



# Fluorosis

State Institute of Health and Family Welfare,  
Jaipur



# Magnitude of Fluorosis

- Worldwide in distribution
- Endemic in 22 countries
- Asia
  - India and China are worst affected
- Mexico in North and Argentina in Latin America
- East and North Africa are also endemic



# Fluorosis in India

- Worst affected - Rajasthan and Gujarat in North India and Andhra in South India.
- Moderately affected - Punjab, Haryana, M.P. and Maharashtra.
- Mildly affected - T.N., W.B., U.P., Bihar and Assam.
- Throughout India - fluorosis is essentially Hydrofluorosis except in parts of Gujarat and U.P. where industrial fluorosis also seen.
- In worst affected states, maps have been prepared of geographic pathology on the basis of fluoride distribution in the drinking water.



# Agent Factors

- Primarily it is Fluoride which is present in drinking water
- When F in water is more than 1.5 mg per litre, it is toxic to health
- pH in terms of alkalinity of water promotes the absorption of F
- Calcium in the diet reduces the absorption of F
- Hard water rich in Calcium reduces the F toxicity
- Fresh Fruits and Vit.C reduces the effect of F
- Trace elements like Molybdenum enhances the effect of F



# Host Factors

- In School going children seen as dental fluorosis.
- In third and fourth decade of life seen as Skeletal Fluorosis.
- Males suffer more than females.
- Migration influences the occurrence depending on which way people migrate.
- Illiterates suffer more frequently in the fluorotic belts.
- Where aluminum ores are mined, it is seen as occupational health hazard.

# Environmental Factors



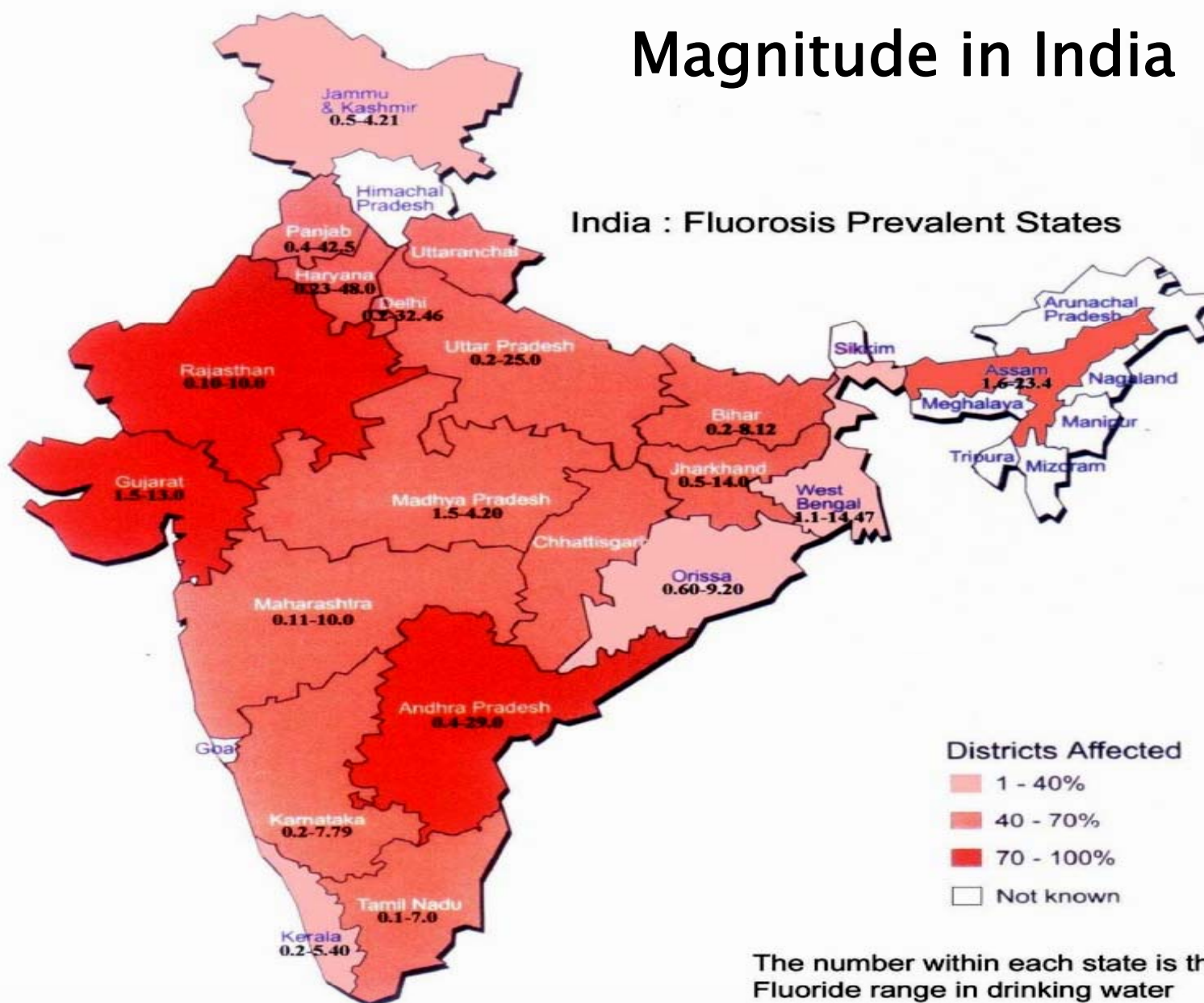
- High Annual Mean Temperature
- Low Rainfall
- Low humidity
- F rich Natural subsoil rocks
- Vegetables from high F belts
- Fluoridated tooth paste particularly when used by children
- Tropical climate
- Developing Countries



