

4.2 Periodontal Disease

Periodontal disease is one of the most widespread diseases of mankind. Gingivitis affects over 80 per cent of young children and almost the entire adult population has experienced gingivitis, periodontitis, or both. (457) "Research and clinical evidence indicate that the damage caused to the supporting structures of the teeth by periodontal disease in early adult life is irreparable, whilst in middle age it destroys a large part of the natural dentition and deprives many people of all their teeth long before old age. The total effects of periodontal disease on the general health of populations cannot yet be assessed." (457)

"Periodontal disease can be considered as the morbid response of the periodontal tissues to extrinsic-local irritants. This response, in turn, is modified by intrinsic systemic conditions operative within the host. Periodontal disease therefore represents the interaction of a variety of etiologic factors which differ in degree of significance at every pathologic site in every patient." (405)

If deviation from perfect oral health is used as a criterion, practically all humans have periodontal disease. The disease may be represented by one or more slightly inflamed gingival units and the condition may be of no public health significance. In the terminal stages of the disease the ultimate consequence is tooth mortality. In assessing the significance of periodontal disease as a health problem to the individual and to the community, one must look at both the prevalence and severity. (436) Periodontal disease is known to have existed as far back in time as historical evidence is available. (4a, 165) It is possible that the increased longevity of man has added to the severity of the periodontal problem. If the life span of primitive man did not exceed some 40 years, loosening of the teeth at old age would be no problem. In modern industrialized countries the mean age of death is considerably higher.

Etiology

Etiology of periodontal disease is complex. However, it has been well established that local microbial factors initiate almost all periodontal disease. (250) The manifestation of the disease is dependent upon host resistance and there is great variability in reaction to the microbial infectious challenge which can be modified by various systemic factors. (405)

A. Aetiological factors in gingivitis and periodontitis

Microbial dental plaque is the primary cause of gingivitis in man and a cause-effect relationship has been shown in longitudinal human and animal studies experimentally. (248, 250a, 250b) Further studies (17, 18, 19) have shown that removal of dental plaque results in resolution of gingivitis. Except in acute necrotizing ulcerative gingivitis (ANUG) the response of periodontal tissues to plaque does not result from bacterial invasion but from bacterial products diffusing into tissues via the functional and pocket epithelium. Subsequent destruction of parts of the gingival and periodontal tissues appears to be due mainly to host mediated phenomena. (250, 375a)

So far studies have not clearly defined a single group of bacteria, much less a specific organism that is responsible for the development of chronic gingivitis. (154e) However current research suggests that bacterial plaque is the cause and the elimination or suppression of plaque is consistent with gingival health. (250, 250a, 250b, 250c, 250d) Evidence implicating microorganisms includes the effectiveness of antibiotics and the ineffectiveness of factors other than bacteria (via plaque) in the induction of periodontal disease. (399)

Subgingival ligatures in animal experiments produce gingivitis but not in germ-free rats. (352) Hormonal imbalance, malnutrition and debilitating diseases did not produce inflammatory periodontal disease in the absence of bacteria. (154e)

The presence of ANUG has been related to the presence of specific fusiform spirochaetal flora. However, other predisposing factors such as poor oral hygiene, nutritional deficiencies and debilitating diseases (405) lower host resistance and affect the resultant severity and extent of the disease. (11, 15d)

Progressive destruction of connective tissue and bone only occurs in areas exhibiting overt gingivitis. However the assumed progression from gingivitis to periodontitis has so far only been shown in dogs. (248) The presence of gingivitis does not necessarily mean progression to periodontitis. (11, 250d)

Formation of plaque on teeth represents a massive accumulation of bacteria already present in the oral cavity. This bacterial colonization and plaque formation occurs in the gingival area of the dentition in healthy individuals relatively independently of degrees of salivation, mastication, malocclusion, intakes and types of food. The microbial flora of the accumulated plaque changes during transition from normal to an inflamed gingiva and from supra-gingival to sub-gingival. (249a, 250d, 308)

Studies in humans suggest that this change in microflora may be associated with initiation and progression of various manifestations of periodontal disease. (249a, 398, 399) Subgingival plaque differs from supragingival plaque in having characteristically relatively more gram-negative anaerobic organisms and more mobile bacteria. (249a)

Bacterial plaque seems to be the most consistent one factor in the aetiology of periodontal disease. Loesche (250d) has drawn attention to the two prevailing philosophies concerning prophylaxis or therapy of plaque-related dental disease. These are called the non-specific plaque hypothesis (NSPH) and the specific plaque hypothesis (SPH). (250d)

Because periodontal disease appears to be directly caused by bacterial dental plaque, it is important to look at factors affecting the amount and composition of the plaque. These factors are as follows: (457)

1. Oral hygiene

It has been well documented that oral hygiene alters plaque accumulation and composition. (248) Socransky (398), Bowden (63) and Loesche (250d) have shown that composition of microflora of plaque varies from one individual to another and from one tooth site to another. The amount of microbial plaque and its composition appears to be relevant to the severity of periodontal disease. (4a, 399) The most important factor contributing to the growth and accumulation of plaque is the failure or inability of the individual to maintain adequate daily mechanical plaque removal. (11) The amount of plaque that can be tolerated varies from one individual to another. (457)

2. Retentive factors

Retentive factors play a significant role in periodontal disease as they enhance the amount of plaque growth and hinder the removal of plaque. Some of the most important factors are

(a) Mineralization of plaque to form calculus: The association of calculus with gingival pathology has been demonstrated but primarily because of its bacterial component. ⁽⁴⁰⁵⁾ The removal of calculus and plaque and improvement in oral hygiene has led to resolution of gingival inflammation. ⁽¹⁸⁾ Calculus formation has also been influenced by the physical consistency of the diet; various nutritional imbalances - particularly soft, high-carbohydrate diet; low salivary viscosity. ^(154g)

(b) The role of saliva in bacterial activity and its relationship to plaque has not been studied extensively and its indirect influence is being explored. ^(421a) Also the effect of aging and systemic conditions both physiologic and pathologic upon saliva needs investigation. ^(154b)

(c) Anatomical irregularities of soft and hard tissues, e.g. badly aligned teeth, poorly related dental arches with reduced self-cleansing, grooves and furcations on teeth, absence of adequate zones of attached gingiva and position of frenal attachments ^(154a) aid in the retention of plaque.

(d) Carious lesions related to the gingival margins tend to retain microbial plaque.

(e) Some iatrogenic factors of plaque retention are subgingival margins of restorations - defective, rough surfaces on restorations, dental appliances such as prostheses. ^(241, 242, 383, 437, 466) The inflammation it creates can alter the gingival morphology so as to favour the accumulation of bacteria and plaque.

3. Diet

Physical characteristics of diet may affect plaque accumulation but only extremes of diet would be significant. ^(154c, 457) Food impaction and accumulation of debris and reduced effectiveness of oral hygiene is influenced by diet. ⁽⁴⁰⁸⁾ Chemical constituents of the diet may affect bacterial growth and colonization, e.g. sucrose will support an increased rate of growth and amount of plaque development. ⁽²⁵⁰⁾

4. Pathophysiological factors

These may lead to increased plaque formation or change in plaque composition:

- (a) pre-existing gingivitis or marginal periodontitis,
- (b) secretions from major and minor salivary glands, e.g. reduced flow or increased salivary viscosity,
- (c) reduced masticatory function leading to increased plaque and calculus formation,
- (d) mouth breathing or lack of lip seal has been shown to be an aggravating factor.

5. Time

is also an important factor in terms of the length of time tissues are exposed to plaque and its complex microbial activity.

B. Host resistant factors

1. Age

Many epidemiological studies show a clear relationship with prevalence and severity of periodontal disease and age. (40, 93, 382) Prevalence and severity increases with increasing age. It is uncertain whether this increase results from decreased resistance to plaque irritants or merely relates to the length of time plaque has been in contact with gingival tissues. (457)

2. Systemic disorders

Systemic factors predispose the local tissue to increased susceptibility to damage from local noxious factors and modify the nature and intensity of the defense reactions. (11, 154d) Some examples of systemic disorders are: blood disorders, diabetes mellitus, sex-hormone imbalance, calcification disorders, and collagen disorders.

3. Genetic disorders

Some genetic disorders have been associated with premature, severe destruction of the periodontium, e.g. hyperkeratosis palmoplantaris, Down's syndrome. (32g)

4. Nutrition

Present data suggests that nutritional deficiencies acting alone do not initiate periodontal lesions in the absence of local

irritants. (406) However, there is extensive information which demonstrates that nutrient inadequacies may predispose the host to periodontal disease or modify the progression of the disease. (7,8,9) Animal studies (405) show where nutritional deficiencies have acted as modifying factors in gingival tissue responses to local irritants, they compromise the host defence mechanisms of saliva, gingival fluid, subgingival microflora, the epithelial barrier, specific and nonspecific immunity and repair. Specific nutritional deficiencies, acting similarly to diseases which interfere with tissue and growth repair, may affect the gingival tissue by accentuating the tissue response to the local irritant. The resultant accentuation of the local gingival disease may thus represent the specific gingival response to a variety of nonspecific metabolic stressors. Alfano (9) states that there is the possibility of end-organ nutritional deficiency as a result of local irritant factors and the inflammation process: thus the tissue cannot respond with its normal defence processes.

5. Drugs

Various drugs have been found to influence the course of periodontal disease, namely sex steroids (contraceptive purposes), dilantin, corticosteroids, hydantoin, sodium, heavy metals and immunosuppressive drugs. (329b) The action of drugs may be by direct contact and tissue destruction, hypersensitivity, induction or by systemic effect. (405)

6. Psychosomatic conditions

Although psychological stress has been suggested as predisposing to acute necrotising ulcerative gingivitis (10) altered nutrition and changes in plaque control may also be operating. (329c)

7. Irradiation

Local or systemic effects of radiation may increase the vulnerability or susceptibility to gingival injury by local factors. (329d)

8. Occlusal trauma

Damage from excessive or abnormal stress on teeth from occlusal forces has been implicated in the progression of periodontitis. (320) It is generally accepted that altered occlusal forces do not initiate gingival inflammation, but rather may change the pathway and possibly the speed of inflammatory spread. (405) In this sense they are

modifying factors aggravating the tissue destruction and altering the morphology of the pockets and the pattern of bone destruction. (329e)

Taking into account the limitations of indices used to describe periodontal disease, factors which relate to prevalence and severity of periodontal disease have been reported quite extensively. (331, 457) Those factors which appear to have significant correlations with periodontal disease can be categorized under the following headings: (a) Social Factors, (b) Local Oral Factors, (c) Habits, and (d) Systemic Factors.

(a) Social factors

1. Age

In all surveys in which severity has been taken into account, periodontal disease progresses steadily through life. (381) Gingivitis is common in the primary and permanent dentition of most children but periodontitis is less common. From 13 years of age onwards the proportion of persons with periodontal pockets and alveolar bone loss increases. (381) The prevalence of destructive disease follows a linear progression from adolescence to old age. (436) After age 30, tooth mortality from periodontal disease is a more common cause than from dental caries and this becomes the dominating cause after 40 years. It is quite difficult to assess from surveys whether tooth mortality results from dental caries or periodontal disease, as persons do not accurately remember the reasons for extractions. The strong correlation with age probably reflects the cumulative effects of the disease rather than the diminishing resistance of older people.

2. Sex

Many studies report that periodontal conditions are significantly better in females than males. (93, 459b) When oral hygiene status is compared between the two sexes, females are significantly better than males and this factor appears to be the dominant reason for better periodontal conditions. In less developed countries, however, periodontal conditions are worse in females than males and it has been suggested that this is due to frequent childbirth and poor nutrition. (329f, 436)

3. Racial differences

Racial differences show in both severity and prevalence of periodontal disease (27) but other factors such as oral hygiene

practices, education, economic level and environment must also be considered. Where data has been standardized for such factors, the differences in prevalence and severity cannot be attributed to ethnic groupings. (457)

4. Socio-economic status

Surveys have demonstrated that periodontal conditions improve as years of formal education increase and as income increases. (35, 408) The severity of periodontal disease is lower where people are more prosperous, have a better oral hygiene and more awareness of oral health values. In well developed countries where even low income groups have an adequate diet, the above-mentioned differences in socio-economic variables as factors affecting periodontal conditions can be attributed to a difference in oral hygiene status. (436) In fact, "differences between sexes, races, geographical areas and socio-economic classes tend to disappear when the groups are classified according to differences in oral hygiene level." (4a) The United States National Health Survey (427) found that poor oral hygiene occurred most often amongst low income groups but it was more closely related to education than to income. Barmes and Richards (340) report many studies which show that socio-economic status and its concomitants, income, education and occupation, are significant factors associated with differences in oral hygiene status and the prevalence and severity of periodontal disease.

5. Area and community factors

A different prevalence for periodontal disease has been reported in urban and rural communities. (459b) However, as pointed out by Richards (341) research data relating to the role of urbanization in periodontal disease presents inconsistent conclusions. He also reported studies as showing better periodontal health in urban areas. (341) Further studies are necessary for a more complete understanding of the role of urbanization.

6. Behavioural and personality factors

Richards and Barmes (341) quote studies which show evidence to support the general thesis of emotional factors affecting periodontal disease: a positive correlation being found between periodontal pathology and emotional and psychiatric disturbances.

7. Other social factors

Failure to perceive a need for treatment for periodontal disease may ensure that the disease develops unchecked. The lack of public and individual recognition of periodontal treatment needs may be a significant factor which correlates with a higher prevalence of periodontal disease. (341) Very few studies report on the availability of care to populations and its role in the prevalence of the disease.

(b) Local oral factors

Microbial plaque, calculus, occlusion and iatrogenic factors are considered to influence the severity of periodontal disease.

1. Microbial plaque

A strong inverse correlation between the prevalence and severity of periodontal disease and the level of oral hygiene has been reported in many studies. (19, 436, 459b) This relationship has been shown regardless of which index has been used to measure periodontal health. The amount of plaque present on the tooth surface reflects the equilibrium between the rate of plaque formation and the frequency and thoroughness of its removal, i.e. oral hygiene is a measure of microbial accumulation on tooth surfaces. A number of clinical trials have shown a definite decrease in periodontal disease when plaque and calculus was removed and this decrease was directly proportional to the improvement in oral hygiene. (18, 414) Oral micro-organisms which colonize the tooth surface in the region of the gingival sulcus are known to initiate chronic inflammatory periodontal disease and to promote its progression. (350, 398) The findings of many surveys have repeatedly substantiated the role of microbial plaque as the principal etiological agent. (239, 327, 398) The common epidemiological finding of a correlation between calculus and periodontal disease appears to relate to the microbial mass on its surface over long periods and to increased possibilities of plaque retention. (342, 457) There is a strong positive association between dental plaque and severity of periodontal disease. (250a, 250b) Sheiham (381) and Russell (358) state that less than 10 per cent of variance in group PI scores remain after the combined influence of age and mouth cleanliness.

2. Iatrogenic factors

There is abundant evidence that restorative dental treatment can increase the severity and prevalence of periodontal disease for

the following reasons: (457)

- (i) Some restorative materials whose surfaces have differing plaque-retaining capacities may influence gingival health. (444)
- (ii) Other restorative materials have corrosion products which are capable of causing cellular injury or destruction. (156)
- (iii) Restorations with imperfect subgingival cervical margins, overhanging proximal margins causing irritation by plaque retention. (150, 224, 241, 242)
- (iv) Prosthetic appliances may cause gingival inflammation, tooth mobility and bone destruction. (328, 374)
- (v) Orthodontic appliances encourage plaque retention. (222)

3. Occlusion

The role of traumatic occlusion in the health of the periodontal structures has not been established, but experimental evidence and clinical observation indicate that periodontal pocket formation may be accelerated by progressive long-term trauma from the occlusion. (247a, 247b, 329e, 470a)

4. Habits

Habits such as tobacco smoking, chewing various products and oral cleansing have been reported to affect the state of periodontal tissues.

(i) Oral cleansing: Regardless of whether gingivitis, periodontitis or bone destruction is measured, there is a strong correlation between the severity of these conditions and oral hygiene. (16) The correlation between the Periodontal Index and Oral Hygiene Index is very close to mean. Many studies (18, 356, 382) have shown that efficient tooth cleaning, irrespective of the method used, is important in maintaining periodontal health. Some studies (18, 356, 382) have shown that regular toothbrushing has a significant correlation with gingival health. The important factor in oral cleansing is the removal of plaque. It appears that the amount of plaque present and its position around the gingiva indicates the effectiveness of oral cleansing.

(ii) Mouth rinsing: There is no definitive evidence which demonstrates the effectiveness of mouth rinsing in the removal of microbial plaque mechanically. However, studies (250c, 250d, 340, 431) have shown that antibacterial mouthrinses may change the oral flora and may have an effect on plaque accumulation and hence on periodontal disease.

(iii) Tobacco: Studies have shown that tobacco consumption increases the prevalence and severity of ulcerative gingivitis (10) as well as simple gingivitis and periodontitis. (314) Also, smokers tend to have poorer oral hygiene than non-smokers. (381) When oral hygiene is similar the effect of tobacco consumption is reduced. Tobacco chewing is associated with a higher prevalence of periodontal disease than is tobacco smoking. (457)

(iv) Betel chewing: Betel chewers have a much higher prevalence and severity of periodontal disease. Oral hygiene is also an important factor and non-users with similar oral hygiene show relatively little differences. (457)

5. Systemic factors

Epidemiological studies reported (457) have failed to detect any systemic factors that are a significant primary cause of chronic periodontal disease, but some studies have demonstrated certain hormonal, metabolic, genetic and nutritional variables that modify the progress of the disease. These can be as follows:

(a) Hormonal changes during puberty, pregnancy and menopause, or brought on by drug therapy are related to changes in gingival disease. (154d)

(b) Groups of people with genetic anomalies, with acquired or inborn errors of metabolism (e.g. uncontrolled diabetes, Down's syndrome, Papillon-Lefevre Syndrome) show a high susceptibility to periodontal disease. (329g)

(c) There is little evidence implicating nutritional inadequacies. However Alfano (7) has suggested that nutrient inadequacies may either predispose the host to periodontal disease or modify the progression of the disease. Also that human periodontal tissues may have end-organ deficiencies of ascorbic acid, iron and folate while systemic methods to assess these nutrients indicate "adequate" levels. He suggests (1) that as the mechanisms defence of the periodontal tissues include the saliva, gingival fluid, subgingival microflora, epithelial barrier, specific and non-specific immunity and repair and (2) that nutrient deficiencies have been reported which compromise each of these defence mechanisms. Therefore, there may be a validity in the concept that marginal nutrition deficiencies at end-organ, i.e. periodontium, will comprise its defence. He goes on to state that he

acknowledges that none of the spectrum of commonplace periodontal disease results solely from primary nutrient deficiencies and there needs to be a re-orientation of perspectives on nutrition and periodontal disease.

In studies in which systemic factors appear to have a role in chronic periodontal disease, the aetiological factor responsible seems to be microbial plaque and the systemic factor modifying the response of the periodontal tissues to microbial products. (154d, 329g, 457)

The single important factor which emerges from epidemiological studies of periodontal disease is oral cleanliness. Differences of demography divide the population into groups with different oral hygiene levels. Periodontal status appears to be a consequence of oral hygiene levels and only a secondary consequence of demographic features, and then only as these features directly or indirectly affect oral hygiene behaviour. (457)

In summary, analysis of surveys from all over the world show that periodontal disease in some form or other is present practically in all persons, but the severity varies widely. (402, 457)

1) Periodontal disease *per se* does not cause mentionable discomfort; its final consequence, the loss of teeth, is what causes problems for both the patient and the health services. The prevalence and severity of periodontal disease have been correlated with a number of conditions out of which age and oral hygiene account for as much as about 90 per cent.

(2) Unequivocal associations have been found with sex, socio-economic factors, and tobacco, but most, if not all, of these variations can be accounted for by variation in oral hygiene. The associations with generalized diseases, nutritional disturbances and malocclusion are not very strong ones.

(3) In the therapy of periodontal disease, the main efforts should be directed towards those factors which are known to have pathological importance.

With this philosophy in mind, it can be appreciated that bacterial plaque and calculus range above any other factors, both because of

their fairly linear correlation with periodontal disease and because they can be removed. That this working hypothesis is correct is evidenced by a number of clinical trials showing that gingivitis can be reduced to the same extent as plaque and calculus. (16, 17, 18. 19, 250a)

Most of the other factors shown to have association with periodontal disease cannot be changed, e.g. age, sex, nutrition, socio-economic considerations. However this information can be used to delineate high risk groups in the community so that services can be planned rationally and priorities for resources can be directed to groups where they will be most needed. Studies on the aetiology of periodontal disease have demonstrated that specific and universal agents for the initiation of periodontal disease are presently unknown. There is, however, overwhelming evidence that these initiating agents are local bacterial products from dental plaque acting on the underlying tissue integrity. (250) The resultant lesion depends both in extent and severity on the host resistance and more specifically on the ability of the local tissue to resist the irritant or repair the injury that has taken place. (375a, 462) Such tissue resistance or repair potential is influenced or modified by a variety of systemic conditions and abnormal occlusal forces. (405) Recent studies reported (462) of immunological responses have indicated the involvement of cellular and humoral mechanisms in defence against the bacterial antigens and some of these reactions may be detrimental to the periodontal tissue. (375) "Control of microbial plaque accumulation appears to be the means by which preventive programmes can be made effective. There is a low level of plaque accumulation that is consistent with long term periodontal health but the amount that can be tolerated varies from one individual to another. However, neither the average level nor the variability has been established." (457). The basic problem of periodontal disease as perceived by the profession is that the community has no definite guidance as to what is the level of periodontal disease which they should accept. However control of dental plaque is the basis of prevention. This improvement in plaque control is associated with behavioural changes related to improved social and economic status and a higher educational level of the public. It has been suggested that "only social changes can be expected to have a marked effect on periodontal disease." (457)

Total absence of periodontal disease in a population is practically unattainable, although current knowledge appears adequate for the prevention or control of the disease at an individual and community level. (462) There are differences in the progression rates of periodontal destruction in various population groups. (462)

Assessment of the disease, its severity and progression rates and its associated patterns within various community groupings should allow the community to put forward proposals to manage the problem. However this assessment of periodontal disease requires analysis of current oral health status, an awareness of the need for management of the disease and a demand for management of the disease. Different concepts of approaches to management need to be investigated and an assessment and evaluation of the current management and the balance of prevention and treatment needs to be made.

