



Good
Morning !!

HAVE A LOVELY DAY !!

Fluoride delivery methods

2. Systemic Fluorides

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INTRODUCTION

- Systemic fluorides provides a low concentration of fluoride to the teeth over a long period of time.
- It circulates through the blood stream and is incorporated into developing teeth.
- After teeth erupt, fluoride contacts teeth directly through salivary secretions.
- Most systemic fluorides have a topical effect but their primary effect is systemic.



HOW DO SYSTEMIC FLUORIDES WORK

- Systemic fluorides are those that are ingested into the body and become incorporated into forming tooth structures.
- Systemic fluorides when ingested during tooth development are deposited to some extent throughout the tooth surface.
- However, the actual mechanism of action of systemic fluorides is from the topical protection as the fluoride present in saliva, which continually bathes the teeth, provides a constant source that is also incorporated into plaque and facilitates remineralisation.



TYPES OF SYSTEMIC FLUORIDES

1. Water fluoridation

Community water fluoridation

School water fluoridation

2. Salt fluoridation

3. Milk fluoridation

4. Fluorides tablets



FLUORIDES COMPOUNDS AND CONCENTRATIONS THAT ARE USUALLY USED IN DIFFERENT SYSTEMIC FLUORIDES METHODS

FLUORIDES METHODS	FLUORIDES COMPOUNDS	CONCENTRATIONS
WATER FLUORIDATION	hydro fluorosilicate (FSA), sodium fluorosilicate, sodium fluoride	0.7 - 1.2 mg/L
SALT FLUORIDATION	potassium fluoride , sodium fluoride	250-300 mg/kg
MILK FLUORIDATION	Sodium fluoride or disodium monofluorophosphate	5 mg/L
DIETRY FLUORIDES SUPPLEMENTATION	sodium fluoride, acidulated phosphate fluoride, potassium fluoride, calcium fluoride	0.25 – 1.0 mg/day Table





WATER FLUORIDATION

- Water fluoridation is defined as “in a communal water supply so controlled adjustment of the concentration of fluoride as to achieve maximum caries reduction and clinically insignificant level of fluorosis”.
- It can also be defined as “the **upward adjustment of the concentration of fluoride in public water supply** in such a way that the concentration of fluoride ion in the water may be consistently maintained at 1 parts per million(ppm) by weight to prevent dental caries with minimal possibility of causing dental fluorosis .”

- The water fluoridation is one of the most common delivery methods of fluoride.
- It presents a **lower cost and long range.**
- However for water fluoridation to be effective it has to be a continuous process and the concentration of fluoride has to be well controlled.
- The recommended concentration varies between 0.7 and 1.2 ppm, depending on the average regional temperature.
- The lower levels of fluoride are recommended for warmer regions. In these locations the intake of water tends to be higher



- The optimal level of fluoride in water for protection against dental caries is approximately 1 part per million. (ppm)
- Fluoridation is the adjustment of water supply to a fluoride content such that reductions of 50 to 70 % in dental caries would occur without damage to teeth or other structures.



HISTORY OF WATER FLUORIDATION.

The first water fluoridation programme was started in the year 1945 in the four cities in USA.

**GRANDS RAPIDS-
MUSKEGON
STUDY**

**NEWBURGH-
KINGSTON
STUDY**

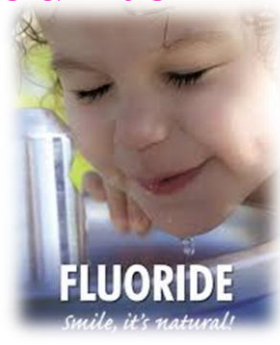
**EVANSTON-
OAK PARK
STUDY**

**BRANTFORD-
SARNIA-
STARTFORD
STUDY**

TIEL – CULEMBORG STUDY

GRAND RAPID- MUSKEGON STUDY

- On January 25th, 1945, sodium fluoride was added to GRAND RAPIDS water supply. **Muskegon town was kept as a control.**
- After 6 ½ years in July, 1951 the caries experience of 6 and 15 years old children residents of Grand Rapids was half that of Muskegon. (reported by - Arnold et al, 1953).
- So impressive was the efficacy of fluoridation that the city officials of **Muskegon also decided to fluoridate their own water supply also.**





NEWBURGH – KINGSTON STUDY

- On May 2nd 1945 , sodium fluoride was added to drinking water of Newburgh on the Hudson river .
- **Kingston town was kept as a control.**
- After 10 years of fluoridation Et Al (1956) reported that the DMF rate had fallen from 23.5 % to 13.9 %, confirming the inhibitory property of 1 ppm fluoridated drinking water.