# Magnitude of Problem

# Magnitude in India

India : Fluorosis Prevalent States



The number within each state is the Fluoride range in drinking water

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



# Magnitude in India



Alarming in at least 17 states of India:

- (I) 50-100% districts are affected - Andhra Pradesh, Tamil Nadu, Uttar Pradesh, Gujarat, Rajasthan
  - (II) 30-50% districts are affected - Bihar, Haryana, Karnataka, Maharashtra, Madhya Pradesh, Punjab, Orissa, West Bengal
  - (III) < 30 % districts are affected - J & K, Delhi, Kerala
- 66.6 million people including 6 million under 14 children are at risk of acquiring fluorosis
  - 2 % children in India are affected by dental Fluorosis

Source: (Nutritional survey of children, Eleventh five year plan 2007-2012) & \*(ICMR, RMRCT, Update vol.1, October 2004)



# In Rajasthan

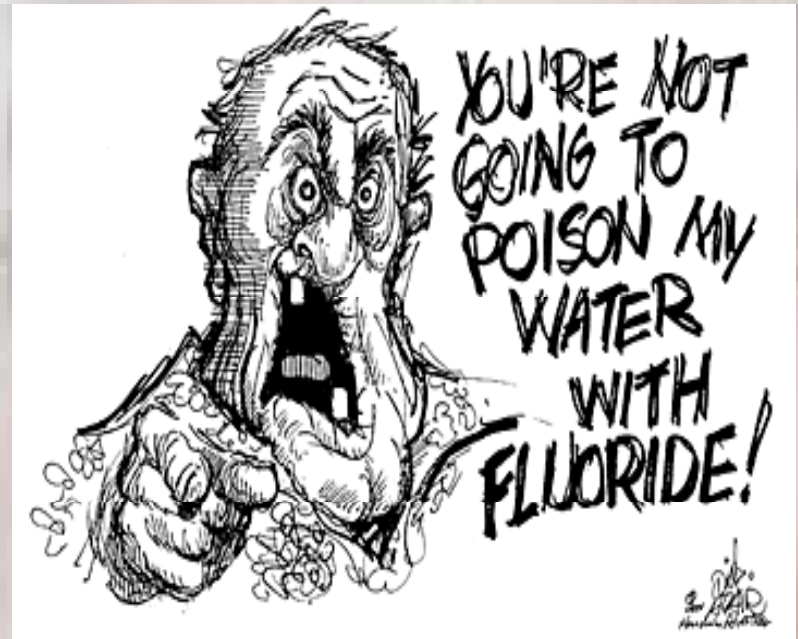
- Fluorides in drinking water from indigenous rocks and ground water around the mica mines (Rajasthan has rich sources of mica).
- All the 32 districts have been declared as fluorosis prone areas. The worst :Nagaur, Jaipur, Sikar, Jodhpur, Barmer, Ajmer, Sirohi, Jhunjhunu, Churu, Bikaner, Ganganagar etc.