Several indexes have been devised to measure the presence and relative severity of periodontal disease (See section 5.2.1). Some of these indexes were developed for epidemiological screening of populations, others to assist the clinician in an ongoing management of the individual patient. All of them are used to indicate a current need for treatment. This need for oral health care will be discussed in a later chapter, and also periodontal disease and the effect of the oral care system on periodontal health production and maintenance will be discussed.

4.3 Dento-Facial Anomalies

There are many definitions of dento-facial anomalies and the specific conditions that should be included in this category. Most dento-facial anomalies are associated with malocclusion and are usually severe. There is a continuum of severity reflecting the "biological gradient" of humans and this also involves a preconceived idea of what is normal. (283) There is therefore difficulty in defining the limitations of the term "anomaly" as there are no discrete variables involved.

Malocclusion has been defined as "the condition in which dental structures are not in acceptable equilibrium with each other or with the facial structures and/or the cranium thus interfering with, or posing a potential threat to, normal tissue development and maintenance, effective functioning or a physiological and behaviour problem." (138)

This definition embraces irregularities of individual teeth, alveolar arches, soft tissues, the neuromuscular system, jaws or any combination of these irregularities.

Malocclusion has existed since the beginning of mankind and is seen in illustrations or reproductions of the skull of Neanderthal man. Written reports of irregularities were made by Hippocrates (460-377 B.C.). (281)

There are many unanswered questions concerning cause and effect which frequently cannot be clearly distinguished. Thus it may be preferable merely to consider "factors associated with" dento-facial anomalies and malocclusion. Also there appears to be no one single factor. Lundstrom (250e) states that non-genetic factors have less influence than genetic in causing deviations. He also states that genetic variability is to some extent due to a direct influence on the development from the genes and to some extent to secondary effects from environmental factors which are more or less under genetic control, (e.g. tooth size, shape, numbers, premature loss and dental caries). Lundstrom (250e) postulates that it may be possible to influence and reduce variability of genetic nature but he is not optimistic in this area, stating that most external factors, e.g. thumb sucking, seems to have very irregular effects and their genetic control is only partial.

One example where the improvement of one of the environmental factors, namely avoidance of early loss of deciduous teeth, has been shown in the study made by Peel (310) following fluoridation in Tamworth, New South Wales. He suggests that the overall improvement in the occlusal status of the population is probably associated with a reduction in premature loss of tooth substance.

Wan (345) states that malocclusion is additive in that the genetic potential for poor occlusion is worsened by the forces of function and/or habits and furthermore the unfavourable pattern could be modified desirably by local factors during development.

Dockrell (112) expresses these interrelationships in aetiology by the following flow pathway:

<u>Causes</u>	<u>Times</u>	<u>Tissue sites</u>	<u>Results</u>
Some predisposing Some existing		Some primary Some secondary	May by one of the following or a combination
1. Hereditary 2. Developmental 3. Trauma 4. Physical agents 5. Habits 6. Disease 7. Malnutrition	1. Continuous or Intermittent 2. May act at different stage levels	1. Neuromuscular 2. Teeth 3. Bone cartilage 4. Soft tissues other than muscles	1. Malfunction 2. Malocclusion 3. Osseous dysplasia

Assessment of factors involved in the variation of occlusal patterns and the dentofacial complex is needed but their measurement and comparison is complex (See Chapter 5, Section 5.2.3)

There is at present no universally acceptable method for the assessment of dento-facial anomalies which are of health significance and require treatment. ⁽⁴⁵¹⁾ Nevertheless, dental and other health personnel are asked to provide advice to parents and children and adults concerning these anomalies. Helm ⁽¹⁸⁸⁾ states that one should consider the correction of dento-facial anomalies "when the efficiency of the dental mechanism is threatened by present or potential conditions which will cause injury to tissue or interfere seriously with function or with mental or physical adjustment."

The success of epidemiological studies of dento-facial anomalies is dependent upon two criteria. ⁽³¹⁰⁾ Firstly, defining the conditions to be studied, and, secondly, having a method of scientific assessment or measurement to evaluate the defined problem.

The data that is abundant for dento-facial anomalies is descriptive rather than quantitative because of methodological shortcomings. Classification systems have been developed, e.g. Fauchard, Fox, Duval, Knussel and Carabelli, and finally Angle developed a classification which has been widely used. ⁽³¹⁰⁾ However, the use of a classification system (e.g. Angle's) to quantify a condition is inadequate as it does not allow any quantitative analysis of severity. ⁽¹⁸⁷⁾ Various methods have been put forward for the assessment of severity of occlusal anomalies. The complexity of these measurements of disturbance of malocclusion is because the indices are discussed in terms of oral

health status and delivery of services related to oral health. (213)

Health authorities are often required to estimate prevalence of dento-facial anomalies so that treatment can be provided to those who need or desire it. However as Foster ^(138a) states, "surveys of the occlusion in population groups usually include in their objectives the academic assessment of occlusal features, the planning of resources for public health treatment programmes, the comparison of differing populations and the screening of groups for orthodontic treatment. The requirements for these purposes differ.

Despite the limitations of all the studies reported, their different definitions and methods of measurements which make difficulties in the comparisons of findings, Freer and Olive ⁽¹⁴⁵⁾ point out the studies indicate the features that different investigators considered were important in the definition and measurement of malocclusion.

Patterns that have emerged ⁽²¹³⁾ are ethnicity, age, sex, geographical location (including drinking water with natural and supplemented fluoride) social stratum (occupation, education, income), diet, other oral conditions (caries activity and periodontal disease) and any history of developmental disturbance (e.g. mongolism).

Barnes ⁽²⁸⁾ states "dentofacial anomalies not only occur in childhood, but almost all prevention and care must be practised or performed in that period." By trying to analyse the incidence and prevalence of dento-facial anomalies within the community, one is defining the need and demand for oral care in this area.

Studies in Australia on the prevalence of malocclusion or on the prevalence of those malocclusions requiring treatment have shown varying percentages ranging from 20 to 80 per cent. (See Table 1)

4.4 Cleft Lip and Cleft Palate

Richards and Barnes ⁽³⁴¹⁾, in their discussion of cleft lip and cleft palate, state that these are amongst the most common of congenital deformities, with heredity playing a very important role in the aetiology of these conditions. The importance of this problem of dento-facial anomaly to the community, both professionals and the general public, in Australia can be seen by the recent extension of

Table 1. SOME REPORTED AUSTRALIAN STUDIES ON MALOCCLUSION^a

YEAR	EXAMINER	NUMBER OF SUBJECTS	AGE RANGE (years)	MAIN FINDINGS		
				Malocclusion	Need Treatment	Require Treatment
1935	Taylor (475)	129	12-15	66.6%		
1956	Barnard (32)	6,787	6-15	81.1%		
1958	Benson (48a)	82	5-12	61.0%		
1963	Godfrey (155a)	1,045	6-17	18.0%	73.4%	
1969	Davies, Kruger, Homan (105)	3,251	6-14	55.1%	29.2%	0.9%
1973	Peel (310)		6-16			
1974	Barnard (40)	997	13-14		42.8%	
1977	Watson (438)	446	5-15		7.1% (specialist)	

^a Adapted from: BARNARD, P.D. Personal communication.
and

JAGO, J.D. The epidemiology of dental occlusion: A critical appraisal.
J Pub Health Dent, 34:2, 80-93, 1974.

health benefits to oral health care services for cleft lip and cleft palate patients. ⁽²⁷⁵⁾ The Cleft Palate Society of New South Wales ⁽⁸¹⁾ suggests that there is an incidence of 1 cleft in 800 live births in New South Wales.

Chi ⁽⁷⁹⁾ cites a study of Rank and Thomson ⁽³³²⁾ which reports an incidence of 1 cleft per 603 births in Tasmania. He points out the fact that studies in countries showing the highest incidence of clefts are those in which there is complete reporting of health status with centralised facilities for treating clefts. He also suggests that such factors as case source, classification of defect, completeness of reporting, sample size and perinatal mortality would lead to variation in measurement of incidence and prevalence.

Brogan ⁽⁶⁸⁾ states that there is a total incidence of 73 cleft cases per 1000 births which would include those children stillborn in Western Australia. He queries the accuracy of reporting of the few studies ⁽⁷⁹⁾ carried out in Australia, as many health facilities only collect incidence figures on those reporting for surgery. ⁽⁶⁷⁾

The Australian Government has been forced to provide some central recording as a patient with a cleft who wishes to claim medical and dental benefits must be issued with a certificate from a prescribed cleft clinic. ⁽²⁷⁵⁾

The Australian Government, by supplying a health rebate of a scheduled fee to certified cleft patients has assisted in making oral health care available to persons with that condition. Other factors in the cost and availability of health care to such patients, such as transport costs, are theoretically mitigated by accrediting as treatment personnel, private practitioners, as well as centralized government clinics; the assumption being that accredited practitioners will be accessible to the majority of the population. A scheduled fee for items has been negotiated by the professional association involved and the government. The patient eligibility has been limited to those persons under the age of 22 years who have cleft palate and cleft lip as well as other syndromes, e.g. Cleidocranial dysostosis, cranofacial dysostosis, mandibulofacial dysostosis, mongolism and achondroplasia. There are other conditions of lesser prevalence in the community.

When planning health services it is essential to know the prevalence of these conditions in order that services can be provided on a rational basis. For example, recently in New South Wales ⁽²⁷⁵⁾ cleft palate patients have been able to receive medical benefits for specialized dental treatment. Some data on the incidence and prevalence of these conditions supported submissions placed before the government by groups demanding government financial support for oral care services.

Knowledge of incidence and prevalence patterns facilitates planning of services for persons having conditions which contribute unfavourably to oral health status. Centralized recording of these conditions is one means by which this data can be collected and studied, as the cleft palate health benefits scheduling system will hopefully show.

4.5 Diseases and Conditions of the Oral Mucosa

As Barmes ⁽²⁷⁾ states, with the problems of satisfactory representative population samples for other oral diseases, particularly precancerous and cancerous lesions, it has not been possible to build up even the rudiments of a historical perspective but from studies and clinical experience we know that there are massive differences in prevalence of some of these diseases in various populations. Pindborg ⁽³¹⁵⁾ defines epidemiology in the "modern concept" as being the "study of diseases in relation to characteristics of the group of persons in whom they occur." He suggests that when discussing the epidemiologic aspects of oral mucosal disease, one should remember that this group encompasses a wide variety of lesions ranging from "excessively rare conditions to diseases with a prevalence of about 25 per cent, and spanning from malignant tumours to the most innocent, often congenital, aberrations." He suggests from a public health point of view the diseases with the highest priority would be

- a) the most dangerous,
 - b) those most prevalent provided they present a therapeutic problem, and
 - c) those rare, but which are of great nuisance to patients
- and he emphasizes the fact that numerous oral mucosal diseases are expressions, often the first of systematic disease.

The main problems faced in determining epidemiological patterns of oral diseases within the community can be divided into three areas:
(I) accurate diagnosis, (II) indices, and (III) community risk group.

(I) accurate diagnosis cannot be fully achieved on the basis of clinical examination alone (as, for example, laboratory investigations are needed to confirm diagnosis) ⁽⁴⁶¹⁾

(II) oral musosa, because of anatomical and histological differences poses a problem of indicating mucosal diseases. Pindborg ⁽³¹⁵⁾ states that we "must rely on morphologic descriptions, and mapping of lesions on topographic charts" plus photographic registration. Also he suggests that where there is such a subjective element present in diagnosis one must rely very much on calibration between investigators and a consistent standard of each investigator.

The World Health Organization has produced as a companion to the ICD-DA ⁽⁴⁵⁶⁾ a guide to epidemiology and diagnosis of oral mucosal disease and conditions ⁽⁴⁶¹⁾ whose objective is "to provide a standard system for the examination, identification and recording of a wider range of oral mucosal conditions. In particular, those that have significant implications in relation to urgent needs for treatment or for prevention".

The W.H.O. manual states that methods described therein can be used to obtain data for the following purposes:

1. estimating the prevalence of specific oral mucosal diseases and conditions and identifying variations in local, regional and national groups;
2. supplying data which can assist public health authorities to determine priorities with respect to (a) health education, preventive and treatment services, and (b) the groups in most urgent need of treatment (oral precancerous conditions and cancer);
3. evaluating possible aetiological factors in the development of oral mucosal cancer.

(III) defining the groups within the community in which these conditions occur. Pindborg ⁽³¹⁵⁾ states that most epidemiological studies of oral mucosal lesions have been carried out on selected

populations and lists the following:

- Institutions
- Schoolchildren
- College students
- Old age homes
- Veterans
- Hospitals - outpatient clinics
- Occupational groups
- Military

He suggests that the ideal situation is the house-to-house survey comprising all ages in a general population. However, as the W.H.O. guide ⁽⁴⁶¹⁾ points out, there are some situations in which neither an examination of the entire population is possible, nor a sample will provide valid data because occurrence of the condition is so rare that it is unlikely that a survey would ever include a single case. The only feasible approach is to maintain a clinical recording system within the general health care system, e.g. the cancer registers. If all cancer cases are reported, the records can be used to calculate the annual incidence. If the records contain details of other facts, e.g. age, sex, oral habits, etc., variables which may be playing a possible role aetiologically can be isolated and investigated further. The W.H.O. guide states as one of its aims "to encourage dental health personnel to perform systematic epidemiological assessment of oral mucosal disease" and to this end, provides a description of standard survey procedures for the diseases and conditions described in the manual. The World Health Organization ⁽⁴⁶¹⁾ states that the objectives of a study determine the kinds of data needed and the form in which it should be collected. When determining sample size for estimating prevalence, information is required on:

- "(a) expected prevalence of condition(s) being surveyed (using data from previous studies or from other similar countries);
- (b) estimation of amount of heterogeneity in the population, e.g. urban and rural environment, dietary habits and occupation, religious practices, demand for services, oral habits. There are usually considerable differences between communities in their exposure to some of these factors and it has been demonstrated some have an important influence on oral mucosal diseases (e.g. smoking and oral cancer). ⁽³³⁹⁾

(c) the required precision of results."

If, as is usual in epidemiological investigations, between 5 and 20 per cent precision level is required, sometimes the only solution is to maintain accurate recording systems based on ICD-DA ⁽⁴⁵⁶⁾ within the national health service, rather than specific surveys. This requires simple recording forms for routine registration of oral diseases and collection by a central body. In New South Wales where this only occurs for oral cancer, it is not possible to ascertain prevalence rates of other conditions. Also the oral care delivery system which is mainly private practice does not have any common record or reporting system which can be used for this analysis. However, there is the school dental service which covers 25 per cent of the New South Wales population, ⁽⁴⁶⁵⁾ which could collect some information. ^(15a)

For the general population there are third party insurance schemes in which records are kept of certain procedures. However these are not detailed enough to register specific differentiated oral mucosal diseases and conditions - merely being a treatment/payment record.

The World Health Organization ⁽⁴⁶¹⁾ lists the oral mucosal diseases of prime interest to the community:

140-145	Oral carcinoma
528.6x	Leukoplakia
528.70	Erythroplakia
528.72	Leukokeratosis nicotina palati
697.00	Lichen planus
528.8x	Submucous fibrosis
054.x1	Herpetic gingivostomatitis
101.x0	Acute necrotising gingivitis
528.1x	Cancrum oris
112.x0	Candidiasis
528.20	Aphthous ulcerations

With leadership shown by W.H.O. in the field of systematizing and standardizing of reporting of oral mucosal diseases, the cooperation of educational institutions involved with oral and other health care personnel and the compliance of government health departments, professional associations (e.g. the Australian Dental Association) and third party insurers, together with the interest and enthusiasm of the general health worker, a standardized national register of oral mucosal diseases could be maintained.

Planning of oral health services must be based on a specific situation analysis and this requires collection of epidemiological and other relevant data. (460) Estimates of the percentage of the population requiring care, and indications of the most common conditions, and the specific groups requiring this care can be extracted from record data (a substitute for epidemiological data) if there is a highly organized comprehensive health service with a detailed recording system which adjusts differences in recordings between clinicians.

One example where, because of the condition being (a) dangerous and (b) prevalent and providing a therapeutic problem in some countries there have been records kept and epidemiological surveys performed, is oral cancer.

4.5.1. Oral Cancer

Oral cancer is classified in ICD-DA. (456) Pindborg (318) states that "epidemiological studies have provided good evidence that a number of aetiological factors are implicated in various cancers in different anatomical sites. Also valuable information has been obtained through analysis of statistical material available from sources such as cancer registers and W.H.O. publications.

Indexes used to describe occurrence of oral cancer and precancer

1. Morbidity expresses the occurrence of the disease in live populations. Two types of rates are used: incidence - a number of new cases in a defined population (usually 100,000) in a given period of time (usually one year), and prevalence - number of cases of disease in a defined population at a specified time; either point, prevalence (i.e. at a specified time), or period prevalence (i.e. during a specified time, e.g. one year).
2. Mortality is the occurrence of death as a result of a specified disease in a given population.
3. Frequency (or proportional rate) is where one disease type in a given site is expressed as a percentage of the same disease in all sites. (317)

Morbidity rates: Incidence rates can be obtained from national or regional cancer registers or by special studies.

Factors which incidence studies ⁽³¹⁷⁾ show as relevant to oral cancer are:

1. Males have a higher rate of oral cancer than females.
2. Incidence is higher in rural areas than urban areas. However studies suggest that outdoor work is associated with higher relative risk than rural residence.
3. There is a marked association with the chewing of tobacco and less marked association with smoking, drinking alcohol and vegetarian dietary customs.
4. It is more prevalent in the aged. ⁽³¹⁶⁾

Mortality rates: Pindborg ⁽³¹⁷⁾ states that the highest mortality rate is found in Hong Kong (11.8 per 1000), caused by large numbers of nasopharyngeal cancers. Men have more oropharyngeal malignancies than women. Pindborg ⁽³¹⁷⁾ comments that many epidemiological studies have shown a decrease in the number of new cancer cases and that the decrease has been greater in men than women and also the frequency of oral cancer has decreased by 66 per cent from 1934 to 1961. ⁽⁴¹⁸⁾

The distribution of intra-oral cancer according to sites has been studied. In Australia, Tan ⁽⁴¹⁹⁾ showed that the most common site for oral cancer was lip (62.1%), tongue (12.3%), salivary glands (10.5%), floor of mouth (5.7%), gingiva (3.7%), palate (3.1%) and buccal mucosa of cheek (2.7%). If lip and salivary gland sites were not counted, the tongue accounts for 44.7 per cent, floor of mouth 20.8 per cent, gingiva 13.4 per cent, palate 11.4 per cent, and buccal mucosa 9.7 per cent. Tan ⁽⁴²⁰⁾ also reported that the most common type was squamous cell carcinoma.

Pindborg ⁽³¹⁷⁾ discussed oral cancers according to specified sites and various factors of aetiology and epidemiology are noted with respect to these sites, as follows:

- a) Lip: Lip cancer accounts for about 25-30 per cent of all oral cancers in Caucasians, predominantly occurring in men of advanced age. It is rare amongst certain ethnic groups with "darker" and "yellow" skin. Factors such as actinic radiation have been questioned, as well as the action of other factors related to outdoor activities. Smoking

may play a relevant role in aetiology (317) and, in particular, pipe smoking has been shown to be significantly associated. Outdoor activities seem to be more relevant than urban or rural differences. (248a) Predisposing lip changes, e.g. chronic cheilitis and actinic elastosis are also associated.

b) Labial mucosa: Epidemiological studies (317) show an association with snuff users who are old and have a high alcohol intake. Aetiological factors are tobacco usage and lime and heat.

c) Buccal mucosa: Pindborg (317) cites studies which suggest that old age, betel and tobacco chewing are relevant epidemiological factors and that the condition is more common in women than men. The aetiological factors suggested are tobacco chewing, using snuff or smoking. Pindborg (317) also cites studies by Casterline (76a) which reported on the habit of chewing polyvinyl chloride (PVC).

d) Floor of the mouth: This is reported (317) as a disease of middle and old age, with a peak in the seventh decade. Reports of increased frequency in women have been suggested to be related to an increase in cigarette consumption. Aetiological factors suggested are tobacco, alcohol and dental sepsis. Pindborg (317) reports studies showing that carcinoma in this site mainly affects patients of lower income groups and patients with liver cirrhosis who smoke or who are heavy users of alcohol.

e) Tongue: Pindborg (317) reports of epidemiological factors of higher incidence in the male and in the 6th to 8th decade of life. Aetiological factors which appear to be relevant include heavy smoking and drinking, tertiary syphilis, opium smoking and associated nutritional deficiencies.

f) Palate: Reports of higher incidence in elderly male and severe smokers. Among the aetiological factors which have been suggested are reverse smoking. (317)

g) Palatine arch: Pindborg (317) cites studies showing this occurring most often in elderly males, associated with multicentric cancers and in people who have been heavy users of tobacco and alcohol.

h) Gingiva and alveolar ridge: Pindborg ⁽³¹⁷⁾ suggested that prevalence is greater in men and in the elderly (50 - 80 years).

Other factors of relevance to oral carcinoma are the malignant potential of oral precancerous lesions. The data on this is influenced by the length of the observation period, age of the patient, location and type of leukoplakia. ⁽³¹⁷⁾ There appears to be very few studies in population groups of precancerous lesions.

The basic aetiological factors relevant to oral carcinoma can be summarised as follows: ⁽³¹⁷⁾

1. Tobacco: the amount, type and manner in which it is used;
2. Heavy alcohol consumption increases risk.
3. Tobacco and alcohol in combination are higher risks.
4. Liver cirrhosis from alcohol helps to initiate or accelerate malignant changes.
5. Industrial hazards, such as polyvinyl chloride (PVC) and dusts in certain industries.

As Maldonalds ⁽²⁵⁶⁾ points out, 85 per cent of oral cancers are directly visible and 11 per cent are palpable, and as Tan ⁽⁴¹⁹⁾ notes, the prognosis of patients with cancer of the mouth is not good. He quotes crude five year survival rates for this Australian study as being 30 to 40 per cent. It is important for oral health that risk factors as enunciated by epidemiological studies are known by the community and the oral care system and also that personnel involved in oral care activities screen patients for oral cancer. ⁽¹²¹⁾

4.6 Defects of Teeth

A wide normal biological variation is evident in the form, size and colour of human teeth. Also abnormal variation is common and may be a consequence of genetic, environmental or pathological factors. ⁽³⁷⁵⁾ Such abnormalities may affect enamel, dentine or cementum and may or may not be clinically evident. Examples are amelogenesis imperfecta, dentinogenesis imperfecta, fluorosis, mottled enamel, "Turner" tooth and tetracycline staining, enamel hypoplasia due to congenital syphilis.

