

## Fluorosis in Developing Countries: Remedial Measures and Approaches

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The review article is focusing on Fluorosis disease, its clinical manifestations and diagnostic procedures. The article is focusing on the magnitude of the public health problem due to consumption of fluoride contaminated water in India and some of the other developing nations. The article throws light on the activities carried out since 15 years under the Government of India initiative for prevention and control of the disease. The significant contributions emerged from India in combating Fluorosis through practise of safe drinking water and adequate intake of essential nutrients viz. calcium; vitamin C, E and other antioxidants, have been described in detail. The article provides comments on the perceptions of the World Health Organization on fluoride in drinking water, WHO monograph, York University Medical Centre (U.K) review on water fluoridation and the fallacies. A five point advocacy package for prevention of Dental Caries instead of promotion of a chemical poison (fluoride) through water, milk, fruit juice and toothpaste is dealt with.

**Key words:** Drinking water, Fluoride, Fluorosis, Diagnosis, Intervention, Prevention, Monitoring Patients, Perceptions: Developing nations vs Developed, Dental Caries, Advocacy Package

### Preamble

Provision of safe drinking water to the community without biological contaminants, poisonous chemicals and promotion of health is a concern, shared by Governments (Federal & State) of all nations. The Governments of the developing world compared to the industrialised nations are constantly involved in reviewing and evolving new strategies for the management of adequate supply of safe water, proper sanitation and hygiene practices among their people. No doubt that it is a stupendous task. However, the task would appear less burdensome, when all partners in the venture could share the concerns as well as provide the necessary inputs for implementing remedial measures. In the global scenario, 23 nations have the problem of excess fluoride in drinking water and resulting endemicity for Fluorosis. Majority of the countries are from the developing

world (figure 1). In India, the extent of fluoride contamination ranges from 1.0 mg to 48 mg/L. 1 mg/L or lesser the better is the norm followed by the country.

In India the problem of Fluorosis has been in existence since early 1930s; initially discovered in bullocks used for ploughing the land and later in human beings living in the same area. In



Figure 1 Countries with endemic fluorosis due to excess fluoride in drinking water

India extensive scientific investigations were encouraged, and funds provided to scientists and scientific institutions to carry out, basic, applied and experimental research. By late 1980s, the country has had substantial scientific data.

The Technology Mission on safe drinking water launched in India by Prime Minister Sri Rajiv Gandhi in the year 1986, has witnessed enormous success and the country has been able to take science and technology to the doorsteps of the people. The activities were networked between water supply and health agencies. Capacity building was promoted among professionals as well as grass-root level functionaries. Water quality testing laboratory infrastructure and modern items of equipment and appropriate training for water analysts did receive high priority among the various activities that were launched. Research and Development activities promoted in the engineering and health sectors have paid rich dividends. India launched a special sub-mission on "Control of Fluorosis" under the Technology Mission in safe drinking water and activities were initiated since 1987.

A Fluorosis Control Cell, was supported by the Government at the All India Institute of Medical Sciences (1987-1997) for co-ordinating the activities between the Water Supply and Health Departments of the 13 State Governments where excess fluoride and Fluorosis was then known to be endemic.

The activities of the Water Mission were pursued with vigour and enthusiasm by all scientific institutions and scientists in the country besides the state water supply agencies. All agencies and scientists were brought together and worked for a common cause. In reviewing the activities retrospectively, it is quite evident that a strong foundation was laid in the country during the initial years.

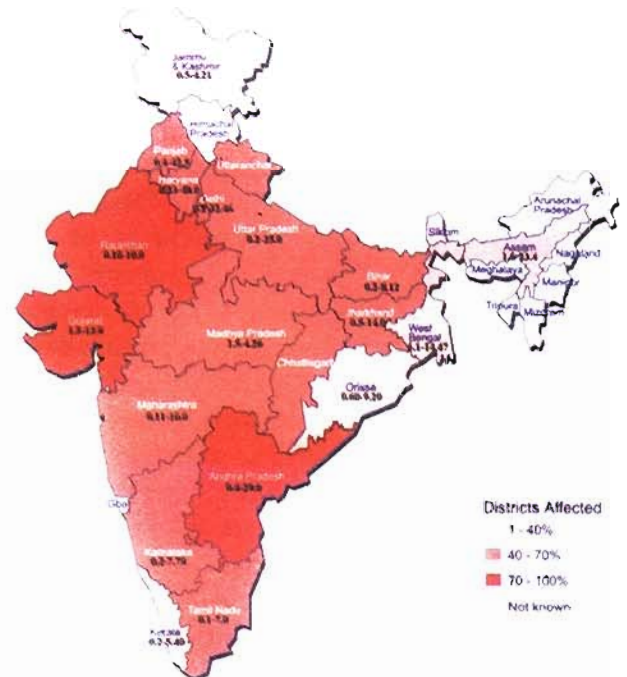
**The Activities of the Water Mission during 1992 - 1997**