EVANSTON- OAK PARK STUDY

- In January 1946, a fluoridation experiment began in Evanston ,Illinois and the nearby community of oak park acted as the control town.
- After 14 years of fluoridation in Evanston, there was a **reduction of 49 % in DMF values.**
- The Evanston-Oak park study presented the most detailed data of all the fluoridation studies.



THE BRANTFORD- SARNIA-STARTFORD FLUORIDATION CARIES STUDY

- In Canada, a project was undertaken in Brantford, Ontario, where fluoride was added to water supply in June 1945.
- The community of **Sarnia was established as the control town.**
- In addition ,the community of **Stratford**, where fluoride was naturally present in drinking water at level of 1.3 ppm was used as an **auxiliary control.**
- After 17 years of fluoridation in Brantford, caries experience was similar to that occurring in the natural fluoride area of Stratford and was 55 % lower than in the control town of Sarnia (REPORTED BY – ET OL-1951 ; BROWN AND POPLOVE,1965)

TIEL – CULEMBORG STUDY

- In March 1953 the drinking water in Tiel was fluoridated to a level of 1.1 ppm.
- **Culemborg** with water fluoride level of 0.1 ppm was the **control**.
- After 13 years of fluoridation, the number of anatomical sites of teeth affected by dental caries was 58 % lower in Tiel than in Culemborg.

OPTIMAL WATER FLUORIDE CONCENTRATION

- The optimum recommended fluoride levels varies with climate because the average consumption of water increases in warmer climates
- In **cold climates** the recommended fluoride level may be as **high as 1.2 ppm** while in extremely **hot climate** a level of about **0.7 ppm is recommended**
- In moderate climates this optimum fluorides level has been shown to be 1 ppm.
- The optimum fluoride concentration for particular community can be calculated by following equation:
- **Ppm fluoride (concentration) = 0.34/E**
- Where **E = -0.038+0.0062 x temperature of the area in degree farhenite.**

PRE REQUIREMENTS OF WATER FLUORIDATION

1. Presence of caries in the community/public
2. Level of fluoride concentrations in their drinking water .
3. Centralized water supply to the community
4. Community acceptance/approval.
5. Installation and maintenance cost.



MATERIALS USED IN WATER FLUORIDATION

- Three types of fluoride equipments
 1. **Dry feeder**
 2. **Solution feeder**
 3. **Saturation methods**
- Dry compound such as **ammonium silico fluoride, fluorspar, sodium silico fluoride.**
- Solution of **hydrofluoro sillicic acid.**

Fluoride is added to water , after it is purified and before it is ready for consumption, with the help of fluoride equipment.

Constant monitoring is required once the water is fluoridated to maintain the constant level of fluoride i.e., **0.8 to 1.2 ppm.**

SYSTEM	PROCEDURE	FACTORS LIMITING USAGE	RECOMMENDATION
SATURATOR SYSTEM	4 % saturated solution of NaF is produced and injected at the desired concentration in the water distribution source with aid of a pump.	Need to clean gravel bed used for filtration.	Suitable for medium sized towns requiring less than 3.8 million lit/day
DRY FEEDER	NaF or silicofluoride in the form of powder is introduced into a dissolving basin.	Care in handling fluoride, obstruction of pipes and compacting of fluoride while storage.	Suitable for medium sized towns requiring 3.8 million lit/day to 19 million lit/day.

**SOLUTION
FEEDER**

Volumetric pump permitting the addition of a given quantity of hydrofluosilicic acid in proportion to the amount of water treat

the equipment must be resistant to attack by hydrofluosilicic acid, necessitating construction in polyvinyl chlorides or another plastic.

Suitable for medium sized and large towns with a capacity of more than 7.6 million lit/day



ADVANTAGES OF WATER FLUORIDATION

- Large number of people are benefited.
- Consumption is regular
- Fluoridated drinking water not only acts systemically
- During tooth formation to make dental enamel more resistant to dental decay, but also has topical effect through the release in saliva after ingestion.
- Fluoridation of community water is the least expensive way to provide fluoride to a large group of people.



SCHOOL WATER FLUORIDATION

- School water fluoridation is one of the possible areas to be explored. This programme helps in limiting caries in school children who are the prime concern.
- It is the suitable alternative where water fluoridation is not feasible.
- The amount of fluoride added in school drinking water should be greater than normal because children have to stay in the school for a short period of time and to compensate for holidays and vacations.

