Fluorosis management programme in India*

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India is among the 23 nations around the globe, where health problems occur due to the consumption of fluoride contaminated water. An estimated 62 million people in India in 17 out of the 32 states are affected with dental, skeletal and/or non-skeletal fluorosis. The extent of fluoride contamination of water varies from 1.0 to 48.0 mg/l.

An innovative approach developed for fluorosis mitigation is reported. Networking between Public Health Engineering and Health Sector personnel, well-defined objectives for provision of safe/defluoridated water; improvement in the health status of the community through nutritional intervention are the highlights of the programme. Modules for use in out-patient departments for early and correct diagnosis of fluorosis have been developed. The need for teaching about fluorosis in medical colleges is emphasized. Early detection of the disease is the crux of the problem.

In the Fluorosis Management Programme, the major thrust is on (i) awareness generation, (ii) opting technology for fluoride removal/strategy for providing safe water on a sustainable basis, and (iii) emphasis on importance of consuming calcium, vitamin C, E and antioxidant-rich diet for minimizing the adverse effects of fluoride.

IN India, an estimated 62 million people, including 6 million children suffer from fluorosis because of consuming fluoride-contaminated water. Although fluorosis was identified as early as 1937 (ref. 1), a programme for controlling the disease through networking between State Rural Drinking Water Supply Implementing Agencies and Health Departments was launched during 1986–87. The Ministry of Rural Development, the nodal Ministry under the Government of India, drew up the policies and action plan.

Basic plan

A submission on 'Control of Fluorosis' was launched with the main objective to provide drinking water with fluoride as low as possible to the community. The fluoride removal technologies, indigenously developed and field tested were identified for operations. Water quality testing laboratories were strengthened in terms of infrastructure and capacity building of the personnel. Fluorosis can be prevented through certain interventions, if the disease is diagnosed at early stages. A protocol was developed and field tested for use in rural areas[2–4]. Emphasis is laid on awareness-cum-update for professionals, i.e. for Medical Officers posted in health delivery outlets and Public Health Engineers, on all aspects of fluorosis and its prevention strategies.

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Table 1. Districts known to be endemic in the various states

State	District
Assam*	Karbi Anglong, Nagaon
Andhra Pradesh	All districts except Adilabad, Nizamabad, West Godhavari, East Godhavari, Vishakhapattanam, Vijzianagaram, Srikakulam
Bihar	Palamu, Daltonganj, Gridh, Gaya, Rohtas, Gopalganj, Pashchim Champaran
Delhi (Blocks)	Kanjhawala, Najafgarh, Alipur, City
Gujarat	All districts except Dang
Haryana	Rewari, Faridabad, Karnal, Sonipat, Jhind, Gurgaon, Mohindragarh, Rohtak, Kurukshetra, Kaithal, Bhiwani, Sirsa
Jammu & Kashmir	Doda
Karnataka	Dharwad, Gadag, Bellary, Belgam, Raichur, Bijapur, Gulbarga, Chitradurga, Tumkur, Chikmagalur, Mandya, Bangalore Rural, Mysore
Kerala	Palghat, Alleppy, Vamanapuram
Maharashtra	Chandrapur, Bhandara, Nagpur, Jalgaon, Bulduna, Amravati, Akola, Yavatmal, Nanded, Sholapur
Madhya Pradesh	Shivpuri, Jabua, Mandla, Dindori, Chhindwara, Dhar, Vidhisha, Seoni, Sehore, Raisen
Orissa	Phulbani, Koraput, Dhenkanal
Punjab	Mansa, Faridkot, Bhatinda, Muktsar, Moga, Sangrur, Ferozpur, Ludhiana, Amritsar, Patiala, Ropur, Jalandhar, Fategarhsahib
Rajasthan	All the 32 districts
Tamil Nadu	Salem, Periyar/Erode, Dharmapuri, Coimbatore, Tiruchirappali, Vellore, Madurai, Virudunagar
Uttar Pradesh	Unnao, Agra, Meerut, Mathura, Aligarh, Raibareli, Allahabad
West Bengal	Birbhum, Bhardaman, Bankura, Puruliya

*Identified during mid-1999.

Figure 1. Map of India showing endemic states for fluorosis.

The important aspect in the programme is sensitizing grass root level functionaries and the community through appropriate information. The required 'Information, Education, Communication' material about the disease and its prevention has been brought out in different regional languages[5].

