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DENTAL CARE FOR SCHOOL CHILDREN

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A Thesis submitted in partial  
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## I INTRODUCTION

"Children may be the victim of fate, but never must they be the victim of neglect" J.F. Kennedy.

With an increasing demand to provide a dental care service for children, there arises a need within the profession to reassess what is to be achieved from the treatment offered, and what benefits will arise from the time and effort involved. Modern dentistry besides answering a popular demand attempts to create a need in the population, through dental health education, for improved standards of oral health. It is important to consider the part played both by the professions and auxiliaries in dentistry for children to the fulfilling of that goal.

Two problems to consider when supplying a service of any kind for children is to determine what is best for the child, and what is best for the eventual adult. A child's need for a functional dentition is greater than that of an adult, because his requirements for calories and nutrients are proportionately greater while he is rapidly growing and living a very active life. From the orthodontic point of view it has long been accepted that the health and eruption of the permanent teeth will benefit by being preceded by a complete and functional primary dentition.

First attempt at prevention should be directed at the expectant mother, and as she frequently attends for dental care at

this time, we should be able, while carrying out routine treatment, to advise her on her diet and its influence on the teeth of her unborn child.

After the child is born, we should continue to give dental care to the mother so that the advice can continue. Examination of the child's mouth from a young age will encourage and interest the mother still further.

This type of care will reduce the amount of restorative treatment of the primary dentition to the minimum. It is imperative at this stage that our restorative dentistry is of the highest class to produce a dentally conscious individual.

Early diagnosis and treatment are imperative for the effective elimination of caries. Gingival pathology begins in an appreciable number of children who have a mixed dentition. The prevention of periodontal disease must begin while the teeth are erupting, and treatment should commence as soon as possible. Thus, the most effective therapy should be given to children, not to adults.

The future development of the dental profession relies on our ability to persuade the community in which we work that oral structures are worthwhile caring for. Dental health education is the answer to this problem. The public's attitude towards its teeth, and to the dental profession, rests largely upon our ability to educate and treat young children correctly so that they will grow into a generation sympathetic to our aims.

Although as dentists, we are obviously responsible for the

health of the masticatory apparatus, in a broader sense we are part of a health team concerned with the well-being of the individual as a whole and the population as a group. We are able to study growth and development, not only of the oral structures, but of the whole individual both physically and psychologically, and to refer the patient for advice and treatment when necessary. In this way, while practising dentistry one has the opportunity to assist actively in maintaining their general health and well-being.

Those practising dentistry for children are patently aware of the short-comings in our techniques and gap in our knowledge. The answer: refresher courses for experienced dentists and continuing courses for dentists with post-graduate experience.

The aim of this thesis is:

- (1) To Review some of the literature on Dental Care for School Children,
- (2) To present a fundamental approach to Dental Health Services for Children with special reference to the Singapore School Dental Service.

## II REVIEW OF SOME LITERATURE ON DENTAL CARE FOR SCHOOL CHILDREN

### 1. Evaluation of Dental Care for Children in New Zealand and the United States<sup>5</sup>

Professional and social attitudes towards the provision of dental care vary greatly between New Zealand and the United States. For fifty years the profession in New Zealand has had the benefit of auxiliaries, the school dental nurses, to provide the bulk of routine dental care for younger children under a Government program met out by taxation. In the United States on the other hand, dental care for children is very largely given by private practitioners.

In New Zealand, ninety three per cent of children under sixteen years participated in the incremental care programs of the National Dental Service. In U.S.A. fifty per cent of the children under the age of fifteen have never been to a dentist.<sup>77</sup> Sixty three per cent of pre-school children also receive dental care from the New Zealand school service.

Many surveys of the dental health of children in New Zealand and of children in the United States<sup>47,61,53</sup> have been reported but this is the first time the examiner is the same.

In this study similar communities, New Zealand city selected was Palmerston North, and in the U.S.A. Webster a few miles outside Rochester, New York, was used.

Very large differences in the ratio *df* in the two countries are apparent. Incremental care in New Zealand results in a high standard of dental fitness in the deciduous dentition despite a high caries prevalence. Most of the *df* teeth are filled. The reverse is the case in the United States where the majority of the *df* teeth are in the *d* component, as shown in Fig. 1.

### DENTAL CARIES PREVALENCE IN THE DECIDUOUS TEETH OF CHILDREN IN NEW ZEALAND AND THE UNITED STATES

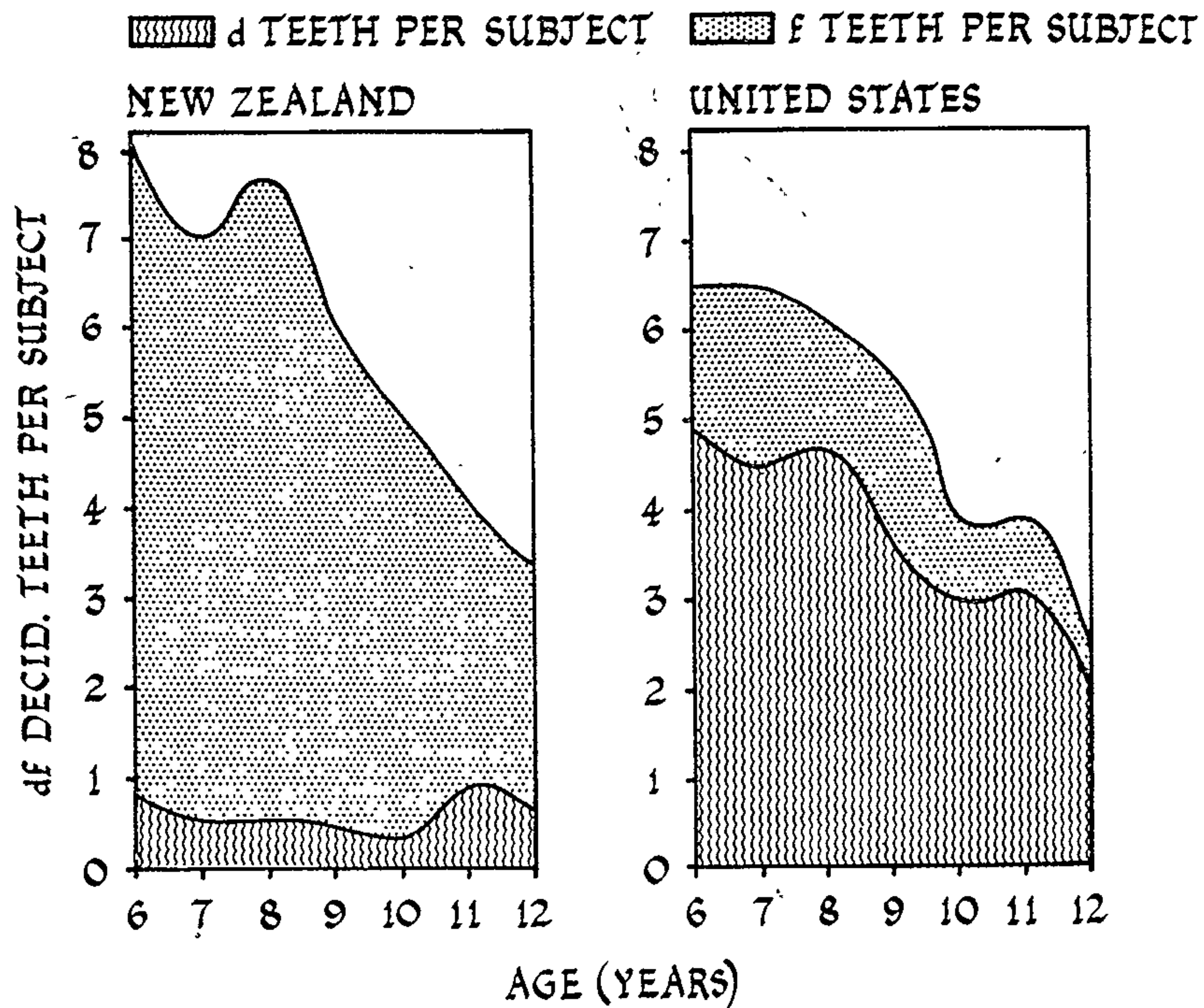


Fig. 1.

The results of the comparison of caries prevalence in the permanent teeth and of the ratio of *D:M:F* are shown in Fig. 2. It reveals a disparity in the treatment services in the two countries similar to that observed in the deciduous dentition. The major component

of the D:M:F in New Zealand is F, the major component in the United States is D.

DENTAL CARIES PREVALENCE IN THE PERMANENT TEETH OF CHILDREN IN NEW ZEALAND AND THE UNITED STATES

▨ D TEETH PER SUBJECT    ▩ M TEETH PER SUBJECT    ▤ F TEETH PER SUBJECT

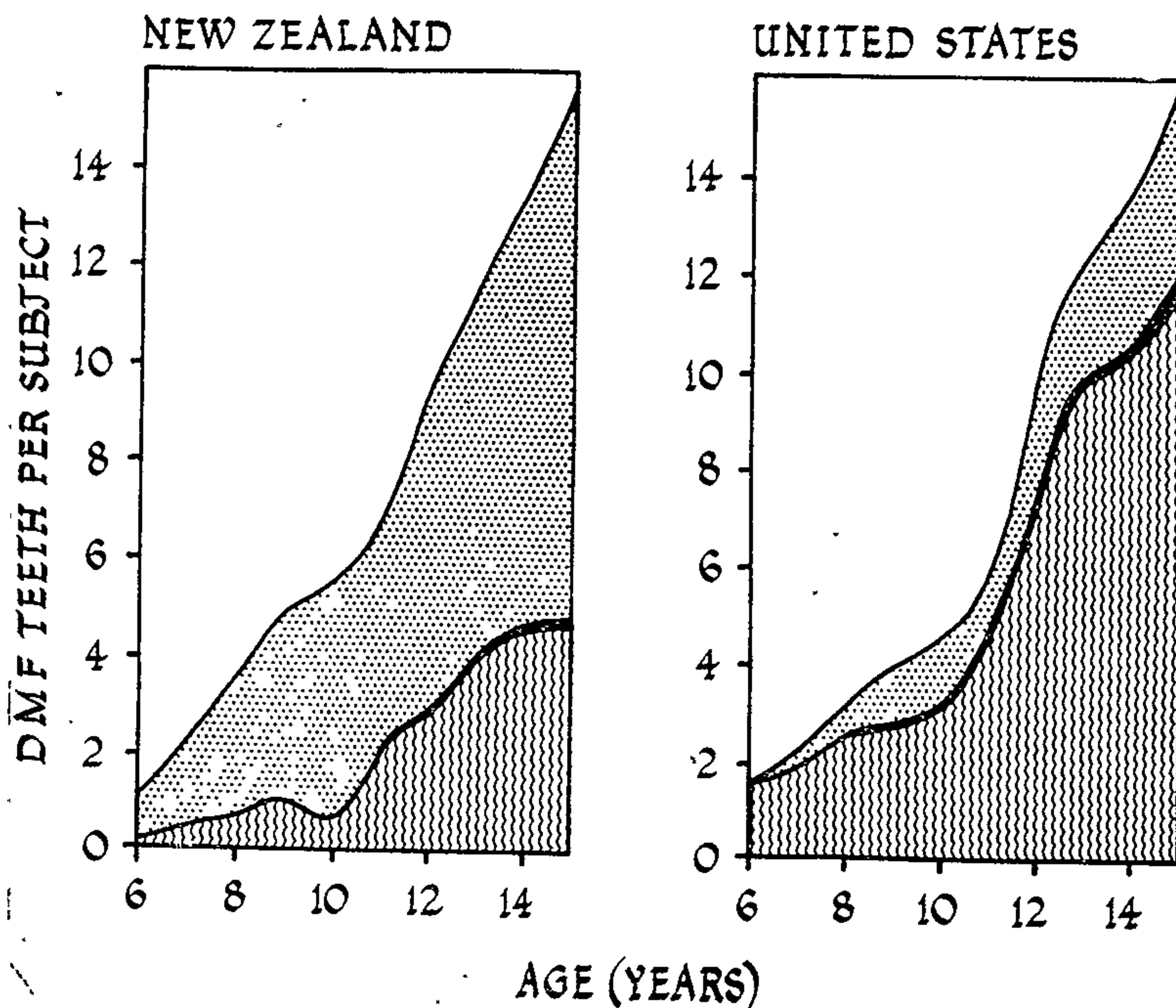


Fig. 2.

The results of the survey show the relative superiority of the New Zealand dental public health program for children over that at present in operation in the United States, measured in terms of dental fitness in the face of uniformly high caries prevalence.

Through the use of government-sponsored auxiliaries a major public health problem has been controlled in New Zealand. The problem in the United States which has been described as appalling is at present receiving intensive study by the American Dental Association.<sup>73</sup>

In New Zealand there is no evidence to suggest any significant regional variation in the treatment service; the program is a uniform one administered by a single authority, the central government. In the United States the area chosen, the North East, has since been reported<sup>78</sup> to have the most adequate dental treatment coverage for children of any area in the country.

The standards of conservative treatment performed by the New Zealand school dental nurses have been assessed by several investigators.<sup>34,40</sup> What is certainly the best summary of these assessments is provided by Dunning of Harvard University in his standard text on dental public health.<sup>28</sup>

The validity of the results regarding overall caries prevalence is probably affected by these limitations of sampling in the two countries but these limitations are unlikely to have any significant effect on the reliability of the inferences drawn regarding the standards of dental treatment coverage in the two countries.

## 2. Occurrence of Gingivitis in School Children

Gingivitis is a widely distributed oral affliction. Many studies have reported on its etiology and pathogenesis but only a few have attempted to measure the extent and incidence of the disease in various age groups. The reason has been the lack of a uniform system of classification and examination for the assessment of gingivitis.

While a number of studies have attempted to determine the extent of gingival disease in adults, very few have been concerned with

TABLE I  
Occurrence of Gingivitis in Children According to Different Investigators

Group Studied	Number Examined	Age Group (in yrs.)	Percent of Persons					Author
			Free	Affected	Mild Gingivitis	Moderate Gingivitis	Severe Gingivitis	
School Children in England and Wales	4,063	2-14	60%	40%	33.2%	6.0%	0.8%	Ainsworth and Young (1925)
Children in 26 States of U. S.	1,438,318	6-8	96.5%	3.5%				Messner, et al (1936)
		9-11	94.4%	5.6%				
		12-14	91.4%	8.6%				
Middle Class Children in India	756	13.8	31%	69%	38.0%	30.7%	Day (1940)	
Fluoride Endemic Area in India	203	5-18	40.4%	59.6%	36.4%	21.7%	1.5%	Day (1940)
Famine District in India	314	Under 13	15.3%	84.7%				Day (1944)
Various Socio-Economic Levels; 14 Nationalities (U. S.)	819b	4-16	89.7%	10.0%	8.8%		1.5%	Bruckner (1943)
	815g	4-16	92.9%	7.1%	5.8%		1.4%	
Middle Class (India) (Islamic High School)	1,054b	9-17	0.6%	99.4%	25.8%		73.6%	Day and Shourie (1947)
English Children	137b	11-14	22.6%	77.4%				King and Francklyn (1944)
	266b	11-14	12.4%	87.6%				
	135	10-14	14.8%	85.2%				
Gibraltar Evacuees	43b	12-14	11.6%	88.4%				King (1945)
	60g	12-14	10.0%	90.0%				
Dundee Primary School Children (English)	40b	12-14	7.5%	92.5%				King (1945)
	40b	12-14	2.5%	97.5%				
	51b	11-14	20.4%	79.6%				
Harpenden Institution (English)	39	11-14	43.6%	56.4%				Schour and Massler (1947)
4 Communities in Italy, Suffering from Malnutrition	682	6-10	59.7%	40.3%	32.4%	6.6%	1.1%	Present Study
	721	11-20	44.7%	55.3%	48.3%	6.7%	0.3%	
2 Chicago Suburbs	804	5-14	35.7%	64.3%	35.9%	12.3%	9.2%	

b - girls

\*b - boys

this problem in children.

Table 1 summarises the data reported by various investigators on the prevalence of gingivitis in children. It is difficult to compare these findings, since different methods were employed to obtain them and the criteria of assessment were often varied.

A review of literature cited above indicates that a number and variety of attempts have been made to assess gingivitis using different methods. It also shows that methods of assessment became refined, more objective and more quantitative as the number of studies increased.

In the beginning, clinicians attempted only to distinguish between the different types of gingival disease and to present only qualitative diagnostic criteria which would enable them to classify (and treat) the various forms of gingival disease.

The second era was ushered in when the clinicians became interested in public health aspect of gingival disease and the extent of the disease among the various population groups.

Ainsworth and Young (1925) first attempted to differentiate between children with gingivitis and those without. They also classified it as slight, medium and severe. This method was subjective and not quantitative.

It was only more recently that King (1945), and Schour and Massler (1947) attempted to define mild, moderate and severe types of gingivitis in a more precise and objective manner. The gingiva was for the first time divided into gingival units, the papillary gingiva,

marginal gingiva and attached gingiva. The P-M-A Index was introduced.

Schour and Massler 1948 indicated that inflammatory changes (gingivitis) are characteristic of young children and that non-inflammatory atropic changes are characteristic of old age (periodontosis, recession). The degenerative changes (Orban, 1947) become more apparent after twenty-five.

#### Occurrence of Gingivitis in Suburban Chicago School Children

The study was conducted in Mooseheart and Melrose Park Schools and was undertaken with two primary objectives:

- (1) to apply the methods of assessing gingival disease described by Schour and Massler (1948) as the P-M-A Index, and
- (2) to establish a "normal" quantitative base line of values for the occurrence of gingivitis in school children with which other studies could be compared.

#### Incidence of Gingivitis

A comparison of data collected (Table 1) on the percentage of children with gingivitis compares fairly well with those obtained by Ainsworth and Young (1925); middle class Indian children as observed by Day (1940), by King and Franklyn (1944) and King (1945). These studies showed that approximately 40% to 70% of the children were affected by gingivitis.

Similarly, the distribution of children into categories of mild, moderate or severe gingivitis as obtained by our method agrees fairly well with similar distributions in England and India. The figures on American children (Messner et al or by Bruckner) were

showed less than 10% affected as criteria employed were different.

#### Effect of malnutrition on occurrence and severity of gingivitis

The studies of Day (1940, 1944) and Day and Schourie (1947) in India, King and Franklyn (1944) and King (1945) in England; and by Schour and Massler (1947) in Italy all indicate that the occurrence and severity of gingivitis tends to increase with an increase in malnutrition.

#### Age incidence

The study showed that the percentage of children affected with gingivitis increased with increasing age. It increased rapidly from five to seven years (from 10% to 70% affected). Thereafter it plateaued but remained high, up to the age of fourteen years (65% affected). Similar trends were observed by Ainsworth and Young (1925), Messner et al (1933 - 1934), Day (1940) and Schour and Massler (1947). The increase was found not in the number of children affected, but also in the severity of Gingivitis.

