

## Chronic Arsenic Toxicity in Bangladesh- The Challenges, Manifestations and how to Overcome it

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### Abstract

Ground water is the main and most important source of water supply in Bangladesh. But the water has been contaminated by arsenic and has become a public health hazards in our country. About 35-70 million people in 61 out of 64 districts of Bangladesh are consuming arsenic contaminated water and are prone to develop health hazards due to chronic arsenicosis. Chronic exposure to arsenic may cause wide range of carcinogenic & non-carcinogenic health effects. So far there is no specific management for chronic arsenic toxicity, though the magnitude of the disease is potentially toxic & fatal. If effective treatments are not provided to those sufferers, it will bring a negative impact in our country as far as economical growth is concerned. Government and its existing resources alone will not be able to meet the challenges due to arsenic toxicity.

The challenges are as under: a) creation of mass awareness about the danger of drinking arsenic contaminated water and to provide arsenic free, bacteriologically and chemically safe alternative source of drinking water to the vast number of the population of the country at risk of developing arsenicosis, b) diagnosing all arsenicosis patients and provide effective management of their condition.

The probable & suitable solutions of chronic arsenic toxicity have been explored. Recommended steps include rain water harvesting, treatment of surface water, proven safe and sustainable technologies implemented under and piped water supply. Besides for further improvement of diagnosis and management of chronic arsenicosis, following steps are needed- establishing and updating an arsenicosis patients data base for early identification of the arse-

nosis patients and establishing an easy and effective referral system so that arsenicosis patients are screened at rural level can be transferred to appropriate centre. Since existing resources of our country cannot fight against these environmental hazards, without the involvement of private sectors and international donor agencies all efforts will be un-sustainable.

**Key-words:** Chronic arsenic toxicity, challenges, management.

### Introduction

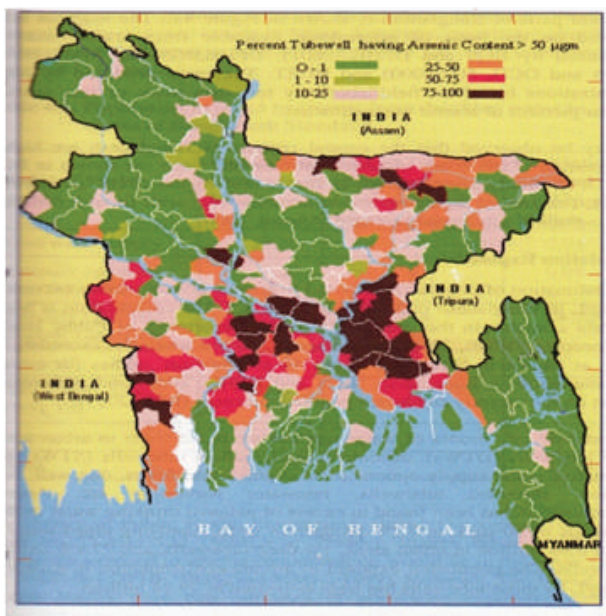
Arsenic contamination of drinking water is a public health hazard in Bangladesh<sup>1</sup>. Approximately one-third of the shallow tube wells in Bangladesh contain arsenic more than 10µg/L, the recommended level of arsenic in drinking water by the WHO<sup>2</sup>. About 35-70 million people of 61 out of 64 districts in Bangladesh are at risk of this poisoning. Chronic exposure to arsenic has the potentials to cause wide range of carcinogenic and non- carcinogenic health effects such as cancer of the skin and internal organs, hypertension and respiratory distress etc<sup>3,4</sup>.

Despite the magnitude of potentially fatal toxicity, there is no effective treatment for the disease so far. Though specific treatment for chronic arsenic toxicity has not yet been fully established, supportive and symptomatic treatment of the patients could help in reducing many sufferings of the patients. If effective, satisfactory and curative treatments are not provided to those patients, it will bring a negative impact in our economy due to incapable of doing hard work. Active participation of our population and combined effort of all concerned will be able save our country from the evil impact of arsenic contamination which is life saving demand of our future generation.

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**Chronic Arsenic Toxicity (Arsenicosis):**

Arsenicosis is defined as a chronic health condition arising from prolonged ingestion of arsenic above the safe dose for at least six months, usually manifested by characteristic skin lesions of melanosis and keratosis occurring alone or in combination with or without the involvement of internal organs<sup>5</sup>. Arsenic toxicity results from absorption of trivalent and pentavalent inorganic arsenic. Chronic arsenic toxicity produces various skin and systemic manifestations including cancer.