Since 1992, the Government commenced its activities by stock taking, compilation of information to assess the successes and failures of the activities by the Central and State Governments. The information that emerged on the number of •

fully covered • partially covered and • not covered villages / habitations were on the increase and it was also evident by then that water quality was not the basis of the coverage but availability of water and quantity were the focus. It was also observed that new districts / villages were emerging as endemic locations. The number of states which were endemic for Fluorosis i.e. 13 during 1987 became 15 and increased upto 17 by the year 2001 (figure 2). Carving out of 3 new states i.e. Chattisgarh, Uttaranchal and Jharkand, the number of states having excess fluoride problem has increased to 20.

The Fluorosis Control Cell established by the Government at the AIIMS, New Delhi, generated very valuable data on the prevalence of excess fluoride in water and Fluorosis. The activities were implemented in the affected districts in a phased manner. The objectives of each phase were as follows:

**Phase I:** To conduct training cum awareness camps and update information on Fluorosis for Doctors, Para-medical workers, Public health engineers and other Governmental and Non-Governmental personnel.



Source of information: 1) UNICEF State of Art Report, 1999  
2) FR & RDF data bank

**Figure 2** Map of India showing endemic states for Fluorosis and the drinking water fluoride content

**Phase II:** To launch epidemiological survey(s) in the affected villages, talukas of the districts as well as water quality survey to assess the exact magnitude of the problem.

**Phase III:** To introduce preventive and ameliorative measures for individuals, families and communities (affected population), so that the disease is controlled as well as prevented. This involves provision for safe water, and health education for the masses.

Capacity building activities followed by water quality testing for fluoride and house to house health survey brought out the extent of contamination of water with fluoride as well as the prevalence of the disease district wise.

It was evident that Dental Fluorosis incidence in children ranged from 2% to 33% in Gujarat; Skeletal Fluorosis incidence ranged from 1% to 75% also in Gujarat. The third form of the disease i.e. Non-skeletal Fluorosis ranged from 25% - 75% of the population of the endemic districts of Haryana and Karnataka.

Extensive research and development activities carried out by the Fluorosis Control Cell at AIIMS, led to the development of scientific procedures which are simple, inexpensive and meaningful for early detection of fluoride poisoning (toxicity) among the community. This was one of the milestones achieved by the Water Mission as the disease could be identified before it appeared in its full-blown form crippling the individuals. Fluorosis mitigation was truly possible since these developments in the country. Fluorosis has no treatment or cure; but it can be easily prevented provided the ingestion of fluoride and its poisonous effects on the human body are detected early. The protocols / procedures developed in India are now being followed as a model by some of the other nations. The two procedures developed for early diagnosis of Fluoride toxicity manifestations are:

#### **Module developed for Clinicians for use in their Outpatients Department**

- 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.

- Non-ulcer dyspepsia viz. nausea, vomiting, pain in the stomach, bloated feeling/gas formation in the stomach, constipation followed by diarrhoea, may be due to fluoride toxicity manifestation besides other reasons.
- Polyurea (tendency to urinate more frequently) and polydipsia (excessive thirst) if detected may be due to fluoride toxicity manifestation besides other diseases.
- Muscle weakness, fatigue, anaemia with very low haemoglobin level may be due to fluoride toxicity besides other reasons.
- Complaints of repeated abortions/still birth in the case of patients hailing from an endemic area may lead one to suspect fluoride toxicity, besides other reasons as fluoride is known to calcify/harden blood vessels (ectopic calcification) and thereby hamper blood flow to the growing foetus.
- 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 in the case of patients hailing from an endemic area should lead one to suspect fluoride toxicity besides other reasons.
- Any discoloration of the enamel surface in the front row of teeth of the patient (central or lateral incisors of the lower and upper jaw) and if it is away from the gums and seen as horizontal streaks or spots may invariably be due to Dental Fluorosis. This is an important clue for follow-up of the members of the family as they may be drinking fluoride contaminated water.

#### **Hospital / Laboratory based diagnostic procedure**

In view of the information provided, the tests that need to be carried out to arrive at a definitive diagnosis of Fluorosis are:

- **Fluoride levels in**
  - Blood (serum) ▪ Urine and ▪ Drinking water

Although 24 hrs. urine is ideal, it is impractical to collect such samples from the rural population/farmers and therefore spot sample of urine is collected for testing. Samples of blood, urine and drinking water are collected in plastic and not glass bottles.

- Radiographs
- Radiograph need to be taken of the region/joint where the patient has complaints viz. pain, rigidity/stiffness.
- Radiograph need to be taken of Fore-arm to look for interosseous membrane calcification.

The latter X-ray is a must, if Fluorosis is to be diagnosed at early stages. This is an important message as fore-arm X-ray is seldom taken unless specially asked for diagnosing Fluorosis.