#### Eruption Gingivitis

During the age period of five to seven years a large number of teeth are erupting into the oral cavity. There is a sharp rise in gingivitis. The percentage remained high until the age of eight years. Between eight to nine years, when few teeth are erupting there is a drop. The occurrence of gingivitis remained high from ten to twelve years of age probably because the bicuspid erupt over a longer period of time.

### Sex difference in the incidence of gingivitis

In the age group from five to eight years girls in general showed a higher percentage affected by gingivitis than did boys, (probably because of an earlier eruption of teeth in girls).

From nine to ten years of age no difference in gingivitis experience could be determined in boys and girls. However, from ten to fourteen years of age, there was a tendency for boys to show more gingivitis than girls, (probably due to better oral hygiene in girls as they approach puberty).

### Validity of examining the Anterior segments only

It was observed that if only the anterior segments were examined and recorded, approximately 92% of the children with gingivitis would be detected, and approximately 82% to 85% of the total number of papillary and marginal gingivae affected by inflammation would be recorded.

It is clear that for purposes of comparison between large groups, examination of the anterior segments alone is adequate.

This study offers statistical proof that the examination of the anterior segments alone for the occurrence and degree of gingivitis is a valid index of gingivitis experience of the entire mouth.

### Treatment and Control of Periodontal disease

Clinical experiments undoubtedly indicate that toothbrushing is a most important patient-administered preventive and adjunctive therapeutic procedure. In no other field of medicine and in the control of no other chronic disease can the patient so effectively assist in

preventing and reducing the severity of a disease as can be done with the toothbrush in relation to gingivitis.

The regular, careful use of the toothbrush controls plaque formation and prevents the retention of soft debris at the juncture of gingivae and the teeth. Maximum effectiveness in this regard is obtained by brushing as soon as possible after meals.

It has been demonstrated that toothbrushing retards the onset of gingivitis, reduces its incidence, improves gingival health and gingival stippling, reduces plaque and accumulated debris and reduces calculus.

Appropriate instructions must penetrate all areas of the undergraduate curriculum. Dental auxiliaries can assist by providing oral hygiene service and instruction. Dentists who employ auxiliaries for this purpose must be adequately trained in their supervision.

3. Deployment and Control of Dental Auxiliaries in New Zealand, Australia and their possible Role in the United States.

Much has been written concerning the training and work of the New Zealand dental nurses who have recently celebrated their 50th anniversary of service.

Australia has come forward with three variants on the New Zealand plan; the oldest is Tasmania (1966), followed by South Australia (1967) and Western Australia (1970).

Dunning reported that the samples of work that he saw were good, generally both in New Zealand and Australia.<sup>27</sup>

### New Zealand

There are 1,350 dental nurses for a population of approximately 3 million. The ratio is one nurse to every 2,200 in the total population, and one nurse to about 500 children from age  $2\frac{1}{2}$  to age  $13\frac{1}{2}$ , the group that actually is served.

One nurse can provide comprehensive basic dental care for 450 children in a nonfluoridated area and for 700 to 1,000 children in areas where the benefits of fluoridations have appeared.<sup>51</sup>

The three training schools turn out about 200 graduates a year and this is sufficient to maintain the working force at current levels.

The dental nurse program is administered by 14 districts each with one principal dental officer in charge. He is assisted by one or two nurse inspectors.

The New Zealand philosophy of executive control has been well expressed by the Minister of Health<sup>6</sup> of Britain, where a similar deployment of auxiliaries has recently occurred.

Because all children from kindergarten onwards (two thirds of the children start at this time, the rest at first grade) receive prophylaxes and screening semi-annually, dental care becomes an accepted part of their lives. The dental nurse also does regular classroom teaching on dental health.

The ratio of total extractions (deciduous and permanents) per 100 restorations declined from 78.6 at the start of the program to 2.8 by 1970.

Youths from 13 to 16 are now referred to dentists on contract for comprehensive care at government expense.

94% at age 15 could still be listed as having had systematic dental treatment. By age 20, this proportion had decreased to 53%.

Cost-benefit analysis recorded over a time period indicate that the school dental nurse system costs \$9.00 per child per year, whereas the adolescent program costs \$17.00 per child per year.

Modernisation of equipment is desired and will occur first in intermediate school clinics. Good work, however, can and is being done with present facilities.

#### South Australia

The Australian plans tend to emphasize a closer control of auxiliaries than the New Zealand plan.

In Adelaide, the school for therapists runs along the lines of the New Zealand schools for dental nurses.

The scope of activity of the dental therapists in South Australia is similar to that of dental nurses in New Zealand, except that they are trained to take radiographs.

Dental therapists in South Australia use high-speed equipment. They do seated down four-handed dentistry.

A new three-chair clinic fully equipped costs about \$45,000 (New Zealand two-chair clinic costs \$7,500).

Each therapist is responsible for approximately 500 eligible school children. There are 50 therapists (1972) working in 23 field clinics. A regional dental officer is in charge of 3 clinics,

(one regional and two satellite clinics). These are situated in the city or town areas.

Much further expansion is necessary before the South Australian program will approach the degree of coverage now found in New Zealand.

#### Tasmania

Tasmania developed a dental nurse program in 1966. It resembles the New Zealand dental nurse program more closely than the dental therapist program in South Australia. The dental equipment is more modern than most equipment in the New Zealand program.

#### Western Australia

In curriculum and scope of activity, this therapist program resembles the plan in South Australia. The dental therapists were allowed to enter private practice in 1972 but in 1973 they were not allowed to do so.

#### United States

The United States is looking into the possible role of the expanded dental auxiliaries now being trained<sup>57,58</sup> and used.<sup>80</sup>

Dental Hygienists have an important role to play both in schools and in private dental offices.

There are three "grades" of dental hygienists in U.S.A.

1. Two-year course leading to the certification in dental hygiene. Majority belong to this category. The hygienists' primary responsibilities are in clinical hygiene, provision of oral prophylaxis, patient education at the chair, the application of topical medications to teeth, mass clinical screening of school children and their referrals

in school health programs and serving as resource person to teachers and other community leaders.

2. Four-year degree public health dental hygienist. Besides the clinical aspects the hygienist should have a general understanding in the field of public dental health including public health administration, epidemiology, statistics and the organisation of related public health programs. She must also possess specific techniques for leading both individuals and groups.

3. Master degree hygienist (two years after degree).  
Usually employed as dental health consultant or supervising dental hygienist in public health service, World Health Organisation or other teaching institution.

The ratio of hygienists to population in U.S.A. is  
1 : 10,000 in 1972.

Their expanded duties to include the clinical duties of the New Zealand-type dental nurse are now being actively looked into.

### Conclusion

The differences between deployment and control of auxiliaries in New Zealand and Australia compared with the proposed deployment and control of similar auxiliaries in the United States leads to the following:

1. Manpower that is required to mount large-scale programs of child care. In New Zealand a small number of dentists, less than 25 annually, and a large number of auxiliaries give systematic incremental care unequalled elsewhere in the world, unless perhaps in

the Scandanavian countries. In Australia, the ideal supervision ratio is about one dental graduate to six therapists. In the U.S.A. one dentist can employ no more than four expanded duty dental auxiliaries. In the period when the United States is concerned about the delivery of incremental care to children, the most important consideration is the relation of the New Zealand and Australian plans to their environment.

2. Dental care is brought to the schools throughout New Zealand and the dental nurse is a full-time resident teacher. She sees the children as individuals in the clinic, as groups in the classroom and in sports.

The direction of the nurses, although distant, is good and a minimum of time and manpower is expended in supervision. Written rules are clear and their enforcement thorough.

Any large-scale incremental care plan for young children if it is to succeed, must be brought to them in schools. For the adolescents, however, the contract plan in private practice offers an attractive example. The Medicaid in the United States offers comprehensive dental care on similar lines.

3. Expanded duty dental auxiliaries fit well into a school dental care program. The United States must plan carefully the control and deployment mechanism best suited to its own people.

In New Zealand school children between the age of 12 to 14 years, cared for in 1951 by the School Dental Service using mainly auxiliaries, showed 7.40 out of 8.58 DMF teeth filled, or a filled tooth

ratio of over 86%. United States children of similar age in Illinois showed at the same period a filled-tooth ratio of just over 50%, and in Massachusetts, of just under 27%. These were in nonfluoride areas with DMF counts of approximately the same magnitude as those found in New Zealand. The New Zealand children had lost 0.29 permanent teeth per child, whereas the United States children have lost 0.63 and 0.62 teeth per child respectively in Illinois and Massachusetts.<sup>26</sup>

Opponents of government dental care for children in the United States must consider very carefully whether the advantages of a laissez-faire economy outweigh these splendid results in control of dental caries among children reported from New Zealand.

New Zealand after fifty years, has a mature school dental service well adjusted to its designed load. South Australia with 23 clinics established in four years needed 300 more therapists to cover 180,000 eligible children. The United States require over 50,000 auxiliaries to care for its 37 million children from 5 years through to 13 years of age.

#### 4. A Review of the Prevention and Control of Plaque.

Evidence from different fields of research suggests that there is a significant relationship between micro-organisms and marginal periodontal disease. Epidemiological data from different parts of the world indicates that there is a close association between periodontal destruction and tooth deposits (Lövdal, Arnö and Waehaug, 1958; Schei et al., 1959, Russell and Ayers, 1960; Greene, 1960; Ramfjord, 1961; Waerhaug, 1967). Clinical experiments have repeatedly shown (Loë,

Theilade and Jensen, 1965; Theilade et al., 1966) that accumulation of plaque on the healthy gingivæ produces gingivitis and that this is reversed after reinstatement of oral hygiene measures.

In addition dietary carbohydrates and micro-organisms of plaque produces caries (Gustafson et al., 1954; Newbrun, 1967; Fitzgerald, 1968; Keyes, 1968; Leach 1968).

The present level of knowledge seems to justify the working hypothesis that:

- (1) bacterial plaque is the only direct cause of gingivitis and marginal periodontal disease, and that:
- (2) without bacterial plaque there will be no caries.

#### Physical Plaque Control

Deposition of plaque begins at the gingival margins and progresses coronally. It is not removed by excessive chewing of coarse food especially in the gingival area. Role of saliva in controlling plaque has yet to be established. Consequently if plaque is to be controlled, it must be actively removed.

Today, toothbrushing and other mechanical cleaning procedures (tooth picks, dental floss, interspace brushes etc.) are considered to be the most reliable means of controlling plaque, provided cleaning is sufficient, thorough and performed at regular intervals. Wide variations exist in brushing techniques, frequency and brushing time.

Frequency of toothbrushing and state of hygiene are conflicting (Pindborg, 1951; Stanmey, 1957; Zaki and Stanllard, 1969; Anerud 1969.)

Gingivitis seems to be more related to the age of the plaque (i.e. bacterial composition) and that subclinical tissue changes appear after two days of plaque development (Løe et al., 1967) and that gingiva can remain clinically healthy with complete removal of plaque only once every second day.

In the well-motivated and properly instructed patient, mechanical measures are effective in controlling plaque (Lövdal et al., 1961; Lightner et al., 1968; Suomi et al., 1969).

Many physically and mentally handicapped patients are unable to manage the technique involved.

#### Chemical Plaque Control

Recent research has shown that dental plaque consists mainly of bacteria. Based on this new knowledge of plaque microbiology and chemistry much consideration has been given to the possibility of controlling plaque formation by various chemical substances administered in dentifrices, mouthwashes, troches, chewing gum and other vehicles.

1. Enzymes Pancreatic enzyme preparations containing trypsin, chymotrysin etc. have been administered topically (Jensen, 1959; Baumhammers, Landay, and Perkins, 1968) or in chewing gums (Ennever, 1961; Ennever and Sturzenberger, 1961; Packman et al., 1963; Warren et al., 1964). Others have incorporated mucinase into dentifrices (Stewart, 1952) and tested combinations of enzymes with proteolytic and carbohydrate hydrolysing properties in vitro (Aleece and Forscher, 1954; Wasserman, Mandel and Levy, 1958).

Recent findings have indicated that certain strains of oral

streptococci can produce relatively large amounts of extracellular dextrans of low solubility (Gibbons and Banghart, 1967). The theory that these substances may be essential to the adhesion of the plaque on the tooth surface and to the cohesion of the plaque components, has prompted the testing of dextranase as a possible plaque-inhibiting agent.

At this stage of research it seems justified to conclude that, at the moment, no single enzyme or combinations of enzymes are conducive to plaque prevention and control.

2. Tensio-active agents Investigations have shown that fluoridation may reduce the surface energy of the teeth (Glantz, 1969) and reduce the tendency of the enamel surface to absorb proteins (Ericson and Ericson, 1967). Attempts to change the electric potential of the tooth surfaces (Leung, 1954; Draus, Leung and Miklos, 1963; Hofmann, Stalland and Schaffer, 1963, Shafter, Schindler and McHugh, 1964; Glantz 1969) represent interesting approaches to inhibiting the adhesion of plaque. Research is still going on.

3. Antibiotics Although several antibiotics<sup>30,44(a),67</sup> show plaque-reducing properties and even though some can inhibit plaque formation completely, there can be no doubt as to the potential danger in maintaining a continuous antibiotic regimen to the problem of life-long plaque control in human beings.

4. Antibacterial agents With reference to his chemico-parasitic theory, Miller (1889) suggested that caries prevention could be achieved through the administration of antibacterial substances.

A search is still on for a chemical inhibitor which could dissolve dental calculus.

Evaluations of numerous calculus-inhibiting agents have been performed by Mühlemann and his associates.

Conclusion Available data from dental research seem to justify the clinical hypothesis that bacterial plaque is the direct cause of marginal periodontal disease and that caries will not develop in the absence of plaque.

Since natural cleansing of the dento-gingival areas of the human dentition is inadequate, plaque control can only be achieved through its active removal at regular intervals. The addition of various enzymes, theoretically capable of interfering with plaque development, dentrifices, chewing gums, etc., has not as yet been promising. Tensio-active agents, antibiotics and other antibacterial compounds are being appraised.

Mechanical tooth cleansing must still be regarded as the most effective means of controlling dental plaque.

##### 5. A Review of Topical Fluoride Agents.<sup>25</sup>

It has been known for nearly half a century that fluoride compounds have an inhibitory effect on dental caries. This fact is one of the major influences responsible for the transformation of dentistry from a discipline that had repair and restoration as its ideal, to one that has preventive as its goal.

Mechanism of action of fluoride in caries inhibition.

Current evidence indicates that these agents appear to inhibit caries by two major mechanisms:

- (a) through enzymatic inhibition of bacterial growth;
- (b) reduction of enamel solubility.

Fluorides applied topically to the teeth tend to concentrate in plaque rather than in saliva.<sup>16</sup>

The fluoride concentration in plaque is sufficient to retard partially the growth of lactobacillus acidophilus by the production of the enzymes, enolase and phosphoglyceromutase both of which are essential in the metabolism of foodstuffs by the bacteria.<sup>16</sup> This plays a minor role since merely 2% to 3% of the total detectable fluoride is present as free ions.<sup>16</sup>

The major mechanism of caries inhibition by fluoride compounds is their ability to reduce the acid solubility of enamel. They are more effective than any other biological acceptable nonfluoride compound.<sup>19</sup> The fluoride is incorporated into the hydroxyapatite crystal by the conversion of hydroxyapatite into fluorapatite, a compound which is less soluble than hydroxyapatite.<sup>13</sup>

Factors which enhance the uptake of fluoride.

Polyvalent metals such as aluminium or titanium, which can form strong fluoride complexes while simultaneously bonding firmly to the apatite crystals, possess the ability to enhance fluoride uptake. An acidic pH enhances fluoride uptake as does the presence of the phosphate ion in a fluoride system.<sup>38</sup> Avoidance of contamination by saliva during application is mandatory for significant fluoride uptake.<sup>62</sup>

Studies employing sealing agents have made it possible to keep fluoride in contact with enamel for prolonged periods, which has been reported to enhance fluoride uptake.<sup>74</sup>

Fluoride uptake by enamel has been found to be inversely proportional to both the natural fluoride content of the enamel and to the age of the teeth being treated.<sup>65</sup>

Modes of application of topical fluorides.

1. Stannous fluoride prophylaxis pastes have been significantly effective when used with a subsequent application of freshly prepared stannous fluoride topical solution in conjunction with daily brushing with a stannous fluoride dentifrice.<sup>49</sup>

2. Zirconium silicate-stannous fluoride paste appears to provide a good degree of protection to acid solubility. As an adhesive agent, zirconium silicate appears to be highly desirable since its action is self-limiting because of its particle size.

3. Electrolytic application of fluoride by use of electrolytic toothbrushes has been shown to increase depth of penetration and concentration of fluoride in enamel and avoid staining of the teeth.<sup>10</sup>

4. The use of lacquer spray to seal fluoride treated tooth surfaces for up to twelve hours has shown a 30% caries reduction.<sup>43</sup>

5. Fluoride gel self-administered in a custom fitted mouth piece is the most effective method of topical fluoride application.<sup>46</sup>  
The self-application of a stannous fluoride-zirconium silicate prophylaxis paste has been shown to be effective with high DMFS.

reductions reported.<sup>68</sup> Results have not yet been confirmed by other independent researches.

6. Use of fluoride-containing mouthwashes has not been shown to be of reliable significant value.<sup>79</sup> Horowitz recently recorded a DMFS reduction of 44% after 21 months of rinsing with solution of neutral sodium fluoride. Because of ease of application, there is considerable interest in this application vehicle.

7. The chewing of acidulated phosphate-fluoride tablets has caused a 20% to 33% reduction in permanent tooth caries.<sup>21</sup>

Comparison of the various major agents in effectiveness.

1. Amine fluorides. It has been reported that amine fluorides give greater resistance to enamel solubility than any other agents but little research on these agents has been done so far.<sup>41</sup>

2. Stannous hexafluorozirconate. 50% caries inhibition in vitro, and in vivo DMFT reductions of 93% to 96%, during a study of one year's length.<sup>70</sup> These results have not been substantiated as yet, by other independent researches.

3. Sodium Monofluorophosphate solutions by means of daily toothbrush application has shown a significant 52% reduction of DMFS, but no subsequent research report has been published to substantiate the results found in the original study.<sup>37</sup>

4. Sodium fluoride has been largely replaced by other more efficient agents in topical fluoride therapy. Single application fluoride vehicle has supplanted multiple application technique of sodium fluoride.