**Fig-1:** Showing intensity of arsenic contaminated (>50µg/L) tube wells in Bangladesh.

**Skin manifestations of Chronic Arsenic Toxicity:**

Pigmentation and keratosis are the specific skin lesions characteristic of chronic arsenic toxicity. The Pigmentation of chronic arsenic toxicity commonly appears as a finely freckled “raindrop” pattern that is particularly pronounced on the trunk and extremities symmetrically distributed bilaterally. Pigmentation may also involve mucous membrane such as under surface of tongue or buccal mucosa. Diffuse hypo-pigmentation, localized patchy pigmentation and leukomelanosis in which the hypo-pigmented macules take a spotty white appearance<sup>5</sup>.

**Systemic manifestations of Chronic Arsenic Toxicity:**

The most common systemic manifestations include neurological, haematological gastrointestinal and respiratory complications. Few effects in different organs and systems are as follows:



**Fig-2:** Showing leukomelanosis of an arsenicosis patient.



**Fig-3:** Showing diffuse keratosis on both soles of an arsenicosis patient.

a) Diseases of nervous system: There are many reports on occurrence of peripheral neuropathy due to chronic exposure of arsenic through drinking water<sup>6</sup>. Irritability, lack of concentration, depression, sleep disorders, headache and vertigo in arsenicosis patient showing features of neuropathy in west Bengal were reported<sup>7</sup>.

b) Haematological effects: Haematological abnormalities have been reported in acute & chronic arsenic poisoning. A characteristic pattern of anaemia, leucopenia and thrombocytopenia was found in a study<sup>8</sup>.

c) Gastrointestinal diseases: It is reported that symptom like nausea, diarrhea, anorexia and abdominal pain is found in cases of chronic arsenic toxicity<sup>9</sup>.

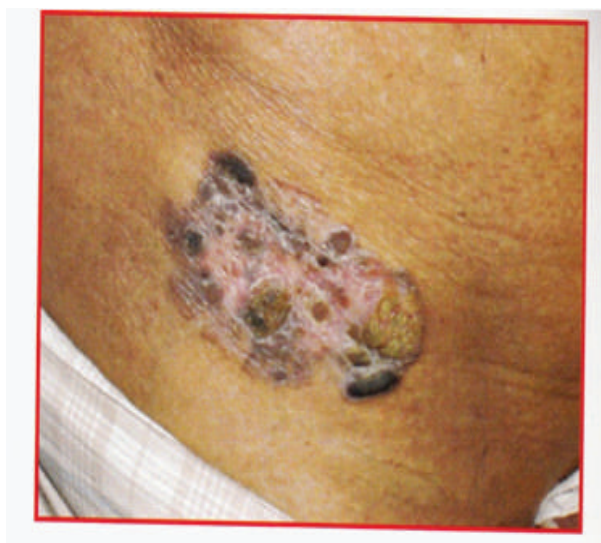
d) Respiratory disease: Respiratory complications include in the form of chronic cough or chronic bronchitis and reduced bronchial function.

e) Cardiovascular diseases: Various study reported an increased prevalence of hypertension, increased incidence of cardiovascular disease including IHD<sup>9</sup>.

f) Metabolic disorder: Study in Taiwan found prevalence of diabetes mellitus among the population consuming arsenic contaminated drinking water<sup>13,14</sup>.

g) Pregnancy outcome: A study of pregnancy outcome and infant mortality was carried out in west Bengal. The study adds to limited evidence of exposure to high concentration of arsenic during pregnancy increases the risk of still birth. However, there was no indication of increased rates of spontaneous abortion and over all infant mortality<sup>9</sup>.

h) Malignancy: It was observed that arsenic was potentially carcinogenic for skin cancer. Bowen's disease, basal cell carcinoma or squamous cell carcinomas are most common type of malignant lesions. There is also evidence of liver, kidney, prostate, urinary bladder cancer through epidemiological studies in several countries.