# Sources of fluoride for human exposure:



Main sources of fluoride :

- Water
- Food
- Air
- Medicament
- Cosmetic





# Permissible limit of fluoride in drinking water prescribed by various organizations

Name of the organization	Desirable limit (mg/L)
Bureau of Indian Standards (BIS)	0.6-1.2
Indian Council of Medical Research (ICMR)	1.0
The Committee on Public Health Engineering Manual and Code of Practice, Government of India	1.0
World Health Organization (International Standards for Drinking Water)	1.5



# Drinking Water fluoride concentration

<b>Drinking Water fluoride concentration</b>	<b>Fluoride from food (Average)</b>	<b>Fluoride from water</b>	<b>Total fluoride intake</b>	<b>Water : Food Ratio</b>
4 ppm	5 mg per day	10 mg per day	15 mg per day	66.6:33.3
8 ppm	5 mg per day	20 mg per day	25 mg per day	80:20



# Fluoride Concentration (mg/l)

Fluoride (mg/l)	Source	Effects
0.002	Air	Effect on plants
1.00	Water	Prevention of Dental caries
$\geq 2$	Water	Effect dental enamel
$\geq 8$	Water	Effect Bones and muscles
$> 50$	Food, Water	Changes in Thyroid
$> 100$	Food, Water	Defective development
$> 120$	Food, Water	Changes in Kidney



# Factors Affecting Development of Fluorosis:

- Concentration of fluoride in drinking water (more than 1.5 mg/ L), food, cosmetics etc.
- Low calcium and high alkalinity of drinking water promotes the absorption of F.
- Age

# Clinical Picture of Endemic Fluorosis

- Dental Fluorosis in Children
- Skeletal Fluorosis in Adults
- Non Skeletal Fluorosis








# Dental Fluorosis

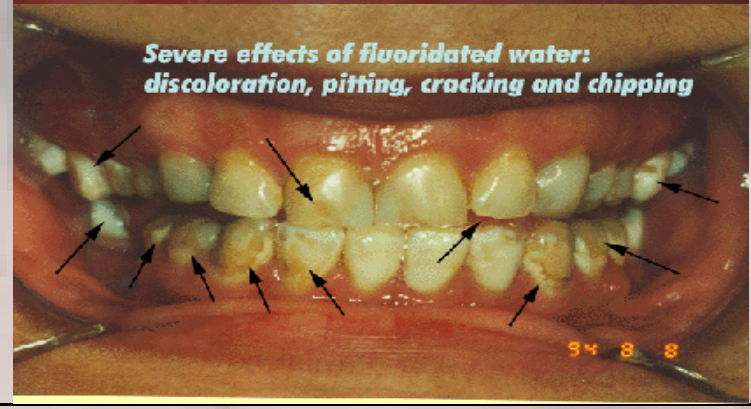
- Teeth become dull and yellow-white spots appear & Gradually turn brown.
- In late stages the whole teeth become black. Teeth may be pitted or perforated and may even get chipped off.
- In endemic zones people lose their teeth at an early age and may become edentate.

# Dental Fluorosis Scale



Type	Wt	Description	
<b>Normal Enamel</b>	0	Enamel smooth, glossy, pale creamy white translucency	
<b>Questionable fluorosis</b>	0.5	Slight aberrations from translucency with occasional white fleck or spots	
<b>Very mild fluorosis</b>	1	Small, opaque, paper-white areas involving less than 25% of the surfaces of the two most affected teeth; may acquire brown stains in adulthood	

Type	Wt	Description
<b>Mild fluorosis</b>	2	More extensive dull white opacities involving less than 50% of the surfaces of the two most affected teeth.
<b>Moderate fluorosis</b>	3	All enamel surfaces affected; distinct brown staining frequent
<b>Severe fluorosis</b>	4	Teeth show marked hypoplasia, attrition and pitting; brown or black staining widespread.