5. Stannous fluoride with its increased effectiveness over sodium fluoride is now widely used. It has been reported to reduce the incidence of new caries surfaces by a range of 30% to 90%.<sup>9,45</sup> Repeated semi-annual applications have been demonstrated to increase the effectiveness of this agent.<sup>50</sup> Aging of a 20% stock solution for 12 to 16 weeks tended to increase the effectiveness of the solution. Stannous fluoride is most effective when its use is combined with use of several agents; namely, the solution, the fluoride prophylaxis paste, and the daily use of a fluoride dentifrice.<sup>36,69</sup> Two thirds of the protection imparted by stannous fluoride in enamel was reported as been lost within twenty-four hours.<sup>78</sup> This finding suggests that repeated applications of this agent are necessary in order to reach its significant clinical effectiveness.

6. Acid phosphate fluoride. The addition of phosphate ions to stannous fluoride was found to increase its effectiveness by 50%. In addition, the uptake of sodium fluoride by enamel was increased by the addition of phosphoric acid. Fluoride uptake by enamel increased three times by the use of acid phosphate fluoride when compared with stannous fluoride.<sup>12</sup> It has been found that the resistance of caries, obtained from topical agents, is dependent solely on the amount of fluoride deposited in enamel. The acid phosphate fluoride solutions applied semi-annually for two years have produced 26% to 67% reductions in DMFT.<sup>48,64</sup> These acid phosphate fluoride gels have been found to produce increased depth and concentration of fluoride deposition in the enamel of children living in fluoridated areas. The concentration of

fluoride at greater depths is dependent on the number of applications.<sup>20</sup> The highest caries reductions with acid phosphate fluoride were found when this agent was used in gel form in a custom tray that was applied daily after brushing the teeth over a six-month period. This procedure has resulted in a 43% to 80% reduction in caries incidence.<sup>20</sup>

Conclusion Because of its established effectiveness, ease of administration and extremely low cost, systemic ingestion of water containing an optimal fluoride content during the period of calcification is the most effective preventive dentistry agent available.

Application of topical fluorides for children who reside in communities with optimal fluoridated water showed reduction in dental decay of 21% to 54%. All child patients should have topical application twice yearly.<sup>39</sup>

The choice of a topical fluoride vehicle must be determined in relation to each patient's individual caries experience or susceptibility. A child with rampant caries, therefore, would be the recipient of topical fluoride applications that would provide maximal topical fluoride uptake. From recently reported data, the vehicle of choice would be an acid phosphate fluoride gel in a custom tray which could be applied daily by the child.

The perfect topical fluoride agent in caries prevention has yet to be found. Meanwhile, interest in this field remains unabated.

## 6. A Review of Occlusal Sealants.<sup>59</sup>

The vulnerability to decay of occlusal pits and fissures have

always been a major dental problem. The impetus for the recent development of occlusal sealing agents and techniques has been prompted by the high occlusal caries rates in both permanent and primary teeth, coupled with the inability of the usual preventive measures to dramatically reduce the decay incidence on these surfaces.

Caries susceptibility of occlusal surfaces.

The extreme caries susceptibility of occlusal surfaces documented by Knutson and co-workers<sup>29</sup> that 43% of all carious or filled surfaces in the permanent dentition of over 4,060 Maryland elementary school children were on the occlusal surfaces. Likewise, Day and Sedwick reported that in Rochester, New York, occlusal decay in 13 year old children accounted for 45% of the caries in the permanent dentition. These figures are particularly significant since occlusal surfaces represent only 12.5% of total surfaces at risk at these ages, yet account for nearly 50% of the caries activity.

The inception of caries in these sites soon after eruption indicates the need for early preventive treatment.

Previous methods of occlusal caries control

The high caries susceptibility of the occlusal surfaces may, in part, be related to the retention of bacteria and food debris within the pits and fissures.

Hyatt advocated prophylactic odontomy in which all occlusal fissures were drilled and the shallow cavity preparations were filled with amalgam.

Bodecker<sup>55</sup> also advocated the "eradication of enamel fissures"

(round burs without amalgam).

Both methods were subjected to criticism in that sound tooth structure had to be removed.

Other attempts at preventing pit and fissure caries included treatment with silver nitrate,<sup>71</sup> zinc chloride and potassium ferrocyanide.<sup>72</sup> None of these treatments proved successful.

#### The effect of fluoride on occlusal caries.

Within the past thirty years, the dental profession has learned to rely on fluoride as its principal cariostatic agent.

Even with communal water fluoridation, occlusal caries remains a significant problem, because the benefits to occlusal surfaces are not as great as those provided to the interproximal surfaces.

The Newburgh-Kinston study,<sup>3</sup> the Evanston study,<sup>8</sup> the Hastings, New Zealand study<sup>60</sup> and the Trel study<sup>4</sup> in the Netherlands, all indicate that better protection is afforded in interproximal than the occlusal surfaces when fluoride is provided through community water systems.

#### Occlusal caries control using sealants.

Essentially three types of sealants have been clinically tested and/or are available commercially for clinical use.

1. The cyano-acrylates which were the first sealant agents tested. See table 2 for results of clinical studies carried out.

The clinical investigations using cyano-acrylates demonstrated the feasibility of occlusal sealing as a caries preventive technique, however, the adhesive system possessed difficult handling characteristics, which made it unacceptable for introduction commercially.

Table 2

CLINICAL SEALANT STUDIES: CYANOACRYLATES

INVESTIGATOR	REFERENCE	TIME (MOS.)	PERCENT RETAINED SEALANT *	PERCENT CARIES REDUCTION **
Cueto and Buonocore	I.A.D.R. 1965	8	80.2	91.5
	J.A.D.R. 1967	12	71.2	86.3
Ripa, Buonocore, Cueto	I.A.D.R. 1966	24	70.8	82.5
Ripa and Cole	J.Dent.Res.1970	12	36.2	84.2
Parkhouse and Winter	Brit.Dent.J. 1971	6	0.0	0.0
Takeuchi et al.	Bull.Tokyo Dent. Coll. 1971	60	-	90.5

\* Completely covered teeth only

\*\* Permanent teeth only

Table 3

CLINICAL SEALANT STUDIES: ADDUCTS OF  
BISPHENOL A AND GLYCIDYL METHACRYLATE (BPA-GMA)

INVESTIGATOR	REFERENCE	TIME (MOS.)	PERCENT RETAINED SEALANT *	PERCENT CARIES REDUCTION **
Roydhouse	J.Dent.Child 1968	36	-	29
Buonocore	J.A.D.A. 1970	12	95.5	100
Buonocore	J.A.D.A. 1971	24	87	99
McCune, Cvar	I.A.D.R. 1971	9	90	88
Rock	Brit.Dent.J.1972	12	54.1	65

\* Completely covered teeth only

\*\* Permanent teeth only

2. Bisphenol A, glycidyl methacrylate and methyl methacrylate (BPA-GMA system) which forms the basis of the commercial products, Nuva-Seal and EpoxyLite Fissure sealant 9075.

Table 3 shows caries reduction by various workers.

3. Polyurethane clinical trials. Polyurethane materials have been tested in laboratory animals for their ability to prevent occlusal caries.<sup>56</sup>

Rock<sup>75</sup> found that six months after application of a polyurethane sealant only 1.4% of treated teeth were completely sealed and none were sealed after one year. Frank and co-workers<sup>31</sup> reported that of 60 children who had their molars or premolars coated with the same material, 55 showed a loss of sealant within 8 to 15 days of application. These investigators concluded that the polyurethane based material was not suitable as a permanent preventive treatment for fissure caries.

#### Tooth-Sealant interface.

One minute application of 50% phosphoric acid etching creates spaces or "micropores" within the surface layer of enamel which allow the sealant to penetrate into the enamel itself.<sup>11</sup>

Projections of sealant called "tags" into subsurface enamel increase the physical bonding of the sealant to the tooth.

#### Selection of teeth for occlusal sealing.

Selection of teeth for treatment should be done on an individual basis and is determined by such factors as:

(1) the caries susceptibility of the individual occlusal surfaces,

- (2) the general caries activities in the mouth,
- (3) the length of time the tooth has remained caries free,
- (4) the patient's total regime (Table 4).

Table 4

INDICATIONS AND CONTRA-INDICATIONS FOR OCCLUSAL SEALING

Clinical Condition	Do not Seal	Seal *
Occlusal Morphology	Well coalesced pits and fissures, absence of pits and fissures.	Deep narrow pits and fissures which "catch" the probe.
General Caries Activity	Many proximal lesions present.	Many occlusal lesions present; few proximal lesions.
Tooth Age	Teeth that have remained caries free for 40 or more years.	Recently erupted teeth.
Preventive Program	If other caries preventive measures are not available	If patient co-operates in total caries preventive program.

\* Only teeth with caries free occlusal and proximal surfaces are indicated for sealing.

Conclusion

Occlusal sealing is intended to be used as one component of a multiple caries preventive approach. Topical fluoride application and systemic fluoride supplement are especially important in a multiple preventive program because of the preferential protection which fluoride provides to smooth surfaces. Diet counselling, proper oral hygiene procedures, and the use of therapeutic dentifrices are other components of this program.

By the combined utilization of all known clinically proven caries preventive methods, the nearly complete elimination of dental caries in our patients can be achieved.

#### 7. Dental Care for the Handicapped Children.

In recent years there has been a growing interest and concern for persons with a handicap. The advent of antibiotics, improved surgical techniques and the advance of medicine has led to a large increase in number of severely handicapped children who survive, and this situation is likely to increase.

Working with handicapped children demands great patience, a deep compassion and requires skills and knowledge not usually taught in dental schools. Dentists undertaking this speciality will find that the work can be distressing, but the satisfaction of helping to make life more bearable for these children is an adequate reward.

No set patterns or routine procedures are followed in treating handicapped children. Problems and personality trait vary with the individual patient. They can be divided generally into:

1. Those who can be treated normally, and
2. Those who need special care.

#### Caries and periodontal disease.

In an institutionalized population, the most common dental findings are a high prevalence of periodontal disease<sup>100</sup> and a low prevalence of dental caries. In Mongolism dental caries occurs less frequently than in non-Mongoloid retarded groups. A study on a group

of institutionalized Mongoloid patients, selected at random, revealed the striking findings that 96% had periodontal disease whereas 53% were caries free.<sup>17</sup> This is due to poor oral hygiene which leads to an accumulation of plaque debris and calculus which constantly irritates the gingival tissues. Habits such as bruxism, tongue thrusting, clenching and mouth breathing are additional irritating factors which contribute to the breakdown of the soft tissues. Malocclusion, congenital bone defects and developmental disorders also play a role in the etiology of periodontal disease.

#### Oral clefts.

Children with oral clefts present some of the greatest needs for dental rehabilitation. Successful therapy requires the solution of a series of clinical problems by a co-ordinated effort on the part of many specialists. Dentists play a key role in the team approach to therapy in guiding the development of the dental arches and facial pattern during growth, in constructing speech appliances which compensate mechanically for tissue deficiencies, proper appearance and speech.

In America all State Crippled Children's Service programs have provided services for children with oral clefts. The preservation of the natural teeth is of such vital importance to successful orthodontic treatment, surgery and speech therapy, that any rehabilitative program for these children should include routine dental care.

#### Deformities of occlusion

Crippled children's service programs in America have been hesitant in providing treatment for malocclusion because of the shortage

of othodontists, no precise method of differentiating - the deviation from "normal", and the costliness of the service. The number of children receiving treatment through Crippled Children's Service programs increased from 746 (1950) to 3,156<sup>76</sup> (1960). In addition, some children have received treatment through dental divisions of state health departments, particularly in New York, which pioneered in the development of public orthodontic programs.<sup>14</sup> Public orthodontic care programs limit service to severe problems found in children whose families cannot finance private care.

#### Treatment

Many handicapped patients require medication to reduce anxiety, fear and apprehension so that ordinary dental procedures can be performed adequately.

If hospital facilities need to be employed, it must be when all attempts to do work on an ambulatory basis have failed. Dietetic prevention is of supreme importance since oral hygiene often leaves much to be desired. School meals or institutions can help by providing a non-cariogenic diet or at least detergent foods to end meals.

The dental problems of handicapped children have received increasing attention of late. In the United States, dental schools, teaching hospitals, rehabilitative centres, and outpatient clinics have established facilities to provide the special service necessary.

#### 8. The purchase of Dental Care - Private Practice.

Many children are eligible to receive dental care from

government clinics and institutions. Others purchase dental care from private practitioners.

The most important development in financing dental care in recent years has been the growth in third-party payment by organisations, the purchase of care on group basis, and the use of prepayment plans.

The changes of socioeconomic pattern in America have resulted in a shift of emphasis from the individual to the group.

#### Postpayment plans

Postpayment plans, sometimes termed budget-payment plans, are for individual purchase of dental care.<sup>18</sup> Today there are in America at least 100 such plans.

Under a budget-payment plan, the patient borrows money from a bank, a finance company, to pay the dentist's fee at the time that the contract for care is made.

Postpayment plans help patients pay for the restoration of accumulated defects by eliminating the necessity for a large immediate expenditure. However, these plans do not appear to have created a significant increase in the utilization of dental services.

#### Prepayment plans

A prepayment plan is an arrangement by which periodic, specific payments (premiums, contributions) are made in advance and used to pay for health services when the need arises.<sup>81</sup>

Prepayment plans can spread the risk of payment of dental care, eliminate unpredictability of costs, and provide a mechanism for regular budgeted payment.

The dental profession recognised early, however, that eventually (after prepaid protection against hospital and medical costs) the public would express interest in prepaid dental care. As early as 1943, the American Dental Association looked into the pre-payment mechanism for the purchase of dental care.

Service under a dental care plan may be provided either through "open" or closed panels. In an open panel:

- (1) any dentist may elect to participate,
- (2) the beneficiary can choose any participating dentist,
- (3) dentist may accept or refuse any beneficiary.<sup>24</sup>

In a closed panel beneficiaries may go only to those dentists who have agreed to provide services under the prepayment plan. Dentists must accept any beneficiary as a patient.

Group practice has resources and manpower which makes it feasible to offer contracts to groups.

The scope of benefits provided in prepayment plans varies widely i.e. "minimal", "basic" and "comprehensive". The trend is towards more comprehensive coverage.

#### Utilization of dental care plans.

The cost of services, although an important deterrent to the utilization of professional treatment, is by no means the only factor. Educational attainment, levels of health knowledge, and cultural patterns are among the other influences which determine the extent which individuals seek care.

Studies of the dental care plan at St. Louis Labour Health

Institute, which offers routine dental care without charge to members of the Teamsters Union and their dependents, was utilized by only 41% of the families and 27% of the eligible individuals during the study period.<sup>22</sup>

Children were more likely to receive care than were their parents. Even in the families with the poorest education and the lowest income, half the children had seen a dentist during the study year and five out of six of these had received care at the Institute clinic.

Over 70% of the nearly 15,000 children eligible for dental care under the program of the welfare fund of the International Longshoremen's and Warehousemen's Union and Pacific Maritime Association, visited a dentist each year during the first five years of operation.<sup>66</sup> Most of these children received complete dental care.

Prepayment plans also offer an excellent mechanism for effective programs of dental health education.

It has been estimated that the number of individuals visiting a dentist annually will increase 20% with the institution of prepaid dental care plans.

The increased number of children receiving routine care under the programs should raise the level of dental consciousness of the next generation of parents. Plans which include dental health educational efforts may be expected to bring about a marked change in attitudes towards dental care.

9. Dental Care for Children - Future Trends.

Trends affecting dental disease.

We have seen that dental caries appears to be a disease of civilization, increasing steadily in prevalence since earliest recorded times. Periodontal disease may have had a somewhat similar history.

Man's success in preparing cooked food and in altering his environment has further diminished his need for an efficient dentition. This may have accentuated the need for reduction of the human dentition.

Both caries and periodontal disease are chronic, multifactorial diseases and their complete prevention will be elusive and difficult. However, several partial preventive measures for dental caries already exist, with efficiencies varying up to the maximum of 60% to 70% seen with fluoridation of communal water supplies.

Dental-health education can do much to alter the attitude to regard teeth as expendable items. Dental-health problems should be linked to maternal and child-health problems (which rate very high) or to the incidence of heart disease (another moderately high interest problem) to increase the amount of attention which will be given to dental disease.

Trends in dental care.

If civilization has brought dental disease, civilization has also brought a large measure of cure for it. Restorative techniques have been improved. Dental care with some measure of prevention of dental disease have been made available to ever-widening population

groups. Efforts to increase professional dental manpower in the United States have done no more in recent decades than keep pace with the growth of the population, so that the dentist - population ratio remains at about 1 : 1900. Only a fraction of dental need is met by this working force. Hollinshead estimates that the efficiency of the profession is increasing at a rate of 3% per year. Preventive measures as fluoridation will also diminish the need for care.

If increases in the efficiency of dental treatment produce a decrease in cost, it is easy to imagine the demand for dental care rising than is the case at present. Government financial aid should operate to reduce cost.

Methods of prevention or treatment once designed, must be made known to people and must be woven into the cultural patterns of the people so that they will be desired. Information travels slowly, and human habits are hard to change. More civilized areas in the world where dental care seems most needed are also those areas where communications are best and acceptance of any new health measure likely to be more rapid.

#### Future courses of action.

Hanlon<sup>42</sup> in discussing "the past as a prologue to the future" in public health, points to three main channels into which effort can be directed:

1. the consolidation of past successes;
2. the remediation of the backlog of disabilities;
3. vigorous, carefully planned attack upon both new and unsolved old problems.

"Consolidation of past successes" in practical terms means the fuller use of the tools we now have for the control of dental diseases. Fluoridation, diet, toothbrushing, dental care should be used more effectively and widely. Social scientists should also be involved to change attitudes and behaviour.

"The remediation of backlog of disabilities" is the rendering of initial dental care where lapses in maintenance care have occurred. In America the backlog is truly formidable. The present efforts of the dental profession can hardly accomplish more than one-quarter the needed dental treatment. Increased dental manpower through the use of dental auxiliaries for child dental care should be vigorously pursued. Preventive measures such as water fluoridation and other fluoride vehicle on the dental care problem in areas of high dental caries incidence should be introduced.

The "attack upon new and unsolved problems" must lie through research. Funds should be readily made available. Dental schools and dental public health programs must foster and train skilful researchers.

For the future dental care of children the 107th Annual Session of the American Dental Association introduced a "Dental Health Program for Children". The objective of this program was stated as follows:

**OBJECTIVE:** The objective of the American Dental Association Dental Health Program for Children should be to make the benefits of an organized program of dental health education, preventive dentistry and dental care available to all children, particularly the needy and underprivileged.