The number of districts affected differs from state to state (see Table 1 and Figure 1).

To identify whether a village is endemic or not, the options available are:

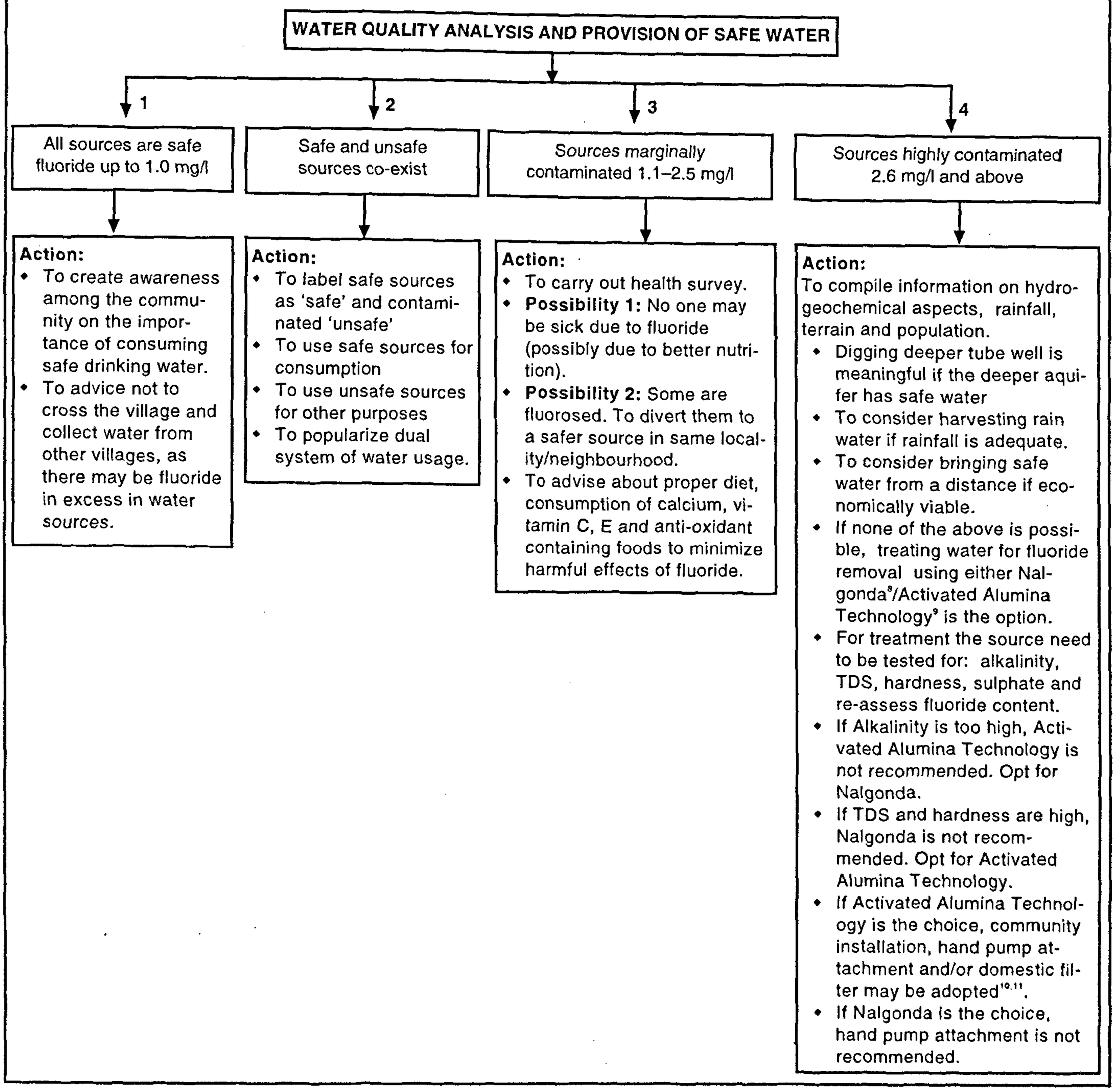
- To test all drinking water sources for fluoride which include ground and surface sources. Table 2 gives the data that emerged from 3 districts in Andhra Pradesh during 1996–1997 (ref. 6).
- To short-list villages through dental fluorosis (DF) survey in school children aged 8 years and above and locate endemicity (Table 3). In the endemic villages 100% water sources are tested for fluoride.