# Timing of chronic daily fluoride ingestion and the corresponding dental fluorosis pattern

<b>Fluoride Intake (mg/kg/day}</b>	<b>When Exposed</b>	<b>Permanent Teeth Infected</b>	<b>Dental Fluorosis Severity</b>
< 0.5	0-3 years	Incisors, 1st Molars	mild
0.10-0.15	0-3 years	incisors, 1st molars, and tips of canines & premolars	moderate
> 0.15	0-3 years	all teeth	severe
< 0.05	3-6 years	Premolars, canines, 2nd molars	mild



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> 0.15	3-6 years	all teeth	severe
< 0.5	0-6 years	all teeth	mild
0.10 - 0.15	0-6 years	all teeth	moderate
> 0.15	0-6 years	all teeth	Severe

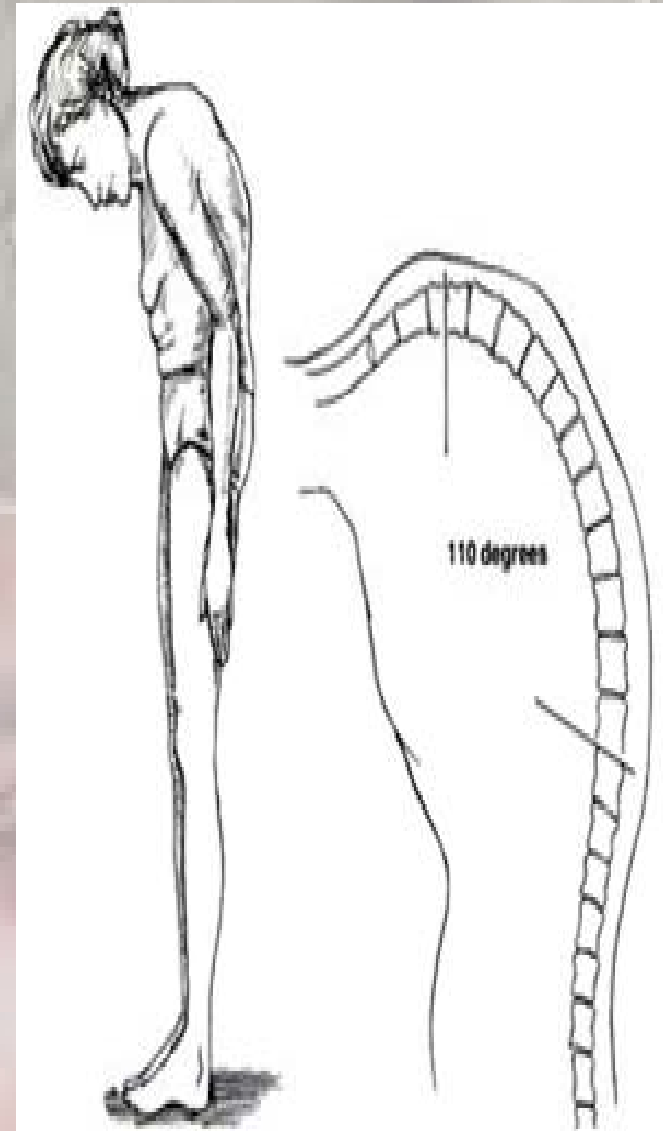


# Dental Fluorosis Treatment

- ✓ **Tooth whitening** - only for mild fluorosis cases.
- ✓ **Composite bonding**- only for severe cases of fluorosis
- ✓ **Porcelain veneers**- they can provide excellent cosmetic results.