The defects may be localised to a single tooth or affect the whole dentition; they can vary in severity from a mild defect of calcification to almost complete failure of enamel or dentine formation.

Many terms have been used to describe these defects, especially those of enamel, e.g. enamel dysplasia, mottled enamel, dental fluorosis, developmental opacities, enamel hypoplasia, enamel hypocalcification and white spots. ^(94a) The terminologies used are not uniform and are usually non-specific. ^(85b)

The prevalence and severity of enamel defects ^(85b) have not been extensively monitored as there has not been an index similar to the DMF index which has been used to assess the pattern of disease within and between populations. However, much attention has been focused on environmentally initiated defects, e.g. mottled enamel, particularly that associated with ingested fluoride. The uptake of the antibiotic tetracycline by developing tooth tissues with consequent staining ^(65a) and defects of permanent anteriors sustained by injury during their development have also been studied. ^(13a)

The "growing tooth is a biologic recorder of both health and disease". ⁽³⁶²⁾ Enamel and dentine provide a precise and permanent record of variations and fluctuations in the normal development of matrix and mineralization phases of tooth development.

Abnormal development is often quite easily observed and is of particular relevance to the person concerned when it is cosmetically disfiguring, or causes reduced function from loss of tooth substance or from increased susceptibility to disease. Quite often these defects present difficult treatment problems.

The aetiology and significance of many abnormalities is not known. However, almost 100 factors have been described ^(393a, 444a) which may be responsible for inducing tooth defects. Despite this broad aetiological basis of tooth defects, it is difficult to allocate most observed defects to a specific causal event. Many of the aetiological factors described are uncommon - systemic or inherited conditions, in which tooth defects are but part of a syndrome. The more common

defects do not appear to be associated with these uncommon systemic or inherited conditions.

Brook (68a) states that abnormal or defective teeth may be caused by either environmental or by genetic factors, or by a complex interaction between many genetic and environmental factors.

Kreshover (238a) offered the concept that abnormal tooth formation is a generally non-specific phenomenon and can be related to a variety of local and systemic disturbances, any of which, depending on their severity and the degree of tissue response, may result in defective enamel and dentine, either of the so-called hypoplastic or hypocalcified variety. Cutress (94a) raises the question as to whether clinically different defects observed result from different aetiologies, different pathological processes or different stages of tooth development. Lesions with a similar appearance do not necessarily have a similar aetiology. The same aetiological factor can produce dissimilar lesions when active at different stages of tooth development.

Many observations of association between tooth defects and environmental (41a, 107, 362) and systemic and genetic factors (375) have been described. However, clinical observations need to be supported by both a qualitative and quantitative measurement if the significance and understanding of defects is to be obtained.

Cutress (94a) reviews comparable studies of enamel defects and concludes that the prevalence of individuals with one or more defects appears to be high; the consensus of observations reporting a prevalence in the region of 30 - 40 per cent, the most commonly defective teeth being incisors (particularly maxillary incisors) and first molars.

Various classifications have been proposed. (13a, 85b, 107, 410a, 458) The W.H.O. ICDA (456), a dental extension of the W.H.O. classification of dental disease, is a classification based on a number of pathological, clinically descriptive and developmental criteria. For epidemiological studies, a specific quantitative and standardized observation is necessary. A group within the Federation Dentaire Internationale is currently working on a suitable system of classification (85b, 94a)

which is not just for a specific purpose as Dean's Fluorosis Index^(13a) was. The group's conclusion, after reviewing previous studies, was that a descriptive classification was preferable than that based on aetiological considerations, the reason being that the main purpose for "collecting and recording enamel defects was to determine their frequency, severity and distribution for the purpose of assessing the magnitude of the clinical problems and assist in identifying their aetiology." ^(94a) The F.D.I. working group proposed a classification of enamel defects under a 3-part system: 1 = Type of Defect, 2 = Number of Defects, and 3 = Location of Defects. ^(85b)

In Australia, reported studies on defects of teeth have been mainly concerned with pre- and post-fluoridation surveys ^(38a, 75b, 75c, 75d) and those associated with tetracycline administration. ^(21a, 65a, 267a)

There appears to be a need for a classification of enamel defects as outlined by the F.D.I. working group. ^(85b, 94a) It is also necessary to record the prevalence in the community of other defects of teeth, as well as those of enamel. Certainly, with a school dental service where children can be monitored and a relatively standardized surveillance could be undertaken, opportunities for gaining information as to the aetiology of tooth defects and their manifestation could be further explored. ^(15a)

4.7 Disorders of Bone

Further hazards to oral health include bone disorders. Although these are not very prevalent in the community, they do have oral manifestations which are relevant to general health status and to the provision of oral care. This generally manifests as either jaw enlargement, asymmetry and malocclusion. Teeth are either resorbed, do not erupt adequately, or have defects of formation. Treatment needed can involve surgical correction of bone, orthodontic treatment. Schafer ⁽³⁷⁵⁾ lists the following as diseases of bone and joints: Osteogenesis imperfecta, infantile cortical hyperostosis, cleidocranial dysostosis, cranio-facial dysostosis, mandibulofacial dysostosis, mongolism, osteopetrosis, achondroplasia, ostitis deformans, fibrous dysplasia of bone, diseases of the temporomandibular joint, traumatic disturbances of the temporomandibular joint.

As previously stated, with oral mucosal diseases additional aids such as laboratory findings are necessary for diagnosis of these conditions. However, as the oral care system will be utilized by people with these conditions, it is clearly necessary that the prevalence and incidence of the conditions in the community is desirable and central reporting would clearly facilitate this. Also, treatment requirements for people with these conditions can be quantified and facilities and personnel needed for treatment can be planned for.

4.8 Defects and Impairment of Function - Disability and Handicap

One of the areas where the oral care delivery system can produce a positive change in the health of the community is in the rehabilitation of defects and impairment of function in the orofacial area. This is described by Friederich ⁽¹⁴⁷⁾ as the area covered by optimal restoration of the functions of appearance, expression, occlusion, mastication, deglutition and speech within the constraints of the residual deformity, the impairment of normal function and the person's health and mental status.

"Defects of the face and stomatognathic system and the impairment of functional dental occlusion resulting from cancer therapy, birth anomalies, trauma, stroke and aging effects are among conditions which impose a serious burden on the quality of life for the patients with the defect, their family, their social and work contacts. The impairment and loss of socially acceptable appearance, speech mastication and other specialized oral and facial functions erect barriers to the acceptance of the individual in society and the acceptance of oneself." ⁽¹⁴⁷⁾

Sharkey ⁽³⁷⁷⁾ has suggested that the psychologic reactions to disability are varied and complicated, and each individual brings to the disability an intensely personal meaning as a foundation upon which the structure of one's total personality rests. For any human being, the face, visible to all, is the most critical area through which ego can be reinforced or destroyed at any age. Some of the most poignant scars to the self image are inflicted by disfigurement as a result of facial and oral disease.

Gessner (148) suggested that the emotional and psychological correlates of facial disfigurement affects the manner in which the patient returns to their family and society. The appearance one presents to the public affects not only what others think of one, but, more importantly, influences what one thinks of oneself. The individual cannot hide the face which is an integral part of social interaction, because our culture places a high value on physical attractive needs. The face is a reflection of the individual. The first impressions others will have of a person's personality and character come from appearance and the face.

Quinn (325) describes the orofacial area as one of the most significant areas of the body in that it is a

- "major source of gratification for newborn babies and also represents security and love;
- area where nutrition is effected;
- place of expression for the individual;
- is used physically to express love;
- is the area for speech and allows one the ability to communicate in a sophisticated and complex fashion."

4.8.1 Dysfunction of the masticatory system

When discussing the factors of importance to the health of the community, and ways in which the oral care system is called upon to respond to a demand for care, some analysis of people who present in the oral care delivery system with symptoms which are commonly referred to as dysfunction of the masticatory system must be included.

Helkimo (186) states that there is a lack of unanimity as to which symptoms should be included in such a complex of symptoms of mandibular dysfunction. The literature describes most studies of functional disturbances of the masticatory system as being carried out on patients referred to specialists for examination and treatment of their symptoms, i.e., clinical material. The symptoms and signs that Helkimo (186) has reviewed in the literature are temporomandibular check or crepitation, temporomandibular joint pain, tenderness or pain of masticatory muscles, impaired mobility of the mandible, irregular path of movement of the mandible and jerkiness of certain movements of the mandible, as well as headaches and facial pain. He also states

that differences between the definitions of the individual symptoms, examination methods and diagnostic criteria have contributed to the difficulty in obtaining a clear-cut picture of what is dysfunction of the masticatory system. However, studies performed on selected groups of people, ranging from dental nurses to university students, show the patterns that emerge are that most people presenting as patients are between the ages of 20 and 40 years and the majority of these are women. Helkimo⁽¹⁸⁶⁾ reported that recent investigations where similar definitions and examination methods have been used showed a prevalence of between 25 and 79 per cent of people having a temporomandibular joint or muscular symptom. Also about 25 per cent were judged as requiring treatment for their symptoms. He does, however, make the point that investigations by Thompson^(422a) showed a similar frequency of symptoms in patient groups as in so-called "normal" or control material. Also, from Helkimo's review it can be seen that symptoms of functional disorders are not uncommon in children. Suggestion was also made that orthodontic treatment may have some connection with joint dysfunction and also that a higher prevalence was found in older children than in younger children.

Reports of studies carried out in Sweden with elderly people clearly show that dysfunction is also common in the elderly⁽³⁰⁷⁾ which contrasts to the age suggested by studies of patients⁽²⁵²⁾ reporting with temporomandibular joint dysfunction. Swanljung⁽⁴¹⁶⁾ states that the denture wearer whose masticatory system functions less competently than that of a subject with a full natural dentition, and who is generally old, does not consider the functional disorder to be an abnormality and so does not present as a patient.

Studies by Agerberg and Carlsson^(2,3) of a group of 15-17 years of age, established by questionnaire that over 50 per cent had some symptoms of dysfunction. However all these figures are not meaningful because it is not known how many of the persons had severe symptoms and if they were in need of treatment. Helkimo⁽¹⁸⁶⁾ describes an anamnestic and clinical dysfunction index which is one way of quantifying the extent of the problem and also to classify and permit estimation of prevalence of symptoms and severity. According to Helkimo⁽¹⁸⁶⁾, assumption is made that 25 per cent of the population need some functional treatment when they are quantified according to the index. There is no sex difference. However it was pointed out that women and

the elderly had a higher frequency of headache and general joint and muscle symptoms. It seems that social and psychological factors may play a role here. Barmes and Richards ⁽³⁴¹⁾ in their review of the literature in this area also report more women having temporomandibular joint problems and anxiety as being a relevant factor. The main problem here remains the constancy or variation in diagnosis of the dysfunction. ^(237, 396) More epidemiological research of different populations is necessary, especially longitudinal studies with a standardized dysfunction index. It appears that finding a suitable index in this area will have many of the problems that measurement of dentofacial anomalies has encountered.

4.8.2 Aging

One of the most prevalent conditions present in our community is aging. In New South Wales, 9.5 per cent of the population in 1978 were over the age of 65 years. ⁽³⁷⁾ Aging is a progressive normal process which could be said to begin prenatally and progress in varying degrees, depending on a series of factors which include heredity, health, closely associated with social well-being, disease resulting from internal environment, nutrition and psychology. ⁽⁷⁷⁾

Biological time is not the same as physiological time and chronological age is not the same as biological age. Aging has been defined as a progression of changes in biochemical processes which determine structural and functional alterations in cells and non-cellular tissue and hence the whole organism. ⁽⁷⁷⁾ However aging does not merely have a physical effect. The irreversible process of aging can be generally understood on an intellectual level. However the emotional impact is an individual phenomenon in quality, intensity, time and effect.

Chang ⁽⁷⁷⁾ lists the following as characteristics of the aged:

1. dehydration, fissuring (tissue fragility);
2. tissue atrophy and decrease in tissue elasticity;
3. retardation of cell division and capacity of cell growth and tissue repair;
4. lowering of the basal metabolic rate;
5. increased pigmentation and fatty infiltration;
6. decreased secretions by cell epithelial structures

from nasal obstruction, atrophy of nasal tubercinates, vitamin deficiencies, drug intoxication, diabetes and local or generalised diseases of the salivary glands, acute infections, irradiation. Glossodynia from lesions, e.g. ulcers, acute and chronic inflammation, herpes, neoplasms, food allergy, temporomandibular joint problems from malocclusion or ill-fitting dentures, cerebrovascular accidents.

8. Manifestations of reactions to loss projected to the mouth - psychologic factors.

While some of the above-mentioned bodily alternatives are general in nature, they have direct effects in the mouth and on the oral system.

"Degenerative or systemic conditions in aging patients may be influenced by their oral condition and the reverse is also true - oral changes are often the result of general deterioration." (77)

Oral changes

Chang (77) has listed the following changes:

1. Tissue changes, e.g. dehydration of the oral mucosa, progressive thinning of the oral epithelium, leaving the tissue vulnerable to mild stresses, nutritionally deficient cells, resulting from avitaminosis A,B,C.
2. Bone changes due to calcium deficiency and poor bone metabolism, leading to osteoporosis and ridge resorption.
3. Abnormal taste sensations including burning sensation, possibly due to avitaminosis B and low estrogenic levels.
4. Decreased salivary flow and resultant difficulty in denture retention.
5. Changes in inter-arch space and concomitantly in the temporo-mandibular joint.
6. A general decreased efficiency of the masticatory apparatus.
7. Tooth loss caused by long-term dental diseases.

Davidoff (95) lists the following aspects as being relevant to the health and well-being of the aging:

1. General facial appearance: wrinkling, loss of elasticity, loss of hair, de-pigmentation of hair and higher incidence of epidermal neoplasms. Atrophy of facial muscles, modification of facial

Shock (389) also suggests the following functional changes as relevant to the aged that relate to loss of reserve capacity:

- a) loss of functioning cells in specific tissues and organs,
- b) the cells remaining in the old tissues which are less capable of performing their activities.

With aging the organ system will show the following decreases in performance capacity of the total body physiology: (389)

Nervous system: impaired vision and hearing, diminished attention, memory and mental endurance.

Endocrine system: decrease or imbalance in secretion.

Muscular system: loss of functioning units, decrease in strength and speed.

Digestive system: diminishing of secretion of ITCL and digestive enzymes leading to malnutrition.

Cardiovascular system: diminished cardiac activity, arteriosclerosis.

Respiratory system: fibrosis, loss of vital capacity, decrease in respiratory efficiency leading to the problem of oxygen exchange.

Urinary system: decrements in renal blood flow, glomerular filtration rate, and tubular functions.

Skeletal system: lessened ability to heal, lowered metabolism, decreased vascularity, reduction in red bone marrow, osteoporosis leading to bone resorption.

Clinical symptoms which are associated with aging are: (95, 421)

1. Modification of tooth structure, periodontal membrane and alveolar bone.
 2. Degenerative changes in oral mucosa and tongue.
 3. Degenerative changes of maxilla, mandible and temporomandibular joint.
 4. Diminished neuromuscular stimulation.
 5. Elevation of the thresholds for perceiving touch, pressure and temperature, and even pain stimulation.
 6. Decreased muscle size.
 7. Diseases of the mouth, including lichen planus, lupus erythematosus, syphilis, drug eruptions, erythema multiforme, pemphigus.
- Systemic diseases, including leukoplakia and Fordyce's disease, aphthous stomatitis, fungus infections, e.g. candida, xerostoma

contours and loss of subcutaneous fat, decrease in bulk of muscles and connective tissue leading to skin drooping, loss of skin tone, decrease in face height.

2. Tongue: depapillation, fissuring, increase in size in edentulous mouth. Changes in taste perception which is exacerbated by smoking and also may be affected by reduction in salivary flow. Decreased sensitivity to sour and bitter tastes if wearing complete maxillary dentures.
3. Teeth: attrition, formation of secondary dentine, cementum apposition and root transparency.

Read (335) also points out that there are special problems making the aged different from other groups in the oral care delivery system. These are:

1. "medical disorders that interfere with effective dental care.
2. physical disabilities that limit their capacity to benefit from oral care.
3. lack of motivation.
4. inability to adapt to essential routines or to use prescribed appliances.
5. difficulties in communication."

Read (335) further concludes from a review of literature that:

1. "practitioner responses in patient care are a critical factor in predicting treatment success.
2. practitioner attitudes about their patients affect the type of care they give.
3. practitioner knowledge of disease processes is critical in predicting treatment patterns.
4. the elderly population presents special health problems of chronic disease and illness.
5. where knowledge is extensive and attitudes positively oriented towards rehabilitation and prevention, practitioner knowledge and attitudes about the aged and chronic disease can be an asset in successful care.
6. research has demonstrated a lack of knowledge on the part of the health care providers of the special problems of the aged, and negative attitudes towards the aged themselves.

7. research has not been carried out on the attitudes and knowledge of dentists about the aged and the aging process."

Some of the problems associated with oral care of the aged are general problems of neglect. (23, 133, 343, 432) Some oral conditions like periodontal disease are chronic and they are the result of long-term neglect of oral hygiene.

The oral health care service has not been utilized to effect a positive change in health status, because of the following:

1. The person has a low perceived need for oral care. (97, 161, 184, 343)
2. They have a relatively weak belief in their own susceptibility to oral disease and dysfunction and also to its seriousness and as a result, utilization of services is reduced. (184, 395)
3. Their access to oral care is limited (either financially or physically) by not being able to attend a dental centre. (77, 259)
4. They have some other form of chronic condition which reduces their ability to manage their own oral hygiene (115, 259, 395), e.g. stroke, arthritis.
5. There is a lack of awareness by practitioners of the special needs of the aged. (295, 335) Much of the treatment required was clinically difficult.

The oral health care needs of the aged can be assessed by evaluating"

- a) the general health status of this group and how it affects their oral health, e.g. chronic disease states, particularly cardiovascular pathoses, diabetes may accentuate existing inflammatory periodontal disease. (407)
- b) the prevalence of oral diseases and conditions in the aged. For example, results of one survey of the Australian population (15c) showed that 65 per cent of 65 year old and over had false teeth only. A study by Ettinger (133) on elderly people showed a prevalence of denture sore mouth on 90 per cent of those examined. A survey of elderly Danish people (161) showed that only 3.4 per cent of the dentate and 28.2 per cent of the edentulous population did not require treatment. However, only 25 per cent thought they needed treatment. Pindborg (316) reports on increased cancer and precancer rates in the elderly which may be due to age changes in

the oral mucosa.

- c) the use of oral health care facilities by the aged. An Australian survey ^(15c) showed that for those over the age of 65 years, 52 per cent had not visited a dentist in the last 5 years.
- d) the prevalence of certain conditions in the elderly population and the oral health care needs of this group of people. For example, there is an incidence of 2-4 new cardiovascular accidents per 1000 population per year. ⁽¹⁹¹⁾ The majority of these occur in the elderly. A very large proportion, 80 per cent of 50 year olds ⁽³⁵⁾ potentially need some type of denture. Hence edentulousness and its management may be a problem for these people. Quite often, after cardiovascular accidents, adjustments of dentures are necessary and are helpful in rehabilitation ⁽¹⁹¹⁾, especially in speech problems.
- e) the oral health care delivery system assumes the functional, psychological and financial independence of the population. However the elderly are not in this position and are reliant for access to care on other people - family or institutional. The organizational structure and managerial factors, as well as the attitudes of personnel in the delivery system are strong factors in determining whether the elderly will receive oral health care and what type of care they will receive. ⁽³³⁴⁾ That there is a need for health care for this section of the population is shown by the results of studies of the elderly in various populations ^(35, 343, 363, 375) in which clinical dental status is reported. However as pointed out by Smith ⁽³⁹⁵⁾ it is important also to consider disabilities and handicaps of the elderly. Pain detracts from a person's sense of well-being, and in the study reported ⁽³⁹⁵⁾ 32 per cent were handicapped because of oral pain, while nearly 30 per cent were limited in their ability to eat and social discomfort and embarrassment resulted from the length of time it took to eat a meal because of difficulty with chewing. Poor appearance of teeth and dentures and difficulties with talking, singing and kissing were also a cause of discomfort.

Aging can be considered as a hazard to oral health, and in planning oral health services, aging and the percentage of the population in this group will need to be taken into account if there is to be a positive health outcome from the system.

4.8.3 Communication disorders

A further area the oral health care system needs to consider is that of communication disorders. There are two main aspects: firstly, how do communication disorders affect oral health, and, secondly, how can personnel involved in the oral health care system play a role in the health of people with communication disorders?

Communication disorders can be divided into three categories:

1. disorders of hearing,
2. central communication disorders, and
3. speech disorders.

These conditions are the end-product of an enormous range of causative factors, including disease, trauma and surgery, as well as psychological disorders and congenital malformations. (228)

Speech is central to the adjustment and functioning of the human being. When disorders occur the effects can be far reaching. Maturation and social development may be disturbed in the younger person and in all ages adjustment to living and social communication. Communication is the means of feedback by which the individual relates with other individuals and the rest of society. The orofacial area is the primary region effecting communication. When viewed schematically, communication involves a receptor system (input), a central processing system and an effector system (output). Kerman (228) illustrates how the spoken message is communicated from the mind of the speaker to the mind of the listener.

1. Linguistic level: the speaker organises his thoughts, selects appropriate words and orders these words according to the rules of his language.
2. Physiologic level: neuromuscular activities are co-ordinated and speech is articulated. The acoustic signal is transmitted to the receiver who translates it physiologically to the linguistic level.

Communication disorders can be viewed in this manner.

Disorders of the receptor (input) system

- a) disturbances in hearing ability, leading to lack of hearing or to a garbling of sound.
- b) disturbances in the visual or tactile systems which detract from the input available to the person.

Disorders of central processing system

Congenital defects, disease and injury are the principal causative factors, e.g. rubell, obstetric procedures, trauma in children, gradual neurologic deterioration, surgery, cerebral vascular episodes and trauma in adults.

Disorders resulting from disruption of an effector system (output)

Disorders in this area may result from disturbances in the motor areas of the cortex, and in the neurologic tracts or in the speech musculature.