The latter approach is recommended as it saves time, energy and expenditure. DF survey is possible through school teachers. The only tool required to train the teachers is a chart showing different forms of discolouration of the teeth suggesting the occurrence of DF. The survey data are recorded in a specially designed format for evaluation using Optical Mark Reader.

Epidemiological survey

To carry out a health survey for assessing the magnitude of the problem, a house to house survey is preferred. During the survey, all the three forms of fluorosis, viz. dental, skeletal and non-skeletal are identified. In the case of non-skeletal fluorosis, significance is attached to early warning signs of fluoride toxicity, viz. non-ulcer dyspepsia[7] and other clinical manifestations (details provided in the module developed for early detection of fluorosis and reported later in this communication). A survey in Kurnool district of Andhra Pradesh with a population of 14,91,791 reveals that 43,927 individuals have DF; 8833 are afflicted with skeletal fluorosis and 30,400 individuals have health problems related to

Box 1. Plan of action for provision of safe drinking water



Interventions for mitigation of fluorosis

Provision of sustained supply of safe water and nutritional interventions are now practised in India, for mitigation of health complaints arising due to fluorosis.

Safe water intervention

Depending upon the raw water quality, the hydrogeochemistry, the terrain, population to be catered to and annual rainfall, the plan of action is drawn up and implemented for provision of safe water (Box 1).

Prior to providing safe water, it is necessary to carry out a benchmark health survey of the community and the timing of the initial survey should be closer to the date of commissioning of the installation for safe water. It is equally important to carry out a 2nd health survey in the same population, 2 or 3 weeks after providing safe/defluoridated water. This is for impact assessment when the health complaints specially early warning signs of fluoride poisoning would disappear and the community needs to be alerted to such changes.

Nutritional intervention

Nutritional intervention is also practiced simultaneously. This requires counselling of the patients and educating those who cook and serve food for the family. The importance of choosing crops which are rich in calcium, vitamin C, E and anti-oxidants for consumption on a daily basis is emphasized. This needs to be monitored initially at intervals of short duration, viz. 3 to 4 weeks to reveal to the members of the family the benefits they accrue from such an approach. A desk review on the impact of nutrition on fluorosis has been brought out by UNICEF[17].

The fluoride levels in blood, urine and drinking water are also monitored for a period of 3–6 months; the complaints gradually disappear with decline in fluoride levels providing great relief to the individual. They would then continue the dietary regime and consume safe water.

Module developed for early detection of *fluorosis*

- Aches and pain in the joints, viz. neck, back, hip, shoulder and knee without visible signs of fluid accumulation, may be due to fluoride toxicity manifestations besides other reasons[18,19].
- Non-ulcer dyspepsia, viz. nausea, vomiting, pain in the stomach, bloated feeling/gas formation in the stomach, constipation followed by diarrhea, may be due to fluoride toxicity manifestations besides other reasons[20–23].
- Polyurea (tendency to urinate more frequently) and polydipsia (excessive thirst), if detected, may be due to fluoride toxicity manifestations besides diabetes and/or other diseases[24].
- Muscle weakness, fatigue, anemia with very low hemoglobin levels may be due to fluoride toxicity besides other reasons[25,26].
- *Complaints of repeated abortions/stillbirth and if* the patient hails from an endemic area, one may suspect fluoride toxicity besides other reasons as fluoride is known to harden/calcify blood vessels and blood flow to the growing foetus is hampered[27].
- Complaints of male infertility with abnormality in sperm morphology, oligospermia (deficiency of spermatozoa in the semen), azoospermia (absence of spermatozoa in the semen) and low testosterone levels and if the patient hails from an endemic area, one ought to suspect fluoride toxicity, besides other reasons[28–30].
- Any discolouration of the enamel surface, in front row of *teeth of the patient (central and lateral incisors* of the upper and lower jaw) may be due to DF. This is an important clue for follow-up.

Essential laboratory tests

To confirm the diagnosis it is necessary to test the fluoride content in blood (serum), urine and drinking water of a patient. Although 24-h urine is ideal, it is impractical to collect such samples from the rural population and therefore spot sample of urine is collected for testing. The samples are collected only in plastic vials and not in glass bottles. Radiographs and forearm X-ray may be obtained.

Teaching about fluorosis in medical colleges in India

Fluorosis is hardly taught in medical colleges in the country. What are the possible reasons?