HISTORY

- This procedure was first started in 1954 in St. Thomas V.S Virgin islands by US public health service division.

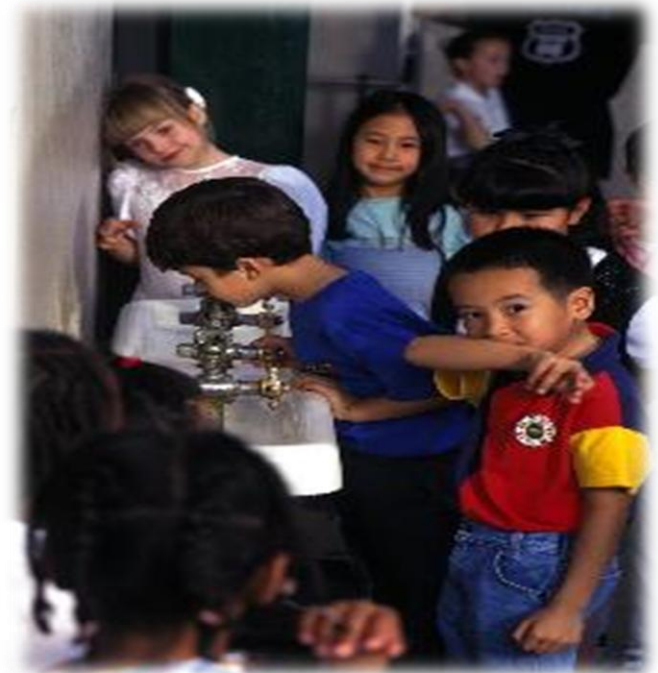
- There has been around 25 to 40 % decrease in dental caries with this program.
- Simple fluoridators particularly that employ the venturi system are most suitable ,because they require almost no maintenance and can be utilized effectively in small instalments of small or medium sized schools.

ADVANTAGES

- good results in reducing caries.
- Minimal equipment .
- Not expensive.

DISADVANTAGES

- Children do not receive the benefit until they go to school.
- Not all children go to the school in poor countries and towns and villages.
- Amount of water drunk can't be regulated.



SALT FLUORIDATION



INTRODUCTION

- Salt fluoridation is a controlled addition of fluoride ,usually sodium or potassium fluoride ,during the manufacture of salt for human consumption.

HISTORY

- First fluoridated salt was introduced by **WESPI in Switzerland** 1948.it has been on sale in Switzerland since 1955.
- Experiments have been conducted with concentration of fluoride in salt ranging from 90 mg of fluoride per kg. salt to 200 -350 mg/kg .

- Initial clinical trial of 90 mg/kg fluoride salt showed 20- 25 % of reduction of dental caries.
- In **1967 Muhleman** showed the safe dose of fluoridated salt, that 300 mg/kg yields 1.5 mg fluoride/5 gm of salt. Tooth from Hungary, after 8 years of salt fluoridates at the level of 250 mg fluoride /kg reported **35-58% of caries reduction**



PRODUCTION AND PREPARATION OF FLUORIDATED SALT

- For effective caries prevention, fluoride must be present in ionic form when salt (sodium chloride) is dissolved in water . There are essentially two different salt production processes:
 1. **Batch processing**
 2. **Continuous processing**
- Fluoride is added to salt by spraying concentrated solutions of sodium fluoride or potassium fluoride.
- **Premixed granules of NaF and CaF₂ with PO₄ are added to common salt.**



ADVANTAGES

- Fluoridated salt is safe.
- Theoretically fluoridated salt prevents dental caries by both systemic as well topical action.
- It does not require community water supply as in case of water fluoridation.
- It permits **individual to accept it or reject it.**
- Low cost
- **Fluoridated salt and iodized salt can be made available to the population.**



MILK FLUORIDATION



INTRODUCTION

- Milk fluoridation is the addition of a measured quantity of fluoride to bottled or packaged milk to be drunk by children.

HISTORY

- It was introduced by Zeigler ,a paediatrician, who started the first project with fluoridated milk in Swiss city of Winterthur in **1953**.
- In **1971**, Dr. Edgar borrow established the **Borrow foundation** (formally the Borrow dental milk foundation) in England, with the aim of promoting the use of milk as a vehicle for fluoride for the benefit of children's oral health.
- The first community based milk fluoridation scheme was introduced in **1988**, in Bulgaria, under the international milk fluoridation program.