**Field/Home based diagnostic procedure where facilities for tests described above do not exist**  
 In rural areas, a field based approach need to be introduced. One can either get drinking water fluoride tested, or use fluoride data already existing, since every district water testing laboratory has been provided with an Ion meter for testing fluoride in water.

If the drinking water has high fluoride, then one should proceed with the following:

- To look for discolouration of the teeth due to Dental Fluorosis in the children of the family.
- To carry out 3 physical tests to assess whether there are aches and pain in the joints (figure 3).
- To retrieve history from the members of the family as to whether they have non-ulcer

dyspeptic complaints, Polyurea and / or Polydipsia.

- To confirm whether the illness(es) in the family is due to fluoride, divert the family to a safer source of water existing in the village, for cooking and drinking purposes and follow up Non-ulcer dyspeptic complaints. If the complaints are due to fluoride, it would disappear within 10–15 days after safe water is consumed.

This is the approach to follow in a rural/village setting. If the disease is confirmed as Fluorosis, the patient should be monitored for the improvement of his / her health through interventions.

Upon diagnosis of the disease the patients need to be introduced to two interventions which they need to practise. The interventions are:

- Provision of safe / defluoridated water for consumption on a sustainable basis
- Nutritional supplementation to combat fluoride toxicity

**Monitoring of Patients Introduced to Interventions**

For complete recovery from the cell injury and disease caused by fluoride and upon introduction to interventions, the individuals need to be monitored. During monitoring, the fluoride levels in blood and urine need to be assessed besides the intensity of health complaints need also to be assessed at frequent intervals.

The data obtained from two patients of Fluorosis after introducing intervention(s) are reported in table 1 & 2.

To have clarity of thought, the information on two patients is recorded, in which there is a basic

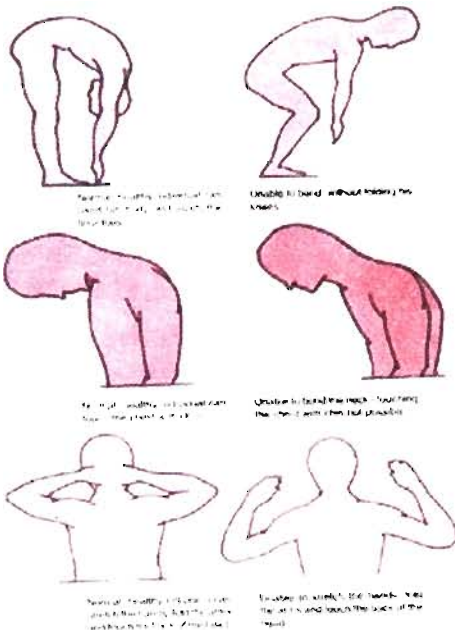


Figure 3 The Three physical test for assessing aches and pain in the various joints of the body

Table 1 Effect of Safe Water and Nutritional Interventions

|   | Water Fluoride original mg/L | Diverted safe source mg/L | Serum Fluoride mg/L | Urine Fluoride mg/L |
|---|------------------------------|---------------------------|---------------------|---------------------|
| 1 <sup>st</sup> observation (September, 1999)                 | 3.00                         | 0.27                      | 0.08                | 8.00                |
| 2 <sup>nd</sup> observation i.e. 2 months after interventions |                              |                           | 0.03                | 4.50                |
| 3 <sup>rd</sup> observation i.e. 3 months after interventions |                              |                           | 0.02                | 1.60                |
| 4 <sup>th</sup> observation i.e. 7 months after interventions |                              |                           | 0.02                | 0.60                |

difference. Table 1, reveals the data of a patient who was drinking chemically contaminated water and the level of fluoride was 3.0 mg/L. For commencing the interventions, the patient was diverted to an existing safe source with fluoride content 0.27 mg/L. The second intervention practised by the patient is based on the nutritional counselling provided. The counselling involves, taking stock of the patient's food habits, the type of food consumed during the course of the day. The patient is then advised to consume, food (cooked and uncooked) which are rich in calcium, vitamin C, E and antioxidants. Depending upon the patient's affordability, the items are specified, recipies are discussed and the various ways in which an agricultural crop / fruit / other items can be consumed 7 days a week, is also explained in simple ways to enable the individual to practice.

The table 1, is revealing the serum and urine fluoride levels of the patient assessed during different time intervals after introducing the two interventions. It is evident that 7 months after interventions, serum fluoride has dropped to 0.02 mg/L from 0.08 mg/L and urine fluoride level has dropped to 0.6 mg/L from 8.00 mg/L. It may not be necessary that both blood and urine fluoride levels will be reduced to normal limits within the same duration. The important message is, withdrawal of

fluoride (from drinking water) and promoting intake of calcium, vitamin C, E and antioxidants, the body is able to combat the disease and repair the damage to the cells and tissues in a manner, the health complaints of the patient begin to decline and improvement in health is recorded. The percentage recovery (improvement) is shown in table 3.

