoma, yaws, leprosy, conjunctivitis, skin infections and ulcers.

Water-based diseases are transmitted by aquatic organisms, such as worms. They may penetrate the skin if unclean water is used for cleaning or bathing. Guinea worms may enter the body through contaminated drinking water.

Schistosomiasis is the world's most destructive parasitic infection. It is caused by several species of flatworms, which can penetrate human skin to enter the body and lay eggs. It can be passed through infected human waste.

Water-related insect vector **diseases** are spread by carrier insects like mosquitoes and black flies, which breed in or near stagnant water. Water-related

insect vector diseases include malaria, filariasis, yellow fever, and river blindness.

Diseases caused by defective sanitation, like hookworm, may be contracted by contact with contaminated soil, which is polluted by human feces in locales where no proper means of waste disposal exist. Hookworm larvae exist in soil and penetrate human skin to make their way into the small intestine.

2.Water-related non-contagious diseases

There are also some n*on-contagious diseases that can cause serious health problems. These occur if elements like nitrates and lead exceed a certain value.*

Nitrate *(NO_3) is very water soluble, and is not retained in the soil. Plants use nitrate ions to make protein, but sometimes rain or irrigation water can leach them into the groundwater. Nitrate is one of the most common groundwater contaminants in rural areas (Farrell-Poe et al., 2010). The most common sources of nitrate are: fertilizers, animal feedlots, municipal wastewater and sludge, septic systems and nitrogen fixation from atmosphere by legumes, bacteria and lightning.*

Healthy adults can consume large amounts of nitrate with few health effects. But, prolonged intakes of high levels of nitrate can lead to gastric problems due to the formations of nitrosamines.

Too much nitrate in drinking water poses a risk to infants less than six months. If an infant is exposed to water that is high in nitrate, he can get sick of methemoglobinemia ("blue baby syndrome"). Bacteria which are present in an infant's stomach can convert nitrate to nitrite, which can interfere with the ability of the blood to transport oxygen. As the illness advances, the baby's skin turns a bluish color, especially around the eyes and mouth. This condition can lead to the infant's death. Pregnant and lactating women, people with glucose-6-phosphate dehydrogenase deficiency, and those with special blood disorders or with reduced stomach acidity may also be exposed to nitrate-induced methemoglobinemia.

To secure the microbial safety of drinking water supplies, must be used multiple barriers from catchment to consumers. Some examples of barriers are: protection of water resources, suitable selection and operation of treatment steps and management of distribution system. It is a better option to prevent or to reduce the pollution of water sources and to use fewer treatment steps to correct the water quality parameters than to rely on a water treatment plant with more treatment stages (WHO, 2011).

3. Water related diseases in the moldavian zone

Most of the wells located on the Romanian territory that had been monitored by the Departments of Public Health during 2010 had exceeded the admissible

values of the nutrients. One of the river basins in which the highest concentrations of nitrates were registered is Siret (ANPM, 2010).

The water from the wells situated in the Moldavian rural areas is being constantly polluted with nitrates because the wells are poorly maintained and are placed near contamination zones, and due to the use of natural and nitrogenous fertilizers (Vasilov and Bustuc, 2000). A very important source of water pollution is the wastewater discharged by domestic residences, industry, commercial properties, and agriculture. To prevent the contamination of surface and groundwater, the wastewater should be collected by sewage systems and purified by a wastewater treatment plant.

Many of the people living on the Moldavian area drink water from wells, especially those living in the rural zones. Most of the underground water sources are contaminated with nitrates.

Press reports numerous cases of "blue baby syndrome" caused by the high level of nitrates present in the water from wells.

In table no. 1 is presented the evolution of methemoglobinemia cases from the Moldavian area during 2005-2010. Iasi and Vaslui Counties registered the most numerous cases of "blue baby syndrome" during 2010 (ANPMI, 2010). During 2009 Iasi County registered the highest number of cases from Romania (INSP, 2009).