This objective should be attained by the application of the following principles:

1. All dental services should be provided which are necessary to prevent disease and to restore and maintain oral health.
2. Guidance and consultation at local, state and national levels should be made available by the profession, through dental associations, in the planning, operation and evaluation of the program.
3. There should be full co-operation in planning, operating and financing the program between private and public agencies at local, state and national levels.
4. The scope of the local program should be determined at the community level and should be based on the general standards which have been established through the state and national programs.
5. The use of all preventive measures should be encouraged and an incentive program for the intensive promotion of the fluoridation of public water supplies should be established.
6. Increased support should be provided for research in all procedures and programs for improving the dental health of children.
7. All preschool and school children, through the age of 18 years, should be included in the program and existing resources should be made available on a priority basis to the younger age group.
8. The initial program in each community should be expanded on a planned and systematic basis to include additional age groups of the school population as rapidly as experience and resources permit.
9. The dental health education components of all local, state

and national programs should be expanded.

10. Every individual should be encouraged to develop increasing responsibility for his own dental health and parents should be motivated to full responsibility for the dental health of their children.

11. The services of private practitioners and of all existing resources and facilities should be utilized fully in the operation of the program.

12. The right of freedom of choice by both the patient and the practitioner should be preserved.

13. The highest quality of dental services should be available to all.

14. The opportunities for the basic and continued education of dentists and dental auxiliaries should be expanded as needed in order to insure an adequate supply of qualified personnel for the program.

15. The use of the voluntary prepayment and postpayment programs for the purchase of dental care for children should be expanded.

16. Priority consideration should be given to reimbursement for professional services on the "usual and customary fee" basis.

17. Fiscal responsibility for the dental care of nonindigent children and families must continue to lie with the individual, the family and private and voluntary agencies.

18. The terms indigent and dental indigent, for the purpose

of this program, should be defined by appropriate state agencies in accordance with existing state laws and regulations in full consultation with representatives of the dental profession.

The chance to make dental caries and periodontal disease as rare as smallpox does exist. Scientific advances may produce highly efficient preventive measures. Health education may secure virtually universal utilization of these measures, and long-range changes in the disease themselves, or in human resistance to them may reverse the upward trends of recent centuries.

Whatever changes do occur, the chronic nature of caries and periodontal diseases, we are dealing with, will make the changes very slow.

### III SINGAPORE SCHOOL DENTAL SERVICES

#### 1. Description of Community

##### A. Geography:

Singapore, a tropical island of 225.6 square miles, lies between 1° 09' and 1° 29' N of the equator. It is situated about three-quarters of a mile to the south of the Peninsula of West Malaysia and is separated by the Straits of Johore. A causeway links the island to Johore Bahru, the capital of the State of Johore.

The country is low lying. Being without hills of note and without a large catchment area it gets a large portion of its water from mainland Johore. With the construction of more resevoirs it is now less dependant on Johore for its water supply. Generally, rain falls throughout the year but there are some months where the rainfall is more than others. The average day temperature is approximately 29.4°C and the average night temperature 23.8°C.

##### B. Demography:

The population figures (1970) showed a population of over 2.1 million comprising of the various ethnic groups:-

Chinese	76%
Malay	14%
Indians.	7%
Others	3%

The population density is 9354 per square mile. It is highly urbanised: Urban - 95%, Rural - 5%. Population by age groups:

0 - 4 yrs	-	235,456	-	11%
5 - 14 yrs	-	569,380	-	27%
6 - 11 yrs	-	363,518	-	17%
12 - 13 yrs	-	145,740	-	7%
15 - 19 yrs	-	246,417	-	11%
20 + yrs	-	1,023,254	-	49%

C. Socio - Economy, Political and Education:

1. Socio - Economy.

Its G.N.P. is second only to Japan in Asia being U.S. \$1000/capita (1970). (Hong Kong U.S. \$800 West Malaysia \$383), and an economic growth rate of 17% per annum (Hong Kong 15%, West Malaysia 8.5%).

Its success is mainly due to its:

- (a) forward looking industrialisation program;
- (b) human resources;
- (c) superb natural port facilities;
- (d) situation right in the shipping routes between Europe, Asia and Australia;
- (e) hub of air routes between Europe, Asia and Australia.

2. Political.

It is governed by an elected parliament. Elections take place once every five years.

The present ruling party is socialist in outlook and has governed the island for more than twelve years.

### 3. Education.

The education system can be classified as a four tier structure:

- (a) Pre-school 4 - 5 years, Kindergartens which could be private or government sponsored.
- (b) Primary schools 6 - 12 years - predominantly government.
- (c) Secondary schools and colleges 13 - 18 years - predominantly government.
- (d) Universities - 2 viz. University of Singapore and Nanyang University - both quasi-government.

Free education is given up to secondary school level for all citizens.

There are four official languages.

The population/dentist ratio is 1 : 5300 (including Division II dentists) and it has a population/doctor ratio of 1 : 1600.

#### D. Diet

The staple food is rice but being exposed to western cultures, customs and influence (high protein and refined sugar intake).

## 2. Development of Dentistry in Singapore

### A. Registration and Dental School

#### Faculty of Dentistry University of Singapore:History

The Dental School was founded in 1929, as a Department within the King Edward VII College of Medicine. From the beginning the courses of study were designed to conform to the British standards. Up to 1949

the School awarded a Licentiate in Dental Surgery which was accorded recognition by the General Medical Council of England in December 1946.

The Dental School commenced to award the Degree of Bachelor of Dental Surgery from 1950 after revising the courses of study to conform to the General Dental Council requirements and discontinued the award of the Licentiate in Dental Surgery from the same year.

The Dental School, University of Malaya (in Singapore), after being a part of the Faculty of Medicine for nearly thirty-three years attained Faculty status in August 1966.

The Faculty's aim is the development of biologically orientated, technically capable, socially sensitive dental practitioners, who are keenly aware of the significance of their potential contribution to the total health of their patient.

The Faculty has an intake of about forty to fifty students annually. The following types of further education are available:

- (a) academic courses leading to higher qualification
- (b) short courses of continuing education (offered by the Faculty and the Singapore Dental Association).

#### Dental Nurses Training School

This was established, with the help of the New Zealand Government, in 1962. It has a yearly intake of twenty students (two or more places are usually reserved annually for foreign students).

There are about 175 dental nurses in Singapore, the majority of which are attached to the School Dental Service. The nurses are all government employed.

B. Legislation, Dental and other Organisations

There are two types of dentists practising in Singapore:-

- (a) Division I (1972): 220 graduates from recognised higher institutions;
- (b) Division II : 200 mainly apprentices without any higher institutional training.

The Singapore Dental Association (membership 186) and the Singapore Registered Dentist Association look after the welfare of their members, Division I and Division II dentists respectively.

Only the Singapore Dental Association has representation at ministerial level. The register for Division II dentists has been closed since 1950.

The Singapore Dental Association awards bursaries, medals of proficiency and book prizes annually to outstanding dental undergraduates. Dental journals and public dental health materials are compiled, printed and distributed by its committees.

The Dental Registration Board of Singapore is a Government established body. It consists largely of dentists and is the governing body of registration of dentists.

The Dental Division of the Ministry of Health is the government department responsible for the maintenance of the School Dental Service, the Dental Section of the Maternal and Child Health Service, the Hospital Dental Service and the Dental Health Education Unit.

The Singapore Armed Forces Dental Corps is responsible for

the maintenance of the dental health of the Singapore Armed Forces. There is no subdivision into Army, Navy or Air Force.

The National Trade Union Congress Dental Service was inaugurated in 1972. Its aim is to provide dental care for its members and dependants at minimal cost.

### 3. School Dental Service.

#### A. Introduction

In the field of dental public health, the aim of the Singapore Government was to concentrate on the prevention of dental caries and comprehensive dental care of school children. The first priority within this group was primary followed by secondary and pre-school children.

To achieve its objectives, Singapore became the first country in Asia to have a completely fluoridated water supply, (concentration of 0.07 p.p.m.), for its entire population of over 2 million in January 1958.

The specific functions of the School Dental Service are:

- (1) To improve the standard of dental health of school children, by affording them regular and systematic treatment.
- (2) To instruct the school children and also the general public in the principles of oral hygiene and the preservation of the dentition.

#### B. History and Development

The School Dental Service began in 1949, or thereabouts, with less than a handful of dental officers. In 1950, one school dental

nurse (New Zealand type) was recruited into the Service, and this number grew slowly to ten in 1962; which year also saw the opening of the Dental Nurses' Training School in Singapore.

Dental Nurses' Training School: Singapore has been employing school dental nurses to supplement the existing dental officer service, but in order to increase the number of dental nurses employed in the school service the Government decided in 1961-62 to establish its own training school. This was achieved with the help of New Zealand. The Singapore School is now a flourishing institution with an annual output of approximately twenty school dental nurses who are trained to treat children up to twelve years of age. Already over 120 dental nurses are operating in clinics and "dental huts" throughout the island. The clinics are situated in the precincts of the schools. The dental nurses are under the supervision of Government-employed school dental officers. As would be expected from the close association which New Zealand has had with the Singapore service, both the training and subsequent use of school dental nurses follow very closely the New Zealand pattern. The School occupies one floor of the Institute of Health Building in the heart of Singapore. The equipment, much of which was supplied by UNICEF, and the fittings are modern and efficient. The staff consists of dental officers and dental tutor sisters, all of whom are deeply interested in their work and maintain a very high standard of training. This is not only providing facilities, within limits, for neighbouring countries, but also an excellent working example near at hand of the use of auxiliaries for others in the region to copy.

School Dental Centres: In 1958 the School Dental Clinic, Institute of Health, Outram Road, Singapore, a multiple-chair clinic, was opened and this was followed by the opening of a second School Dental Centre at Pegu Road, with thirteen dental chairs, in 1963. The Pegu Road School Dental Centre is also the administrative headquarters of the School Dental Service. Each centre has a school bus, the function of which is to transport primary school children to and from their schools during school hours.

The first batch of school dental nurses graduated in 1964 and they were subsequently posted out to dental clinics situated in primary schools.

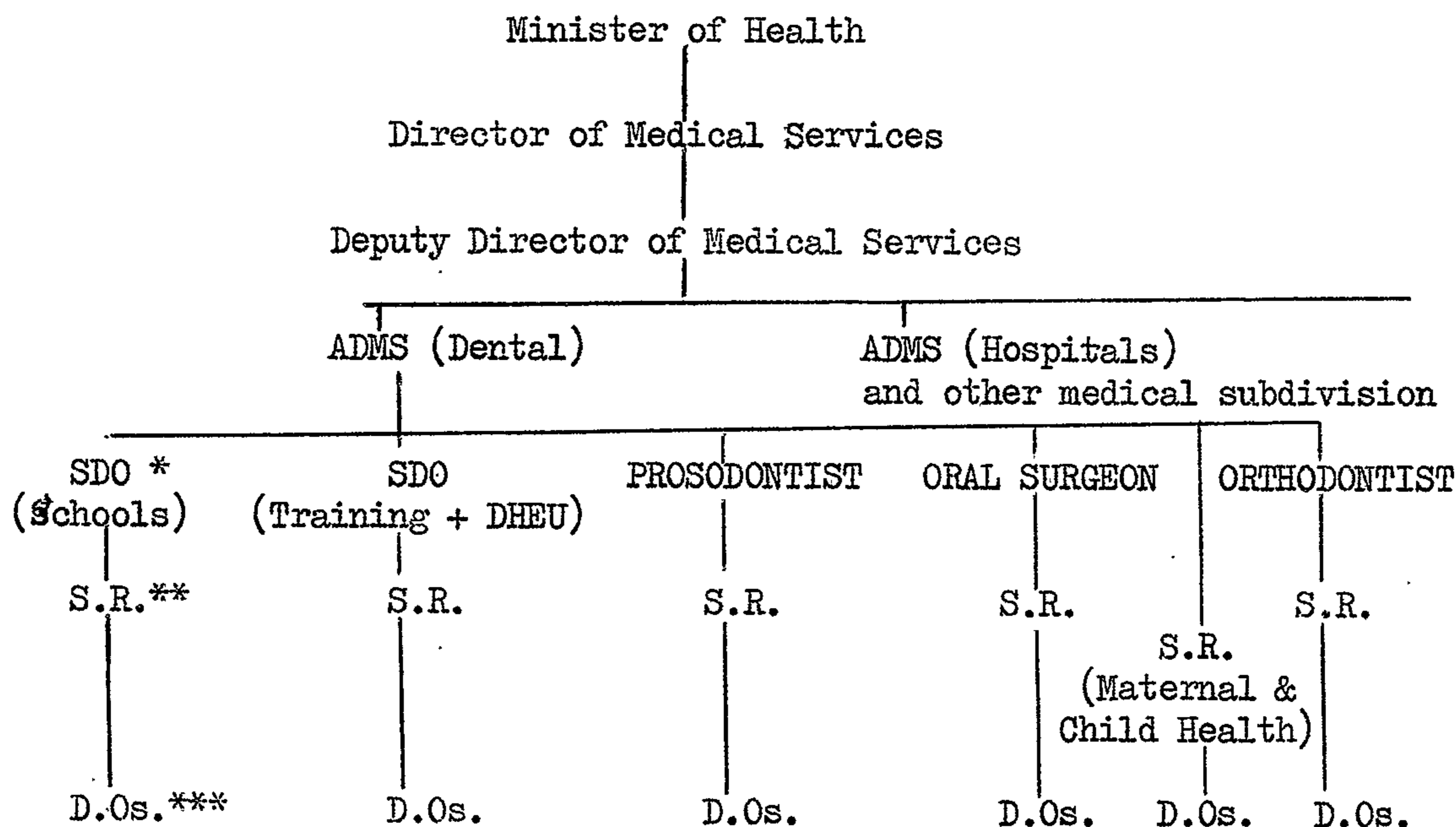
School dental clinics are of two types:-

- (i) usually two-chair clinic situated in a school classroom.
- (ii) "dental hut" - substantially constructed little building in the school compound, usually also a two-chair clinic.

These school dental nurses all come under the control of the Head of the Singapore Dental Service, designated the Assistant Director of Medical Services (Dental). With the passage of time the number of school dental clinics, dental officers, school dental nurses and other auxiliary staff grew steadily in number. However, it is noteworthy that only after the first batch of school dental nurses graduated in 1964 did the School Dental Services begin to develop more rapidly.

The School Dental Service was reorganised with the appointment of a Senior Registrar in charge, School Dental Service, in May 1966. The Senior Registrar was later promoted to Senior Dental Officer,

in charge, School Dental Service in October 1968. He is directly responsible to the Assistant Director of Medical Services (Dental), who in return is answerable to the Director of Medical Services, through his Deputy.



\* Senior Dental Officer

\*\* Senior Registrar

\*\*\* Dental Officers

Maternal and Child Health Centres: More than ten dental clinics were built into these centres and there is close co-operation between staff of these centres and the school dental service to ensure that it is through these centres that many mothers can be reached for dental health education and early dental care for their pre-school age children.

Dental Health Education Unit: This was set up in 1969. Its goal being:

- (a) to stimulate dental health awareness, and
- (b) preservation of life-time teeth and their supporting structures.

Though the society is getting more and more affluent each day, the demand for dental care has left much to be desired. Virtually free dental care for school children is available in the School Dental Service but only about 70% of primary school children accept treatment. In 1965-66 it was observed at the Dental Nurses' Training School that only 24% of children had clean mouths when first seen and 50% did not know or did not brush their teeth.

C. Staff and Clinics

The growth and development of the School Dental Service in respect of staff and clinics are shown in Table 4.

Table 4

Year	Staff				Dental Clinics		
	DO inc. SDO	Operating Aux. *	Non Operating Aux. **	Total	Single Chair	Multiple Chair	Total
1967	38 +	71 ++	45	154	3	44	47
1968	36	83	42	161	3	50	53
1969	36	90	42	168	2	56	58
1970	34	100	42	176	2	58	60
1971	37	112	39	188	2	62	64
1972	41	123	39	203	2	67	69
1973 1.6.73	44	120	40	204	2	69	71

\* 1 dental sister and school dental nurses

\*\* D.A., Health servants, dental technicians, drivers

+ Includes 1 Senior Registrar, no S.D.O. because S.D.O. appointed Oct.68.

++ No Dental sister, she joined in 1968.

Treatment

Priority is given to dental treatment of primary school children (6 to 12 years). Out of the present 380,000 primary school children, about half are receiving regular and systematic incremental dental care commencing from first year of primary school by the School Dental Service. It is the aim to cover the total primary school population eventually. To achieve this, about twenty student dental nurses are being recruited each year. School dental nurses work only in primary schools under supervision of school dental officers. (Ratio of 1 dental officer to 6 to 8 school dental nurses). Dental nurses on completion of their two-year training at the Dental Nurses' Training School have to complete another year of "field-training" under direct supervision of dental officers at dental centres before they are posted out to school dental clinics. One dental officer is in charge of three to four of such clinics.

The main bulk of dental care in primary school children is taken care of by dental nurses. Primary school children in some school clinics are examined at least once a year and in several clinics twice a year.

The nature of the treatment given by the dental nurse is rigidly standardised. It includes amalgam fillings in both deciduous and permanent teeth, the extraction of deciduous teeth and prophylaxis. Pulp capping is used as well as zinc oxide and zinc-oxyphosphate temporary fillings. Dental nurses are trained to recognise malocclusions but not to treat them. In such cases the patients are referred to the

dental officer in charge, who may in turn refer them to the government orthodontist. .

A Dental Sister was assigned to the Senior Dental Officer (Schools) in 1968. She is a dental nurse inspector and her main duties are to see that the school clinics are orderly and clean, the instruments and equipment are kept in good order, the records are properly filled out and completed and that dental nurses wear the regulated uniform. She also checks the monthly returns from the clinics and summarises them for the periodic reports required by the division.

Dental care for secondary school children is being given by dental officers at the two dental centres and at one attached to an outpatients' dispensary. Patients attending these centres pay a nominal fee.

The Government Orthodontic Unit works in close co-operation with the School Dental Service and cases of malocclusion are referred by school dental officers to this Unit. Less complicated cases are attended to by dental officers themselves.

#### Mobile School Dental Clinic

There are three mobile airconditioned clinics each equipped with two dental chairs. Each unit has a complement of four staff viz. the dental officer, a school dental nurse, a dental chairside assistant and a driver. The mobile clinic covers rural schools (sometimes for as long as a week at each school) and handicapped children's homes plus homes for blind and spastic children.

Table 5

Treatment - Annual Return of Work Done for Years 1967 - 1972

Year	Total Attends est	Fillings			Extractions			DIE & OHI	Per. & F. est.	Full F. est.	
		Silver Amalgam	Silicate	Other	Total	Perm	Decid				Total
1967	275881	123799	9531	53697	187027	26123	98695	124818	NA	1300	11
1968	317712	148376	9860	65356	223592	25437	95589	121026	NA	1232	4
1969	385215	192664	12715	70879	276258	23919	123627	147546	NA	1038	-
1970	414611	292869	12000	72174	287043	20901	118510	139411	NA	294	6
1971	424599	217952	11518	65200	294670	19373	124985	144358	NA	614	-
1972	422011	210615	10707	62040	283362	18935	122549	141184	NA	448	41
1973	←	est	est	est	—	—	—	→	—	—	—

(Note NA = Non available)

It is significant that the number of permanent extractions is decreasing yearly, despite the increase of yearly total attendances - see Table 5.