The table 2 is reporting a different scenario. The patient was fluorosed, but his drinking water is safe with fluoride 1.06 mg/L. Though the water fluoride was in the safe limit, blood and urine recorded high fluoride levels and therefore the message is, the patient was consuming fluoride either through food, dental products, drugs or any other source.

Therefore the patient continued to consume water from the same source; but advised to avoid very high fluoride containing food/other substances viz:

- Black tea (tea without milk)
- Black rock salt (Kala namak)
- Red rock salt (Sindi namak)
- Canned / tinned food products where fluoride may be used as a preservative and may not have been indicated on the can / container.
- Chat or such snacks on a regular basis as black rock salt is used in chat masala.

Table 2 Effect of Nutritional Intervention

|  | Water Fluoride original (mg/L) | Serum Fluoride (mg/L) | Urine Fluoride (mg/L) |
|--|--------------------------------|-----------------------|-----------------------|
| 1 <sup>st</sup> Observation (Oct. 1999) prior to intervention              | 1.06                           | 0.08                  | 2.50                  |
| 2 <sup>nd</sup> Observation i.e. 1 month after intervention                |                                | 0.04                  | 1.46                  |
| 3 <sup>rd</sup> Observation i.e. 5 months after intervention               |                                | 0.03                  | 1.00                  |
| 4 <sup>th</sup> Observation i.e. 10 months after Intervention (Sept. 2000) |                                | 0.03                  | 0.70                  |

Normal Serum Fluoride: upto 0.02 mg/L; Urine Fluoride: upto 0.10 mg/L

Table 3 Health Improvements: Expressed by the Patients

| S. No | Manifestations                  | Affliction before intervention (%) | Improvement during interventions      |                                       |                                       |
|-------|---------------------------------|------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|
|       |                                 |                                    | 1 <sup>st</sup> impact assessment (%) | 2 <sup>nd</sup> impact assessment (%) | 3 <sup>rd</sup> impact assessment (%) |
| 1.    | Gastro-intestinal (NUD)         | 100                                | 70                                    | 100                                   | -                                     |
| 2.    | Muscular Weakness               | 60                                 | 40                                    | 50                                    | Complete recovery                     |
| 3.    | Polyurea                        | 30                                 | 20                                    | 30                                    | Complete recovery                     |
| 4.    | Polydypsea                      | 50                                 | 20                                    | 40                                    | 10                                    |
| 5.    | Pain and rigidity in the joints | 90                                 | 30                                    | 60                                    | Complete recovery                     |

The improvements were graded on a scale for obtaining consistent results n = 10

- Ayurvedic tablet often consumed by the people for stomach problems, gas formation etc as it has high content of black rock salt rich in fluoride.
- Some of the salted snacks packed and sold as it contains black rock salt.
- To avoid some of the homeopathic tablets containing Fluoride for supplementing calcium intake.
- To avoid use of fluoride containing dental products, viz. toothpaste, mouth rinse, varnish, fluoride tables etc

The patient is also advised to consume high calcium, vitamin C, E and other antioxidant rich diet as described in the case of patient No. 1. The table 2 data, shows, the reduction in serum and urine fluoride levels to 0.03 mg/L and 0.7 mg/L respectively over a period of 10 months.

Although it is important to follow-up patients in a specified time interval, it is often not possible as they begin to feel good / healthy with less and less of health complaints, they would turn-up for follow-up as and when it is convenient to them. One has to bear in mind, that the uneducated, rural folks would do such things and interval at which the monitoring is carried out therefore has wide variations and is evident from table 1 & 2.

In investigations using human patients affected with a degenerative disease viz. Fluorosis, every patient is an entity by itself and different from the other in a number of ways viz. body weight, hormonal status, body metabolism and therefore statistical evaluation like mean, S.D / S.E is seldom applied and therefore presentation of data in such a manner as often applied to animal model studies have not been attempted.

It is interesting to note that in both the patients whose data are presented in table 1 & 2, the serum fluoride levels are high and the values are same, whether the major source of fluoride entry is drinking water or food / other substances. It is also note worthy that in both the patients even after 7 and 10 months after interventions the serum fluoride levels are 6 and 7 fold high respectively.

It is also the observation that when the source of fluoride is withdrawn, the kidneys begin to excrete large amounts of fluoride for quite some time. From which organ / tissue or cell, the fluoride

is being readily released, is a matter which requires further investigation / probing into.

If the patient is followed-up, may be after 2 years they may have attained normal limits of fluoride by then, would have gone back to work and would not comeback, though they are very precious patients for follow-up.

Though the osmolarity and electrolyte content of urine may throw some light to our understanding of the issues, it has not been carried out in the patients reported in this communication.