# Skeletal Fluorosis :

- Associated with lifetime daily intake of 3.0 to 0.6 mg/ l or more.
- When a concentration of 10 mg/ l is exceeded in drinking-water , Crippling Fluorosis can ensue and lead to permanently disability.





# Stages: Skeletal Fluorosis

**Preclinical Stage:** the patient feels no symptoms but changes have taken place in the body

- Biochemical abnormalities occur in the blood and in bone composition
- Histological changes can be observed in the bone in biopsies

**Early clinical stage:**

- Pains in the bones and joints
- Sensations of burning, pricking, and tingling in the limbs
- Muscle weakness
- Chronic fatigue;
- Gastrointestinal disorders and reduced appetite.
- Changes in the pelvis and spinal column can be detected on x-rays.



## Second clinical stage:

- Constant pains in the bones, ligaments begin to calcify.
- Osteoporosis may occur in the long bones, and early symptoms of osteosclerosis
- Bony spurs may appear on the limb bones, especially around the knee, the elbow, & on the surface of tibia and ulna.

## Advanced skeletal fluorosis (Crippling Skeletal Fluorosis):

- Extremities become weak and moving the joints is difficult.
- The vertebrae partially fuse together, crippling the patient.



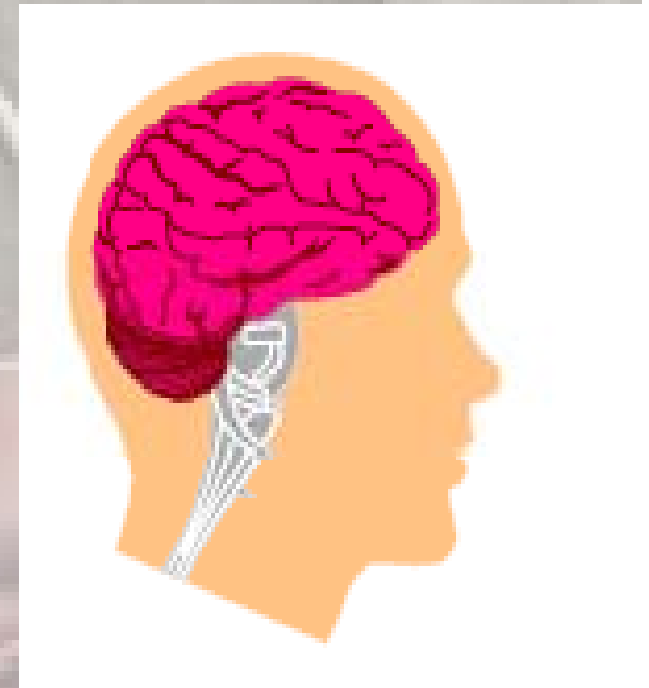
# Tests for Skeletal Fluorosis

- **Coin Test:** The subject is asked to lift a coin from the floor without bending the knee. A fluorotic subject would not be able to lift the coin without flexing the large joints of lower extremity.
- **Chin Test:** The subject is asked to touch the anterior wall of the chest with the chin. If there is pain or stiffness in the neck, it indicates the presence of Fluorosis.
- **Stretch Test:** The individual is made to stretch the arm sideways, fold at elbow and touch the back of the head. When there is pain and stiffness, it would not be possible to reach to the occiput indicating presence of Fluorosis.

# Non Skeletal Fluorosis

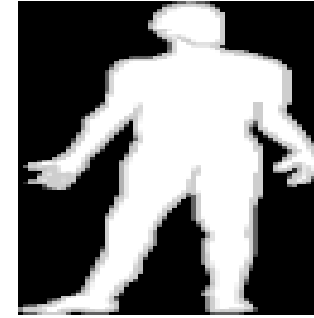
## 1. Neurological Manifestations

- Nervousness & Depression
- Tingling sensation in fingers and toes
- Excessive thirst and tendency to urinate
- Frequently (Polydypsia and polyurea)
- Control by brain appears to be adversely affected.
- Muscular manifestations



## 2. Muscular manifestations

- Muscle Weakness & stiffness
- Pain in the muscle and loss of muscle power



## 3. Urinary tract manifestations

- Urine may be much less in volume
- Yellow red in colour
- Itching in the region of axilla