#### Preventive and Dental Health Education

Apart from curative aspect, emphasis is also being laid on more dental health education activities by the staff of the school dental service, both on a group and/or individual basis.

Singapore's strategy of dental health education is through competitions, exhibitions, daily toothbrushing drills and sustained program instructions to both children and adult.

#### Dental Health Program

##### A. Dental Health Week/Exhibition - held annually

1. Dental Health "King" and "Queen" contests (senior and junior sections);
2. Posters/Slogans competition;
3. Games and songs in primary schools;
4. News, radio, T.V. and other mass media.

##### B. Caries Preventive Programs in Primary Schools

1. Mass toothbrushing program in primary schools (commenced in 1970), on an incremental pattern commencing from the earliest primary classes. Prizes and certificates were awarded to the best class and teacher during the annual dental health week.
2. Incorporated into the school curriculum of nutrition, diet and correct oral hygiene instructions. (Both Ministries of Health and Education gave their fullest support)

3. Seeking early and regular treatment;
4. Using of detergent foods;
5. Flossing of teeth;
6. Interdental stimulators.

C. Positive Preventive Measures

1. Topical application of fluoride (zirconium-silicate stannous fluoride prophylactic paste, stannous fluoride paste and sodium fluoride solution);
2. Fluoridation of water supply. Because of its established effectiveness, ease of administration, and extremely low cost systemic ingestion of water containing an optimal content of 0.7 ppm was introduced into the Singapore water supply. (1.0 ppm optimal for temperate countries) The ingestion of fluoride during the period of calcification of the teeth is the most effective preventive dentistry agent available.

4. Cost of Dental Care.

Cost of dental care for school children is borne mainly by Government, (School Dental Service), or by patients in private practice. For adults it is borne mainly by patients (private practice) or by Government through the Hospital Dental Services (means test applied), and the Maternal and Child Health Services.

A small fee is levied in the School dental centres and the Hospital Dental Services. Referred cases to the Hospital and the Dental Faculty have to pay treatment and/or consultation charges.

5. Future Trends and Priority Needs for Improving School Dental Service

1. There are plans to increase the intake of student dental nurses to give a complete dental care service for all primary school children.

2. Response from kindergarten children at the moment is disappointing, but with increased dental health education planned to reach expectant mothers in maternal and child health clinics, it is hoped that the situation will improve.

3. Secondary school children - plans to develop the school dental services to cater for this group.

4. It is also intended to build large school dental centres with a dozen or more dental chairs for each in future. This will facilitate administration, supervision and control of staff, etc. These centres will cater mainly for secondary school children.

5. An organised and well-funded campaign to promote dental health consciousness among the population.<sup>85</sup>

6. Improvement of the Dental Health Education Unit,<sup>85</sup> of the Health Ministry and establishment of a Dental Health Foundation.

7. Encourage and promote private dental practice with government loans to young graduates.<sup>85</sup>

IV A FUNDAMENTAL APPROACH OF DENTAL HEALTH SERVICES FOR SCHOOL CHILDREN

1. Problem and Need of Child Dental Health (with special reference to Singapore).

Introduction:

The major dental disorders in children are dental caries, periodontal diseases and malocclusions.

Dental caries in children is widespread. The pattern of dental caries indicated higher prevalence in predominantly urban countries, urban areas, deciduous dentition, and Chinese groups, in mixed ethnic countries, in the Western Pacific Region.

A. Dental Caries

To ascertain need the report of Wong, Goh and Oon on "A Ten Year Study of Fluoridation of Water in Singapore"<sup>101</sup> presents data on dental caries experience in children, aged 7 to 9 years, for the base-line year 1957, and annually for a ten year period beginning in 1959. Comparable data for the control city, Malacca, in West Malaysia are presented also for each year through the year 1965 when Singapore ceased to be part of Malaysia. Slightly more than 2,000 children, equally divided between two ethnic groups, Malays and Chinese, were examined annually.

The prevalence of dental caries in deciduous teeth of

children in Singapore and Malacca for the baseline year 1957 was very high for both Malays and Chinese, with def averages of 10 to 12 for children aged 7 to 8 years. It continued at this high level in Malacca throughout the study years to 1965. On the other hand, the dental caries experience in deciduous teeth in Singapore children aged 7 to 8 years, after ten years of water fluoridation, had been reduced by 33.6% for Malays and 35% for Chinese. The percentage reductions in 8 to 9 years age group were as follows:-

Malays	7 - 8 years	33.62%
	8 - 9 years	21.74%
Chinese	7 - 8 years	31.0 %
	8 - 9 years	23.07%

The percentage reductions of the mean def teeth per child were higher in the younger age group of children of both races than in the older age group of children.

The data on dental caries in permanent teeth of Singapore children indicate that in 1957 the DMF averages were high for both Malays and Chinese. Fluoridated water reduced the prevalence rate of dental caries from 2.9 mean DMF teeth per child (1957) to 2.0 mean DMF teeth per child (1966) - a reduction of 31.0% in Malay children 7 to 9 years of age. The mean DMF teeth per child of Chinese children 7 to 9 years of age was reduced from 4.4 to 2.1, representing a reduction of 52.2%.

The percentage reductions were as follows:-

Malays	7 - 8 years	33.33%
	8 - 9 years	35.58%
	7 - 9 years	31.03%
Chinese	7 - 8 years	45.94%
	8 - 9 years	55.76%
	7 - 9 years	52.27%

An analysis of the trend of DMF averages for Malacca children indicates that they increased approximately 20% and that all this increase occurred during the period 1957 to 1960. In general, there was no significant change in the prevalence of dental caries in the permanent teeth of Malacca children (control) during the years 1960 to 1965.

Figures 1 to 4 show decreasing trends of dental caries between 1957 to 1968 of Singapore children as opposed to Malacca children.

Figures 5 to 7 show decreasing trends of dental caries between 1957 to 1968 of Singapore children.

**REPUBLIC OF SINGAPORE — TEN YEAR FLUORIDATION SURVEY**  
**INCIDENCE OF DECAYED, RESTORED & EXTRACTED PRIMARY TEETH**  
**SINGAPORE & MALACCA 7-9 YEARS**

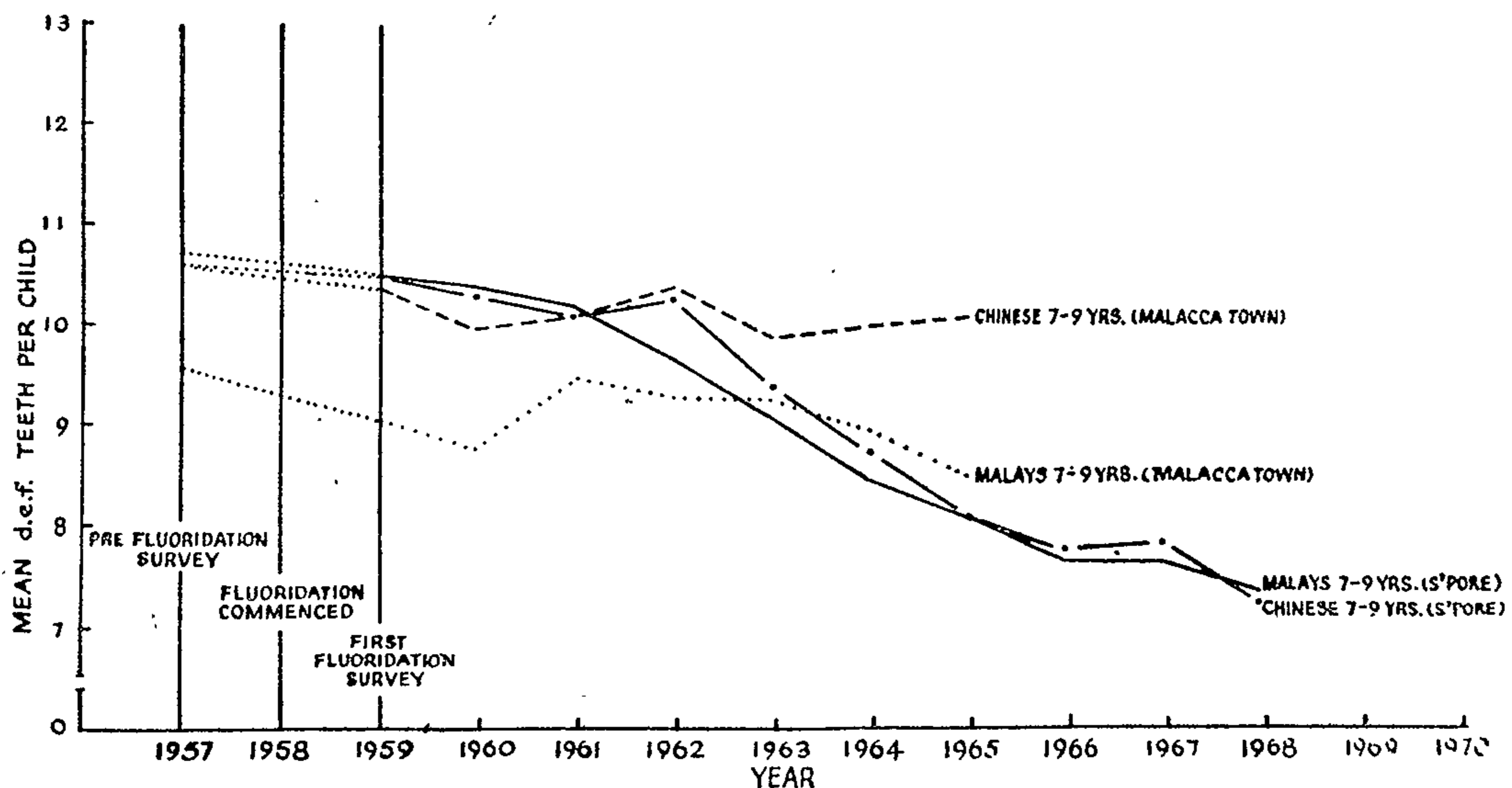


FIGURE 1

**REPUBLIC OF SINGAPORE - TEN YEAR FLUORIDATION SURVEY**  
**INCIDENCE OF DECAYED MISSING & RESTORED PERMANENT TEETH**  
**SINGAPORE & MALACCA 7-9 YEARS**

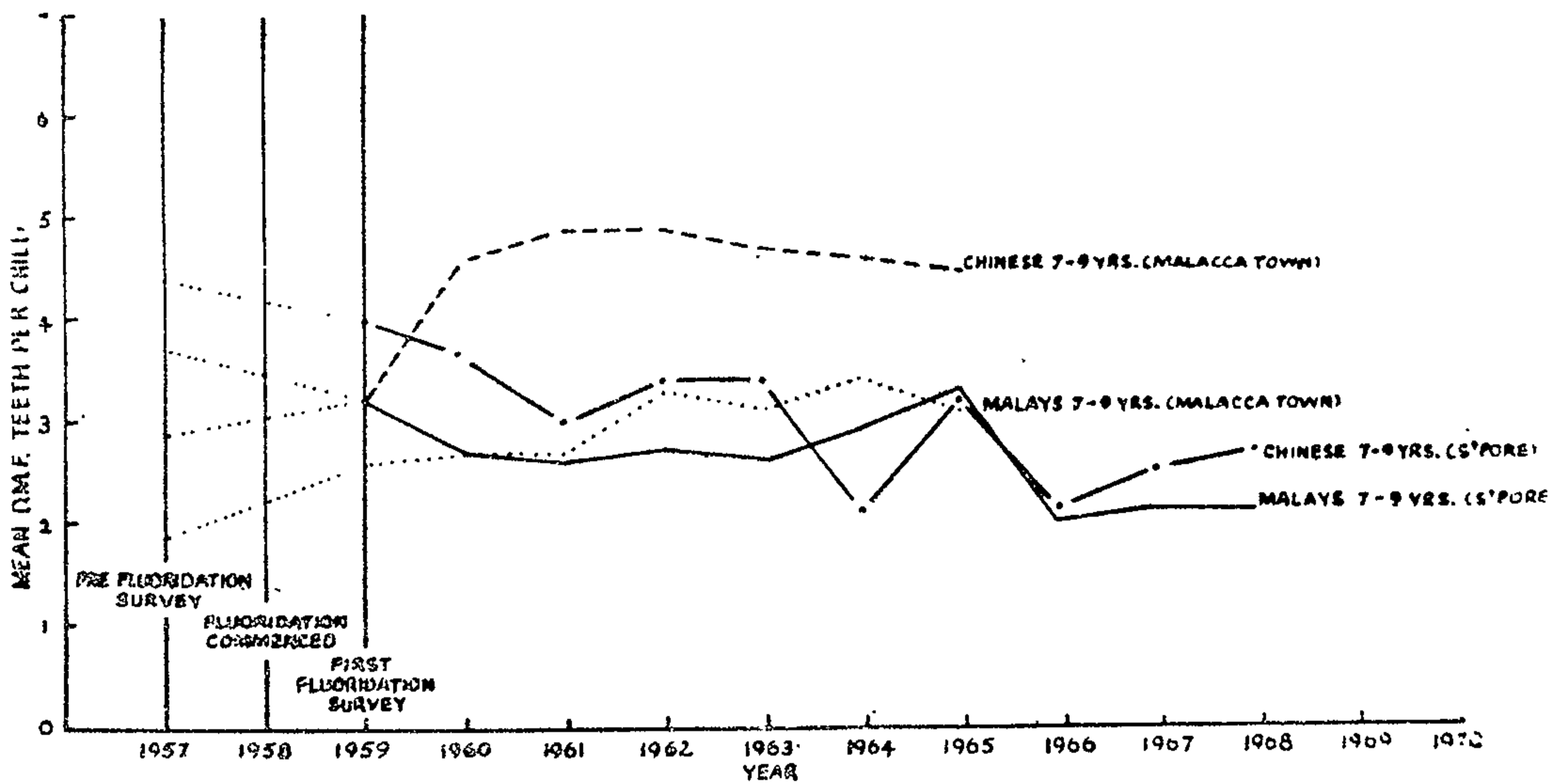


FIGURE 2

**REPUBLIC OF SINGAPORE - TEN YEAR FLUORIDATION SURVEY**  
**INCIDENCE OF DECAYED, MISSING & RESTORED TEETH OF MIXED DENTITION**  
**SINGAPORE & MALACCA CHILDREN 7-9 YEARS.**

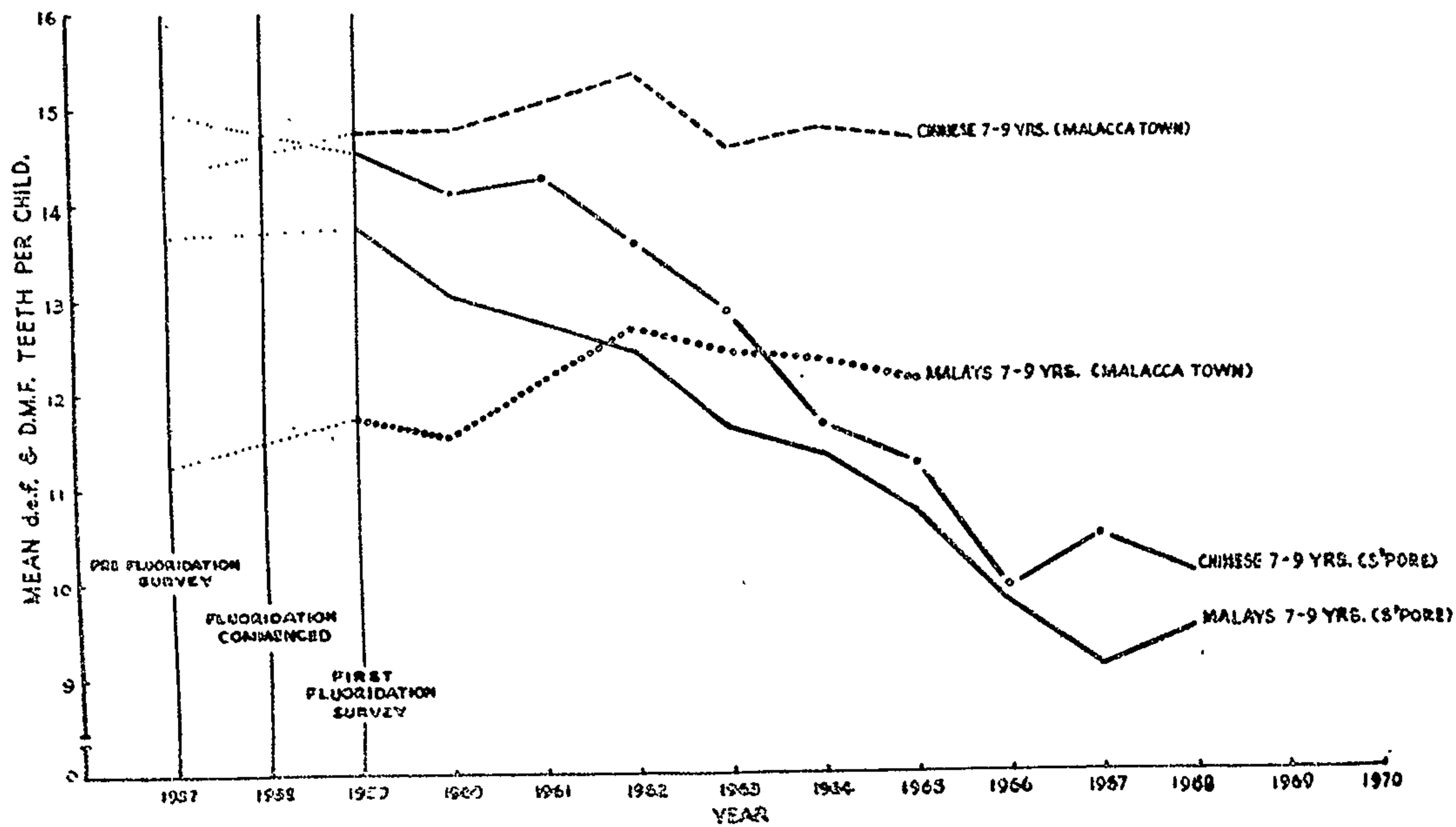


FIGURE 3

REPUBLIC OF SINGAPORE - TEN YEAR FLUORIDATION SURVEY  
INCIDENCE OF DECAYED, MISSING & RESTORED FIRST PERMANENT MOLARS  
SINGAPORE & MALACCA 7-9 YEARS