It is the observation that the first and the earliest relief (i.e. 1<sup>st</sup> monitoring should be within 15 days after interventions) shall be from gastrointestinal complaints. On complete withdrawal of fluoride, the gastrointestinal mucosa can regenerate and the Non-ulcer dyspeptic complaints shall disappear in a matter of 10 - 15 days. Safe water is better than any medicine. The second monitoring after 3 months and third monitoring after 1 year are ideal. The response of the body to fluoride withdrawal and nutritional supplementations are revealed in the following 3 tables. Table 1 & 2 are revealing data from just 2 patients, one drinking fluoride contaminated water and the other, whose water is safe, but consuming fluoride through dietary / other sources.

The developments in science and technology in particular to the issues focusing on Fluoride and Fluorosis mitigation, achieved by India in a short span of 13 years is remarkable. Fluorosis has become an easily preventable disease. Efforts are on to conduct continuing medical education programme on Fluorosis mitigation for teachers in medical colleges. Similarly engineering college teachers are also being trained on recent developments for water quality testing, quality control and fluoride removal procedures.

#### Review of the progress of the Sub-Mission "Control of Fluorosis" by Government of India

The efforts of the state Governments to defluoridate the fluoride contaminated sources were reviewed during 1995. The Government's investments to bring out the Harcharan Singh Committee Report (1995) has indeed highlighted the successes and failures in no small measure. The reasons for failures and the remedial measures for

rectifying the failures have been put on record. The recommendations of the report had it been taken seriously and mid course corrections introduced, by now at least 40% of the endemic village population would have had safe water for drinking. It is the observation in India that reports and recommendations are seldom taken seriously for implementation. Instead of community installations which failed miserably as there was no maintenance, presently domestic defluoridation of water based on Activated Alumina Technology is being popularised amidst the rural community.

#### The Activities of the Water Mission during 1997-2001

It is common knowledge that with change of Governments, change of policies and programme do take place. But Water Mission is one activity which was least affected by change of Governments. Rather Water Mission activities for providing safe drinking water to the rural community continue to be a top priority agenda of the Government with substantial fund allocation for its programme.

However, there are certain changing trends which perhaps may not be healthy in achieving the goals. A number of scientific institutions viz. (1) Bhaba Atomic Energy Research Centre, Bombay (2) All India Institute of Hygiene and Public Health, Calcutta (3) All India Institute of Medical Sciences, New Delhi (4) Institutions under CSIR (5) Defense Laboratory, Jodhpur (6) S.J. Engineering College, Mysore and others which were very closely associated with Water Mission activities, gradually drifted away and contributions from scientific institutions became minimal. This in a way has resulted in set-backs to the Water Mission and its activities. The scientists and scientific institutions need to be the backbone of the national programmes. It is time that we realize that policy planners and administrators can plan but not implement programmes. Between planning and implementation, mid course or location specific changes need to be introduced. That can only be done by those who have field experiences. A successful programme is invariably implemented by scientists. They need to be under the umbrella of the "Water Mission" to contribute their best to the nation.

#### Global Consultation Centre for Fluorosis Mitigation

The wealth of information and the expertise that the nation has in the Fluoride and Fluorosis mitigation programme is commendable. The Fluorosis Research and Rural Development Foundation (FR & RDF) set-up in Delhi as a Non-Governmental Organisation during 1997 upon closure of the Fluorosis Control Cell of the Water Mission located at AIIMS, has now emerged as a Global Consultation Centre. The State Governments, Bilateral and UN Agencies are drawing upon the expertise of this NGO for sound planning and implementation of Fluoride and Fluorosis mitigation programmes in the endemic states. The greatest strength of the NGO is the expertise in Human Resource Development as well as vast field experience in the water and health sectors which are the most important prerequisites for programme planning and implementation.

#### Views on Specific Issues in the Water Sector in the Indian Context

- India has the technology for removal of fluoride from the drinking water. The Activated Alumina and Nalgonda Technologies developed, field-tested with several modes of water delivery systems, require handling by the community and not by the Government Departments.
- The alum and lime (for Nalgonda Technology) and Activated Alumina for the filter, the suppliers need to get their product(s) Certified by competent authorities and label the product as "Defluoridation grade". This would help standardisation of the procedure by the users and obtain good quality treated water.
- The Government should consider tie-up with one or more of the Aluminium Industries or any Petrochemical industry / or any other for the right grade of Activated Alumina and for a guaranteed supply of good quality defluoridated water. Once the raw material of good quality is available in plenty, the Activated Alumina Filters for defluoridation of water will be in the market at an affordable price.
- If the excess fluoride problem need to be resolved, the efforts ought to be networked

with all partners in the sector and integrated in its operations.