Urinary tract manifestations

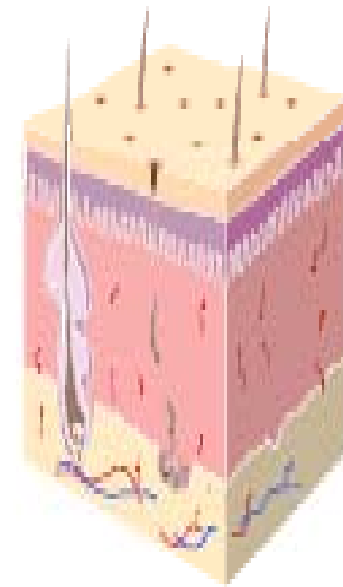
Kidney'



## 4. Allergic manifestation

- Skin rashes
- Perivascular inflammation.
- Pinkish red or bluish red spot, round or oval shape on the skin that fade and clear up within 7-10 days.

### Allergic manifestation



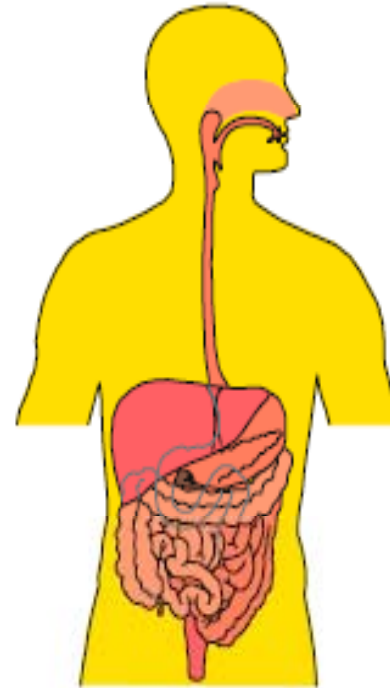
## 5. Gastro - intestinal problem

- Acute abdominal pain
- Diarrhoea
- Constipation
- Blood in Stool
- Bloating feeling (Gas)
- Tenderness in Stomach
- Feeling of nausea

## 6. Red Blood cells

- Formation of echinocytes.
- Anaemia.

### Gastro - intestinal problems





# De-fluoridation:

-At Household Level

-At Commercial Level



- De-fluoridation is the process of removal of excess fluoride from water.
- WHO has identified and evaluated the most promising de-fluoridation methods :
  - Bone charcoal
  - Contact precipitation based on the addition of calcium and phosphate compounds
  - Nalgonda Technique
  - Activated alumina