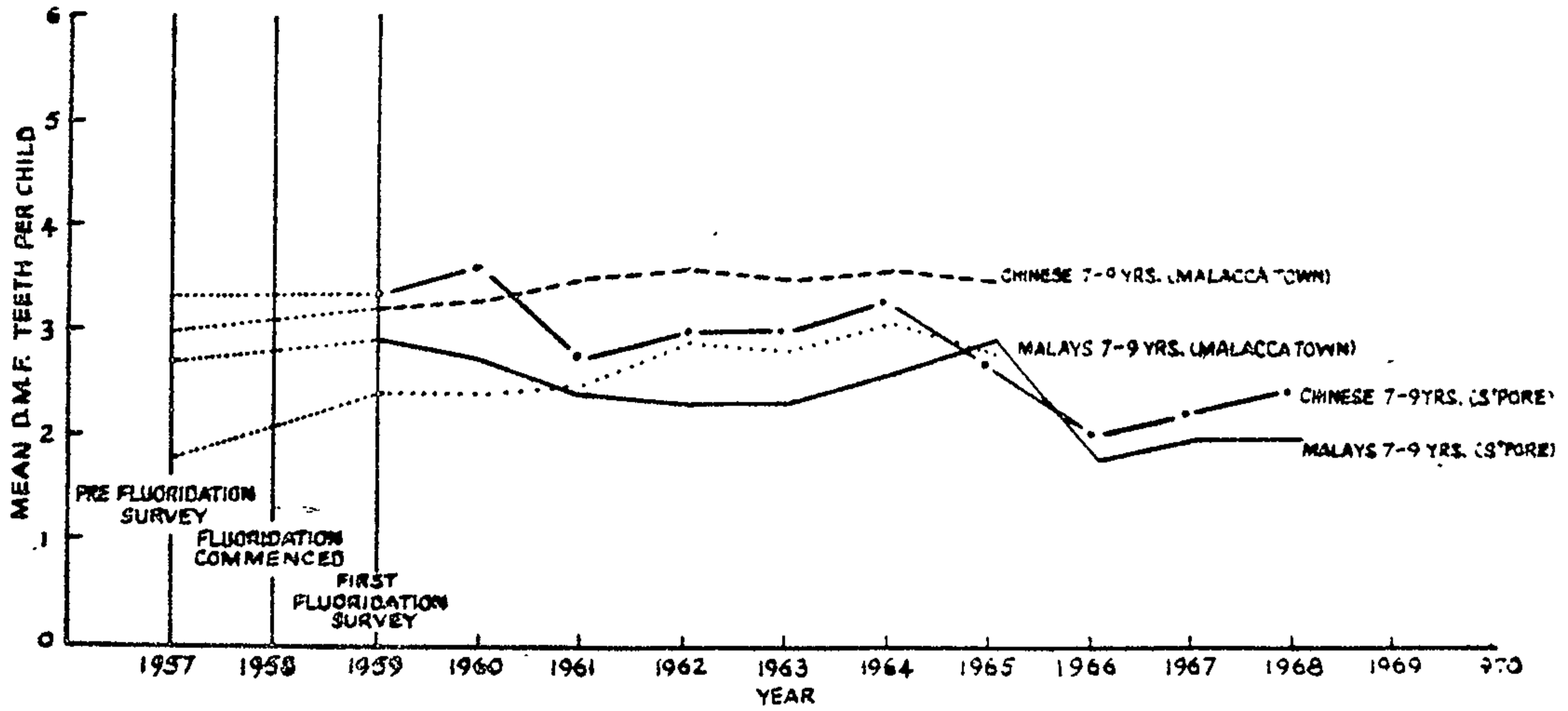


FIGURE 4

REPUBLIC OF SINGAPORE  
TEN-YEAR FLUORIDATION SURVEY  
INCIDENCE OF DECAYED, RESTORED & EXTRACTED PRIMARY TEETH

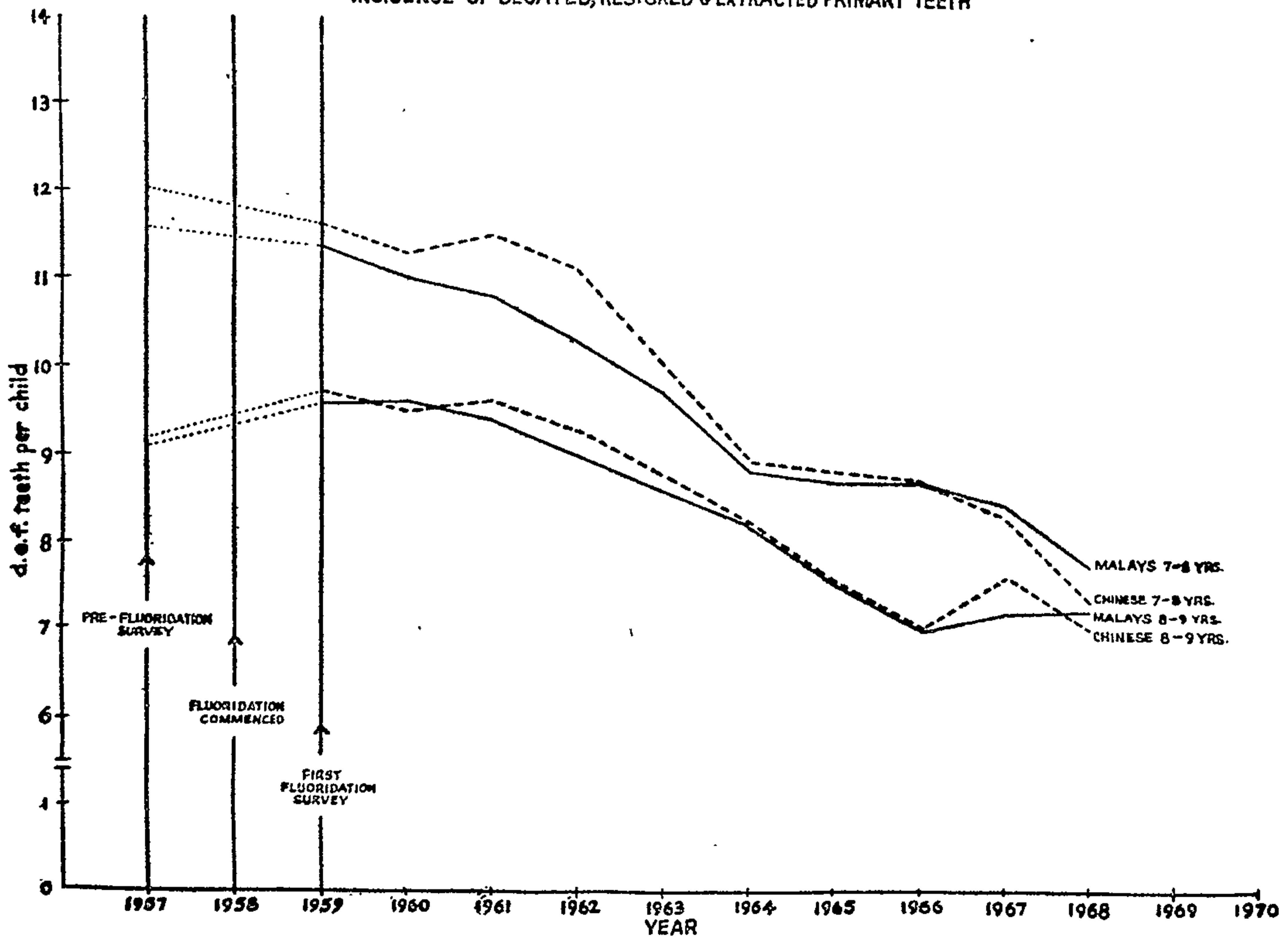


FIGURE 5

### REPUBLIC OF SINGAPORE TEN YEAR FLUORIDATION SURVEY

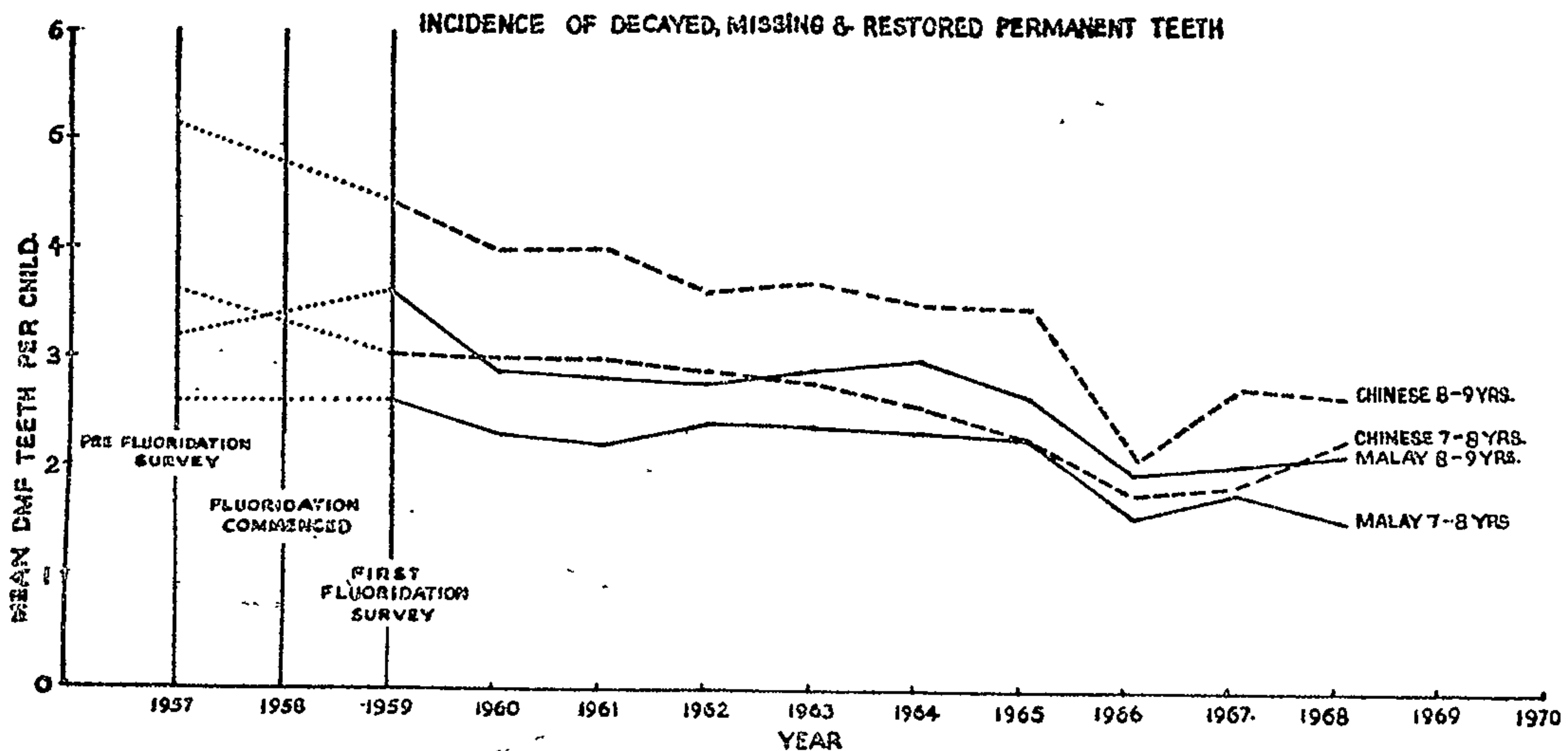


FIGURE 6

### REPUBLIC OF SINGAPORE TEN YEAR FLUORIDATION SURVEY

INCIDENCE OF DECAYED, MISSING & RESTORED TEETH OF MIXED DENTITION

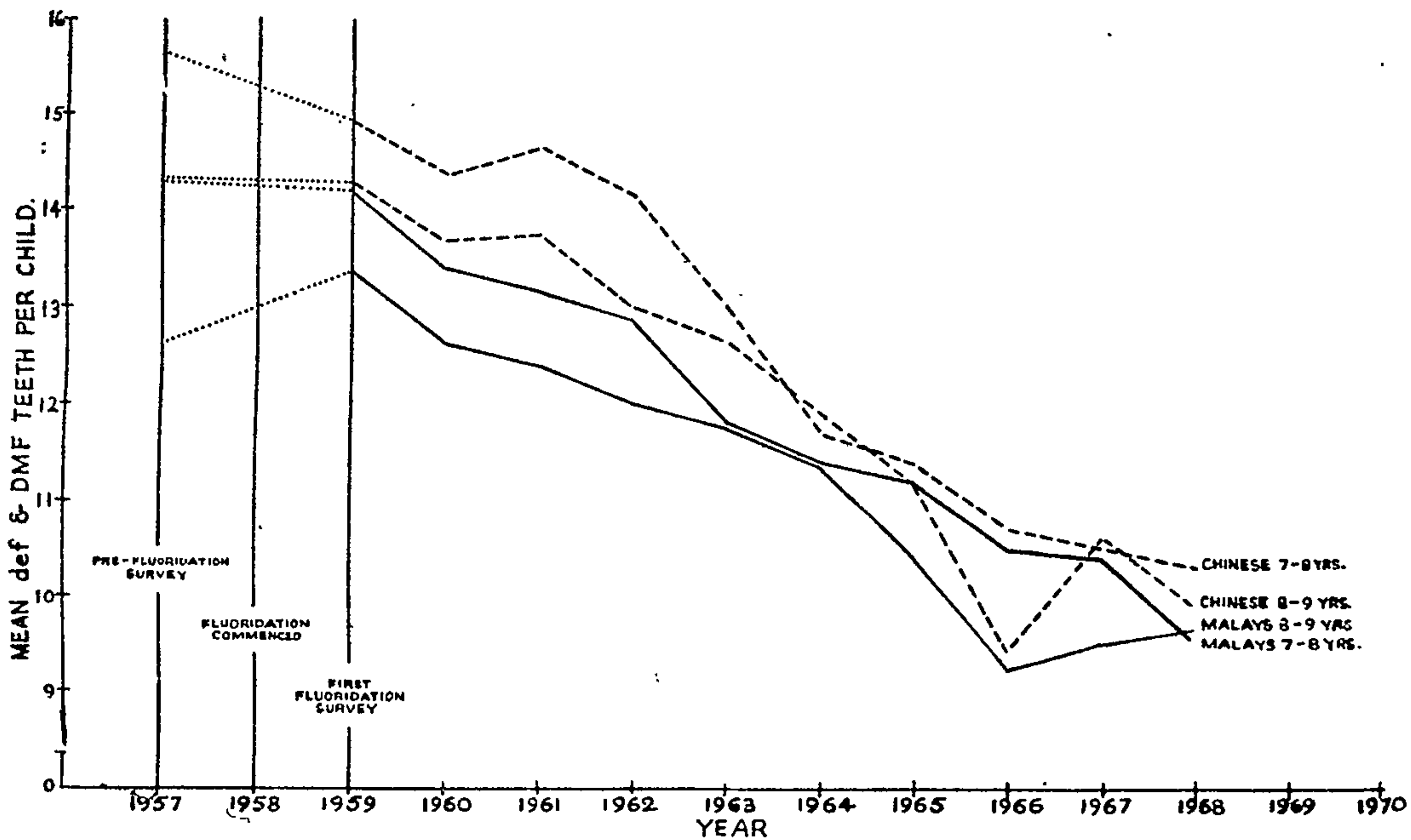


FIGURE 7

The percentage of teeth showing enamel opacity of idiopathic origin was higher in Singapore than in Malacca children. From 1966 to 1968 enamel opacity due to fluorosed enamel accounted for approximately 5% of the total number of teeth affected.

The authors of the Singapore Study concluded that 0.7ppm of fluoride in drinking water is a satisfactory level. This was later confirmed by Galagan.<sup>35</sup>

(Since the one-third reduction in the prevalence of dental caries is appreciably less than demonstrated in other studies, it would appear that this conclusion is worthy of reconsideration as was done in Hong Kong where the fluoride level was increased to one part per million.)

B. Gingivitis and Periodontitis in Selected Countries  
(National Survey results)<sup>99</sup>

Years	Singapore	
	Gingivitis %	Periodontitis %
5 - 6	66.0	
11 - 12	73.0	0.9
13 - 14	75.7	5.8
15 - 19	77.5	7.2

The prevalence of periodontal diseases was quite similar for the three ethnic groups, Malays, Chinese and Indians, and increases with age.

Calculus increased also uniformly by age. Although materia alba and calculus were slightly lower among Chinese than among Malays

and Indians.

C. Handicapping Dentofacial Anomalies

Persons with handicapping dentofacial abnormalities increased from 16% in children aged 6 years to 40% in children aged 13 years, and continued at about this level through the age of 18 years.<sup>52</sup>

(Malaysia)

Having ascertained the types and degree of dental needs the next logical step is to Plan and Evaluate dental health services to meet the needs.

2. Planning and Evaluation Activities in School Dental Health Services.

The choice of procedures to be utilized varies from country to country. It is largely dependant on socio-economic development and political system.

The WHO Expert Committee on Public Health Administration devoted its 1951 discussion largely on health planning and has contributed an excellent collection of WHO technical reports and paper for our understanding of and guidance in the uses of the planning process.<sup>89 to 98</sup>

National planning in countries with centrally planned economies (e.g. Singapore and New Zealand School Dental Services) will clearly differ from that in countries with a free enterprise economy, especially if dental care is mainly provided by the private sector (e.g. U.S.A., Australia and Scandinavian countries).

Where dental health services are intended to cover the whole

population, planning and evaluation can be fully combined with manpower planning.

Large services might have special units for planning or have dental representation in national health planning units.

Many studies relating to planning and evaluation need developing at national level so that the whole process can be constantly improved. These efforts might involve the following:

- (i) periodic analysis of manpower distribution;
- (ii) examinations and surveys in local and national areas;
- (iii) repetition and expansion of national surveys;
- (iv) dental education reviews - undergraduate, postgraduate and continuing education.

In this way, countries will be able gradually to build up a core of information relevant to planning and evolution.

Health planning is a complex and continuing process. As a viable process, it must include specific commitments by government for financing. It may involve several ministries other than health, such as those responsible for education, (e.g. Singapore's mass tooth-brushing campaign and the introduction of dental health in the curricula of primary schools), construction ("dental-huts" for primary school children in Singapore) and water works - fluoridation of Singapore's water supply commenced on an experimental basis in May 1956 when the first fluoride feeder was put into operation at Bukit Timah Water Treatment Station. This was followed by the installation of three additional feeders at other strategic points of the extensive water

distribution system, and following continuous preparatory work during 1957 by the City Water Engineer and his department, the entire water supply of Singapore was fluoridated in January 1958 as a public health measure, involving a population of over 2 million.