- Capacity building / human resource development also need to commence from engineering and health educational institutions to ensure sustainability of the efforts. HRD programme for executive engineers and medical officers posted in the districts has limited scope to spread the right message to the new recruits.
- Programmes in educational institutions need to be encouraged and supported nation wide. National / international / UN funding agencies may consider such investment worthwhile for achieving the goal of safe water for all.
- Unscientific / uncalled for publicity promoting fluoride (for prevention of Dental Caries) need to be stopped as there is an awakening world over on the harmful effects of fluoride. Fluoridation of drinking water and dental products in the industrialised nations should be discontinued and other measures adopted.
- As "health is a state subject", the endemic states for "Fluoride and Fluorosis" which are 20 in number now in India can also take the initiative to ban the manufacture and sale of all fluoridated brands of toothpaste and promote the sale of specially manufactured "fluoride free" toothpaste which only uses raw materials of high quality so that fluoride does not arise as a contaminant from cheap / inexpensive raw material used for manufacturing the product. These need to be implemented in India, considering the seriousness of the health problems, due to fluoride entry to the body through diverse avenues.

**A Five Point Advocacy Package for Prevention of Dental Caries instead of Promotion of Fluoridated Products (toothpastes, mouth rinses, varnish and drinking water)**

1. To create awareness, sensitise mothers on the cause of Dental Caries (i.e. it is a bacterial disease due to unhygienic oral conditions).
2. To stress-upon the need for consuming a balanced diet with adequate calcium, vitamin C, E and other antioxidants and its merits.
3. To sensitize expecting and lactating mothers the need to specially focus on additional

requirements of calcium and vitamin C besides the items mentioned above during pregnancy and lactation through dietary sources so that the growing foetus, eventually would have good and healthy teeth and bones.

4. To avoid providing children with sweets / chocolates / sticky carbohydrates which shall ruin the teeth by promoting bacterial growth.
  5. To create awareness on the importance of brushing / cleaning the teeth after every meal, with or without paste / and / or flossing to get rid off food particles sticking in between the teeth and hidden crevices of the gums which is the basic cause for bacteria to breed in the oral cavity, production of acids and cavity formation.
- Pushing a chemical poison i.e. fluoride to a child through drinking water and dental products has serious health implications and pushing it to the mother while she has conceived the baby, it is only ensuring that the foetus may get aborted / lead to still birth and if born would have Dental Fluorosis and other deformities.
  - All the fine calculations for fluoride, dose of fluoride, pea-size toothpaste to use and that kind of stuff that are popularised by commercials are nothing but gimmicks.
  - In spite of practising the 5 point advocacy package mentioned above if a child develops Dental Caries, for some unknown reason, then the Dentists can prescribe a drug which he / she considers appropriate to treat the condition.
  - Adopting fluoridation of toothpaste, mouth rinses, drinking water, milk and fruit juices in the name of prevention of Dental Caries to the entire civil society is grossly unethical and unscientific.
  - There is an urgent need to put a stop to the publicity of multinational corporations on the fluoridation business through the diverse media.

**Drinking water guideline for Fluoride**

- WHO standard / guidelines for fluoride is under criticism / review.
- WHO guideline for fluoride suggest that 1.5 mg/litre is "desirable". In this context the word "desirable" is unsuitable; fluoride is not "desirable" as enormous scientific literature available have taught us.



- Rely on the Indian Standard for fluoride 1.0 mg/litre upper limit; lesser the better as fluoride is injurious to health (BIS).
- Many countries follow blindly the WHO norm / guidelines which need to be changed.
- US EPA standard for fluoride i.e. Maximum contaminant level (MCL) is 4.0 ppm is rather unsuitable for any country around the globe.
- Senegal reduced the standard for fluoride from WHO guideline i.e. 1.5 mg/litre to 0.6 mg/litre; during early 1990s due to health reasons.
- Germany stopped fluoridation after 15 years due to health reasons.
- In France there is no fluoridation.
- In many European Nations, fluoridation is not encouraged for health reasons.

#### WHO's Fluoride Monograph of 2000

- WHO is in the process of bringing out a revised edition of the "Fluoride Monograph" initially published during 1970. The draft monograph is now available on the Web site. Scientists around the globe and many Organizations including UNICEF and the 3<sup>rd</sup> International Conference on Fluorosis and Defluoridation held in Chiang Mai, Thailand during November 2000 have made serious criticism on the unsuitability of the new monograph and has sought for a complete revision of the manuscript. This is due to information explosion in the sector, which cannot be overlooked.
- The WHO draft monograph was discussed at length in the International Conference on Fluorosis and Defluoridation of water (2000) held in Chiang Mai, Thailand and the participants from 13 Nations mostly from developing countries have suggested amendments to be incorporated to the WHO monograph. The recommendations have been brought out by the Organisers of the Conference (Eli Dahi & Sunsanee R 2001) and the same is now furnished to WHO for consideration. The recommendations are as follows. It is important that the scientists and scientific organizations in the developing countries need to be aware of recent developments in the field of Fluoride and Fluorosis and the policy makers in these

countries need to understand the reasons for questioning the rationale of the WHO approaches.