Problems in verbal production may stem from disorders in the central nervous system or the peripheral structures or from faulty learning or psychological factors.

Organic aetiologic factors in disorders of communication are cerebral palsy, multiple sclerosis, Parkinson's disease, cleft palate, surgical extirpation of the larynx. Stuttering and hysterical aphoma are causative factors which could be functional.

The major areas of concern in the health care system where communication disorders are relevant to the personnel involved with the orofacial area are the following: (228)

1. Treating patients with communication disorders and being able to communicate with them.
2. Asking patients with oral motor apraxia to position their tongue or to perform specific mouth movements.
3. Differential diagnosis between aphasic patient and patient with confused language as a result of organic brain damage.
4. Patients with dysarthria and concomitant neuro-muscular weakness may need construction of prosthetic aids (e.g. velopharyngeal palatal seal). (179)

5. Inability of person to receive meaningful messages because of hearing impairment and hence not being able to understand advice or treatment.
6. Necessity for patients with apraxia and dysarthria to retain their natural teeth if possible so as to facilitate rehabilitation of speech.
7. Ability of person to maintain oral hygiene when they cannot control their mouth movements because of oral motor apraxia.

The benefits of prosthetic aids in speech rehabilitation has been shown. (439) The involvement of oral health care personnel in this area of health delivery could bring to this field the skill and knowledge of those used to working in the orofacial area and together with other members of the health team, rehabilitation techniques can be developed which make a positive change in the health status of people with communication disorders. Special preventive and oral health promotion programmes can be developed to preserve and maintain oral structures in this population group.

4.8.4 Head and neck cancer and head and neck trauma

The tragedy of facial disfigurement has far-reaching effects on a person's mental health, family security and socio-economic survival and all these factors influence a person's general health status.

Comprehensive management of people who have this problem requires integration of a broad range of knowledge and skills in order to function as a rehabilitation team. (191)

In the case of head and neck trauma the oral health care personnel can participate by preventing deterioration of oral tissues through maintaining oral hygiene, altering diet; after homeostasis has been achieved. (403) Consultation with the rehabilitation team in the positioning of fixation appliances can prevent major occlusal adjustments post-recovery. (123)

In the case of head and neck surgery for cancer, for example in planning reconstruction, the strategy must take into account not only what portion must be removed, but what must remain to safeguard the patient as a member of the human race. (198, 297)

In the development of the treatment plan, consideration should be given to the rehabilitative process, incorporating preventive and elective decisions which can conserve healthy tissue and enhance the ultimate function of the patient. ⁽¹⁴⁷⁾ For example, in radiation treatment consideration of protection of the essential dental and oral structures not immediately involved in the target area is necessary as well as consideration of the effects of radiation on the rehabilitation functions of prosthetic appliances. ⁽¹⁹⁷⁾ In addition, the participation of the oral health care team in follow-up maintenance of orofacial and speech rehabilitation facilitates recovery.

4.8.5 The dying patient

The following factors are relevant to the dying patient in terms of their oral health and susceptibility: ⁽³²⁵⁾

1. Painful teeth.
2. Infections of oral soft tissue which is susceptible to generalized stomatitis with or without ulceration.
3. Drug induced side effects, e.g. xerostomia
4. Susceptibility to acute suppurative parotitis from poor oral hygiene and diminished salivary flow.
5. Pathological bone fractures.
6. Intractable pain.
7. Reduced oral hygiene.

Greenberg ⁽¹⁶⁴⁾ found significant oral diseases discovered while examining terminally ill hospitalized patients.

1. Oral abnormalities caused by systemic disease or as a result of therapy prescribed for systemic disease, e.g. oral ulcers from anti-metabolite therapy, acute necrotizing ulcerative gingivitis in patients with terminal malignancy, oral candidiasis, uremic stomatitis, acute dehydration parotitis, gingival bleeding, e.g. from severe neutropenia.
2. Localised oral conditions which confuse medical diagnosis or treatment, e.g. oral infections which make diabetic control difficult; or which cause fever of unknown origin.
3. Oral lesions incidental to medical diseases, e.g. soft tissue and bony lesions such as pemphigus and lichen planus. Palliative oral treatment may keep the patient comfortable or more extensive treatment may be necessary.

4. Emergency dental treatment is required, e.g. acute pulpitis, periapical or periodontal abscesses.

The management of the dying patient is similar to the management of patients with a more favourable diagnosis. (174) Care should be taken so that the patient is as comfortable, both physically and emotionally, as possible. An uncomfortable mouth and lack of effective dentition can be an important focus of discomfort and pain for the terminal patient. Oral care which gives the patient a sense of dignity and worth at this most critical period is a service which the oral care delivery team can give. (325)

4.8.6 The chronically ill and handicapped

The World Health Organization defines the handicapped child or adult as one who "over an appreciable period, is prevented by a physical or mental condition from full participation in the normal activities of their age group, including those of a social, recreational, educational and vocational nature." (139) Another definition of a handicapped child is "one who for reasons of social, physical or intellectual difficulty requires special care in home management, education and health services." (212) Chronic refers only to the duration of the condition and not the severity. Many chronic conditions are not necessarily disabling. A chronic illness is one that persists over a long period of time with symptoms or disabilities which are prolonged, either because healing cannot take place or the continued activity of the disease process occurs. (369) The impact of the disease or the condition plus the duration of the resultant disability and its effect on a person's social, economic and vocational status will inevitably result in psychological changes and difficulties. (369) As already pointed out, the oral cavity plays an important role in the satisfaction to be achieved from life. All its functional activities, whether concerned with food intake, communication or emotional expression are the same in normal or handicapped individuals. "Development of the appropriate sensory experiences within the oral cavity is necessary to supplement the functional development of the nervous system and to provide the raw material for learning." (139) For example, "the role of the oral cavity can be important psychologically in that if a cerebral palsy person can be independent in his eating, he can gain confidence to be independent in other areas." (212)

Improved standards of care available to the community, the development of medical skills and more babies surviving through early infancy (139, 212) has meant the numbers of disabled and handicapped within the community have increased.

Also, advances in psychiatric medicine, the use of drugs to control various conditions has meant that the number of individuals who remain and are cared for at home has increased. (139) In New South Wales, 12.5 per cent of the population is classified as being disabled. (417)

Some different kinds of handicapped groups are listed by Franks (139) and Jago (212) as follows:

1. blind, or partially blind.
2. deaf, or partially deaf.
3. educationally subnormal.
4. epileptic.
5. maladjusted.
6. physically handicapped, e.g. cerebral palsy.
7. handicapped in communication (e.g. defective speech)
8. chronically ill (asthmatics, those with coronary heart disease, diabetes, congenital heart disease).
9. senile
10. affected by brain injury.

Five per cent of the child population in Victoria has been classified as handicapped and over 3 per cent of the population are "mentally retarded". (212) Gurling (171) conducted a study on handicapped children to seek the prevalence of various specified conditions in the South Australian handicapped child population and outlined some of the problems in determining the size of this group in the community. (171) There is no universally accepted nomenclature for all the many different categories of handicapped people and also many people have more than one handicap. As there is no complete registration of these individuals it is not possible presently to gain an accurate picture of the prevalence of handicapped individuals in the community. (212)

Some of the disorders affecting the neuromuscular and musculo-skeletal systems that may result in chronic disease and disability which are relevant to oral health and to problems of adjustment to disability, use of remaining abilities, motivation, learning ability and skills are as follows: (369)

1. mental status affected, disorientation, loss of memory and learning ability.
2. disorders of communication.
3. visual deficiencies.
4. paralysis of affected extremities
Cerebral palsy - patients who have the following problems: motor disabilities, mental retardation, impaired speech, hearing and vision.
5. Sensory impairment, enamel hypoplasia, higher incidence of caries, gingivitis, malocclusion and bruxism.
6. Decubiti and resultant pressure sores, spasticity, joint contractures, myositis ossificans, osteoporosis, emotional difficulties.
7. Multiple sclerosis, motor weakness, co-ordination problems, trigeminal neuralgia prevalence, vomiting.
8. Arthritis and ankylosing spondylitis, temporomandibular joint involvement.

Jago (212) adds some general comments on handicapped children:

1. Anomalies of dentitions are more frequent, particularly in children with Down's Syndrome and a higher incidence of severe periodontal disease.
2. Enamel hypoplasia is more prevalent in children with cerebral palsy.
3. Epileptic patients on drug therapy with hydantoin group of compounds frequently have hyperplastic gingivitis.
4. Rampant caries is common and is due usually to "neglect and failure to obtain dental service".
5. Poor oral hygiene, more debris and calculus.

Franks (140) points out that handicapped persons may not have a particular liability to dental caries but that they "suffer disproportionately from the consequence of this disease. He suggests that the following factors may be relevant:

1. "feeding of young handicapped children may present difficulties to parents and there is a tendency to retain them on the feeding bottle for much longer. Sweetened comforters may be employed frequently. Disordered diet may lead to a constant intake of soft, sugary foods."
2. Oral hygiene procedures may be difficult and neglected.

Franks (140) also points out that these factors may be relevant to the increased incidence of gingival and periodontal disease. However drug therapy and vitamin deficiencies are also factors influencing periodontal disease. (140, 212)

Other health problems mentioned by Franks (140) were:

1. Increased risk of dental injuries by epileptics.
2. A higher incidence of malocclusion and enamel defects.
3. Long term drug therapy, e.g. tetracycline staining of teeth.
4. Bruxism and gross attrition of teeth.
5. Dental and facial mutilation.
6. Attacks of acute oral conditions in chronically sick on long term drug therapy.

Groups of handicapped people within the community show a definite need for oral health care. (140, 172, 212) However, as Franks (140) emphasizes;

1. Oral care is essentially an elective service and has traditionally served those who "have had the motivation to seek it."
2. Other health advisers who these people are in regular contact with put dentistry low on their order of priorities for the person.
3. Parents are slow in seeking care.

Factors relevant to the above situation appear to be: (140, 172, 212)

1. Apprehension about reception of a difficult patient by parent or operator.
2. Parents or guardians have not the time or energy for elective treatments.
3. Availability and accessibility to oral care facilities, including transport, finance and location of facility.
4. Operators not adequately trained to cope with logistic, psychological and communication problems in dealing with a

handicapped person.

5. Low value given to oral health in the total health of people with handicapping conditions.

Davidoff (96) sums up the problems "facing the oral care system which differentiate special patients from ordinary patients as being:

1. Medical conditions which deter effective dental care.
2. Physical disabilities which limit the patient's capacity to benefit from dental care.
3. Absence of, or limited motivation.
4. Inability to adapt to essential routines or to use prescribed appliances.
5. Difficulties in communication."

The aim of oral care is to affect a positive change in the health status of the individual, and the delivery system will need to note both the aetiological factors plus patterns of oral disease and conditions in this special group of people and their difficulties in access to, and utilization of, the oral care system.

5 CONCEPTS OF NEED FOR ORAL HEALTH CARE

5.1 Need and demand

5.1.1 Normative need

5.1.2 Felt need

5.1.3 Expressed need or demand

5.1.4 Comparative need

5.2 Oral health indices

5.2.1 Periodontal indices

5.2.2 Dental caries indices

5.2.3 Malocclusion indices

5.2.4 Malocclusion and Dento-facial anomalies

5.2.5 Combined indexes of need for oral care

5.3 Uses of estimates of need for oral health care

The health situation is one which deals with the relationship between people and not simply between cells. The basic problem is sociological and is concerned with health behaviour and the attitudes of the operator and patient. (268) Menendez (279) suggests that a great part of present day person's needs are socially created, i.e., needs which result from the daily functioning of a given system which imposes fixed demands on people which result in health problems.

Before discussing the system factors which affect oral health, it is pertinent to examine how we define oral health in terms of "need" and "demand" and indicators used to analyse the effects the oral health care delivery system has on oral health.

Firstly, the general definitions of need and demand will be discussed and the perspectives involved in their definition.

Secondly, a discussion in general terms of indexing or measurement and what is involved here.

Thirdly, how the oral health indexes fit into these perspectives.

5.1 Need and Demand

Bradshaw (64) has proposed four definitions which discriminate between needs, want and demand and which help explain and describe a model which administrators and research workers can use.

- a) Normative need: A need in a given situation. A desirable standard is laid down and is compared with a standard that actually exists. If an individual or group falls short of the desirable standard then they are identified as being in need. This is not absolute. Normative standards change in time with the values of society. This need also changes according to the profession's definition of what is a desirable standard.
- b) Felt need: Need is equated with want. People are asked whether they feel they need care. This is an inadequate measure of "real need" as some ask for help when they don't need it, others only ask for what they know they can receive. An individual's

perception determines felt need.

- c) Expressed need or demand: This is felt need turned into action. Those people who actually demand a service and enunciate it by attending a health care service centre. We measure this usually by the number waiting for care taken as a measure of unmet need. However it is a poor definition of "real need". This is, in fact, perceived need modified by a person's likelihood of receiving care. When an individual feels a barrier, levels of demand may be reduced and felt needs may be redefined.
- d) Comparative need: This is found by studying the characteristics of those in receipt of a service. If people with similar characteristics are not in receipt of the service, then they are in need.

Canvin (73) suggests that for planning purposes we can adopt "normative need" as a workable concept provided that "desirable standards" represent "current professional wisdom".

Canvin (73) also suggests a newly defined need, "designated need". Because of financial constraints or physical constraints it is not possible to meet all the normative need in the community. In this case he suggests (a) the standards remain the same and some people's normative needs remain unmet, or (b) standards are changed and all this newly defined need is met, or (c) a mixture of both.

The "desirable" standard set for normative need takes account of professional expectations and also those of society.

The profession tends to define need in terms of a specific disease level at which they can provide a service.

Looking at Bradshaw's four definitions of need in the area of oral health, one can make the following comments:

5.1.1 Normative need

Normative need is where a desirable standard is laid down and has been used for dental caries. The profession has been able to set quite definable standards varying from initial caries

(white spot lesions) to cavitation. With the use of radiographs the definition has included caries in different structures of the teeth. Discussion has ensued as to the discriminatory ability for caries diagnosis. However in planning oral health services, dental caries is defined as a decayed tooth, or a decayed surface and is more in line with Bradshaw's comparative need. Radiographs are used within service facilities for defining level of treatment. In other words the profession defines decay as being "cavitation" ⁽⁴⁵¹⁾, the tooth surface needing restoration. Therefore all those people with "decayed" teeth or tooth surfaces are defined as needing a restoration. In fact, the World Health Organization ⁽⁴⁵¹⁾ sets its survey form as dental caries status and treatment of teeth. Certainly this does not express a definable disease entity. On the other hand it will reflect the "wants" of the community and hence, if analysed from this perspective, may point to factors influencing utilization of oral health care services.

5.1.2 Felt need

Role behaviour is of relevance to this perspective of need. There is little motivational component for being orally ill. Relief from normal social obligations is slight and also a visit to a dentist is popularly associated with the more painful dental remedies. Willingness to adopt the patient role may be reversed. ⁽¹⁰⁶⁾ Davis ⁽¹⁰⁶⁾ also suggests for preventive dental behaviour, visits to the dentist operates to enforce lay norms of preventive activity and not to label dental conditions. He suggests these behaviours will vary by cultural *milieu* (the congruence of lay health orientations with professional norms) and by the lay referral structure of the host community. He set this utilization behaviour out as in Table 2).

The World Health Organization Oral Health Surveys Service Utilization Section ⁽⁴⁵¹⁾ asks the questions (a) Do you want any dental advice or treatment, (b) Is anything wrong with teeth, gums or mouth now, and (c) What sort of advice or treatment do you want?

These questions are to try to "assess the subject's understanding of his own need and desire for care" and from the responses a planner could "estimate what proportion of the population would use existing oral health services". Because of the nature of oral disease, i.e. chronic, long-term, not acutely disabling and treatment services being associated with painful experiences and retribution from the dentist

Table 2. UTILIZATION BEHAVIOUR PATTERNS FOR HEALTH CARE^a

Congruence of lay culture with professional health norms	Truncated, loosely-knit lay referral system	Cohesive, extensive lay referral system
Congruent lay culture (e.g. middleclass)	Medium utilization rates and medium patient delay; medium ratio of symptomatic to asymptomatic visits; considerable variation about the mean	High utilization rates: low patient delay: low ratio of symptomatic to asymptomatic visits: little variation about the mean
Incongruent lay culture (e.g. sections of the working class)	Low utilization rates; high patient delay; high symptomatic:asymptomatic ratio; considerable variation about the mean	Low utilization rates: high patient delay; high ratio of symptomatic to asymptomatic visits; little variation about the mean

^aFrom: Davis, P. Compliance structures and the delivery of health care: The case of dentistry Soc. Sci. Med., 10:331, 1976.

for the client not conforming to a certain behaviour pattern, Davis (106) feels that felt need is a difficult area to define and certainly does not express a definable disease entity. On the other hand it will reflect the "wants" (demands) of the community and hence if analysed from this perspective may point to factors influencing utilization of oral health care services.

5.1.3 Expressed need or demand

Davis (106) points out that research suggests that a very small proportion of illness episodes ever reach the notice of official health care agencies. However the "patient-practitioner relationship remains the pivotal point of health care since it is only at this juncture that the technology and expertise of medical science can be brought to bear on the illnesses and discomforts of its potential clientele".

However this concept of technology etc. being brought to bear on patient-practitioner pivotal point does not fully explain all the areas of importance in the needs. For example the most successful oral health measures (e.g. water fluoridation for dental caries) was successful as it did not rely on this pivotal point and comes to the client before any contact with the health practitioner.

Ill health is perceived as a disharmony. This is the link between disease and society and is a necessary condition for the occurrence of adaptive behavioural process within the social system. One of the most important adaptive reactions is to consult a health worker, usually a professional, for counsel, diagnosis and treatment. Activity of the patterns of seeking and using preventive, diagnostic and therapeutic services is a form of adaptive social functioning and may be iatrogenic if the care sought or offered is inappropriate, excessive, insufficient or ineffective.

Perceived morbidity at the individual level may or may not conform to the view of the health profession or of society. Perceptions, not diseases, prompt the patient to complain, to consult a health worker and to seek care. Seen in this context the problems the health professionals are presented with will vary over time and space, depending on people's sensitivity to the social determinants of disease. (234a)

Kohn (234a) suggests that perception of needs does not lead to use unless need is of sufficient severity or concern to warrant action and unless resources are perceived to be appropriate, available or accessible at a cost that the consumer can afford or is willing to bear.

Decision-making is a process in which individuals move through stages. The perception model (234a) is a complex interaction of past experience, factual knowledge, scientific orientation and other personal factors associated with variables describing for example, education and income, ethnic group.

The relationship is cybernetic as regardless of whether use occurs, the decision to ignore the health services system and the level of entry affects further behaviour in response to the perception of the same or even different needs.

Davis (106) suggests that the literature concerning the consultancy relationship has given recognition of a very wide range of possible work-role relationships which affect the demand concept. These vary by "cultural setting, stage of illness defining process, type of illness condition, kind of medical work, etc. The importance of the role of practice organization and the wider lay community in determining patterns of patient-practitioner interaction and treatment style is being recognised.

The World Health Organization's International Collaborative Study of Dental Manpower Systems in Relation to Oral Health Status (83) had as its specific purpose "to define the relationship between structural characteristics of national systems for dental care delivery and selected measures of effectiveness and efficiency for the consumer, the provider, and organization in which they both operate".

Hall (175b) defines demand as the "sum of the amounts of the various types of health services that the population of a given area will seek and has the means to purchase at the prevailing prices within a given time period.

According to the Donabedian model (114) need generating a demand for services will differ according to the clients or providers' perspective and also according to the concept of need used. Need for

services also has perspectives from client and from provider point of view. The danger of taking, for example, waiting lists as a parameter of unmet needs is that one uses utilization rates as a measure of demand. Demand may differ from utilization. (See Figure 13)

Demand includes the parameters of potential demand (derived from normative needs and required service needs) and effective demand (actual use). The latter will vary according to the cost to the client or provider and priorities given by both.

Demand is affected by the following factors: (175b)

- a. Demographic: e.g. size, distribution, density, growth rate, age structure and sex ratio of population.
- b. Economic: disposable income, time available.
- c. Social and cultural: education and level of health consciousness and the value placed on health.
- d. Health status may reflect demand but may be overwhelmed by, e.g. socio-economic level.
- e. Accessibility: factors facilitating use, e.g. time, cost, cultural and social barriers.
- f. Resource availability: this is affected by economic, cultural, and health value systems.
- g. Resource productivity: if increased higher level of demand can be met.
- h. Health care technology: affects services that can be offered and also the workforce required to produce them. The provider can also determine demand by prescribing services in order to utilize technology.

5.1.4 Comparative need

The fourth definition of need used by Bradshaw. (64)

This was found by studying characteristics of those in receipt of service and contrasting this with those having the same characteristics and not being serviced, given characteristics of health being the same, some people had been determined by the provider of services and needing services and these had been performed. The level of service may be different for the same original characteristic but the decision had been made that there was a need for care.