Rationale of milk fluoridation

- The nutritional value of milk has been well documented .
- Milk is often available to children through school and nutritional programs and the use of such distribution systems can provide a convenient and cost efficient vehicle.
- Virtually all forms of milk products are suitable for fluoridation and the process is relatively simple.
- Milk fluoridation can be targeted at those communities in greatest need.

- Research has been demonstrated the effectiveness of fluoridated milk in preventing dental disease .
- The bioavailability of fluoride is not reduced by milk.
- Fluoridated milk keeps a permanently **low level of ionized fluoride within the oral cavity** ,promoting remineralisation. This topical mechanism contributes to the caries preventive effect of fluoridated milk.



PLANNING A MILK FLUORIDATION PROGRAMME

- There are a number of points, which have to be considered when deciding whether milk fluoridation is necessary for any given community.

DENTAL HEALTH STATUS:

- The oral health status within the community especially that of the children must be determined properly. If the DMFT among the children is moderate to very high, then there is a clear indication for caries preventive programs.

❖ OTHER FLUORIDE SOURCES:

- The levels of fluoride in the drinking water of the community and whether **fluoride tooth pastes** are being used should be considered before the fluoride dose to be delivered in the milk estimated.

❖ URINE ANALYSIS

- When a decision has been taken to implement milk fluoridation scheme, **urinary fluoride monitoring procedure is mandatory** with respect to safety and compliance of the program.



❖ FLUORIDATING THE MILK

- Fluoridated milk can be produced in number of forms,
- **Liquid (pasteurized and sterilized) and**
- **Powder**
- Each containing a variety of fluoridating agents so as to provide them with the optimum amount in line with recommendations of WHO Expert Committee (1994), i.e. ranging from zero to 1.0 mg fluoride per day according to the age of the child and the fluoride concentration in the local water supply.



MILK DISTRIBUTION PROGRAM



COMPOUNDS USED FOR MILK FLUORIDATION

- Calcium fluoride
- Sodium fluoride
- Disodium monofluorophosphate
- Disodium silicofluoride



FLUORIDE SUPPLEMENTS

- Fluoride supplements are available in different forms such as fluoride tablets ,drops , lozenges.
- Fluoride tablets, drops and lozenges are not available over the counter but prescribed by the dentist or paediatrician to individual patients or as a part of school or home based preventive dentistry program.



FLUORIDE COMPOUND USED

- Most commonly used is **sodium fluoride** .
- Other compounds used are acidulated phosphate fluoride, potassium fluoride or calcium fluoride.
- Supplements contain measured amount of fluorides, **0.25 mg , 0.5 mg, 1.0 mg.**
- They should be taken on daily basis according to the prescribed dosage schedule.
- The council of **DENTAL THERAPUTICS OF AMERICAN DENTAL ASSOCIATION** recommends the dosage schedule for dietary fluoride supplements as shown in the table :

AGE	Fluoride concentration of drinking water (ppm) (ADA 1994)		
	< 0.3	> 0.3 < 0.6	> 0.6
0-6 MONTHS	-	-	-
6 MON TO 3 YRS	0.25 gm	-	-
3 TO 6 YRS	0.5 gm	0.25 gm	-
6 TO 16 YRS	1 gm	0.5 gm	-

- Correct dosage is based on the **concentration of fluoride in drinking water, age and weight** of the child and other available fluoride.
- **Not more than 1 milligram of fluoride** should be ingested each day from all available systemic sources.



INDICATIONS FOR USE

- In areas where there are no central supplies, where the fluoride concentration of well-water is low and where parental motivation is very high.
- As an interim measure in these communities with a central water system that have not yet implemented community water fluoridation.
- In areas where water fluoridation or salt fluoridation schemes cannot be implemented.
- In families where there is high degree of mobility involving frequent changes in the place of work and residence and where parents wish to ensure daily fluoride supplementation themselves.

BENEFITS

- The use of dietary fluoride supplements from birth to age 13 or 16 years provides caries reduction from 16-65%.
- Supplements provide systemic and topical benefits for primary and permanent teeth.



CONCLUSION

- When used appropriately, fluoride is a safe and effective agent that can be used to prevent dental caries.
- Fluoride is needed throughout the life to protect teeth against tooth decay.
- To ensure additional gains in oral health systemic fluorides has been introduced.

References

1. Essentials of Public Health Dentistry, 4th edition; SOBEN PETER; Pg. no. 265-280.
2. Textbook of pedodontics , 3rd edition, NIKHIL MARWAH ; Pg. no. 257-265

Thank you...