Tab. 1 - Methemoglobinemia cases from the Moldavian area, during 2005-2010

County	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Iasi	42	28	19	6	31	20
Botosani	21	1	-	7	8	8
Bacau	31	-	-	16	8	7
Vaslui	14	15	5	-	5	12
Neamt	7	16	6	1	12	3
Others	9	-	-	4	-	-
Total	**124**	**60**	**30**	**34**	**64**	**50**

source: ANPMI, 2010

The most vulnerable age interval is between 0-3 months, more than half of the infected babies are boys and most of them are fed with formula or breast and formula. 60 % of the cases were exposed to nitrate concentrations over 100 mg/l (Popescu and Friptuleac, 2010; Tudor, 2007; Vasilov et al., 2001). In some cases the nitrate concentration from the water used to prepare the food was lower than

the maximum admissible of 50 mg/l, with values of 48.5 and 48.9 mg/l (Dăscălița, 2010). 70 % of the infected people drank water from wells without sanitary protection and in more than 50 % of the cases the wells were less than 10 m long (Tudor, 2007).

To prevent the diseases caused by contaminated water it is necessary to supply the population with drinking water from a centralized water supply system and/or to inform them about the danger that they are exposing to when they drink water from a contaminated well. People that build wells should avoid the zones situated near stables or latrines, and should ensure their sanitary protection. Also people should be informed about the importance of breast feeding and of the risks that babies are exposed when they are fed with formula made with water from contaminated wells.

5. Water supply and sanitation systems in the moldavian area

The main way to ensure the protection of people's health is to supply them with drinking water from centralized water supply systems and to collect and treat the wastewater through centralized sewage systems.

Tab. 2 – Lengths of water distribution networks from Moldavian area

Year	Iasi County(km)	Bacau County (km)	Galati County (km)	Neamt County (km)	Suceava County (km)	Vaslui County (km)	Vrancea County (km)
2009	1433.89	no data	no data	646.64	no data	785	1389.3
2008	1269.30	1501.90	1556.9	420.137	952.2	871.4	1172.3
2007	1071.99	1335.10	1355	414.977	907.2	425.9	830
2006	1035.66	1194.40	1263.5	no data	834.7	411.2	no data
2005	932.32	1055.60	1138.9	no data	813.3	404.1	no data

Over the last few years the number of villages supplied with drinking water has significantly grown. For example, in Iasi County, the number of connected villages has increased from 51 in 2005 to 158 in 2008, in Bacau County from 67 villages in 2005 to 76 in 2008, in Neamt County from 28 villages in 2007 to 36 villages in 2009, in Vaslui County from 9 villages in 2005 to 52 villages in 2009, in Vrancea from 46 villages in 2007 to 50 villages in 2009, in Galati County the number of villages connected to system has been relatively constant, but the number of people connected has grown from 49.12 % in 2005 to 54.75 % in 2009.

The analyzed data shows that in the last few years have been made significant improvements on the water supply infrastructure and service. In Iasi County, year 2000, the distribution network was 832.9 km long, and by 2009 it has grown to 1433.89 km long (table no. 2). Also, from only 16 villages supplied in 2000, 158 villages were being supplied in 2009. In 2011, 342.840 out of 814000 inhabitants were connected to the water network (Toma, 2011).

In order to meet the statements of 200/60/EC Directive, during the last few years, all the water service operators from the Moldavian area have been making considerable efforts to rehabilitate, modernize, and expand the water supply infrastructure. There are still many villages without connections to centralized water supply systems. For example, in Botosani County only 30% of the population is connected to water supply systems.

"County strategy for accelerating the development of public utilities services of Iasi" for 2010 states that “in 72 out of 93 villages the nitrate level measured in public wells is above the legal limits. In order to conform to the water supply regulations, all these villages must have adequate water supply systems by 2015”. Thus, it is required that the regional water supply system of Iasi County to be extended.

Few Romanian villages have a sewage system and fewer possess a wastewater treatment plant. This is one of the reasons why many surface and underground water sources from the Romanian territory are polluted. The situation on Moldavian area makes no exception from the lack of wastewater collection and treatment. For example in 2009, in Iasi County only 17 villages were connected to a sewage system, in Bacau County 56 villages, in Neamt County only 7 villages, in Suceava County 34 villages and in Vrancea County only 9 villages. In Botosani County only 24 % of people are connected to a sewage system.

In order to reduce the number of illness cases caused by contaminated water and by the lack of sanitary facilities, water supply and sanitary systems must be built, rehabilitated and extended.

Conclusions

To comply with regulations on water supply, all villages where the nitrate level measured in public wells is above the legal limits must build water supply systems by 2015.

The Iasi County has the highest number of methemoglobinemia cases in Romania.

Water supply and sanitation systems must be built and extended, in order to protect the population’s health.

In several cases children got sick of the “blue baby syndrome”, though the nitrate concentration from the water used to prepare the food was lower than the

maximum admissible of 50 mg/l.

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