- **The Monograph's title "Fluoride in Drinking Water"** is not informative. A reader is at a loss as to what to expect from the monograph. The monograph in general does not seem to pursue a specific thesis in a coherent manner. It is rather like a collection of essays, each of which is completed only in reference to itself. The heart of the problem is with the monograph's conceptual framework, which is not crystallized, and its objectives, which are not apparent. The title is indicative of this overall lack of clearly stated goals.
- **On "Guidelines and Standards"** The figure "1.5" mg F / L being associated with the WHO guideline, of which its advocacy is "a level at which Dental Fluorosis should be minimal", has been puzzling for over the past ten years. Why is it "1.5"? What scientific data is the figure based on? Theoretically as well as empirically, the figure seems to be far above the proven safety level. There is already ample evidence that the so-called recommendation level of 1.5 mg F / L could cause Dental Fluorosis for an entire community in a number of developing countries. Moreover most of the caries prevention literature presented appeared in an era when the topical application of fluoride was still not fully practised as much as at the present time. This calls the concept of "optimum concentration" into question. The Workshop felt that conceptually any conclusion about "optimum concentration" should be revised. Ethically the recommended figure of "1.5" should be reduced as far down as "0.5" which is the figure that many countries found to be the maximum tolerable range. Hence it is suggested that the chapter should be rewritten in a more scientific manner rather than as a series of unsupported statements.
- **On "Removal of Excessive Fluoride"** If the monograph is to be true to its professed objective, this chapter should be at its heart. The value of the monograph should lie in the provision of an overview of simple methods for the defluoridation of water, together with their

conceptual basis and detailed information on the rationale behind the given designs. It would be highly useful if the chapter on defluoridation dealt more extensively with appropriate technology that is, knowledge that works well in local contexts and is answerable to local problems with the consideration on the application scale. It should include well-trying methods such as the Alumina and resin techniques. It could even consider reverse osmosis which, although more expensive, is now available in many countries. There are other techniques that have gone through experimentation and research in different scientific centres and communities, which the WHO "monograph" could well take into account and benefit from. Moreover though the monograph gives the impression of being sophisticated and offers techniques and information about defluoridation, it is far from being comprehensive enough for practical use. It lacks a detailed discussion on the problems of applications, which are essential for field projects.

- On "Human Health Risks". The majority of the participants, who are knowledgeable about fluorotic areas, are of the opinion that the information is rather out of context. The problems of Fluorosis are far more severe than they seem to be perceived by the author who has contributed the information to WHO. For a population whose health is already at great risk by natural fluoride, the monograph could be misleading.
- On "Beneficial Use" and "Artificial Fluoridation" It is strongly suggested that the chapters dealing with the above topics in the monograph should be omitted. This is not only because they do not conform to the main purpose of the monograph but also because the information is already amply and easily available elsewhere. If the WHO "monograph" is to be of greater use for those who suffer or will suffer from Fluorosis, the focus needs to be on the toxicity of fluoride. The strategies for combating the problems are to publicize the danger of fluoride and to address the question of how we can ideally get rid of, or realistically reduce, fluoride quantity in water consumption.

But the monograph tries instead to advocate the benefits of fluoride and justify artificial water fluoridation. Therefore, for any population truly threatened by excessive fluoride, the information on the use of fluoride is irrelevant. It is ironic that while the WHO "monograph" could be more useful for the developing countries that cover the largest portion of the world fluorotic regions, the text seems to adopt a developed-country perspective.

- On the overall picture The monograph, in its professed focus, has a variety of themes. It tries to incorporate mutually incompatible themes of defluoridation and artificial fluoridation in a limited quantity of pages. Different portions assume different levels of simplicity and sophistication on the part of readers. It is difficult enough to satisfy the curiosity of people who seek knowledge and judgement beyond the elementary level. The volume even contains some serious factual errors. Substantial improvement could therefore be made to the text. This includes the style of writing and the way the text is conceptually organized. Although the monograph is in the form of a scientific treatise, the flow of prose and the choice of words should not be left aside, for they have a direct impact on the messages conveyed.
- If all these suggestions cannot be accommodated for whatever reasons, be they scientific or otherwise, it would be highly appreciated if WHO could issue another publication primarily aimed at the mitigation of fluoride in water consumption. Such a publication would directly serve a great number of people in developing countries.

The information on WHO Fluoride Monograph and the concern voiced by the developing countries have been detailed, so that the nations having excess fluoride problems should adopt policies and programmes relevant to their country and should refrain from adopting WHO guidelines which are unsuitable for developing countries. The people of developing countries should be aware of the need to develop policy guidelines relevant to their country considering various socio-economic, climatic, nutritional and geohydrological factors.

