Arsenic Poisoning and Risk Substitution:

Contamination in Public Water Sources of Bangladesh

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In 1993, a mass breakout of water supplies tainted with the element arsenic was discovered in Bangladesh. Many health risks are prevalent in populations affected by the water contamination, in the form of cutaneous manifestations. The correction of the microorganism issue that preceded the arsenic issue failed to take into account the risk substitution, or the potential risks involved in the solution of the issue, which led to the outbreak of arsenic poisoning. The calculated health risk substitutions are essential for the development of solutions to world health crises, to prevent the introduction of greater risks.

Arsenic contamination of public water supplies is currently a major health concern in the nation of Bangladesh. It is estimated that between 33 and 77 million people living in Bangladesh are at risk of drinking contaminated water. Ground water and dug wells that are used for drinking water obtain unhealthy concentrations of arsenic naturally via arsenic-rich sediments. Historically, surface water in Bangladesh has been known to be contaminated with microorganisms, which caused a steep rate of disease and mortality. To prevent the drinking of this surface water, a large number of tube wells were dug to provide the citizens of Bangladesh with clean well water. While tube wells had been used well before this time, it is believed that the increase in tube wells has contributed to the arsenic contamination dilemma. The National Institute of Preventative and Social Medicine in Dhaka took measurements of water quality from these tube wells and found that over half of the measurements returned concentrations of 50 µg of arsenic per liter of water, well over the maximum level of 10 µg/L recommended by the World Health Organization (WHO). The increase of people drawing water from the tube wells is believed to be the cause of the increase of arsenic concentrations in the ground water, leading to the outbreak of arsenic poisoning (Smith, Lingas, & Rahman, 2000).

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Many health risks are associated with arsenic poisoning. Arsenicosis is the most common health risk associated with arsenic poisoning. Arsenicosis is characterized by cutaneous manifestations, such as melanosis, keratosis, and cutaneous cancers. Skin lesions are another common symptom of Arsenicosis, and tend to be one of the earliest manifestations of Arsenicosis (Das & Sangupta, 2008). Arsenicosis is classified as a chronic disease with a large latency period between contraction and appearance of symptoms. A slight discrepancy in the actual time of the latency period has developed, with some reports of two years being the minimum latency period and others suggesting five years (Howard, 2003). One of the major issues of Arsenicosis is its ability to induce carcinogenesis after the exposure to arsenic has ended. The high risk of cutaneous cancers leads to a high mortality risk associated with Arsenicosis (Das & Sangupta, 2008). It is estimated that of the 1.5 million people occupying West Bengal, 200,000 are afflicted with Arsenicosis. The high risk of Arsenicosis from exposure to arsenic-tainted water supplies is a reason for concern in this public health emergency (Smith, Lingas, and Rahman, 2000).

One of the major points of concern that was raised by the issue of arsenic poisoning was that of risk substitution. In the case of Bangladesh, the tube wells that were dug replaced the health issues of diarrheal disease caused by microorganisms with the issue of arsenic contamination and Arsenicosis. When the tube well solution was formed, there was no prediction of risk substitution, and there was not an adequate amount of evidence to evaluate the probability or nature of the risk substitution that occurred. This incident provided a good lesson to public health organizations on the importance of risk calculation. In the development to a solution to the arsenic contamination emergency, it is essential that risk substitution must

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be taken into account and that a risk substitution evaluation be accurately completed for a proposed solution. With the increase of scientific knowledge available concerning various risks, an accurate risk substitution evaluation is both practical and urgent. Various hazards must be taken into consideration when formulating a solution. Three principle types of hazards are associated with water sanitation: toxins derived from cyanobacteria, microbial and pathogen hazards, and chemical hazards. Microbial and pathogen toxins represent a much greater health risk overall than chemical hazards, and it is assumed that no safe threshold exists for microbial toxins. These risks were not considered in the development of the tube well solution, but they must be taken into account when comparing the risk substitution of a possible solution to the arsenic emergency. The level of uncertainty involving the epidemiology of the health risks associated with arsenic exposure, and the progression of Arsenicosis make a quantitative risk comparison difficult. Qualitative comparisons prove to be much more manageable in formation and are vital to the formation of a solution. There are many important points to address in a qualitative risk substitution assessment. The nature of the health risks (chronic, acute, etc.), the knowledge available for treatment, and the medical resources available are examples. While developing solutions to the arsenic crisis, it is important to consider the risks attached to a solution, as well as comparing the new risks to the current risks, to avoid creating a different emergency with greater health risks (Howard, 2003).

The situation in Bangladesh is one that clearly shows the need for safe water and the importance of risk management in delivering water. While the tube well solution provided a reprieve from the risk of microorganism infection in Bangladesh, the failure to properly evaluate the health risk substitution led to the current crisis of arsenic exposure and

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Arsenicosis. Proposed solutions must take into consideration qualitative risk substitutions, such as the nature of possible new risks and resources available to treat new health risks. Failure to properly calculate a risk assessment may lead to a solution that further increases health risks, or introduce new risks that are worse.

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