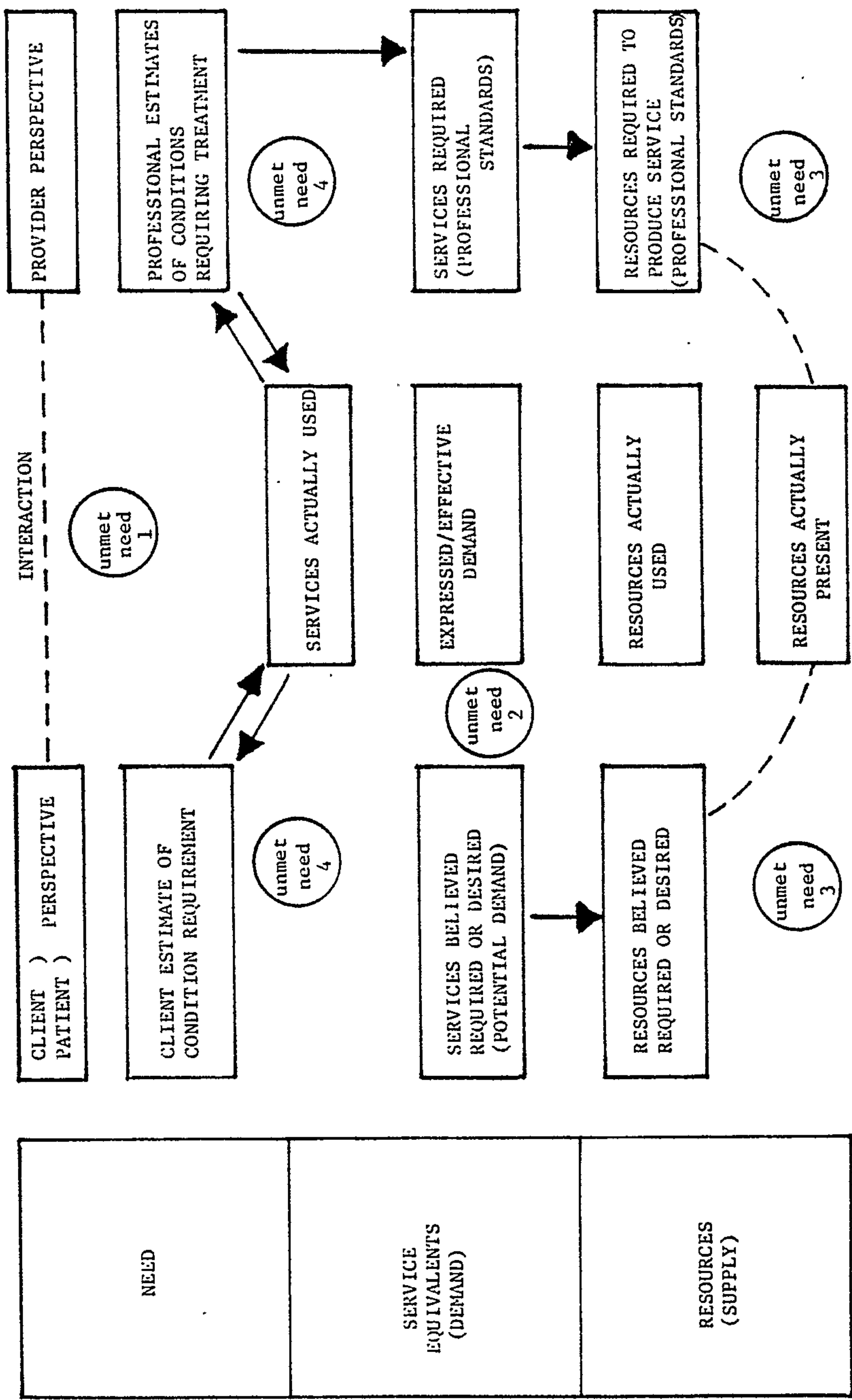


Figure 13. Concepts of need and demand.

From: Donabedian, A. Aspects of medical care administration. Specifying requirements for health care. Cambridge, Harvard University press 1973. p.114.

It is pertinent at this stage to suggest that the provider makes the decision that services are needed according to the parameters of biological factors present and whether the health care delivery system can solve the problem of illness as seen as a deviant from the norm by providing the appropriate resources and personnel. One makes the proviso though that this need for care relates to what the professional determines is necessary, the system may not be able to provide them to every person but theoretically they are available.

Donabedian ⁽¹¹⁴⁾ suggests that when looking at the question of need and demand for intervention one should look at it from a client or patient perspective and from a provider perspective. One can also look at "need" from the perspective of the requirements of a particular person or at the need for services and hence resources, i.e. that there are two levels to the concept of "need". Firstly, the individual "needs" care as there has been a disruption in the balance of equilibrium for health. Secondly, the client "needs" some treatment. This is usually defined by the provider. Donabedian ⁽¹¹⁴⁾ has portrayed this interaction, as shown in Figure 13).

Donabedian ⁽¹¹⁴⁾ postulates that the reasons for the differences in perspectives between client and provider is that the client is concerned with the immediate manifestations and less concerned with ultimate consequences. The provider is concerned with immediate proceedings, e.g. relief of pain but essentially concentrates on long-term manifestations.

However control to looking at the question of need is how is it measured? This raises the question of indicators of health and the indexes used by the profession as a normative procedure.

Two factors are of interest to the professional on measurement of need for care.

Firstly, that there is present a state of deviation of the tissue from what has been defined as normal by the profession as a whole at that particular moment in time.

Secondly this condition needs some intervention to either arrest it, prevent the condition from going further, or to restore it to some

functional state which has been lost by the process.

The level of intervention and type of intervention is determined by the health care system of that place and time. It may vary for different individuals, groups or communities. (78)

The profession describes the status of normality and then attaches a label to the deviation. The normal state is given a value and an index is described which measures the distance from normality. The numbers used for indexing can reflect an integral scale or a non-integral scale, depending on the accuracy and reproducibility of the factor being measured and the criteria used to determine the measurement.

Webster (473) defines index as a "ratio or other number derived from a series of observations and used as an indicator or measure of a certain condition."

Jago (212) states that "advantage of any index is that it enables summarization of diverse elements into a single meaningful concept expressed as a number."

Bice (53) has suggested that the foremost criterion for an index is its usefulness to decision makers: consumers, health professionals, planners or legislators.

Chen (78) suggests that another criteria necessary for an index is that it is reliable. This has to do with the consistency or stability with which an index measures a concept. The degree of reliability being reflected in the degree of standardization of the calibration of the index. Also this has to do with the validity of the concept. In this aspect the index is normative, i.e., the concept is valid in differentiating for a group of people certain states or conditions. It is "quantifiable and consistent with evolving medico-scientific knowledge." (78)

Bice (53) states that progress in measurement is marked by our increasing ability to discriminate among quantities and qualities of phenomena. Jago (213) writes that indexes used to measure oral status are "all indexes of mobility or describe conditions which precede morbidity. All represent provider assessments only." Siegman (391)

also points out that morbidity measures of incidence or prevalence are descriptive counts that do not account for dimensions of severity intensity and duration. He also states that "accompanying each and groups predominant patterning of disease or health problem is the appropriate selection or construction of health indicator".

The factors ⁽²⁷⁰⁾ of usefulness of the criteria used for an index are its simplicity, reproducibility, susceptibility to statistical treatment and availability of data.

The three concepts which emerge as important considerations in looking at oral health indexes are: (a) validity and reliability, (b) usefulness to decision makers, and (c) dimensions of the indexes used, taking into account factors such as severity, intensity and duration.

Indices are a form of measurement to formalize and have a reproducible factor for comparison. The World Health Organization, in its publication on Oral Health Surveys ⁽⁴⁵⁰⁾ suggests measurements are needed for the following purposes:

1. Estimating the prevalence of specific oral diseases and conditions and identifying variations in local, regional or national groups.
2. Supplying baseline data for subsequent evaluation of oral health care programmes.
3. Supplying data to assist health administrators in determining priorities with respect to:
 - health education, preventive and treatment services.
 - the groups in most need of oral health care.

Also measurements are used to give a more accurate estimate of

- a. the extent to which existing oral health services are coping with the current need for treatment,
- b. the nature and extent of required preventive, curative and restorative services,
- c. the costs of establishing, maintaining and expanding an oral health care programme, including an estimate of workforce requirements.

These objectives can be equally applied to the individual as well

as to the community.

The occurrence of a disease or condition may be measured as prevalence (total disease existing in the population at any one time) or as incidence (the number of new cases occurring in a given period of time). Because of the chronic nature of most oral diseases, prevalence rates which reflect the recently occurring cases and the backlog due to neglect are much higher than incidence rates. Prevalence data provides an estimate of the total treatment requirements at the time of the study.

The need for care for an individual is determined both by the "attack of dental diseases and by the amount of dental care received". (468) The reduced incidence of dental caries resulting from use of domestic water containing optimum levels of fluoride reduces the need for restorative dentistry through life. (130) The most important factor determining the amount of care needed by a group is its past utilization of oral health care services. (292, 468a)

There is a close relationship between regularity with which care is sought and the extent of the backlog of need for care. (35) Because of the cumulative nature of oral diseases, unmet needs for care increases with age until the final result of neglect, complete edentulousness, limits the need for care to prosthetic replacement. (356) All of the influences that may determine utilization of services are therefore related to the extent of accumulated treatment needs. (292)

Uses of estimates of need can be classified into four areas: (402)

1. Evaluation of outcome of oral health care:

"Precise measurement of need to be satisfied is an essential prerequisite for the evaluation of a programme or policy outcome." (44a) An analysis of need for care can indicate aspects of success or failure of both the quantity and quality of oral care provided for any given population. Estimates of need were applied in this manner for the International Collaborative Study of Dental Manpower Systems (ICS). (459) For example, ratios of teeth treated to teeth requiring treatment, either for unmet needs or treatment, were calculated for the study countries, (459a) thus giving an interaction of the quantity of care and quality of

care delivered. In New Zealand Cutress ⁽⁹³⁾ estimated the need for care using tooth surfaces requiring restoration, periodontal treatment as defined by four treatment modalities, prosthetic requirements as needing a new or repaired or relined denture. The New Zealand study was to determine a baseline from which objective evaluation of the oral care system could be estimated. However, it was also an historical evaluation of the preceeding years' oral care. The use of need estimates for evaluation can be extended to evaluation of care not required because of the success of preventive programmes. Doessel ⁽¹¹³⁾ used estimates of need for care for children to carry out a cost-benefit analysis of water fluoridation in Townsville, Australia.

2. Formulation of Priorities:

Estimates of need for treatment analysed according to different groups within the community can be used in conjunction with data on oral status to establish high risk groups and groups disadvantaged by the current oral care delivery system. The concept of formulating priorities among population groups is part of the broad social policy of rationing of health services on a scientific basis of need in order that social justice prevails. The Baume Report ⁽⁴⁴⁾ states that "to the extent that an understanding of need underpins the development and introduction of policy, a system will be rational and probably more equitable and more efficient". He also states " ... and further where choices between competing claims have to be made, the extent of need should be one critical factor in these judgements." ^(44a) However in making use of need estimates it is important to realise "the values of professionals and politicians are involved in the process of defining needs to be measured, in setting priorities between different areas requiring measurement and in methods used to identify need. These values must be recognized and stated." ^(44b)

Surveys of need for oral care have documented the extent of oral care that is needed by the community and have pointed out to policy makers that prevention programmes are necessary in the pursuit of oral care for the community. ^(428a,366) Other studies have pointed out groups in the community who have a large amount of care required, e.g. the disadvantaged schoolchildren ⁽⁴⁰¹⁾, elderly ⁽³⁴⁸⁾ and handicapped ⁽¹⁷²⁾. These studies use the concept of comparative need ⁽⁶⁴⁾ to enumerate at what point they fit into the delivery system for oral care.

3. Estimates of Need may be translated into equivalent units of services and resources necessary to satisfy these needs. That is a way of estimating present and future service needs in terms of both preventive and curative programmes. ⁽²⁶⁾ The necessary prerequisites are reliable data comprehensive enough to calculate with good precision according to various services indicated or possible, the number of service units required. This then allows calculation of operator numbers and types, operational settings and equipment required. Data on treatment met indicates how much of the need is being serviced and data on treatment failed is a quality assessment of oral care. ⁽²⁶⁾

A number of studies have made use of estimates of need in oral health care programmes. One such study ⁽¹⁹³⁾ used a survey of need for dental care to plan a programme for institutionalised populations near London. Barmes ⁽³⁰⁾ in a report to the New South Wales Branch of the Australian Dental Association translated data on oral care needs into service units for workforce estimates for New South Wales.

Total services and resources required have been adapted to expected utilization rates in an attempt to avoid allocation of resources which will not be taken up by the population. ^(347a)

Downer et al. ⁽¹¹⁷⁾ have field tested an information system based on the need for oral care for planning and evaluating oral care programmes. This estimates needs from a survey of need for care in which a computer programme is utilized for the survey data and analysis of data. A similar project ⁽⁴²²⁾ has been tested in Australia on the need for oral care in the Australian Armed Services. Use was also made here of computer programmes to aid in data analysis. Another sophisticated planning framework which uses estimates of oral care is the system dynamics model of Pugh-Roberts. ⁽¹⁵⁸⁾

An accurate estimation of the oral health care needs requires knowledge of the status of health, a well-defined standard of what constitutes good health and a knowledge of what science and technology can do to improve health. Using this normative approach may mask the vast range of individual differences and needs. ^(44c) Also in relation to measuring need the normative estimation of need for care may resist dramatic changes. For example, unless an assessment of severity or rate of progression (especially for dental caries and periodontal

disease) can be adequately included in a precise way, need for care may estimate treatment services which may in fact over-treat the condition. (91)

In the estimation of need for oral care selection of items of care to be considered should be based on the effectiveness of treatment and its efficiency. There are few reported studies available on the comparative effectiveness and efficiency of alternative patterns of care in oral health. (113) Once the items of oral care available have been selected, (234, 459) the approach used for estimation assumes differing levels of objectivity. Estimates derived from surveys are relatively objective because of attempts at standardizing criteria for measures. Need varies here from individual to individual and population to population as assessment is influenced by cultural, economic and social situations of the client and the provider. (93) Availability and accessibility of services, plus the provider's technical proficiency and "busyness", are relevant factors in estimations of need gained from the analysis of records.

Estimates in a survey of need for care by epidemiologists may not necessarily match estimates of the oral health clinical provider. (402) Completeness of data and precision of estimation are controlled by the study design and are part of the process of estimation of need. Cost levels will influence these factors. As the oral diseases of caries and periodontal disease plus susceptibility patterns and rate of progression will have to be incorporated in estimates of need for care. For example, rate of progression of dental caries differs for population groups using fluoride preventive programmes. (321) Estimation of need for care and also type of intervention may be altered by the change in the rate of progression of dental caries.

Analysis of service or treatment records are increasing as pressures for quality control, cost containment and third party financing are increased. These records may be able to be utilized more fully if standardized techniques are utilized in the original assessment of need.

5.2 Oral Health Indices

There is no single comprehensive index of total oral health. (84) One of the problems in having a comprehensive index is that the qualitative range of oral disorders is very diverse. Jago (84) has also queried whether it is meaningful to have a single oral health

indicator.

A single summary indicator may serve little to differentiate the types of need for oral care and prevalence of certain conditions and their severity. Recently measures which attempt to deal with a general concept have been formulated. For example,

Index of Dental Need (IDN) (240a)

Oral Health Grading (OHG) (71)

Barenthin Model (24)

Oral Health Index (293, 294)

Each index summarises the most common oral conditions and a method is used for weighting the contribution of each of the conditions. Some₂ social variables are also included in the IDN, Barenthin and Oral Health Index.

Choice of an index:

The purpose for which it is being used is the essential feature of any index. Most indexes of oral health are used for purposes of comparison. (368) To reduce error between the individual components of the index, simple procedures of examination are used and the application of objective criteria rather than subjective skill and judgement. The effect of this is to limit reporting to clear, positive (i.e. relatively advanced) definite lesions or conditions. Comparability is obtained at the cost of underestimation of a disease in its incipient stage, for example, dental caries.

The factor of intra- and inter-examiner error is increased progressively as subjective skill and judgement are used. (358)

The dynamic character of the disease or condition must be considered. Most indices used for oral health indicators are clinical and descriptive, (270) and they count the number of dental units affected in each person, which is more sensitive than the number of persons affected. (270)

However, oral conditions occurring infrequently or which run a brief and acute course are measured by conventional morbidity and mortality reporting. (358) The prevalence of oral clefts has been

described by ratio of instances to live births. (67) Prevalence of oral cancer has been reported - the number of new patients per 100,000 persons per year, or the number of deaths per 100,000 persons per year. (418)

Most oral diseases are of high prevalence and are chronic in nature, hence most specific oral indices describe the relative severity of a disease which runs a chronic and predictable course from inception to total destruction of tissue. (358)

Efforts have been made to standardize reporting of oral diseases and conditions according to specific objective criteria. (451, 456, 458, 460, 461)

5.2.1 Periodontal Indices.

To measure disease in the supporting structures of teeth it is far more difficult than to measure caries. (84) This is because periodontal disease measures a process which begins with a microscopic lesion and progresses to a clinically obvious lesion, leading to the eventual destruction of the supporting structures of the tooth. (6a) Pocket formation and bone destruction are "steps" in the process. (99) Indices of periodontal disease are measurements which express numerically the status of a group with respect to the disease. They can be used to measure prevalence or incidence. They can also be used to measure the severity of a disease ranging from its absence to its terminal stages.

Requirements of an index should be: (99)

1. Simple to use and permitting the study of large numbers of persons with minimum time and cost.
2. The criteria defining the components should be clear and understandable to promote accuracy and reproducibility.
3. A severity index should be equally sensitive in process and should indicate in a meaningful way the clinical stages of the disease process.
4. It should be amenable to statistical analysis. (6a)

Indices must be used that can produce interstudy comparisons. At present there is a "confused spectrum of ideas and approaches". (183) The inflammatory response of the gingival tissues and its interpretation

is very complex ⁽¹⁸³⁾ and within and between examiner variability in diagnosis is high. ⁽⁹⁹⁾ There is no convincing evidence that an examiner can differentiate between gingivitis which will resolve without any treatment and an early gingivitis which will lead to periodontitis unless treated. ⁽⁹⁹⁾ Therefore there is a tendency for most assessments of gingivitis to be too high. Also, there is little evidence that the severity of gingivitis is related to the progression of inflammation to the deeper supporting structures of the teeth and subsequent pocket formation. ⁽¹⁸³⁾ If a particular index is used to describe the severity of periodontal disease it should be equally sensitive throughout the scale. That is, one should be able to recognize with objectivity and certainty one of the stages in the progression of the disease from gingivitis to tooth loss and use this as an estimate of the prevalence of other stages in the process. ⁽⁹⁹⁾ The essence of all the indices is to classify the periodontal status of a person or population with a single figure which takes into consideration the prevalence as well as the severity of the condition. It has not been possible to find a classification of periodontal disease which is universally acceptable. ^(6a) Davies ⁽⁹⁹⁾ points out that the objectives of the study will determine the choice of index. There have been many efforts to classify the indices used and standardize them. ^(6a, 42, 436, 457) One of these classification systems has the terms reversible, and irrervisible and composite. ⁽⁴³⁶⁾ A reversible index can return to zero, when the disease which they have measured disappears. These indexes assess active disease as opposed to irrervisible indexes which assess the permanent damage caused by active disease. ⁽⁴³⁶⁾ The combination index makes use of both irreversible and reversible signs of the disease and each can be expressed as a separate index or as a combined index.

In most diseases it is sufficient to assess the presence or absence of disease, but if one is to use the index for any planning purposes, it is necessary to be able to use for decision-making purposes, that is, to differentiate between groups of people with periodontal disease in terms of both prevalence and severity and to make decisions concerning treatment needs. There are several general types of epidemiological studies which Davies ⁽⁹⁹⁾ has classified as:

1. A public health survey whose purpose is to assess the extent to which periodontal disease is a public health problem and to gain information to estimate treatment needs. A very simple index is all

that is required in this case. The World Health Organization's Oral Health Surveys ⁽⁴⁵¹⁾ categorizes treatment, differentiating between uncomplicated therapy, complex therapy and terminal therapy. There is the proviso that this is to define action required only in general terms and if "different types of treatment are required in different parts of the mouth, only the most advanced or radical form of treatment is scored."

2. The descriptive epidemiological study which is to determine the differences in prevalence between different groups. In this case, a refined index measuring both prevalence and severity is more appropriate. Davies ⁽⁹⁹⁾ suggested the periodontal index (PI) of Russell. The W.H.O. Guide to Oral Health Epidemiology ⁽⁴⁵⁸⁾ states that when more detailed epidemiological information is required the periodontal index (PI) can be used. This index is classified as a Reversible Index by Waerhaug and Alexander. ⁽⁴³⁶⁾ Gjermo ⁽¹⁵¹⁾ also states that the PI as introduced by Russell ⁽³⁵⁶⁾ is suitable for large-scale epidemiological surveys. Gjermo ⁽¹⁵¹⁾ also states that the Periodontal Disease Index (PDI) as proposed by Ramfjord ⁽³²⁶⁾ is suitable for this type of measurement. Another index, the Gingival Index (GI) of Loe and Silness ⁽³⁴²⁾ (also a reversible index) with modifications represents what Gjermo writes is a "highly reproducible absence or presence type of index for gingivitis" but that there is a "need for an additional system for assessing periodontal destruction". The Suomi-Barbano Index (SB) ⁽⁴¹³⁾ may also be suitable for this type of measurement but similar considerations which apply to the Gingival Index also apply to the Suomi-Barbano Index.

The reliability of the index is very important in these studies. Smith ⁽³⁹⁷⁾ describes a study using PDI where intra-examiner reliability was 84 per cent. Shaw ⁽³⁸⁰⁾ describes a study where strong correlations (+0.79 - +0.84) were achieved for GI scores and also there was very little between examiner variations. Ranking order of subjects was also closely maintained. This aspect of reproducibility of index is most important and is one of the necessary degrees in evaluating the choice of index. Accuracy in reproduction will need to be as sensitive as the purpose for which the information on measurement of the disease is going to be used.

3. The constructive epidemiological study whose purpose is to determine reasons for differences in prevalence between different population groups. As the relationship between periodontal disease and the status of oral hygiene has to be well established (250) assessment of oral hygiene has been used as a measurement in some cases. The W.H.O. Basic Methods handbook (451) suggests using a simplified version of the Oral Hygiene Index (OHI-S) as developed by Greene and Vermillion. (167) The OHI-S Index is recommended (458) for determining the presence of calculus and debris. The OHI-S, together with presence or absence of periodontal disease index is used to indicate periodontal treatment requirements. These recommendations have been subsequently modified and a new index, the CPTNI, has been developed (5a) and is being assessed in relationship to established indexes. (94) Smith (397) in a study which was to standardize examiners, found that intra-examiner agreement of 80 per cent was reached in the two components of the OHI-S index - scoring for supragingival calculus being higher than for debris or subgingival calculus. For a full description of indices used for the measurement of soft deposits, see Mandel (258) and for hard deposits see Volpe (430).

4. A further classification for the use of indices described by Gjermo (151) is that of long-term studies designed to evaluate the effect of prophylactic or therapeutic measures, or to study the development of gingivitis and subsequent periodontal destruction. This may be for the total mouth or it may be more confined to different areas of the mouth, or even different surfaces of teeth, separately. An index which has a severity scale is necessary. Gjermo (151) lists the Gingival Index of Loe (250b) plus measurements of loss of attachment (153), the SBI as described by Suomi (415) and the PI, PDI as suitable for this purpose. The PMS index is also mentioned, but calibration is a difficulty with this index. (6a, 151) The W.H.O. Guide to Oral Health describes the gingivitis and periodontitis site prevalence index. (458) This index is being tested.