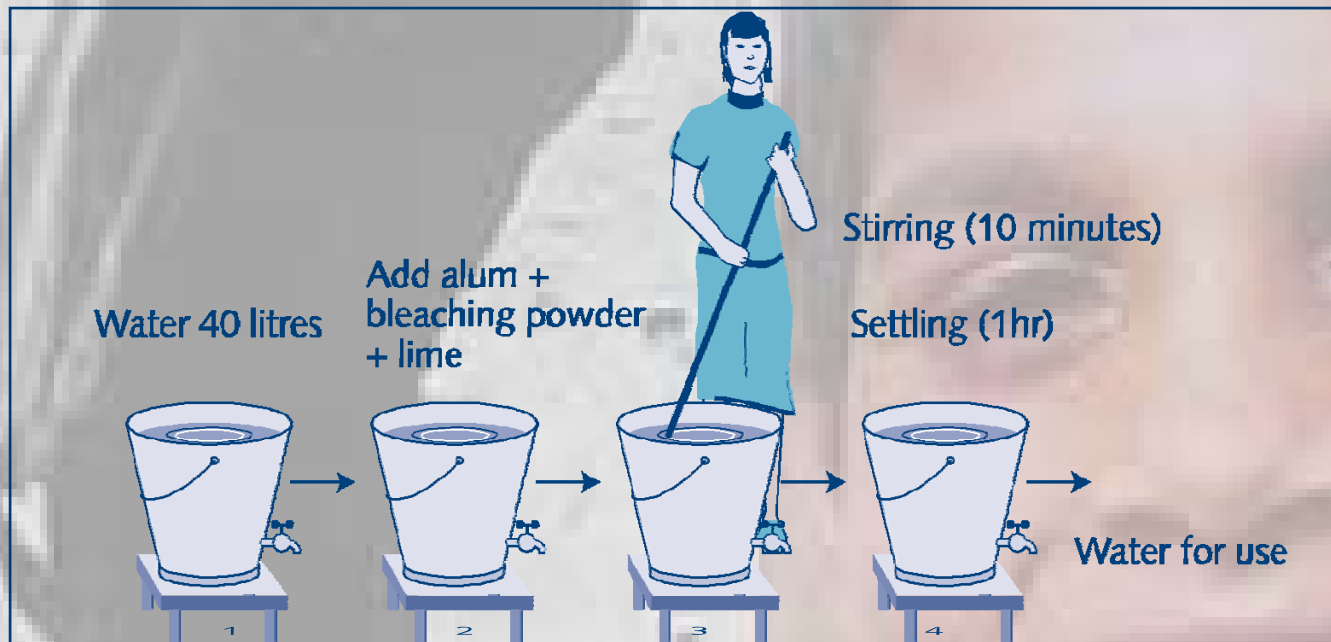


# At Household Level

# Nalgonda Technology: Water Treatment



- De-fluoridation using Nalgonda technology (Adapted from RDNDWM, 1993)
- Raw water mixed with aluminium sulphate (alum), lime or sodium carbonate (1/20<sup>th</sup> of alum) and bleaching powder (3 mg/l).
- Stir water slowly for 10-20 minutes and allow to settle for nearly one hour. Supernatant is withdrawn. Discard the sludge.





# These Do NOT Remove Fluoride

- **Boiling Water** :This will concentrate the fluoride rather than reduce it.
- **Freezing Water**: Freezing water does not affect the concentration of fluoride.



# Drugs

**Medicines:** The list of fluorinated drugs number in the hundreds but the more common ones include:

- Celebrix
- Cipro
- Diflucan
- Prozac
- Dalmane
- Lipitor and
- Nearly all of the halogenated general anesthetics.

Depending on the molecular formula, these drugs contain from 3% to 17% fluorine by weight.



- **Antidepressants: nonaddictive drugs are used to induce deep sleep:**

- Amitriptyline
- Elavil
- Clobenzaprine (Flexeril)
- Zanax
- Paxil
- Klonopine
- Citalopram,
- Prozac
- Paraxetine
- Fluoroquinolones

- **Sleeping Pills:**

- Valium
- Halcion
- Restoril

- **Corticosteroids: Prescribed for severe pain**
  - Prednisone
  - Cortisone
- **Acetaminophen (nonsteroidal anti-inflammatory plus antipyretic [lowers fever])**
  - Tylenol
  - Liquiprin
  - Datril
- **NSAIDs (Nonsteroidal anti-inflammatory)**
  - Motrin
  - Advil
  - Aspirin
  - Indocin
  - Ibuprofen
  - Excedrin
  - Midol
  - Nuprin



# Food Supplements





# Food for ameliorating fluoride effects :

## Calcium:

Milk, (2) dahi, (3) jaggery (4) green leafy vegetables, (5) til seed, (6) cheese, (7) kamal kakdi, (8) arbi, (9) Chulai ki sag, (10) jeera, (11) drumsticks and the leaves, (12) soya products (13) broccoli etc.

## Iron:

Beet root (2) apple (3) raw and ripe banana (4) brinjal etc.

## Vitamin C:

Vegetable oil, (2) nuts (almond, peanut), (3) whole grain cereals, (4) green vegetables, (5) dries beans etc.

## Vegetables and fruits rich in antioxidants:

Papaya, (2) carrot, (3) pumpkin, (4) spinach and other leafy vegetables, (5) garlic, (6) spring onion, (8) chilly, (9) pepper, (10) apple, (11) cherry, (12) oranges (13) ginger etc.