**Fig-4:** Showing bowen's disease-- a skin malignancy.

#### **Management of chronic arsenic toxicity:**

A total of 56758 patients of arsenicosis have been detected by the DGHS office in Bangladesh<sup>10</sup>. There is no specific, effective and satisfactory drug treatment for arsenicosis. The recognized chelating agents' e.g DMPA, DMSA are toxic, costly and above all not recommended by the experts. Public and private sectors have made considerable progress towards management of the patients to some extends, it is anticipated a significant number of problems and issues are still out of appropriate attention<sup>11</sup>. Presently, the management of arsenicosis focuses on five key approaches which are far from complete<sup>5</sup>.

a). Cessation of exposure to drinking water or other items with elevated concentration of arsenic. Some of the main strategies for safe drinking water include:

i) Treatment of surface water- It includes slow sand filter or pond sand filter, conventional surface water treatment plants etc in the areas with adequate and good quality surface water.

ii) Rainwater harvesting has good potential in most parts where there is rainfall.

iii) Deep tube well- Dugging of deep tube well can provide water of acceptable quality which must be monitored for arsenic.

iv) Treatment of arsenic contaminated water- A variety of options is available depending on technologies and cost.

b). Administration of drug or nutritional supplements – Nutrients and anti-oxidants directed at hastening recovery or averting disease has been under taken. Commonly used anti-oxidants include beta carotene, Vit –E, and Vit –C.

c). Provision of non-specific supportive care to improve physical symptoms or treat selected complications-Keratolytic agents e.g 5-10% salicylic acid, 10-20% urea based ointment are used for the treatment of keratolytic lesions.

d). Secondary prevention of latent effects through medical surveillance-The management of arsenic associated cancer patients are dealt with existing national standard policy through medical surveillance.

e). Counseling and education to address psychosocial sequel of the illness and provision of appropriate rehabilitation. Programs should be implemented on educating patients and other community members so that misconception, false belief which leads to stigmatization, family disruption and social hardship are dispelled.

***The challenges of chronic arsenic toxicity:***

The main challenges are-

a) creation of mass awareness about the danger of drinking arsenic contaminated water and to provide arsenic free, bacteriologically and chemically safe alternative source of drinking water to the vast number of the population of the country at risk of developing arsenicosis.

b) Diagnosing all arsenicosis patients and provide effective management of their condition.

c) Looking into some hydro-geological issues being urgent in nature<sup>12</sup>.

***Recommended steps for the challenges of chronic arsenic toxicity:***

a).The following options are recommended for the provision of safe drinking water to the affected population in Bangladesh<sup>12</sup>.

**1) Short term options:**

The possible technological options are given below-

\* Dugging of deep tube well (where suitable aquifers are available).

\* Rain water harvesting

\* Treatment of surface water (where surface waters of good quality and adequate quality are available).

\* Treatment of arsenic contaminated water. Short-term options are to be provided under arsenic mitigation program areas where > than 40% tube wells are contaminated.

**2) Long term options:**

\* Proven safe and sustainable technologies implemented under short term options.

\* Piped water supply

b) For further improvement of diagnosis and management of chronic arsenicosis, following steps should be undertaken:-

\* Establish and update an arsenicosis patient's data base for early identification of the arsenicosis patients.

\* Establish an easy & effective referral system so that arsenicosis patients are screened at rural level can be transferred to appropriate centre. Multi disciplinary support services can be given to the patients of different corner of the country by setting up arsenic centre in various medical college hospitals.

\* Training should be given to different categories of health care providers at primary, secondary and tertiary levels of health care.

\* Inclusion of the issues in the curriculum of under graduate medical students and of paramedics.

c) It is believed that contamination of drinking water in Bangladesh is due to geological rather than depth. The following steps should be undertaken immediately for proper guidance in relation to safe drinking water<sup>12</sup>.

\* Proper map of the aquifers.

\* Finding their geological age

\* To correlate them with geological evolution of the Ganges, Brahmaputra, Meghna delta complex.

\* Screening of all the tube wells, and irrigation wells should be undertaken for the arsenic content in the water and unsafe ones should be marked. Those wells found to have higher arsenic content more than 0.05 mg/l should be sealed and those with less than 0.05 mg/l should be monitored regularly at once in a year. A database of all water analyses for arsenic is to be prepared and updated regularly.

\* More reference laboratories should be set up to validate and control the analyses done in the Upazila levels.

**Conclusion**

Arsenicosis is not only a physical health problem but also a social phenomenon. The arsenic effected victims gradually become crippled and incapable of doing hard labour. Ultimately arsenic victims fail to

contribute in the economic development of our country. To face the catastrophe, huge amount of budgetary involvement is mandatory. Government and its existing resources alone will not be able to meet and fight against these environmental hazards. Help of international donor agencies should be arranged. Otherwise there will be negative impact in our economy and our uprising economical growth will be jeopardized.

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