Hazen (183) points out that marked differences exist in the description of the evaluation of gingival inflammation. Since gingival inflammation is one of the diagnostic indicators used to test for the presence of periodontal disease and is used in most indices, the standardization of its characteristics to allow reproducibility is important. (6a)

As plaque has been implicated as one of the major aetiological factors in periodontal disease ⁽²⁵⁰⁾ indices which measure presence or absence, thickness, area of attachment, pathogenic potential are important in studying both the disease process and also as indicators of groups within the community who have a predisposition to periodontal disease. As well, as removal of plaque has been established as a major factor in prevention and treatment of periodontal disease ⁽²⁵⁰⁾, indices which can measure the effectiveness of plaque removal are most useful. Measurement of plaque can involve numerical indices, e.g. PDI ⁽³²⁶⁾, PDI modified ⁽³⁸⁸⁾, total area measured, thickness ^(392, 393), plaque weight, laboratory measurements (turbidity, bacterial counts, chemistry), pathogenic potential ⁽²⁵⁸⁾. The problem confronting the examiner is the selection of the particular index. This will depend on the nature of the agent or procedure to be tested and is a mechanism of action. ⁽²⁵⁸⁾ Also essentially all indices are ordinal scales. Therefore a higher score implies a greater severity although there is no implication that a unit difference in the index implies a unit increase in severity. ⁽⁴⁷¹⁾ It is apparent that for successful use of indices with minimum intra- and inter-examiner variation clearly defined descriptions of the criteria must be available and the examiners must be adequately trained. ⁽²⁵⁸⁾ Since removal of plaque is still one of the best means of controlling periodontal disease, evaluating procedures must be directed to measuring this endeavour.

A measurement used by investigators to describe periodontal disease is pocket formation. It is not observable by surface scanning but can be assessed by probing. ⁽⁸⁴⁾ It is less subjective than the recognition of gingival inflammation ^(6a) since the depth of the pocket can be measured. The presence of pockets (4mm or more) have been regarded as being in need of treatment ⁽⁴⁵⁷⁾ and any index making use of measurements of this phenomena is assessing past periodontal disease experience. The PI ⁽³⁵⁶⁾ uses the presence of pocket formation as part of its measurement. Waerhaug ⁽⁴³⁶⁾ states that the main shortcoming of the index is that there is no provision for differentiation between a slight pocket deepening and one to the apex. The PDI ⁽³²⁶⁾ measures pocket depth from the cemento-enamel junction to the gingival margin and from gingival margin to the base of the pocket. Calculus often has to be removed to determine the cemento-enamel junction. There are numerous technical problems involved in obtaining accurate and

reproducible measurements of these distances. (328) To restrict probing and make for a more simple, faster assessment for periodontal pockets, the PDI, PI and Gingivitis and Periodontitis Prevalence Index, CPTNI use representative sites and teeth to form the index. (457) However whole mouth pocket distribution can be assessed. If that is the criteria needed for measurement there is a difference between the purposes of an epidemiological survey and a clinical study or trial. In the epidemiological survey one is concerned with the behaviour of the disease in a population group while in the clinical trial one is concerned with the nature of the disease, its behaviour in individuals with or without treatment. (328)

Epidemiological surveys use relatively large samples representative of populations which places limitations of time and environmental facilities on the examination. In the clinical study or trial "one is concerned with the behaviour of the disease for individual teeth, with individual anatomical and functional characteristics which may influence the progress of the disease and the results of treatment." (328) Teeth in different parts of the mouth may have varying degrees of pocketing.

Bone loss may be an indicator of past disease activity, but not always of present disease activity. (84) The greatest incidence of bone loss usually occurs in later life and it is not possible to measure past periodontal treatment accurately as it is with caries. (84) Radiographic techniques have been used to detect and assess periodontal disease. (57, 58, 59, 261, 368) "With roentgenographic techniques it is only possible to obtain interproximal measurements of the relationship between alveolar crest and reference landmarks on the teeth." (328) Radiographic examination determined alveolar crest height fairly accurately and distance from pocket base to bone is fairly constant. (415) However, radiographic bone and clinical pocket measurement have a large variability for individual pairs of measurement of pockets and bone levels. (415) It seems that radiographs do not add essential information regarding attachment levels of the periodontium to accurate clinical measurements with suitable probes (126) and therefore indexes using clinical probing appear to be the method of choice. (167, 382, 457, 458)

In many indices used in the evaluation of periodontal disease there is amalgamation of different measurements with essentially different units in a way that is not always comparable. (5a, 42, 471) The variables are, however, only poorly correlated. (152) Also, by combining different anatomical sites, sensitivity is lost. (471) Development of techniques such as multivariate analysis will help to overcome these problems as data from measurements of specific areas and for specific clinical conditions will not have to be recorded only in the form of a composite index (471) but can be kept as raw data and used to calculate differences between comparable studies. Lu (250g) lists the benefits of multivariate analysis as:

1. being able to combine a large number of clinical variables into principal components (factor analysis);
2. capable of computing correlations between sets of variables (canonical analysis);
3. capable of performing prognostic predictions based on clinical observations (discriminant analysis).

However, Lu (250g) states that the concept of unit measurement taken for unit involvement presents difficulties. Statistical techniques however can be used to rate persons according to delineated criteria and index weighting can be used.

As can be seen by the above discussion, assessment of periodontal disease by the indexes outlined does not necessarily show definitively the need for treatment. In fact, most of the existing index systems have been shown to be of limited value in this respect. (151) The indexes only tell whether the periodontal conditions in one group are better or worse than in another group or population. They can perhaps allow streaming of population groups and determine whether and how much further diagnostic tests are advisable in order to determine intervention type and resources required.

Information on the type of treatment needed, time, money and workforce requirements for treatment delivery would depend on treatment philosophy. Also, the index would need to be flexible to meet future therapeutic advances and should also deal with preventive measures. The periodontal treatment need system (PTNS) (48) attempts to form such an

index, not on a numerical scale, but on an ordinal scale. A high correlation was found between age and PTNS and that both these factors may be used to assess the need for treatment in differing populations. This index was modified ⁽²²⁰⁾ and has been further developed. ^(5a)

A periodontal needs assessment was also included in the International Collaborative Study of Dental Manpower Systems in Relation to Oral Health Status. ⁽⁴⁵⁰⁾ All these methods assess periodontal treatment needs at the time of survey and it is very difficult to assess previous treatment experience. ⁽⁹⁴⁾

General dental treatment records are usually very limited in information concerning periodontal disease and so provide little data source. Specialist treatment records however are quite specific and have been used. Third party records would be usable, e.g. treatment would be recorded over a period of time by the individual patient. However, this data may be difficult to extract, depending on how the records are compiled. Research into correlation of periodontal status indices - type of intervention - treatment resources indices - is currently being undertaken. ^(5a)

5.2.2 Dental Caries Indices

Indices of dental caries have been discussed by many investigators. ^(84, 101, 104, 358)

Russell ⁽³⁵⁸⁾ suggests that there are usually four signs of the activity of dental caries which may be observed and counted in a population.

1. The number of persons with evidence of the disease,
2. the number of teeth with evidence of the disease,
3. the number of surfaces of teeth with evidence of the disease,
4. the number or size of lesions of the disease.

The number of persons with evidence of the disease is rarely used as an index of a population except in groups where prevalence is extremely low. ^(124, 358) This may be a more valid index of a lifetime of susceptibility to caries than one which is influenced by factors of treatment as only initial attack is counted. ⁽³⁵⁸⁾

The number of teeth with evidence of the disease: the most widely applied dental caries index used today is the DMF (Decayed = D, Missing = M, Filled = F) introduced by Knutson in 1938⁽²³¹⁾ for permanent teeth and adapted for primary teeth (def) by Gruebbel in 1944.⁽¹⁶⁹⁾

This index describes diseased teeth or tooth surfaces (D) plus those treated (either missing [M] or filled [F]). The individual frequencies are added together; however it is an additive operation that does not imply equivalence. It measures two processes instead of the usual one: disease and treatment.⁽⁸⁴⁾ Dental caries is a process which occurs over a period of time and the resultant destruction of tooth structure is recorded according to certain clinical signs. For a tooth surface to be recorded as decayed, certain conditions must be present. These have been defined by investigators and are now standardized.⁽⁴⁵⁸⁾ The definition of decayed (D) used, describes need for treatment as defined by the profession.⁽⁸⁴⁾ This index for decay (D) can be used as an index of prevalence of dental caries. Modifications of the decayed (D) index have been suggested in order to study the rate of progression of the decay process and also try to quantify the severity of the lesion resulting from the decay process.^(433, 460)

Radiographs have been used as an aid in diagnosis of carious teeth or tooth surfaces,⁽³²⁾ and also to determine the rate of progression of the lesion.⁽³²¹⁾ The use of radiographs and reliability have been evaluated.⁽²⁰⁶⁾ Conclusions have been made that there is a correlation between clinical diagnosis and diagnosis of decay using radiographs as an adjunct.^(32, 124a) Comparisons between different examinations using clinical, radiographic and fibre optic examination⁽²⁹⁸⁾ point to correlations between all techniques. However, as Howat⁽²⁰⁶⁾ suggests, the criteria established for the studies being undertaken may not be suited to all trials - measurement is only of objective validity. At what stage should a carious lesion be recorded has been discussed.⁽¹⁰⁹⁾ Studies which describe the number or extent of individual lesions or place of lesion help to describe the pattern of dental caries attack^(246, 358) and can also be used to evaluate effectiveness of preventive agents.⁽⁴⁵⁸⁾ One of these methods, the hierarchical method, has been evaluated by Poulsen.⁽³¹⁹⁾ A modification of this system has been used by the Danish Child Dental Health Service.⁽³⁷¹⁾

Various ratios are used to provide meaningful data to investigators concerning dental caries status with respect to treated status and comparisons have been made between different groups. ⁽³⁵⁸⁾ For example, for prevalence studies groups of similar ages who are expected to have similar numbers of teeth or tooth surfaces at risk according to the number of teeth erupted are compared for the number of decayed teeth or surfaces or surface sites. ⁽³⁵⁸⁾ Status of eruption can vary and statistical methods are used to make corrections for this. ⁽³⁵⁸⁾ For rates of progression, surfaces and depths of surfaces affected are counted. ^(321, 461, 470)

As dental caries is a chronic disease, i.e. it progresses over time, indices have used other components in addition to the decayed tooth or surface. These are indexes of the treated tooth as prior evidence of the disease. This has been measured by filled (F) tooth or tooth surfaces and missing (M) tooth. The question always arises as to the reliability of using these indexes and how they equate numerically to the concept of evidence of decay, e.g. how many decayed surfaces were present and how this relates to filled surfaces. Debate has ensued as to how many surfaces should be counted for a missing tooth. ⁽³⁹⁴⁾ Also in studies of teeth of the primary dentition, teeth can be missing, having been exfoliated or from trauma. ⁽³⁹⁴⁾ In teeth of the permanent dentition, the tooth may be missing from trauma, periodontal disease, or extracted for orthodontic or prosthetic reasons. The number of surfaces counted for caries may have only been one and the tooth has been extracted. Hence the M index has no measure of severity and also may be missing for reasons other than decay which the person may not remember or know about. ⁽⁸⁴⁾ The filled (F) component is a measure of the treatment decision by the person providing the treatment and is evidence only that the operator felt that the tooth required a restoration. The number of surfaces filled is also only a measure of the restoration designed by the provider of treatment. ⁽³⁹⁴⁾ Both of these components (M and F) are only evidence of dental caries in the light of the prevailing standards or norms of treatment decisions. Comparisons can only be made with the knowledge of this constraint.

Characteristics and interrelationships of the various indices between individuals and groups are estimates of caries experience made by people interested in the presence or absence of dental decay and its severity of destruction of dental tissue in individuals or groups of

people at a point in time or over a period of time. The most important aspect in the index used is the reason for its use and this will determine the criteria used in the description and how it will be statistically used. (31, 159, 361)

Conversion of this data into treatment needs is important for health planning, either for the individual as their treatment plan or for a group or community. Converting dental findings into need for treatment must take into account the condition of the individual tooth, number and condition of teeth in the mouth, their relationship to each other. Also another difficulty in converting dental findings into needs is the wide variation in the methods and types of treatment for a given dental condition. Two methods of conversion of dental caries prevalence and severity findings into treatment needs have been commonly used. The first is based on the assumption that carious teeth should be filled and the second involves conversions of findings into either time taken to carry out procedures or into units based on fees for different items. (394)

As outlined in W.H.O. Basic Methods ⁽⁴⁵¹⁾ treatment requirements of teeth are coded according to normative standards of professional treatment. As described by Fanning ⁽¹³⁷⁾ annual caries increments can be used to estimate projected needs for treatment. The procedure for quantifying treatment needs using indexes such as the Dental Services Index ^(47a) basically converts treatment including restorations or extractions into relative value units which are weighted according to well-defined criteria.

For an assessment of the indexes for dental caries it is important to consider the use of the index, the criteria used to describe its validity and its reliability and reproducibility. (354, 355)

When drawing conclusions about basic susceptibility and patterns of dental caries it is important to have a thorough knowledge of the limitations of the index and the validity and reproducibility of the criteria that are involved in the summarization of the diverse elements expressing as a number, a concept which has meaning to a specific group of people and a body of scientific knowledge. (111)

5.2.3 Malocclusion Indices

Moyers ⁽²⁸³⁾ suggests one should ask three questions concerning indexes: "What are we indexing, why are we indexing, and how can we index?". He answers these by stating that one is attempting to express in simple mathematical terms for statistical uses, one of the most complicated of bodily functions - not a simple disease, but the summation of growth, genetics and environment, complicated by sexual and racial variation. One needs to make an inventory of the occlusal needs of communities in order to ascertain the efficiency of various methods of treatment, and to assess why patients seek occlusal corrections and to evaluate health personnel's abilities to distribute services to the community. One must express reliability, osseous disharmonies and any dental deviations which contribute to dental disorder and any neuromuscular variations affecting the malocclusion."

Difficulty has also arisen in defining what conditions constitute a normal occlusion. As Graber ⁽¹⁶⁰⁾ states, "normal in physiology is always a range, never a point". This concept of range of normality of an intact dentition in proper arrangement and balanced with functional and environmental forces ⁽³¹⁰⁾ has led to a multitude of methods of assessment. These fall into two broad categories: ^(138a)

- a) measuring occlusal features, and
- b) defining 'handicapping' occlusal conditions.

Measuring occlusal features has been used most frequently. It consists of "defining the occlusal features to be measured, allocating a score or grade for each degree of discrepancy and adding together all the scores to give a final total score of malocclusion for the individual." ^(138a)

Systems using this method include: Treatment Priority Index ⁽¹⁶²⁾, Occlusal Index ^(411a), the Handicapping Malocclusion Assessment Index (adopted as the American Association of Orthodontists' Index) ⁽³⁶⁰⁾, Handicapping Labiolingual Deviations Index ⁽¹¹⁹⁾. In all these indices the final score is taken to be an indication of degree of need for treatment and various weightings are used. Other indices used without weightings are: Bjork, Krebs and Solow ⁽⁵⁶⁾ and the F.D.I. Index ⁽⁴³⁾, both measure and score occlusal features but do not assess treatment. The Eastman Aesthetic Index ^(206a) also measures occlusal features in scoring aesthetic values of occlusion.

The subjective nature of transfer of a measure of the occlusion to a measure of need for treatment is obvious. However the use of such an index brings some degree of objectivity to this assessment.

The nearly universal use of Angle's Classification in the past has made it virtually the only indicator of the prevalence of different types of malocclusion in different populations.^(213, 310) Jago⁽²¹³⁾ emphasises that "Angle devised his classification as a prescription for treatment and not an epidemiological tool. His system hence does not quantify the elements of occlusal disharmony and cannot be used to measure the severity of such disharmony". Angle's classification is thus an indicator of malocclusion. Helm⁽¹⁸⁷⁾ also pointed out that Angle's classification has the following basic shortcomings:

- ".. 1. Not sufficiently differentiated;
2. Individual morphological traits not adequately defined;
3. The number of combinations of single traits of malocclusion is infinite;
4. An exhaustive classification cannot be made into a limited number of types;
5. There is no severity classification.
6. It cannot be used to express a large number of dentofacial anomalies, e.g. the relationship of teeth to the face;
7. Different concepts are used by different operators for positioning of anterior-posterior relationships..."

The second method put forward for allocating individuals for treatment is to make a definition of a handicapping condition and to then allocate individuals falling within that definition. This system was proposed by the World Health Organization⁽⁴⁴⁹⁾ and by the National Research Council Assembly of Life Sciences^(138a). The methods of assessment do not lend themselves to measurement techniques and include a large subjective element. Various definitions have been used to determine what is a handicapping condition. Helm⁽¹⁸⁸⁾ suggests that treatment is needed if traits present, imply or expect to imply a threat to well-being, i.e., an increased risk of (a) tissue destruction [caries, periodontal disease, trauma, root resorption], (b) disturbances of physiological function [temporomandibular joint disorder, muscular dysfunction, speech defects, masticatory disturbances], and (c) socio-psychological disturbances.

However there is little evidence available on socio-psychological or physiological effects of malocclusion on any population. The clinical estimates are subjective and therefore the indices can be no more objective than the clinical measurement on which the index is based.

Nevertheless, once an issue has been defined as a problem for society, an effort must be made to measure that problem, especially in the social or behavioural dimension now appropriate to it, ⁽⁸⁴⁾ and various groups are working to develop such an index. ⁽⁴⁶⁰⁾

In the past, the World Health Organization ⁽⁴⁵¹⁾ had recommended for a basic survey that a dentofacial anomaly be recorded as present if one or more of the following criteria were met:

- ".. 1. It has a significant and unacceptable affect on facial appearance;
2. It causes a significant reduction in masticatory function or results in a significant impairment of speech;
3. There is a gross defect such as cleft lip, palate, or pathological or surgical injury that unquestionably has high priority for treatment;
4. It constitutes an occlusion predisposing to tissue destruction in the form of periodontal disease or caries."

Meaningful cut-off points have yet to be established for combinations of traits and individual traits which identify individuals who require treatment in public programmes. ⁽⁴³⁾ Helm ⁽¹⁸⁸⁾ sees the current public health problem as bridging the gap between recognition of the occurrence of defined single traits and determination of the need for treatment of these conditions.

Most indexes are measurements only of the teeth. There is little information on the combination of traits which are responsible for the facial morphology. ⁽¹⁸⁸⁾

No objective method exists to date of measuring the relationships between occlusal factors and social functioning. At the moment all indexes are based on the clinician's concepts of the effects of malocclusion on oral health and facial appearance. ⁽³²³⁾ Whether anatomical deviations interfere with function may depend on individual adaptability. ⁽²¹³⁾ The condition which becomes dysfunctional for the

individual becomes a subjective decision on the part of the person, their parents or peer groups and the health personnel.

Barmes (28) states "that as a standardized measurement of dento-facial anomalies is still elusive and the actual diagnoses of an anomaly is probably of less importance than the demand for an acceptance of care, any data compiled on measurement of actual anomalies present should be viewed with scepticism." However, for purely academic purposes it is relatively easy to make objective measurement of an occlusal factor but to transfer these measurements to a resource planning or screening purpose involves a value judgement, which will differ between cultures, races, amongst socio-economic and educational groups, health personnel groups and over time periods.

Traditionally the demand for initiating orthodontic measures and the economic burden of treatment has rested mainly with the patients, or with their parents. However dentists have played a large part in stimulating demand. In the case of the dentofacial anomalies such as cleft lip and cleft palate, Pierre Robin Syndrome and others, both the medical and the dental practitioner have referred patients for treatment in this area to health care services.

The provision of treatment has often been determined by the educational and socio-economic level of the family rather than the severity of the malocclusion. Helm (189) points out the benefits in Scandinavian countries of the systematic orthodontic examination of the children based on defined criteria. The profession regards this as a decisive advance towards a just selection of patients. Furthermore the benefit of this organisation and knowledge of the population permits optimum planning and timing of treatment in relation to the development of the individual child. With the introduction of the Australian School Dental Service, the opportunity is present to obtain basic figures on the prevalence and incidence of dentofacial anomalies granting the problems already discussed of a reliable index. Personnel working in the field have reported that there is a need and demand present in the community with respect to dentofacial anomalies and their treatment. (438) As a community, orthodontic services are financed either publicly through the School Dental Service, or through private practice as well as through general taxation (where the training

programmes for specialist orthodontic personnel are funded in part). Resources should not be allocated on an ad hoc basis. Children should not receive treatment for insignificant malocclusions at the expense of children with severely handicapping malocclusion. As Helm⁽¹⁸⁸⁾ suggests, treatment of obviously harmful malocclusions should be available to all. Jago⁽²⁷³⁾ quotes Garn⁽¹⁴⁸⁾, who pointed out that malocclusion is a health problem of major magnitude which is under-emphasised and under-investigated, but suggests that some progress has been achieved. Research involving large scale surveys on different ethnic and geographical and social populations will need to be carried out with the view of establishing rates for prevalence, dental age-specific rates, and rates for incidence, as well as the relationship with other oral conditions. The criteria for defining malocclusion should continue to incorporate subjective elements into the index, but these must be standardized.

5.2.4 Malocclusion and Dento-facial Anomalies

Estimation of need for care is not an absolute concept in the area of dento-facial anomalies including occlusal relations. There have been no definitive indexes developed in this area. However in the area of occlusal relations, different methods have been used to assess community orthodontic needs. For example, Suckling⁽⁴¹¹⁾ investigated a system which uses occlusal traits by surveying the need for care. Freer⁽¹⁴⁴⁾ used Angle's Classification with Grainger's⁽¹⁶²⁾ treatment priority index to try to place an estimate of need, e.g. for care on a surveyed group. For gross cases of dento-facial anomalies, diagnosis of the condition means a diagnosis for treatment. As discussed previously (see Section 4.3), until central registers are formed, it is difficult to assess the amount of treatment needed for these conditions. In the case of orthodontic services and need for treatment, the conditions which are dysfunctional for the individual to operate in their environment becomes a subjective decision. A study by Horowitz⁽²⁰²⁾ reported an examination of perceptions of children with respect to their occlusal appearance and actual clinical measurements of malocclusion. The results suggested that preference patterns of children differ from the classification of severity formed by dental professionals. As index of need for care is a professional determined index, efforts have been made to define the problem social and behavioural dimensions⁽⁸⁴⁾. For example, Draker's⁽¹¹⁹⁾ work on the Handicapping

Labio-Lingual Deviation Index (HLD) begins to define what is handicapping to the individual and helps in estimations of priorities for treatment needs. Until clear guidelines have been formulated by the scientists and communities as to appropriate indices for malocclusion, their use is limited.