# Steps to Reduce Fluoride

- **Avoid fluoride supplements**

## **Fluoride Rich Food Substances**

- Black tea and Lemon tea (tea with milk is safe);
- Black rock salt (kala namak);
- Black rock salt lased pickles,
- Garam masala, salty snacks,
- Chaat and Chaat masala
- Canned fruit juices
- Cannel fish
- Fluoride contaminated drinking water
- Chewing of tobacco
- Supari (arccanut) and
- “Hajmola” and other “Churan” containing rock salt.



- **Fluoride Rich Dental Products:**

- Fluoridated toothpaste
- Mouth rinse
- Varnish and
- Sodium fluoride tablets



# At Commercial Level



# Commercial Methods:

- **IISc method**

- The magnesium oxide method, commonly called the IISc method
- Most effective method & costs 15–30 paisa/l to defluoridize.
- Magnesium oxide is easily available and the technique is economically feasible.

- **Solar distillation**

- Because of its simplicity and very little maintenance, it can be adopted for rural communities of India



## Other ways to remove Fluoride

- **Reverse Osmosis Filtration**
- **Activated Alumina De-fluoridation Filter:** Used in locales where fluorosis is prevalent, expensive and require frequent replacement
- **Using harvested rainwater for drinking**



# Project Bhagidari

- A community –based Self Sustained Safe Drinking Water Program(De-Fluoridation Plant).
- A community –owned water purification model that facilitates **Public Private participation** to deliver safe water at Price affordable to the community



## Need :

- No access to safe drinking water.
- Water contamination with high fluoride and pathogens.
- Resulting bone deformities



## Objective:

To improve the health of the people of nearest residing community through a Sustainable model approach, based on Public Private Partnership (PPP)



## Social Impact

- Employment Generation
- Reduction in Fluorosis cases and bone deformities
- Better health & reduction in medical bill for the poor.
- Water Quality standards confirming to BIS/WHO
- Right to use retained by community
- Community awareness on the water and environment.
- Safe & clean water to community at nominal cost –Rs 2 and 40 Paise for a family





# The Tripartite Partnership Model

**BQSCH  
Community**

**Technical Partner**



Capital cost  
Legal approval  
Water source  
Land  
Awareness

Technology  
Annual Maintenance  
Quality Assurance  
Health Education  
Training

Community promotion  
Distribution  
Social Marketing  
Health Education  
Training

**Social Partner**

**RBIN/JaP provided the fund of  
Rs8.2 lacs as a partial capital  
cost of project**



# Case studies

## Case 1:

**Patient:** a doctor specialized in surgery; unable to stand long hours and operate on patients due to back pain. Pain killer was providing only temporary relief.

**Reason for the health problem:** high fluoride in drinking water which the patient was not aware of as fluoride does not change colour, taste or odour. On confirmation of Fluorosis to, the interventions provided relief and recovery from the ailment.



## Case 2:

Patient: a lawyer, 45 yrs old with severe non-ulcer dyspeptic complaints, lived for 10 years on milk of magnesia. Fluorosis had reached an advanced stage and the patient was also suffering from secondary hyperparathyroidism; edentulous. On confirmation of the disease as Fluorosis, non-ulcer dyspepsia disappeared within 10 days on diverting to “safe drinking water” with fluoride not exceeding 0.5mg/L; milk of magnesia was not required thereafter.



## Case 3:

Patient: a 9 yr old boy with dental fluorosis. Mother, a doctor was concerned and went around different hospitals in the city without realizing that the boy was exposed to high fluoride and the discolouration on the teeth is dental fluoride in urine and serum were high. Repeated enquiries on food habits in the family and that of the boy in particular, did not yield



beneficial results. Cause of dental fluorosis was eventually traced to intake of a homeopathy drug from the age of 2yrs till then. On stopping the drug which was provided for calcium supplementation, the fluoride levels in serum and urine were brought to normal limits. There was very little that could be done for the child except that the discoloration of teeth could be masked by appropriate dental procedure, when he becomes an adult.



# Thank You

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