**International concerns on Fluoride and Fluorosis**

- Fluoridation of drinking water, fruit juice, milk are being promoted by Industrialised nations based on 60 years old, scanty scientific evidence, need to be reviewed / abandoned as fluoridation is accompanied by high prevalence of Dental Fluorosis in children and other serious health implications of the soft tissues in the community. The cost of Dental health care is emerging as costlier in Fluoridated cities compared to Non-fluoridated cities as reported by UK (1997).
- “Fluoridation” of the industrialised nations are being opposed by the Citizens Councils and many water agencies. 6 million people are exposed to fluoride, through fluoridation of water in U.K.
- Fluoridation is being viewed as “medication without consent”. It is being viewed as against “human rights”.
- Fluoridation is causing serious health problem due to • thyroid gland malfunction, • gastrointestinal problems • low haemoglobin • muscle destruction • neurological complications • blood vessel blockage • impairing testicular function to mention a few.
- There is a serious problem of children afflicted with Fluorosis in the Ukranian town Sosnivka. The number of children affected by fluoride poisoning has increased from 600 to 3000 in a matter of a few years.
- One of India’s neighbouring countries, Pakistan, fluoride contamination of drinking water has crippled the people in many villages in the outskirts of Lahore. The villages are: • Manga Mandi • Buccheki • Kot Asad Ullah • Talab Sara • Sha Kalanwala. The amount of fluoride in ground water in the above villages ranges from 5.26 mg/L to a maximum of 26.32 mg/L (Hameed, Lahore - 2000). After examining the children, the Physicians have advised “Surgery” to treat the children. This is no approach to deal with Fluorosis. Such glaring unawareness also prevails among Health Professionals.
- Problems emanating from excess fluoride ingestion exist in Sri Lanka, Japan, Thailand,

China and in very severe form in most of the African nations.

**York University Medical Centre (UK) Review on Water Fluoridation**

The author during 1998, addressed the MPs and LORDs of the House of Commons of the British Parliament besides the Health Minister and her Advisors on the harmful effects of fluoride, as a result of ingesting Fluoride contaminated water, food, drugs and use of dental products (Susheela 1998). This presentation was as a result of high incidence of health problems prevailing in Fluoridated cities in U.K. The British Government as a result, entrusted the York University Medical Centre to constitute a committee and review the situation and recommend to the Government the course of action that need to be initiated. York Review was completed in March 2000 and the report was published in the British Medical Journal during the same year. Unfortunately the report has focused the scientific rationale of viewing the effect of fluoride on teeth in a highly compartmentalised manner ignoring / discarding the enormous scientific literature available globally on the severe health problems due to fluoride on tissues other than teeth. This approach of the York University Medical Centre (UK) in bringing out the Review Report at the Government initiative and getting the report published in British Medical Journal (Marian S McDonagh et al. 2000) has attracted more criticism than any other scientific report till date.

The York Review Report can be summarised as follows:

- “What is already known on this topic of water fluoridation
- Dental caries cause morbidity and suffering and incur costs.
- Artificial water fluoridation has been used as a community intervention to reduce prevalence of dental caries for decades in some countries, but its use remains controversial.
- What York Review adds:
- A systematic review of water fluoridation reveals that the quality of evidence is low.
- Overall reduction in the incidence of caries were found, but they were smaller than previously reported.

- The prevalence of Fluorosis (mottled teeth) is highly associated with the concentration of fluoride in drinking water.
- An association of water fluoride with other adverse effects was not found. BMJ October 2000."

It is a fact that the York Review considered only fluoride exposure from water fluoridation. It did not examine the total fluoride exposure of individuals / population from all sources. The very narrow criteria of the review resulted in the exclusion of all animal studies, all biochemical, molecular level studies besides all mathematical and statistical models effectively eliminating from the review a vast body of scientific evidence attesting to the harmfulness of fluoride via exposure from water and a wide variety of other sources. Major contributions emerged globally over a period of 6 decades were pushed aside in one stroke, to justify the validity for water fluoridation.

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## Concluding Remarks

The need to view and assess the issues of Fluoride and Fluorosis in the developing countries has become extremely important as the changing trend in policy planning and implementation is based on scientific data emerged from the respective nation(s). Policies and programmes based on geo-climatic conditions, high intake of water, shortage of safe drinking water, draught, poor nutritional standards, illiteracy, unsanitary conditions and associated issues are far more relevant to the community of the developing countries to combat their health problems.

The communication has focussed upon relevant issues for tackling fluoride and Fluorosis problems in the developing countries. The multinational companies (MNCs) and their approach to misguide the public to use fluoridated products is considerable. The best each country can do is through creating proper awareness among the people on the dangers of fluoride. Such efforts have yielded beneficial results to a large extend among the civil society in India.

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