5.2.5 Combined Indexes of Need for Treatment

Lambert's Index of Need for Treatment ^(240a) is a comprehensive multi-dimensional index comprising a number of carious tooth surfaces, periodontal condition (by gingival bone count) and orthodontic conditions. It is not a numerical value, but a nominal scale. It however does not take into account traumatized teeth or the need for prostheses, nor other oral diseases and conditions. For an index to be applicable for adults, it would need to provide for the full range of oral diseases and conditions, and also classified social and behavioural patterns to determine treatment behaviour. Lambert and Freeman ^(240a) in their study developed an Index of Dental Behaviour (IDB). This includes preventive treatment and neglect behaviour. Due to the lack of uniformity in the record system and comparability between examiners in this study, there are barriers for using this system to estimate different population groups by other examiners. ⁽⁸⁴⁾ The Oral Health Grading (OHG) Index used by Bulman et al ⁽⁷¹⁾ divided oral status into three areas: dental, periodontal and prosthetic, and graded them as good, fair or poor. This in fact was a measure of oral neglect, rather than oral needs, and gave little indication of treatment needs.

5.3 Use of Estimates of Need for Oral Care

The need for oral health care may be subdivided in terms of

1. Diagnostic needs
2. Preventive needs
3. Disease, disability or dysfunction-oriented needs. ⁽⁴⁰²⁾

This division is somewhat arbitrary, but it reflects the orientation towards types of treatment levels that the provider of oral care utilizes and the philosophies of the health care system as a whole.

The need for care may be estimated by different approaches, as described previously. ⁽⁶⁴⁾ (see also Section 5.1)

1. The normative need is that need which the expert opinion determines.

The sources of data are:

- i. surveys of oral health status
- ii. surveys of need for care
- iii. analysis of service or treatment records
- iv. the best judgement of dental practitioners.

2. Perceived need is that need which the person feels is present.

Data sources for this area are:

- i. surveys of populations asking questions which indicate perception of a health problem
- ii. analysis of service records
- iii. data from community groups concerning need for care, e.g. media reports.

3. Expressed Need-Demand

Data sources for this include:

- i. records of utilization of service (effective demand)
- ii. normative needs as determined from sources described above, plus analysis of demographic characteristics, e.g. age ratios of population, expected population changes, plus utilization of services data from service records, plus analysis of social, political, economic and cultural barriers to utilization of health care services.

4. Comparative Need.

Data sources are from:

- i. survey of oral health status
- ii. surveys of need for care
- iii. analysis of service records
- iv. judgement of dental practitioners.

Diagnostic needs are determined to be present in population groups that epidemiological surveys have shown to be high risk groups. As critical approaches to these estimations are presently lacking, estimation of needs in this area will not be discussed. However, current research in this area has been suggested as desirable by international health organizations. (449, 462)

Preventive needs are determined to be present if epidemiological surveys of oral health status have shown a high prevalence of an oral disease or condition and also a high incidence within special groups. This emphasizes a need for preventive measures to reduce further prevalence.

The World Health Organization Oral Epidemiology Programme (27, 31, 36d) is attempting to collect data on oral diseases and conditions and therefore facilitate comparisons. These can then be used to determine the need for preventive services as trends can be forecast more accurately. (29) To facilitate comparisons, standardized methods for data collection have been developed and promoted. (458, 460) Also, reports have been prepared on technical aspects of normative treatment programmes which are known to be effective in preventing oral diseases and conditions. (446, 453, 457, 462) These reports are the result of workshops held, research programmes sponsored or promoted by the World Health Organization and other health care organization, e.g. the Federation Dentaire Internationale, the United States Public Health Service, the United Nations Educational, Scientific and Cultural Organization, the Pan American Health Organization, and the health departments of nation states.

The estimation of these needs has been by professionals analysing survey research, (427, 428, 459) treatment service data (242, 459) and by discussion amongst their colleagues. This is largely dependent upon value judgements of appropriateness of procedures in the presence of tangible signs of present need. (402) The concept of comparative need is central to this estimation. On the map (189) (see Figure 14) showing data for dental caries (27, 189) Australia is shown as having a high prevalence using the DMF index for 12 year olds. The global map points out preventive needs for dental caries.

The estimation of need for care arising from diseases, disabilities or dysfunction relies on the concept of normative need. However it is still subject to individual clinical variation in interpretation.

As previously stated, information sources are basically surveys of oral health status, surveys of need for oral health care, analysis of service or treatment records, the best judgement of dental practitioners.

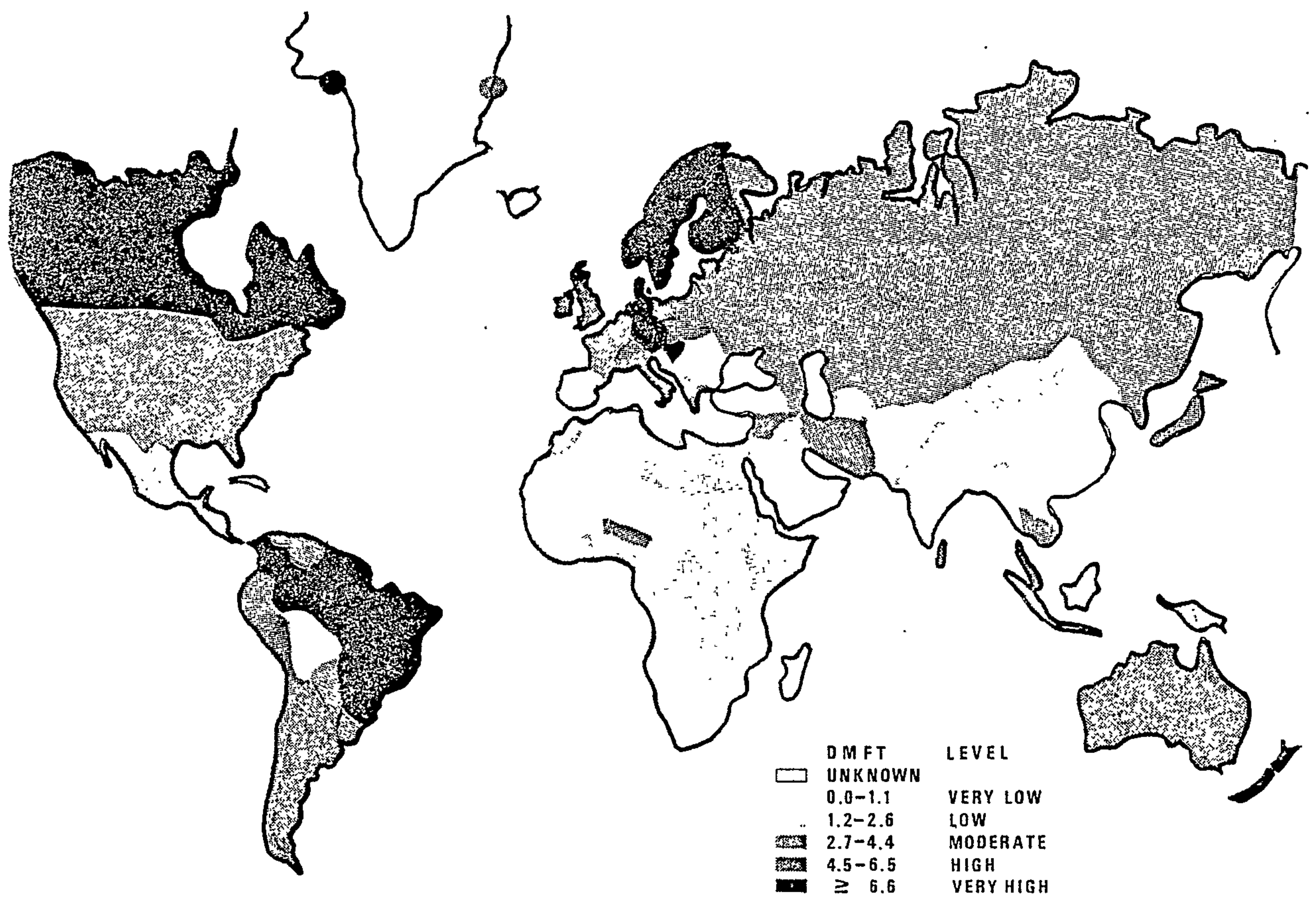


Figure 14. Caries prevalence at 12 years. W.H.O.Global Bank 1970's

From: Hebe, L. A. and Hauge Jorden, O. "The rise and fall" of dental caries : some global aspects of caries epidemiology. Community Dent. Oral Epidemiol, 9:295, 1981.

These surveys actually assess oral diseases and conditions in terms of prevalence and severity. The estimation of need for care has then been taken from indexes expressing this. This has received the most emphasis from the experts and a considerable body of literature can be identified in relation to these areas. (see previous chapters)

Dental caries has been traditionally assessed through the use of the DMF index ⁽²³¹⁾ and the def ⁽¹⁶⁹⁾ index. These indexes apply to either tooth (T) or tooth surfaces (S) and are irreversible indices measuring the relevant destruction by accumulated treatment for past and present dental caries. The total index score is of little value in the estimation of need for dental care, ⁽⁴⁰²⁾ as both tooth or surface may be filled and decayed. However this index has been used to generate estimates of restorative and exodontic needs. ^(71, 93, 32) Using the component scores of this indice, especially the decayed tooth component, estimates have been made on the initial needs ⁽⁷⁶⁾ the backlog ⁽²⁷⁴⁾ or incremental ⁽¹³⁷⁾ needs.

Initial needs - requirements for care to achieve oral health for the individual or group entering for the first time.

Backlog needs - requirements of entrants or re-entrants to a programme where there has been previous neglect of care.

Incremental needs - periodic provision of care of specified time intervals to a person or group who has previously received care to the stage of oral health. ⁽⁴⁰²⁾

Frequently the assumption has been made that all carious teeth should be filled. Occasionally the decayed tooth component is divided into teeth to be restored and teeth to be extracted. ^(38a) Lack of available information on the relationship of decayed teeth to restorative and exodontic needs because this is a health service resource problem concerning availability of specific oral health care, is perhaps one reason why there has not been clear estimates of need for specific care items from oral status data.

Indexes made from proportions of the components of the DMFT have been used to measure the extent to which dental caries is dealt with or not dealt with. ⁽⁸⁴⁾ These include Jackson's Treatment Index (TI) ⁽²⁰⁹⁾ Walsh's Care Index ⁽⁴³⁴⁾ which utilizes the complete DMF index. Jackson's Restorative Index (RI) ⁽²¹⁰⁾ and Gluck's Restorative Treatment Need (UTN) ⁽¹⁵⁵⁾ do not use the whole DMF, only the D and F components.

The latter indexes can be applied in communities of all age groups whereas the former are applied to relatively young populations. ⁽⁸⁴⁾ The indexes are descriptive but cannot be readily translated into quantities of care required. ⁽⁴⁰²⁾

The DMFT index is based on the dental epidemiological perspective of caries experience and the relation of caries experience to need for oral health care and may be at variance with actual clinical treatment subsequently provided. ⁽⁴⁰²⁾ The relation between a survey of decayed teeth and the restorative and exodontic care provided for decayed teeth in the clinical setting has been studied by Pickles. ⁽³¹³⁾ This study showed a considerably higher number of permanent teeth diagnosed for treatment in a clinical setting than at the time of treatment. A similar phenomena has been reported concerning deciduous teeth in New South Wales. ⁽⁹⁰⁾

Simplified methods of surveying dental caries have been developed by the World Health Organization ⁽⁴⁵⁸⁾ and have been adapted and validated ⁽⁸⁶⁾ and used to predict needs for treatment. ⁽³⁰⁾

Another approach to the translation of DMFT data for the estimation of oral health care needs is analysis of DMFS data. Changes in filled and unfilled surfaces in each tooth over time in longitudinal clinical trials can give estimates of restorative needs. ⁽¹⁹⁵⁾ DMFS data where rates of progression of the carious lesion are determined ⁽³²¹⁾ could be used to estimate need for care. However this data is frequently not available.

The distribution of missing teeth, both those missing due to dental caries and those missing for other reasons, may be used to estimate the need for replacement of missing teeth with either removable or fixed prostheses. However the estimate needs to take into account factors such as the relationship of adjacent or opposing teeth and therefore cannot be extrapolated from DMF data except in the case of edentulousness.

The relationship between long term restorative care and tooth mortality has been investigated, ⁽¹⁹⁵⁾ the conclusion being that regular attendance postponed the breakdown of the natural dentition by five years. Analysis of survey data on oral health status over time points to differing needs

for care in population groups. A high prevalence of edentulousness has shifted from a lower age cohort to a higher age cohort over time (35b) and can be used to show a need for care.

Surveys of Need for Care

As an alternative to the translation of data on oral health status to estimates of need, methods are now established (458) to estimate need for oral health care at the time of the examination in the survey.

For dental caries, Beck (47) introduced the Dental Service Index, DSI, which varies directly with the annual caries increment of age specific populations and also indirectly with the amount of treatment received before the examination. It has well-defined criteria for the recording of restorative needs. A similar method was used by Davies. (104, 105) This has now been accepted by the World Health Organization (458) and has been used to determine need for care in the Australian population. (40, 422, 459)

Treatment Records

Analysis of service or treatment records can show data which may be used to generate estimates of need for care, e.g. the School Dental Service, dental hospital, community clinics, third party carriers or individual practitioners.

Access to such data can be difficult or costly. Other difficulties to be encountered are in collation of data, as frequently data is not available on the actual number of patients involved in attendance, treatment series or items of oral health care.

Treatment series of items of care, not patients, are often the key statistic in reports of dental services. Great Britain (163), the United Dental Hospital of Sydney (426), Wright (465). Other services do relate treatment to actual numbers of patients seen in any one year. (176, 301)

Third party carriers also have the potential to make available summaries of service records in the form of profiles of patient need for oral health care. (402) This would be especially useful in areas of non-routine care, as this differentiation is not well made in simpler indexes. (461)

Service data from individual practitioners is an untapped source: however the validity of these findings may well be in question because of samples of practitioners selected. Any estimation of need for care on records is biased away from those people who do not utilise services regularly and hence the need for care in the total population will be weighted by this factor.

Judgement of the General Practitioner.

This is an intuitive guess made without any form of data collection and analysis present as in the previous approaches. It is a result of clinical impressions gained from clinical experience. It is heavily dependent on recall of impression, type of person attending and other biases. These estimates may be the work of one individual or the consensus of a group. ⁽⁴⁰²⁾ Clinical audit using, for example, radiographs, and peer review committees are methods currently used to try to standardise assessment. ^(128, 189, 301)

Survey of Oral Health Status - Periodontal Disease

The epidemiology of periodontal diseases concomitants has been studied using a multitude of indices. (See Section 5.2.1)

Two pathways are apparent. That concerned with measuring disease in the individual clinical situation and the other in populations. ⁽⁴⁰²⁾ As previously discussed, no one index has emerged as suitable for measurement of periodontal disease. "There is no precise definition of what constitutes periodontal disease and what specific preventive and curative measures are required for various disease states and levels." ⁽²⁶⁾

The need for periodontal care may be equated with various severities of periodontal disease and Russell's Periodontal Index has been used to estimate this need, ⁽³⁸³⁾ as has the WHO/FDI CPTN Index. ⁽⁹⁴⁾

Most indices used to describe periodontal disease do not have a scale reflecting severity and treatment needs.

As a method of estimating need, percentages of populations with a positive score for an index (i.e. presence or absence) ⁽⁴⁵⁷⁾ or with a maximum score of a particular index category can be used to indicate percentages of the populations that require some type of care. ⁽²⁶⁾ However these indexes provide only the "most peripheral information about treatment needs". ⁽²⁶⁾ The tendency for the vast majority of the population

to have a positive score, and the equivocal nature of the scores which combine different categories such as gingivitis and periodontitis, means that only inferences can be drawn about treatment needs.

Survey of Need for Oral Health Care - Periodontal Disease

A method of treatment planning in actual treatment programmes based on Russell's Periodontal Index was devised by MacPhee ⁽²⁵¹⁾ and subsequently modified by Newcomb. ⁽²⁹¹⁾

Another method was developed by Gjermo ⁽⁴⁵¹⁾, the PTNS. Davies ⁽⁹⁹⁾ also proposed a system to assess periodontal disease treatment need, but after testing, it was modified and is now included in the World Health Organization's Oral Health Survey Methods. ⁽⁴⁵¹⁾ A similar index, the Periodontal Treatment Requirement Index (PTR), assigned a severity score to six segments of the mouth. However no estimate of time required for treatment was given. Bellini's study ⁽⁴⁸⁾ and also one by Mann ⁽²⁶⁰⁾ found that the length of time of treatment required was found to be associated with sex, in that more treatment time was required for males. Markkanen ⁽²⁶²⁾ showed a high reproducibility rate in a study using many investigators, including the modified PTNS. Previously the World Health Organization ⁽⁴⁵⁷⁾ with its Periodontal Status Index (PSI) which correlated ⁽⁹⁴⁾ with Russell's PI and Green and Vermillion's OHI ⁽¹⁶⁷⁾ utilized these indexes to give periodontal treatment needs. However the PTNS is now recommended by the World Health Organization ⁽⁴⁵⁸⁾ as part of its guide to oral health epidemiological investigations, as it lends itself to workforce and cost calculations, both of which are necessary for planning. This index, now called CPTNI, is currently being refined by a WHO/FDI working group. ⁽⁵⁰⁾

Surveys of need for oral care have documented the extent of oral care that is needed by the community and have pointed out to policy makers that prevention programmes are necessary in the pursuit of oral care for the community. ⁽³⁶⁶⁾ Other studies have pointed out groups in the community who have a large amount of care required, e.g. the disadvantaged schoolchildren ⁽⁴⁰¹⁾, elderly ⁽³⁴⁸⁾ and handicapped ⁽¹⁷²⁾. These studies use the concept of comparative need ⁽⁶⁴⁾ to enumerate at what point they fit into the delivery system for oral care.

Oral health status and oral care as discussed in Chapter 3 are subjective values. In order to introduce an objectivity into these discussions, status and need for care forms of standardized measurement or classification using globally acceptable indices has been described. The uses for these indices differ and the oral diseases and conditions are varied. Some observations on the extent and depth of the problems encountered in this task have been noted. This has been included in order to highlight the problems encountered by society in efforts to achieve planning objectives. These are a prerequisite for working towards the preservation and maintenance of oral health in the context of a policy of social justice.

- 6 THE ORAL HEALTH CARE SYSTEM
 - 6.1 Status/Intervention Index
 - 6.2 Formal pattern system
 - 6.2.1 The purpose of the activity (F1)
 - 6.2.2 The performers of the activity (F2)
 - 6.2.3 The environmental form (F3)
 - 6.3 System description - intervention
 - 6.3.1 The purpose of the activity (F1)
 - 6.3.2 F1-F2 relationship
 - 6.3.2.1 Description of promotional and preventive practices
 - 6.3.2.2 Description of therapeutic practice
 - 6.3.3 Further description of performers (consumer/provider) (F2 I and II)
 - 6.3.3.1 Consumers of the activity
 - 6.3.3.2 Providers of the activity
 - 6.3.3.3 Environmental form
 - 6.4 Factors influencing the system
 - 6.5 Use of oral care services

This will be approached from the population based concept. That is, the population represents not only the political base of perceived need for care to which all politicians and all social services are sooner or later responsive and accountable to. It also represents the scientific base which is used to establish the normative need for care, i.e. the need determined by expert opinion. (440)

The aim of the oral care system is taken to be that of making a positive change in oral health of a person or community. The actual process which is enacted before a person or a community actually uses, or becomes part of the health care system, depends to a large extent on the population's need for care.

An individual's perception of internal or external disturbances gives rise to the distress and discomfort that provide the stimulus for intervention by society to correct dysfunction. The recognition of disorders constitutes perceived morbidity. This initiates internal tensions which in turn lead to behaviour aimed at diminishing the tension. The process involved in maintaining health, coping with disease, and seeking health care is seen as adaptive and regulatory. The corresponding behaviour is directed towards seeking treatment, or altering the system of compensatory change or a combination of both. (440)

As shown in Figure 6, (see p.53), people's psycho-biological system equips them to perceive and interpret information from internal and external sources and to employ this information in decision-making and in the regulation of behaviour. One receives and communicates information, e.g. symptoms, from one's psycho-biological system; compares this with information received from the exterior and with information stored in one's memory and hence detects imbalances. The model shows the individual's connections with family, neighbourhood and community in general and the social interactions that influence one's health and use of health services. (440)

The existence and organization of a health care system can influence both the individual's perception of need for care and the need to use the system. The perceived need is strongly influenced by what is available, and what is available may be influenced by the demand for

it. (440a)

Basically the health care system allocates resources to meeting those needs for which an efficacious form of intervention is possible. One that has been shown to be beneficial by scientific means and will, if applied, improve the health and wellbeing of the population. (440)

Oral care is carried out by a number of different agencies in a host of transactions with individual consumers and population groups. Out of the many different encounters between consumers and providers one can discern a relatively distinct and stable set of social relationships. The elements of the oral care system are so related that a change in the state of any element induces changes in the state of other elements. The system can be identified as a distinct functional area with its own occupational structure and a unique pattern of practice that sets it apart from other service sectors in society. (175f)

The oral care system model is a process as depicted in Figure 15.

The input components include - system consumers
- system providers
- system resources including facilities, information.