- It is strange to note that neither the teachers in medical colleges nor the health administrators know about the latest developments in the field.
- Majority of the medical professionals are under the *impression that fluoride is good for the teeth.*
- As fluorosis provides very little scope for introducing a therapy, it is not a challenging disease in the field of curative medicine.
- Medical students seldom get to see a patient with fluorosis in the wards, as they are not admitted since very little can be done in the advanced stages of the disease; unless a clinician is interested to investigate the case from research point of view.

We need to conduct up-dates on fluorosis for the Faculty of the Medical Colleges and the final year medical students as fluorosis is often diagnosed as a 'mysterious disease'. *There is an urgent need to implement* the fluorosis management programme in an appropriate manner.

Major constraints in achieving the desired results in mitigation of fluorosis

- Fluorosis is on the increase due to widespread occurrence of fluoride containing minerals in the earth's crust. The indiscriminate digging of bore well for water and total unawareness that water quality needs to be tested before accepting a source for consumption is one of the major reasons for the spread of the disease.
- The health professionals and public health engineers are not fully aware of the disease characteristics and therefore, extensive up-dates are called for in medical *and dental colleges. Besides, engineers specializing* in public health also need to know about fluorosis and defluoridation of water.

- Networking between the Health and Public Health Engineering departments is a new approach. Working in an integrated manner requires a new work culture and is a time-consuming exercise.
- The quality of drinking water has to be monitored and its sustainability needs to be ensured. The health professionals are now being inducted to surveillance activity (i.e. external auditing) which is yet to gain momentum.
- Community participation needs to be encouraged.
- Funds are required to provide 40 lpcd drinking water to the rural community. Perhaps 10 lpcd would meet with the requirements if safe water is used exclusively for consumption.
- The project mode operations being practiced in the country may require major changes. A village/block as a unit needs to be tackled in a holistic manner. Unless such strategies are adopted by the government/bilateral agencies, Fred Pearce's comments (*The Guardian*, 9 and 16 July 1998) on UN agencies sinking boreholes in the past, but never testing the water for its quality, is likely to be repeated as the 'system' in a project mode approach does not make provision for testing water quality or similar activities unless hard and software activities are integrated at the planning stage itself.
- The damaging effect(s) caused by multinational corporations (MNCs) promoting fluoridated products in India, in the name of prevention of dental caries is considerable and counter-productive. The regulatory agencies both national and international need to consider such issues and set guidelines for MNCs to follow. Alternate approaches for prevention of dental caries, viz. promotion of oral health and hygiene practices with adequate calcium and vitamin C intake through dietary sources should be encouraged.

Almost 6 decades ago the 'western world' commenced addition of fluoride to drinking water with the belief that it would prevent dental caries in children. Fluoridation of drinking water and dental products attained considerable publicity then, but it is now being questioned by the people of those nations and is labelled as 'medication without consent'.

It is recorded that West Germany discontinued fluoridation after 15 years as a result of legal and health considerations[31]. A report from Greece mentions that fluoride leads to many pathological disorders[32]. The French Environment Ministry has confirmed that France opposes fluoridation[33]. The National Agency for Environmental Protection in Denmark is opposed to fluoridation in their country[34]. There is no fluoridation in Japan and in many other countries[35]. However, in certain parts of Britain, USA, Canada and Australia, people continue to consume fluoridated water and the respective Governments are reviewing the situation.

Water quality standards are also being revised. WHO guidelines have been followed by many nations including India. However, the unsuitability of the norms for fluoride are being increasingly felt and new norms are formulated. Senegal reduced the upper permissible limit of fluoride in drinking water from 1.5 ppm to 0.6 ppm (ref. 36) based on the prevalence of DF with 1 mg/l of fluoride in drinking water. India reduced the upper limit of fluoride in drinking water from 1.5 ppm to 1.0 ppm, with a rider, 'lesser the fluoride the better, as fluoride is injurious to health'[37].

The Fluorosis Management Programme in India detailed in this communication is rather unique as no other endemic nation around the globe, has embarked on such a massive operation. The major strength of the programme is the vast scientific literature that is available in the country. It is for this very reason that during 1998 Britain sought information from India to assess whether to continue or discontinue fluoridation of drinking water in their country[38]. The Fluorosis Management Programme in India is planned for the rural and semi-urban population in the country; there is a need to consider similar activities in the urban sector where tube well water is supplied by Municipalities due to shortage of treated water and fluorosis is surfacing among the urban population.

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