Health planning has specific objectives and targets which may be subject to modification from time to time.

It has built in requirements for evaluating statistics so that its efficiency and effectiveness in attaining objectives can be assessed and public funds accounted for and making dental health services available to an ever-increasing proportion of the people. Basic dental health program must therefore include:

- (a) preventive measures;
- (b) treatment or dental care; and
- (c) manpower requirements and cost of application.

### 3. Organisation and Administration of Child Dental Health Services.

#### 3.1. Methods of collecting, recording, evaluating and reporting data on orodental conditions in children.

##### General Consideration

Any systematic approach to a program of dental health services for children must take into account three objectives: diagnosis, treatment and prevention of the major dental health problems of children - tooth decay, periodontal disorder and handicapping anomalies.

Diagnosis may involve four steps:

- (i) collecting,

- (ii) recording;
- (iii) evaluating; and
- (iv) reporting.

The appraisal of orodental conditions serves a triple purpose:

- (i) basic planning and evaluation of dental health programs;
- (ii) the establishment of the basis of the curative and preventive phases of dental health programs;
- (iii) furtherance of international research activities on the epidemiology and etiology of orodental disorders.

Internationally accepted standardisation is essential in regard to:

- (i) classification;
- (ii) terminology;
- (iii) examining and recording methods,
- (iv) the selection of the proper indices; the data should be:
  - (a) simple;
  - (b) reproducible;
  - (c) quantifiable
  - (d) analysis,
  - (e) clinically meaningful;
- (v) processing and analysis of data in accordance with principles of medical statistics.

#### Tooth Decay

Standardisation of caries recording methods so far has received greatest attention and has achieved universal uniformity.

Public dental health services are mainly interested in cross-

sectional surveys on the prevalence of tooth decay, in the form of DMF(T), def(t), DMF (S), def (s) indices.

In order to arrive at uniform, reproducible diagnostic data:

- (a) the criteria must be precisely defined;
- (b) the examination equipment and technique must be standardised;
- (c) there must be uniformity of data recording (standard forms etc.)
- (d) the examiners must be trained and calibrated.

#### Periodontal Diseases.

The child's oral health may be affected by conditions that manifest themselves in the gingiva and mucosa.

Indices may be classified on the basis of whether they measure reversible or irreversible pathology.

Two examples of the reversible type index which have been widely used in children are the Papillary Marginal Attachment Index (P.M.A.) of Schour and Massler and Russell's Periodontal Index (P.I.)

Ramfjord's Index measures both reversible and irreversible pathology.

Schour and Massler,<sup>77b</sup> using the P.M.A. index, reported in 1947 that 40.2% of children (6 - 10 years) in Italy showed evidence of gingivitis.

In 1959, Nevitt<sup>72a</sup> examined 1,346 12-year-old children in ten cities and villages in Egypt, using Russell's index. Mean periodontal scores ranged from a high of 1.07 in Bibeis to a low of .47 in Esna. These scores were reported to be about halfway between prevalence rates in India and the United States for the same age group.

Jamison,<sup>51a</sup> using Ramfjord's index, studied a group in Teamesh, Michigan, and reported that approximately 25% of children (aged 5 - 14) who had deciduous teeth had destructive periodontal disease.

WHO methodology<sup>85b</sup> is the basis of classification of periodontal status by the rapid examination of the full mouth (30 - 60 seconds to complete) takes into account:

- (a) the periodontal tissues,
- (b) the need for extraction, and
- (c) the presence of calculus.

This method is recommended for basic survey.

#### Handicapping Anomalies

The HLD index includes clefts, traumatic deviations, excessive overjet, overbite, protrusion, crowding in terms of measurable, reproducible units taken from either patient or models without special equipment. The index gives a criterion for the suitability of children for orthodontic treatment and also provides prevalence data for epidemiological studies. A universal acceptable index is yet to be found.

#### Summary

For all recordings, generally accepted terminology and definitions of criteria should be used. International organisations like W.H.O. and F.D.I. have been examining the question of terminology and definitions in the dental field.

3.2. Organisation and administration of dental health services for children; administrative, staffing and financial aspects.

Requirements of Dental Health Program:

- (a) Epidemiologically based on facts and data;
- (b) Socially adapted to the way of life of people and satisfying their needs;
- (c) Administratively integrated into general health services; and
- (d) Economically, lie within available resources.

Guidelines and Priorities<sup>33</sup>

- (a) Dental Department within the Ministry of Health directed by Dental Surgeon (e.g. ADMS (Dental) Singapore).
- (b) Manpower - Dentists and auxiliaries.
- (c) Dental Health Promotion, Education and Prevention (Dental Health Education Unit in Singapore).
- (d) Establish priority - first children, followed by pregnant and nursing mothers e.g. Singapore Government Dental Service.
- (e) Urgent day to day treatment - relief of pain etc.
- (f) Establishment of framework of Dental Public Health Service into which aid and assistance can be put at an appropriate time.
- (g) Development of Government and Private Practice.

Administration

When a dental health service for children has been planned and its scope determined, a decision must be taken on its administration.

- (i) Overall administration and control of the Government School Dental Services in Singapore is vested on the Senior Dental Officer (Schools) who in turn is responsible to the Assistant Director of Medical Services (Dental).
- (ii) Administration can be in the hands of private practitioner or private health organisation in the private sector.
- (iii) A group of parents may combine in organising treatment for their children. Instances are known where such an initiative, on a completely private basis, led subsequently to an extensive children's dental health service, managed by the public health authorities and financed out of taxation.

#### Staffing

Dentists and auxiliaries engaged in treating children require not only technical and diagnostic skill, but also psychological insight and an ability to get on with children.

Dentists not only should be acquainted with treating caries but also should have some orthodontic training so that they can give intelligent advice to parents and also carry out simple treatment.

Specialists in orthodontics and oral surgery will also be required, the latter essential for the care of clefts.

Full-time dentists should be given further salary increments (2 increments in Singapore) and promotion if they attend specialist courses to improve their professional qualification.

Some part-time appointments can be combined with private practice.

### Finance

A budget must be drawn up in two sections:

- (i) capital and non-recurring expenditure;
- (ii) operational expenses.

Estimates will have to take into account the increasing expenditure as the service develops.

The Singapore School Dental Service is a salaried Government Service. If the Service is only partially financed from public funds or is entirely a private responsibility, then the situation will be more complex.

If support from public authorities is not forthcoming, planning organisations must try to make an arrangement by which the parents of the children contribute towards the costs. If parents are poor social welfare organisations will often provide assistance.

### 3.3. Organisation and provision of dental treatment care for children

The main effort in the dental service for children must be directed to the prevention and treatment of dental caries.

Provision must also be made for the early treatment of periodontal diseases since it has been shown by Cohen that the causative factor of this disease frequently occurs within a few months of the eruption of teeth.

Having ascertained the order of need, a decision must be made on the nature of the treatment to be provided. At the same time means of prevention, including dental health education, should be

provided for.

Nature of treatment to be provided.

Ideally, a child should be examined, and any necessary treatment provided from the age of three to school-leaving age and through adolescence to the age of 21.

In primary schools examinations should take place at six-monthly intervals, thereafter annually. In U.K. under the National Health Service Act, dental treatment is free up to the age of 21. In New Zealand there is the adolescence scheme in addition to the School Dental Service.

The extent of dental manpower required depends upon whether the service is to be manned entirely by fully qualified dentists or whether these are to be assisted substantially by dental auxiliaries. Account must also be taken of the contribution of dental private practitioners.

In order to assess the number of dental personnel required, consideration must be given to the estimated number of children a dental surgeon alone or in conjunction with auxiliaries can deal with.

In U.K. a full-time dental officer should be able to undertake responsibility for annual examination and treatment of 2,500 to 3,000 children.

A dental nurse could give systematic care to 1,000 to 1,500 children depending on the decay incidence which is strongly related to fluoridation.

Auxiliaries undertaking the treatment of children generally

fall into three classes i.e. hygienists, dental nurses and dental therapists.

#### Provision of Treatment

Treatment may be given in centres - serving a group of schools e.g. Pegu Road Dental Centre and School Dental Clinic, Institute of Health in Singapore, "dental-huts" and clinics attached to schools, or in mobile clinics.

Orthodontic Specialist treatment for school children is provided in these centres. The services of orthodontic consultants are becoming increasingly available as more dentists return from abroad after training.

#### Prevention

##### (i) Caries

Incidence of caries can be reduced up to 65% in permanent teeth and up to 50% in deciduous dentition by instituting water fluoridation in water supply. Where articulated or piped water supply is not available, other vehicles for providing an optimum intake of fluoride should be explored. Today, the most promising substitute is salt and flour.

Topical fluorides and mouth rinsing with fluoride salts have effects of up to 30% reduction of caries incidence.

##### (ii) Periodontal disease

The only method available both for prevention and controlling periodontal disease is good oral hygiene and plaque control.

Regular toothbrushing using the correct size toothbrushes

and the correct toothbrushing technique will remove plaque which is the cause of caries and periodontal diseases.

#### Dental Health Education

This together with toothbrushing drill are encountered to varying extent in different countries; Singapore being an outstanding example of daily mass toothbrushing in primary schools. Bulk of dental health education work can be undertaken by non-dental personnel such as school teachers, school nurses etc. Involvement of these personnel is of utmost importance to minimise loss of operating-time by dental personnel.

#### 4. Curative Aspects of Dental Health Services for Children.

##### 4.1. Curative aspects of dental health services for children.

The prime importance of preventive measures needs no emphasis. Curative measures will also be necessary in any dental health program.

The services provided will vary widely in accordance with the needs and resources of each country. Priorities must be established if a comprehensive children's dental health service is impossible.

Close co-operation between maternal and child health centres and dentists is also essential.

If lack of resources makes it impossible to provide a dental service for both pre-school and school children, top priority must be given to children just starting school.

In most cases the child's first contact with the dentist

will occur in the school dental service. Dental inspection and treatment should be carried out at least once a year and preferably twice.

A decentralised system like the over seventy "dental huts" and clinics built in the vicinity of primary schools dotted all over the island of Singapore help to bring dental care close to where the children stay.

Larger towns should have a centrally-situated clinic with a staff of specially trained dentists to which surgical, orthodontic and other complicated cases, including handicapped children, can be referred.

Full-time school dentists are to be preferred, although the work done by private dentists is recognised in rural areas especially.

A children's dentist should, whenever possible have good equipment at his disposal, including an x-ray apparatus and should always use only first-class materials.

The team concept using operating auxiliaries and chair-side assistants in providing care for children should be developed with respect to dentist : school population ratio.

One requirement for a progressive school dental service is the establishment of close co-operation between the school dentist, the school doctor, the school nurse and the teacher.

Experience has shown that a good dental health program will lay the foundation in children of an increased sense of responsibility and readiness to continue dental care after school.

Most European countries do not have an organised school service and where they exist cover not more than 25% of children of that age-group.

#### Treatment of gingival disorders

Importance of the prevention and early treatment of gingival disorders was widely accepted.

#### Costs of Treatment

There are many variations between different countries ranging from free treatment for the whole school population to treatment free for the low income groups only or free with the exception of certain services. The financial resources of the country must not be overlooked.

Priority given to the conservation of the permanent dentition before that of the deciduous dentition should not be taken as minimising the great importance of care for the primary dentition.

#### 4.2. The role of orthodontics in a dental health service for children.

Facilities for orthodontic treatment should be included in any dental health service for children. This treatment should aim at the optimum form and functioning of the masticatory system.

The demand for orthodontic treatment is growing in organisation of dental health services for children.

#### Prevalence of dentofacial anomalies

Mâlocclusion in deciduous dentition is lower than in mixed and permanent dentition.

In the mixed and permanent dentitions it can be as high as 50% to 70%.

Fortunately, the actual need for orthodontic treatment is much less.

The main consideration in orthodontic prophylaxis is the preservation of the deciduous dentition.

### Treatment

Many cases of tooth malposition are produced by harmful habits such as thumb and finger-sucking. These should be eliminated by taking measures in early childhood to prevent the malposition.

Planned or serial extractions can be of great value in a dental health program. In many cases treatment with appliances has to follow the extractions.

Early treatment helps to prevent more difficult situations arising at a later stage.

Orthodontic treatment, even in the simplest form, should not be undertaken unless the preservation dental care of the child is assured.

In some cases prolonged treatment cannot be avoided. Once treatment has started, it must continue until a satisfactory result has been obtained.

Role of dentists and the orthodontic specialists:

Simple cases should be treated by the dental practitioner and complicated ones by the specialist.

Any general dental practitioner should be able to:

- (a) recognise early deviation from the so called normal development of the face, jaws and teeth;
- (b) recognise predisposing factors and incipient malocclusion;
- (c) irregularities of the dentition and refer them to a specialist;
- (d) recognise abnormalities of function;
- (e) institute prophylactic measures;
- (f) carry out simple treatment with removable appliances.

The orthodontic specialist has to look after severe malocclusion and cases referred to him. Besides, much orthodontic work has to be done under his supervision or in accordance with his prescription.

In organising an orthodontic program provision must be made for an adequate number of specialists.

In a dental health service for children the function of orthodontics would be the prevention, interception and treatment of incipient conditions which would require regular treatment at a later age.

Orthodontic treatment as compared with the other requirements for preventive and curative care.

Depending on manpower, finance and other resources, the following priorities are suggested:

- (a) prevention and treatment of caries in the permanent dentition;
- (b) orthodontic prophylaxis;
- (c) prevention and treatment of caries;
- (d) orthodontic treatment of simple cases with simple removable

appliances by dental practitioners, and specialists  
(excluding those cases which need treatment for purely  
aesthetic reasons);

- (e) treatment of more advanced malocclusion by specialists  
(excluding those necessary for purely aesthetic reasons).

Measures should be taken to provide care for children with  
severe malocclusions, cleft palates etc.

#### 4.3. Auxiliary dental personnel in dental health services for children.

Owing to differences in economic and social conditions as  
well as opinions held on this question, individual countries have  
provided various kinds of auxiliary personnel with corresponding  
variations in their respective fields of work.

Few countries are able to meet even the first-priority dental  
needs - incremental dental care for school children. Because of the  
grave shortages of dental manpower and funds to support them, it is  
widely recognised that maximum use must be made of auxiliary dental  
personnel.<sup>2,7,32,54</sup>

A ratio of 1 dentist to 9 dental auxiliaries - 5 operating,  
2 chairside assistants, 1 technician and 1 receptionist clerk is  
suggested as minimum requirements for a dental health team.<sup>83</sup>

The functions and responsibilities of the auxiliary dental  
personnel vary widely in the countries which use them. The two main  
categories are:

- (i) dental auxiliaries who are permitted to work in the mouth,

- and are termed "operating dental auxiliaries";<sup>88</sup> and  
(ii) those who have no such contact with patients termed  
"non-operating dental auxiliaries".<sup>88</sup>

In North and South America the duties of auxiliaries such as the chairside assistant are being expanded to include limited intra-oral work.<sup>1</sup>

The functions of dental hygienists are being expanded in the United States of America and Japan to make them more productive than they have been hitherto.<sup>84</sup>

#### Classification

The New Delhi WHO/TUDP Seminar identified three broad categories of dental personnel and recommended a range of duties and responsibilities for each.

##### Category 1 (Professional)

A graduate of a university or dental college who is registered to practise dentistry.

##### Category 2 (operating auxiliary)

Includes the school dental nurse (New Zealand type) as in Singapore, the dental hygienists (U.S.A. type), the dental therapist in South Australia and others who have duties and responsibilities associated with intra-oral care of patients.

##### Category 3 (non-operating auxiliary)

Envelopes: (a) the Clinical, and (b) the Technical (Laboratory) types, viz. the dental chairside assistant and the dental technician.

Category 2:      Operating dental auxiliary

Definition:      A person who not being a professional, is permitted  
(role)              to carry out certain treatment procedures in the  
                         mouth under the direction and supervision of a  
                         professional.

Range:              This cadre of personnel should be employed in main-  
(scope and          training a specific treatment group (e.g. primary  
limitations)        school children 6 to 12 years in Singapore); giving  
                         special attention to teaching the principles of oral  
                         hygiene and the prevention of dental diseases to  
                         patients, school classes, teachers, women's  
                         organisations and similar bodies. Ability to  
                         recognise conditions requiring referral.

Duties may also include a combination of the following:

- (1) The cleaning of teeth;
- (2) The removal of calculus;
- (3) Individual and group instruction in oral hygiene;
- (4) Topical application of medicaments;
- (5) Examining patients and charting the dental condition;
- (6) Preparation of cavities in deciduous and permanent teeth and filling them. (Dental nurses in Singapore do not prepare and fill anteriors with plastic materials.)
- (7) Simple extraction of teeth under local anaesthesia; (Singapore dental nurses are not trained to do block anaesthesia using local anaesthetics);

Restrictions placed on this category are:

- (1) They are not registered or licensed as professionals;
- (2) Their work may often be limited to children but local circumstances may be such that adult groups might also be treated;
- (3) They should normally work within a public health service (i.e. School Dental Service, Singapore).

Category 3:      Non-operating auxiliary

(a) Clinical - chairside assistant

Definition:      A person who assists the professional in his clinical  
(role)              work but does not carry out an independent procedure  
                         in the oral cavity.

Range:              Duties of this cadre of personnel usually include all  
(scope and              or some of the following:  
limitations)

- (1) Reception of the patient;
- (2) Preparation of the patient for treatment;
- (3) Preparation and provision of all necessary facilities;
- (4) Sterilisation, care and preparation of instruments;
- (5) Preparation and mixing of restorative materials;
- (6) Responsibility, on completion of treatment, for care of the patient until the latter leaves;
- (7) Preparation of the surgery for the next patient;
- (8) Presentation of documents to the dental surgeon for his completion; filing of these documents;
- (9) Assistance with x-ray work, including processing and

mounting of x-rays;

- (10) Instruction of the patients, where necessary, in the correct use of the toothbrush;
- (11) After care of persons who have had general anaesthetics. However, this type of auxiliary may be permitted in suitable circumstances to carry out any of the following procedures within the mouth under direct supervision of a professional:
  - (1) Application of rubber dam (e.g. dental chairside assistant in South Australia);
  - (2) Application of matrices;
  - (3) Placement of plastic materials in prepared cavity;
  - (4) Trimming and polishing of fillings;
  - (5) Polishing of teeth;
  - (6) Exposure of x-rays in mouth.

(1 to 5 not done by dental chairside assistant in Singapore.)

(b) Technical (Laboratory)

Definition: A person who assists the professional by carrying out  
(role) certain technical laboratory procedures.