The process component is the actual intervention strategy. (See fig 16.)
The output components are in three levels: (365j)

1. The direct output components include goods and services that are produced by the system, irrespective of how they affect or are used by the target population, e.g. provision of preventive programmes for dental caries for school children.
2. Intermediate effects or impacts. These are the changes made in the problem being solved or in the persons served by the direct outputs, e.g. reduction of dental caries incidence and prevalence in school children.
3. Ultimate effects or benefits - personal or social advantages or disadvantages deriving from the system's impact. Avoidance of dental caries has the benefit of maintaining a person's oral health. Social benefits may be limited (e.g. reducing a person's time spent in the oral care system) or far reaching prevention

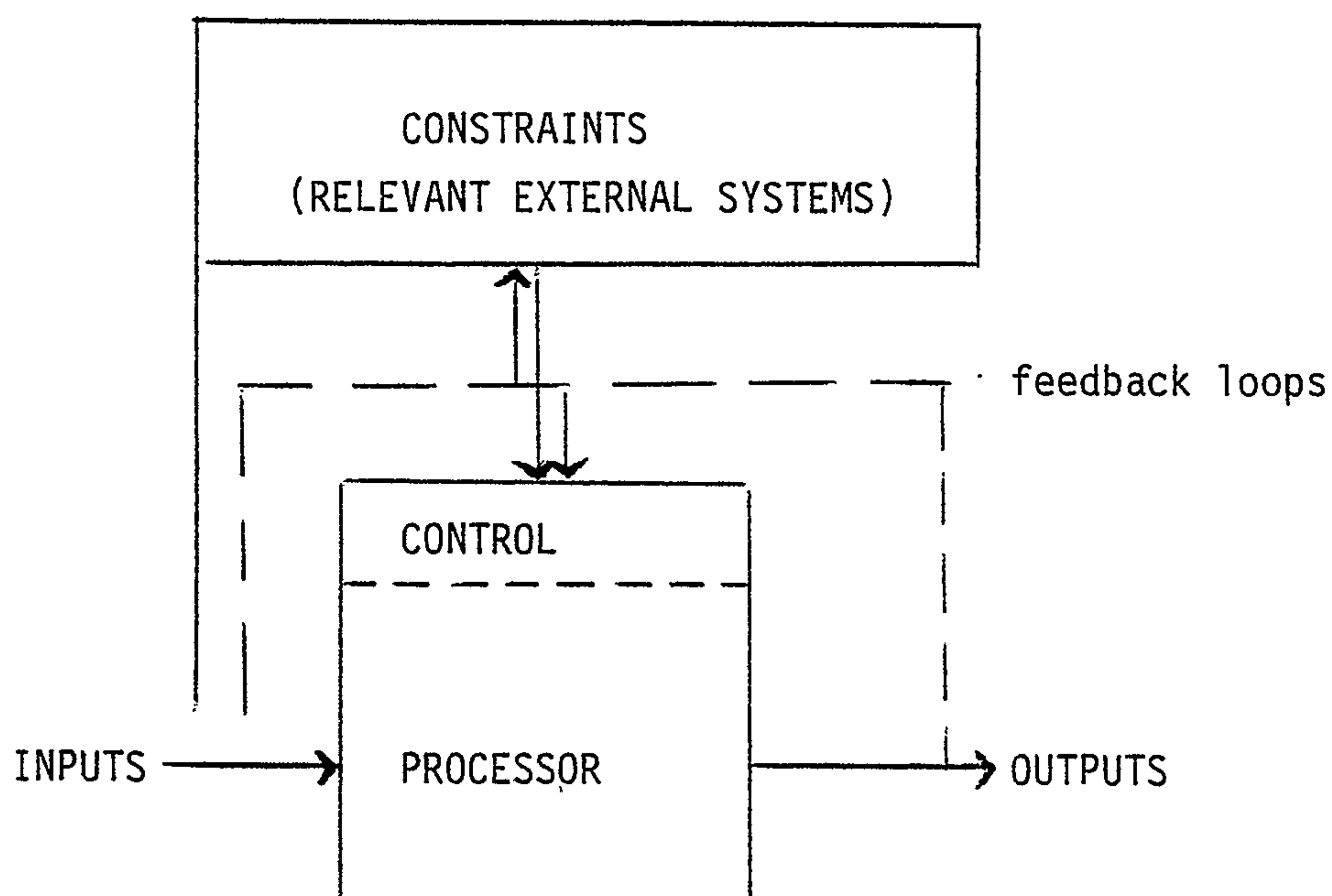


Figure 15. General components of oral care system.

Adapted from: Schaeffer, M. Administration of environmental health programmes; a systems view. Geneva, WHO Public Health pap No. 59, 1974. p.52.

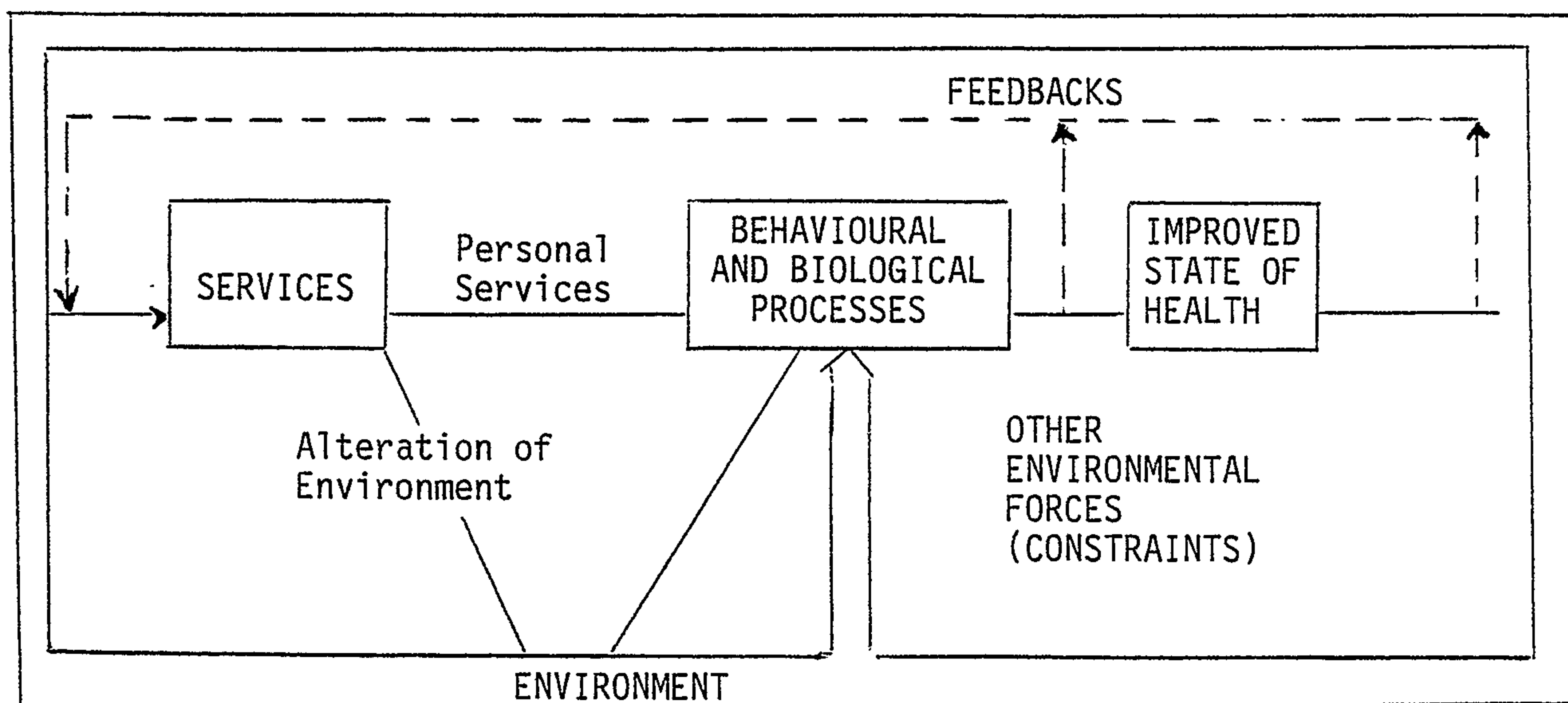


Figure 16. The process component as intervention strategy.

Adapted from: Schaeffer, M. Administration of environmental health programmes; a systems view. Geneva, WHO Public Health pap No. 59, 1974. p.95.

of dental caries completely. "Ultimate effects of disease reduction are felt at the demographic and economic levels and in the capacity of people to enjoy life." (365j)

Systems may generate unintended or side effects in the course of their operation also.

The system consumer can be defined as the population utilizing resources which the health care system has allocated which are effective in intervening to improve the oral health of the population.

The total population are consumers within the oral care system with the exception of very young children who may not have entered the system and a very small proportion (e.g. 2 per cent in Australia)^(13c) who have never visited a dentist at some stage in their life.

Description of the oral care consumer is usually quantified by parameters which describe location in oral care systems. The position in the system is crucial as, to a large extent, it determines the individual or group style or pattern of oral care use. A key determinant is the history of contact that the individual or group has had with the oral care services.

This can be determined by various indicators which are listed as follows: (234a)

- A. Location in the system:
 - 1. initial contact with the system
 - 2. current source of care
 - 3. perceived barriers to care, i.e. reasons for not using the system
 - 4. decision making on oral health matters
 - 5. influence of lay advisers.
- B. Use of the system:
 - 1. most recent visit
 - 2. circumstances of last visit, including reasons for visiting health personnel, period of time waited after onset of symptoms before actual contact with the system, provider type utilized, services received, cost of services (financial, time, social), geographic accessibility and acceptability of services.

Health Service System factors acting on the consumers as affecting use have been portrayed in Figure 17. (234a)

Predisposing factors are knowledge of and attitudes towards health, illness and health services. They are culture linked.

Enabling factors are:

1. availability of health services - possibility of purchasing them as they involve opportunity costs, e.g. time lost from other activities, travel time, opportunities foregone, financial costs.
2. accessibility of health services - socio-economic and geographic factors.
3. acceptability of health services - cultural attitudes and consumer/provider relationships.

The system provider can be defined as the person or group of people who provide oral health care, that is, they actively intervene to change the oral health of the community, the group, or the individual. The provider is usually classified as oral care personnel and others.

6.1 Status/Intervention Index

The oral health care system includes all those services available to a population, be they public or private, preventive or curative, emanating from health or other agencies, or even legal or illegal. (26a) The oral health care system can be described in terms of its organizational settings within which care is provided by specified personnel to the consumers of the care. Each organizational setting is governed by rules, both formal and informal. Task oriented procedures are provided by especially trained personnel who play a specified role within the organizational setting. Roles have parameters of action set by both the educational system, the health system and the general community and the government.

In order to provide an oral health care service, intervention is needed by the individuals themselves or organized intervention by other individuals or community groups. These interventions can either maintain or change the health status as well as prevent deterioration. The oral health care system intervention needs of the individual or the community has been described by Beach (45b) as a continuum from 0 to -1 where the scale represents need for intervention and the range describes the need for, and existence of, organization within settings

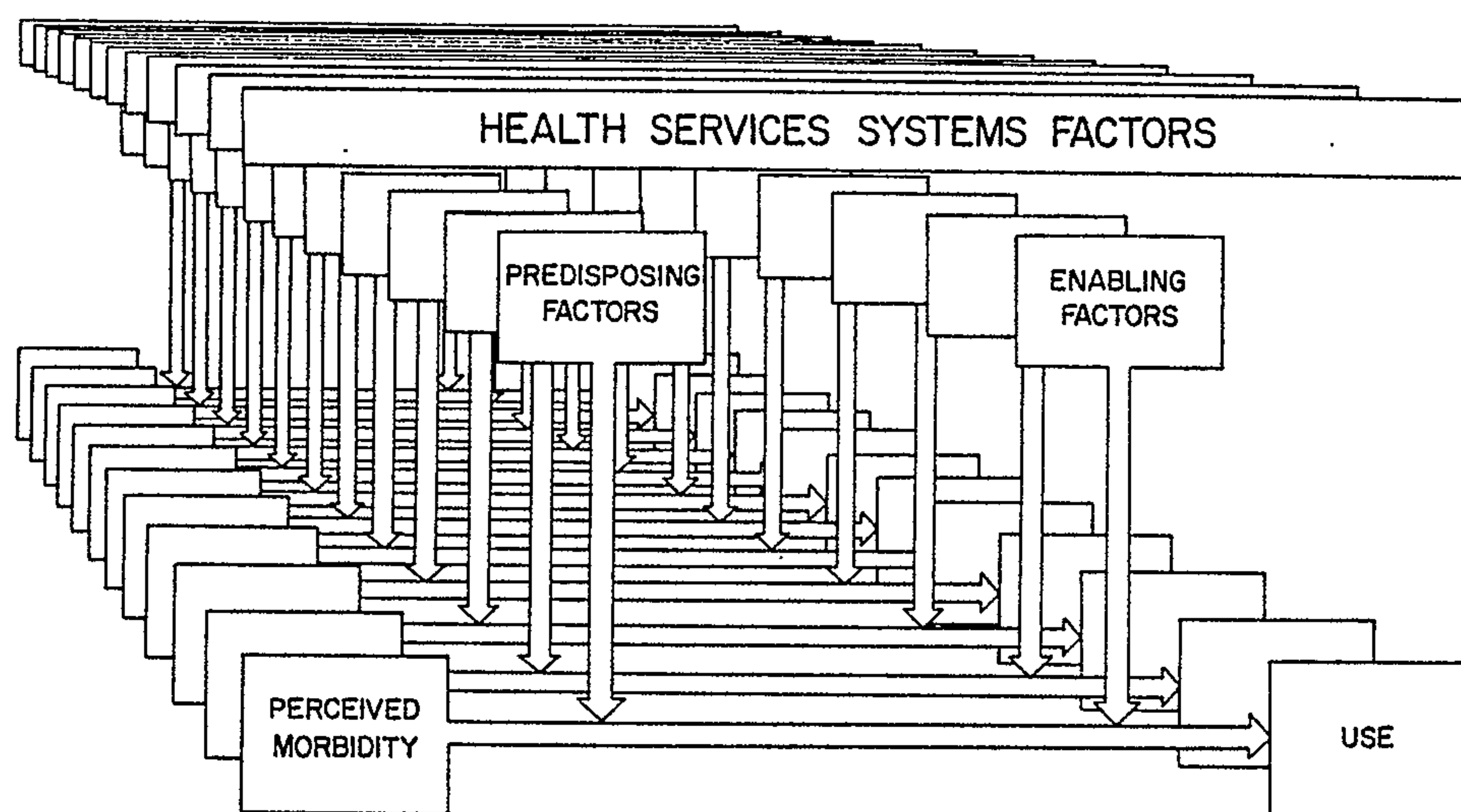


Figure 17. Health service system factors.

From: Kohn, R. and White, K. L., editors. Health Care: an international study. London, Oxford University Press 1976. p.13.

providing care, more organization being needed to provide intervention in the oral health status at the -1 end of the scale. Oral health status has also been described by Beach using a classification 0 to -1. (45b) (see Table 3). A person's oral health status can be defined by professional standards and then allocated to each individual in terms of intervention needs. 0 describes a person with an absence of need for care. This need for care is defined by the oral care workforce. However this does not mean that there is no need for prevention or health promotion. As the prevalence of dental caries and periodontal disease, especially within the community is almost universal (see Chapter 4), the oral care system has set up organizational structures to provide health promotion and disease prevention.

Currently there is a World Health Organization committee (30a) investigating the concept of an analysis of the oral health care delivery system in terms of status intervention as portrayed in Table 4 and using the philosophical concepts as described by Beach (45b), namely the concept of "zero" signifying the absence of stress because of the absence of need for decision making and reduction of uncertainty by specific measurement and classification of status and intervention systems.

6.2 Formal Pattern of System

The oral care delivery system has been described as a system of organized human activity which actively intervenes to affect oral health status. It has been described according to three formal functional patterns: (45b, 344a)

1. the purpose of the activity (F1)
2. the performers of the activity (F2)
3. the environmental form (F3)

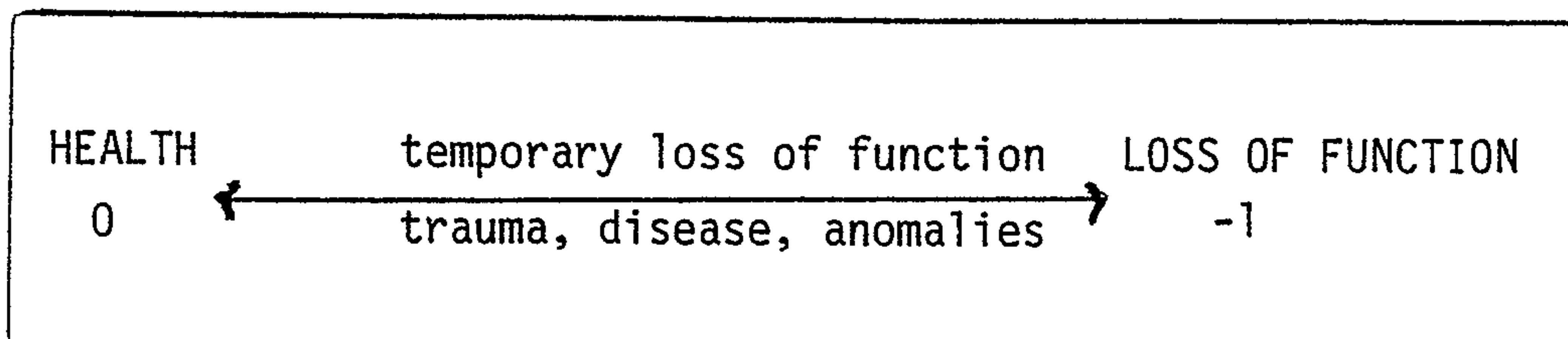
6.2.1 The purpose of the activity

This can be described as 'Dental Practice', i.e. oral health care and can be divided into three types of practice:

- a. promotional practice - development of health to its maximum potential;
- b. preventive practice - preservation of health, and
- c. therapeutic practice - repair of damage already done.

F1 relates to oral health education, oral care experience, oral health knowledge, biological suitability of intervention, availability

Table 3 MODEL FOR ORAL HEALTH STATUS ^a



^a

Adapted from: Beach,D. Status intervention index.
Mimeograph. Atami, Japan, Health Performance Institute.
Standards Division, 1981

Table 4. STATUS/INTERVENTION IN ORAL HEALTH.^a

0	<u>Health</u>	<u>Handicap/Dependence</u>				1

^aFrom: WHO. Performance simulation training and community care systems: report of the first meeting of a sub-group of the expert panel on oral health to review and evaluate performance simulation training for oral care. Ot Su, Japan 1982. P.7.

of resources.

Oral care, i.e. organized intervention, is either in terms of promotion of oral health, prevention of deterioration of oral health status, maintenance of existing status, restoration of status, or modification of an unsuitable form, the F1 being described by Beach in terms of practice in a continuum -.0 to -1. ^(45b) (See table 5.)

6.2.2 The performers of the activity (F2)

I. Consumers, and II. Providers of the activity.

I. The consumers in the system being defined in terms of whether the activity is directed for consumption by

- a. the general public
- b. specific groups
- c. individuals.

II. The providers of the activity, i.e. the organized intervention being categorized as

- a. self
- b. oral care personnel
- c. other health care personnel
- d. others

The oral care personnel can be defined as: (27a)

1. Professional - a university or dental college graduate who is registered to practise dentistry independently;
2. Operating auxiliary - a person who, not being a professional, is permitted to carry out certain treatment procedures in the mouth under the direction and supervision of a professional;
3. Non-operating auxiliary - (a) clinical: a person who assists the professional or operating auxiliary in their clinical work but does not carry out independent procedures in the oral cavity,
(b) laboratory: a person who assists the professional by carrying out certain technical laboratory procedures.

This classification is categorized according to combinations of functions ^(27a) and reflects the predominant usage but is by no means universal. Some overlapping occurs between operating and non-

Table 5. ORAL CARE IN TERMS OF STATUS INTERVENTION.^a

STATUS INTER- VENTION	Temporary Loss of Function					Oro-facial Tissue Removal Replacement
	Health Promotion	Health Maintenance	Restoration of Function	Trauma - Disease Anomalies	Rehabilitation of Function	
Need Need for Care	Prevention	Maintenance and Control	Dental Restoration	Surgery	Dento-alveolar Recontour Reposition Replacement	
	0 -.0, -.1	-.2, -.3	-.4, -.5	-.6, -.7	-.8, -.9	-1

^a Adapted from: BEACH, D. Status intervention index. Mimeograph.
Atami, Japan, Health Performance Institute,
Standards Division, 1981.

operating auxiliaries, with non-operating clinical auxiliaries occasionally entering the operating category when trained to perform such intraoral procedures as placing restorations, fitting matrix bands, taking radiographs. Also the laboratory auxiliary in some areas operates outside the legal registration system and makes prosthetic appliances and fits them in the mouth.

Other personnel who provide services are:

1. Secreterial and administrative personnel within the oral health care system. Both these can assume functions where they can directly provide services, e.g. the secretary can be trained as a non-operating auxiliary.
2. Other health personnel, e.g.
 - (a) professionals from other systems, e.g. medical
 - (b) auxiliaries from other systems, e.g. medical.
3. Technicians who manufacture and maintain the facilities used by dental personnel.

The providers of the oral health care system are also part of other systems, for example, the educational system.

The types and roles of providers of oral care will differ marginally according to the need and resources of specific nation states. (25)

- a. Oral Health Care Personnel in Australia include the following:
(25, 27a, 35a, 37, 184a)

Operating: dentist
 school dental therapist)
 dental hygienist) operating auxiliary*
 (dental prosthetist or denturist)

Non-operating: dental technician (laboratory)
 dental surgery assistant (clinical)
 oral health educator
 receptionist

* Operating auxiliary - A person who, not being a professional, is permitted to carry out certain treatment procedures in the mouth under the direction and supervision of a professional. (27a)

b. Health Care Personnel include:

Operating: medical practitioner
 nurses

Non-operating: nurses
 pharmacist
 health educator
 administrators

c. Others involved are

teachers
water fluoridation technicians
commercial company representatives
media personnel
politicians
religious personnel
community leaders
parents or guardians
friends and relatives
administrators

6.2.3 The environmental form (F3)

This is used to describe the organizational settings within which the activities can take place.

This organizational setting can be totally within the oral care system or can be part of another system, e.g. the educational system, the political system, the government system; no system being mutually exclusive of the oral care system but each system drawing its consumers, its providers and its organizational setting around a specific purpose of activity. Hence the description of the environmental form could proceed from the organizational setting providing intervention at the treatment end of the scale (the clinic, the hospital) to that used in providing promotional and preventive practices, i.e. self, the family, the school, the neighbourhood, the village, the town.

The range of environments are also being affected by part of other systems. These include the political system, governmental system, educational system, commercial system, economic system. The providers and consumers, also, all have their own effect on these systems, according to the strengths and weaknesses of the members, their political power, the resources available (e.g. finance, time), the attitudes to oral health status and the necessity for caring for oral health, competing with other situations and perceived problems.