Range: The normal duties of this category of auxiliary who  
(scope and should work under the direction of a Category 1  
limitations) professional, may include any or all of the following:

- (1) Casting of models from impressions of patient's mouth;
- (2) Construction of appliances for the mouth;

- (3) Treatment of metals and plastic materials used in construction of such appliances;
- (4) Construction of splints used in maxillo-facial surgery;
- (5) Construction of orthodontic appliances;
- (6) Construction of special appliances such as obturators and special prostheses.

Supervision of dental auxiliaries i.e. dental nurses in Singapore is initially "direct" as in the two school dental centres and subsequently "indirect" when they are posted out to "dental-huts" and clinics in primary schools.

The relationship of the operating auxiliaries with basic health services e.g. maternal and child welfare, is essential where health guidance services for the mother and child are given.

In the School Dental Service in Singapore their duty is giving systematic incremental dental care to primary school children. Their other tasks are the dissemination of information on self-care methods for dental health and the development of dental health interest, whenever opportunity arises.

The ultimate responsibility for the dental health of the child must remain with the dentist, who must be skilled and trained to undertake his duties and appreciate also his responsibilities in the supervision of dental auxiliaries.

5. Preventive Aspects of Child Dental Health, including Dental Health Education.

5.1. Preventive Services in a dental health program  
for children.

One of the most important direct activities of a dental public health service is the prevention of disease on a community basis.

Since probably only 15% to 20% of the population seek dental services regularly, there is little prospect that efforts of the dentist in private practice can reach a majority of his community. The remainder of the population will be reached by community programs or not at all.

Some dental preventive procedures are applied most appropriately in the community for the benefit of groups of people because they may be more efficient, less expensive or easier to control - as in the case of fluoridation. Other procedures, such as topical applications of fluorides or the provision of mouthguards, can be applied either in private practice or on a group basis.

These examples point up the importance to the dentist and the auxiliary, of participating in the development of community programs.

In every country priority must be given to prevention. The prevention of dental diseases in children can be considered under four headings:

1. Diseases affecting general health;
2. Dental Caries;
3. Periodontal diseases;
4. Malocclusion.

1. Diseases affecting general health

Ideally all carious teeth are to be filled. Every tooth with an infected pulp must either be treated or roots extracted. Removal of oral sepsis must be established before any other treatment is carried out.

2. Dental caries

The following aspects of this subject are considered:

(a) Nutrition and diet

The effect of the former appears to be mainly confined to the formative period, and the latter to the period after the teeth have erupted.

Nutritional factors during tooth development can modify both the histological structure and chemical composition of teeth, thereby influencing the resistance of teeth and periodontal structures to disease.

Dietary factors play an important role in the aetiology and prevention of dental disease.

The dietary factors which have so far been shown to adversely affect dental health are the continual ingestion of refined carbohydrate and a deficiency of substances which require vigorous chewing. Carbohydrate retention on the tooth surface is a necessary condition for caries initiation. Plaque together with sugary foods produce acid which dissolves tooth enamel.

The most impressionable lay people for nutrition advice are expectant and nursing mothers and mothers of pre-school children to

take advantage of the vitamin supplements and welfare foods available.

Efforts to guard the child's dental health must continue at school. Sales of confectionery in the school tuckshop should be restricted as far as possible and the sale of fruits, nuts, raw vegetables or non-fermentable carbohydrates encouraged.

Biology and domestic science teachers can give lectures on the effect of nutrition and dietetics on teeth in classes run for older children and teenagers.

Preliminary trials with soluble inorganic phosphate salts ( $\text{NaH}_2\text{PO}_4$ ) have indicated that it may have some effect in curbing the cariogenic potential of sugar coated cereals.<sup>15,82</sup>

(b) Instruction in oral hygiene; dental prophylaxis.

To promote good oral hygiene, individual instruction and supervision are necessary.

In prevention of dental caries, the educational elements of dental prophylaxis carried out by the dentist or auxiliary personnel are of greatest importance.

(c) Dental treatment

Areas of food retention (open cavities, etc.) must be eliminated. Plaque control must be instituted.

(d) Topical use of fluorides

A considerable inhibition of dental caries can be attained through the direct application of fluoride solutions, pastes or gel to young teeth.

The classical experiments of Knutson and Armstrong (1946),

using a 2% sodium fluoride solution, showed 35% to 40% reduction in new caries over a period of three years in children of 7 to 15 years of age. The method involves four applications at weekly intervals. This procedure commenced at 3 years, 6 years, 10 years and 13 years of age.

Mouth rinsing with solutions of neutral sodium fluoride 0.2% weekly and 0.05 daily as recorded by Horowitz (1972) showed a drop of 51% DMFT and a drop of 44% DMFS, over control after a 20 month period. This is a practical, effective and cheap method using limited professional personnel.

The use of stannous fluoride in dentifrices has also been looked into.

Topical applications are of value, but on a plane of effectiveness well below that of a lifetime use of a fluoridated water.

One important advantage of topical application is immediacy of effect. Caries inhibition begins as soon as treatment is initiated.

(e) Mass prevention

Water fluoridation is the most effective and economic method for reducing dental caries incidence by 60% to 70%. Fluoride should, if practicable, be introduced into all public water supplies. The optimum fluoride level is usually determined relative to annual average maximum temperature and is given as less than 1.0 ppm for tropical countries. Tropical countries using these lower levels should evaluate the results achieved and if the drop in dental caries

prevalence is not as great as expected, consideration should be given to raising the level of fluoride, as was done in Hong Kong. Regular monitoring of the fluoride level at various distribution points should also be carried out.

Results in Europe and United States confirmed the effectiveness of water fluoridation even in older age-groups.

The use of tablets may be difficult or even dangerous in the absence of adequate supervision. Similarly fluoridation of milk could also be dangerous. Table salt and bread would seem to be the only other vehicles for administration of fluoride.

It should be understood that water fluoridation does not supersede the other caries preventive measures which are still indispensable.

### 3. Periodontal diseases

Prevention of these diseases is as important as that of dental caries. It can be divided into the control of systemic factors and the control of local factors.

#### Control of systemic factors

A well balanced diet is of importance in the development and maintenance of healthy tooth supporting tissues.

#### Control of local factors

Poor oral hygiene is the main cause of gingivitis in children i.e. inefficient physiological cleansing, often combined with incorrect methods, or a lack of toothbrushing and rinsing. Gingivitis if left untreated may result in periodontitis. Prevention of gingival disorders

in children seems therefore to be an important factor in the reduction of periodontitis in adult life. Plaque and irritants result in gingivitis.

Plaque control - the only way to effectively remove plaque is physically - by thoroughly cleaning all your teeth by brushing and flossing. And since plaque constantly reforms, it must be regularly dis-organised at least every 24 hours.

#### 4. Malocclusion

The dentist responsible for the child's dental health must observe the development of the dentition and jaws and must therefore have a good understanding of orthodontics. Prevention should replace treatment as far as possible. Good oral hygiene, including preservative dental treatment, is a requisite for orthodontic treatment.

#### 5.2. Education of children in dental health.

Dental health education is instruction in the procedures necessary to maintain a healthy mouth and motivation to continue these procedures throughout life.

The objective of community dental health education is to disseminate knowledge and to affect group attitudes, while that of the individual dental health education is to motivate the recipient to act upon that knowledge.

Community education would be likely to change group attitudes so that their personal beliefs could be translated into action.

It is possible for extensive community dental health

education to create a group attitude that is socially acceptable to look after one's teeth. The people of Scandinavia and United States appear to have generally adopted this point of view.

On a national basis, the advertising media of press, radio and television can be utilized. Medical, para-medical personnel and others can influence the public, provided they are properly organised.

Expectant and nursing mothers in ante and post natal clinics are easily motivated to receive advice on the care of their babies, and dental "units" are now being included in these clinics in Singapore.

Dietitians can also be contacted to ensure that their advice will include the problems of oral health.

Later, the school environment can be used. Head teachers and class teachers have special training that enables them to influence children. School meals and tuckshops could also be planned to create positive dental health, and teacher-parent associations approached to help produce a more receptive environment.

The dental nurse, therapist or hygienist may help considerably in this work. She can spend a greater amount of time working in closer liaison with welfare clinics, nurseries, schools, hospitals and other groups. However, it must be remembered that the main duty of dentists, therapists, hygienists and dental nurses is that of personal educators at the chairside.

5.3. Preventive aspects of dental health services for children as carried out by the patient.

(Supervised or non-supervised)

Patients may be divided into two groups, parents and children.

The parents

To promote good dental health in their children, parents should:

- (1) Arrange housing and living conditions to the best advantage for themselves and their children;
- (2) Provide an adequate balanced diet, particularly in the case of the expectant and nursing mother and the child;
- (3) Supervise the children's oral hygiene;
- (4) Watch out for dental disorders;
- (5) Arrange that the children visit the dentist regularly;
- (6) Try to prevent or correct bad habits and posture in their children which might cause malformation of the teeth and jaws;
- (7) Supervise the health education of their children;
- (8) Parents should also try to obtain as much information as possible on dental health. As in all education, example is important and parents should practice personal oral hygiene and visit a dentist regularly.

The children

The prevention which can be carried out by the child consists

entirely of local measures. He should learn:

- (1) To maintain good oral hygiene by using the toothbrush properly and regularly and by rinsing the mouth with water, especially after meals;
- (2) To avoid bad habits such as thumb-sucking etc.;
- (3) To acquire good dietary habits and tastes and to finish a meal with detergent food;
- (4) To avoid eating sweets, particularly sticky ones, and sweetened drinks;
- (5) To avoid eating between-meals snacks and food after going to bed;
- (6) To learn to safeguard teeth when engaging in sports and to value personal appearance;
- (7) To visit a dentist regularly.

## 6. Teaching and Training in Child Dentistry

### 6.1. Teaching and training in child dentistry - undergraduate and postgraduate training.

#### Undergraduate training

One of the essential objectives of undergraduate dental education is to provide students with the knowledge, skills and attitudes that they require to become competent general practitioners of dentistry.<sup>87</sup> Traditionally, in most Western countries the emphasis has been on the education as a private practitioner. This is understandable in a country like Australia where over 80% of the

dentists are in private practice<sup>23</sup> but makes no sense for countries where all dentists are in government service and it does not make much sense for countries where a high proportion of dentists are in Government service as in Singapore.

Because of the high prevalence of dental diseases and a lack of dental manpower, highest priority must be directed towards the development of a strong component of preventive dentistry and dental public health (with emphasis for children) in the undergraduate curricula of dental schools, so that the future dental practitioners will give appropriate importance to the preventive aspects of total health programs.

#### Review of dental course

Constant review of existing dental course is important, in particular with regard to child dental health services. The main factors to be considered are:

(1) Teachers:

Correct calibre only to be appointed. Full time preferable, but part-time may be necessary as a stop gap measure.

(2) Accommodation and facilities for teaching;

The establishment of a children's department requires careful consideration. In clinic design, a balance must be struck between considerations of privacy, by which the close relationship between patient and operator is maintained, and teaching requirements which demand ease of supervision.

(3) Supporting staff:

It is important to meet the need for adequate supporting in the form of secretaries, chairside assistants, dental nurses, etc.

(4) Clinical material for teaching:

Some dental schools have taken the responsibility for the dental treatment of children in nearby schools.

Teaching materials for pre-school, primary school, etc. should be looked into.

(5) Curriculum:

Since all students are not necessarily destined for a career in children's dentistry, an adequate balance in the dental course must be maintained.

Students should be taught how to conduct themselves as a head of the dental team and to work with auxiliaries. Sufficient time must be allotted to children's dentistry. Scope of subjects in children's dentistry, methods of teaching, clinical requirements and finally an examination to be given at the end of the course, thus indicating to the students the importance of the subject.

Postgraduate training

Postgraduate training in children's dentistry is particularly important in a country where expansion of the dental profession and auxiliary is contemplated in order to provide an increased dental service for children.

The types of courses desirable are:

(1) Short, intensive refresher courses of one or two weeks' duration, suited to the busy general practitioner or school dentist who

needs to be brought up to date with modern methods.

(2) Intermediate duration full time course of 1 to 3 months in public dental health and/or children's dentistry leading to a certificate designed to meet the needs of individual dentists or countries.

(3) Long courses of one year's duration leading to a Diploma in Dental Public Health (or equivalent) for all public health dentists and over two or three years leading to Masters or PhD. for those who hope to become specialists, consultants, university teachers or research workers.

6.2. Orthodontic teaching with special reference to the training of the dental practitioner.

If priority is to be given to children's dentistry, curricula in dental schools must be modified accordingly. At the present time the length of the orthodontic course for the undergraduates differs widely.

It is suggested that 75 hours of theory and 250 hours of practical work should be considered as a minimum.

In the undergraduate curriculum more time could be spent in both departments of orthodontics and paedodontics.

Postgraduate courses for dental practitioners should also be conducted.

6.3. The training of dental auxiliaries.

The classification of dental personnel (WHO, New Delhi, 1967) into professional, operating auxiliaries and non-operating

auxiliaries was considered generally applicable to the Western Pacific region.

The use of dental auxiliaries must be fully encouraged and a number of factors affecting the type of auxiliaries needed should be taken into account.

School dental nurses are appropriate in primary schools in areas of relatively high caries prevalence, but if caries was low, more dental hygienist type auxiliaries may be required.

Dental hygienists should be used for all age groups under the supervision of a dentist for all periodontal prevention and control.

The use of non-operating chairside assistants should be encouraged to increase productivity of dentists and in selected situations they could be shared by two or more operating dental auxiliaries e.g. dental therapists in South Australia.

#### Operating-Auxiliaries: training

Educational entry standards for auxiliaries should be equated with comparable vocations in each individual country (e.g. dental nurse to general nurse in Singapore and Malaysia). The curriculum should be adapted to the specific duties of the auxiliary and also the needs of the country. Flexibility of the curriculum should allow changes or revision to meet the demands and needs of the dental service as shown by current epidemiological data.

When trained, operating auxiliaries are capable of using more sophisticated equipment, such as high speed. However, supply

and maintenance are a basic constraint to this principle.

Supervision should be adequately maintained - being direct and close for those newly trained and thereafter indirect varying with the experience and ability of the operating auxiliary. Supervision and direction should be by dentist although periodic spot checking was recommended as a means of supervision. Each child should be examined by a dentist at initial enrolment and be seen by a dentist at regular intervals thereafter.

Non-operating auxiliaries: training

Chairside assistants

There are at present two training alternatives:

- (1) By the dentist - an informal apprenticeship.
- (2) A formal course of 1 to 2 years usually taken part-time at a dental school, followed by an examination and, frequently, the granting of certificates of proficiency.

Technician (Laboratory)

A formalized full-time course extended over two years is recommended. In some developing countries the technicians' functions should be expanded to include other non-clinical duties, such as (a) maintenance of equipment, (b) storekeeping, and (c) x-ray processing when required. (Chairside assistant should learn to do these expanded duties.)

One of the biggest weaknesses in developing countries is the problem of maintenance of equipment, resulting in the loss of productivity.

### Legislation

Duties and responsibilities of all types of dental auxiliaries must be defined, preferably by legislation. Legislation is required for operating dental auxiliaries and registration was considered unnecessary for non-operating auxiliaries or operating auxiliaries allowed to work only within public health services. For operating auxiliaries working outside these health services, registration is necessary.

Refresher courses for dental auxiliaries are also needed.

### 7. Research in Child Dental Health

The entire dental health program in any country or area must be considered as a long-term research project, i.e. it should be based on sound, quantitative information regarding prevalence of dental diseases as well as resources available for combating it.

It is the responsibility of the dental schools to make the profession aware of the value of research. Public health dentists in the service must be given enough time off from their routine work to concern themselves with research problems.

Although it is well within the range of every dental service to contribute new basic knowledge to the science and practice of child dental health, such contributions must come mainly from the academic and research institutions.

Topics of major importance or those that can be handled by officers of dental services for children are the following:

- (1) General subjects, such as child psychology and study of the

emotions, growth and development, genetics, nutrition and diet, endocrine and other systemic disorders.

- (2) Dental caries and its sequelae - methods of prevention etc.
- (3) Techniques and materials in operative and restorative dentistry.
- (4) Endodontic - clinical and histopathological research.
- (5) Gingival disorders and other diseases of the oral mucosa.
- (6) Dento-maxillo facial deformities.
- (7) Traumatic injuries of teeth and surrounding tissues.
- (8) Handicapped children - treatment and management.

Scientific consultants may be appointed to help develop research and preventive measures.

#### 8. Summary and Conclusion

1. The dentist is the key person in the dental care of children. His education in children's dentistry and orthodontics should be sufficient to meet the needs of public dental health services. In addition to specific dental problems, it should include subjects such as child growth and development, psychology and public health.

2. In the planning, supervision and evaluation of public dental health programs for children, research aspects should always be kept in mind. Public dental health officers can make substantial contributions to research if the necessary means and time are provided. Co-operation between the dental services and research centres is recommended.

3. The use of dental auxiliaries must be fully encouraged and a number of factors affecting the type of auxiliaries needed should be listed. It was recognised that effective delivery of dental services would need dentists complemented by appropriate dental auxiliaries.

4. There should be a dentist directing dental health activities within the Ministry of Health.<sup>86</sup>

5. It is essential that dental health administrators and clinical dentists should exchange views and experiences regularly.

6. In order to promote dental health services, the collection and evaluation of data on the clinical, epidemiological and operational aspects of dental health activities are of major importance. There should be uniformity of definitions and terminology. This is best effected at international level.

7. The battle for dental health cannot be won by the dental profession alone. If dental diseases in young children are to be prevented, more attention needs to be given to the care of children's teeth by all medical and paramedical personnel.

8. It is recommended that the dental profession should make greater use of the services of teachers and health educators in promoting all aspects of dental health education of the public.

9. School and health authorities should be drawn to the desirability of reducing the consumption of easily fermentable carbohydrates, particularly in a fine form (sugar) and taken in between meals.

10. Water fluoridation is the most effective and economical method in reducing dental caries incidence by 60% to 70%.

Topical fluorides were recommended as a method which will produce a reduction of dental caries incidence (30% - 40%) when water fluoridation has not been implemented.

11. The increasing demand for orthodontic treatment cannot be met today. For this reason, more specialists in orthodontics should be trained and postgraduate courses organised for dentists engaged in dental services for children.

12. More attention should be given to the prevention and early treatment of gingival disorders in children, as they may give rise to severe pathological conditions in the tooth-supporting tissues at a later age.

Our objectives in practising dentistry for children are:

(a) our concern for the child in general: for his physical, mental, and emotional well-being in every way, and

(b) our concern is for his oral health in particular; for the prevention of oral disease and maldevelopment, for their early treatment when they occur, and for the relief of pain and suffering when present. By following these objectives we achieve a service which is, after all, the right of the child as an individual, a population which is dentally educated, an ever increasing knowledge of our subject, and an elevation of the status of the profession.

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