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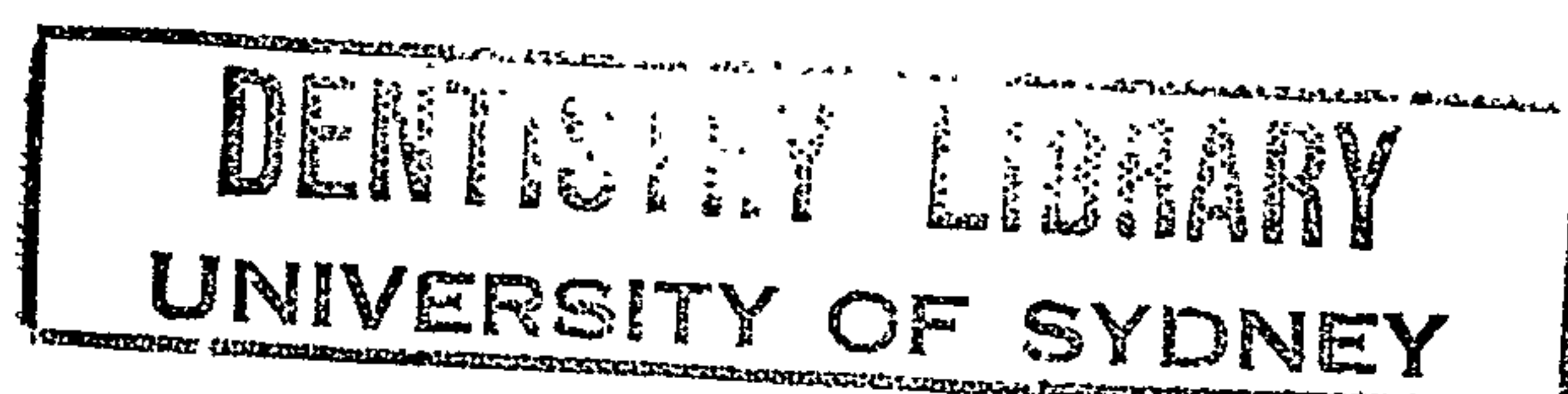
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COST-EFFECTIVENESS ANALYSIS OF THE
STATE ORTHODONTIC SERVICE
AT NEWCASTLE

PETER DAVID FROST
BDS (Hons)
Sydney

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Department of Preventive Dentistry
Faculty of Dentistry
University of Sydney
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A b s t r a c t

The State Orthodontic Service (S.O.S) was established to make orthodontic care more accessible for isolated people of New South Wales. A cost-effectiveness analysis was performed of the Service at Newcastle in its third year of operation. A cost-effectiveness study is an economic analysis, comparing alternative means of achieving a desired outcome. The analysis was conducted by estimating the cost per episode of treatment and defining effectiveness as it relates to the provision of orthodontic care. The episode of treatment considered was a four premolar extraction case, treated with full upper and lower Begg appliances. Fixed costs were not considered. In order to determine the elements of an effective orthodontic service, a user survey was conducted. 164 questionnaires were distributed and 27 people were interviewed over a three month period. The survey considered four groups associated with the Service. The groups comprised patients aged 17 years and less, parents/guardians of the patients aged 17 years and less, patients aged 18 years and over and the supervisors of the Service. The most cost-effective operator alternative were 1st year full time specialists at \$175. Specialists employed on a fee-for-service basis were the most costly alternative at \$649. An effective orthodontic service was considered to be one that delivers treatment of a high standard and ensures the same operator is seen for the entire treatment. Patients considered the major benefits of orthodontic treatment to be improved appearance and greater confidence. Restriction in the type of foods that can be consumed was considered to be the main problem associated with treatment. The most important objectives of the Service were to provide for the need and demand of orthodontic care in the public sector and train future specialists. Decentralization reduced the patient monetary cost by 57%, the number of patients that would need to travel for over 3 hours to attend appointments was reduced by 25%, and patients were able to allocate more time to education. Treatment being free of charge was valued highly by patients and parents/guardians. However, the majority of patients stated that they were prepared to pay a fee for treatment provided this was less than \$300. The S.O.S. of N.S.W. proved to a highly acceptable method of delivering orthodontic care.

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I n t r o d u c t i o n

The State Orthodontic Service (S.O.S) of New South Wales represents a collaborative effort on the part of the Department of Health, New South Wales Government, United Dental Hospital of Sydney, University of Sydney, and selected country centres to make orthodontic care more accessible for country people. The Service was implemented in the final months of 1987, and is currently in its third year of operation.

Analysis of the Service was considered appropriate at this stage of development. Analysis enables an evaluation of the objectives and the performance of the program. Continuation of funding can only be justified for services that are of proven value. A formal description of the principles on which the Service is based is required in analysis and is an aid in determining the appropriateness of this method of orthodontic delivery.

Analysis may take various forms. The analysis favoured by health care workers is the cost-effective analysis. A cost-effectiveness study is an economic analysis, comparing alternative means of achieving a desired outcome. It is an objective measure of the benefits and costs, tangible and intangible, of a program. This type of analysis represents an amalgamation of health economics and the area of interest, in this case orthodontics. Cost-effectiveness analysis has been applied to many areas of medicine and has been used to examine the most suitable method of fluoride delivery in dentistry.

The purpose of this study is to determine the cost-effectiveness of the State Orthodontic Service by estimating the cost per episode of treatment and defining effectiveness as it relates to the provision of orthodontic care. The episode of treatment considered is a four premolar extraction case, treated with full upper and lower Begg appliances. In order to determine the elements of an effective orthodontic service, a user survey is conducted to record opinions on various aspects of orthodontic delivery. The areas examined include the importance of various characteristics of

an orthodontic service, and the benefits and problems associated with orthodontic treatment. In addition, the likely response to the introduction of a user pays system is examined. The alternatives considered for the delivery of orthodontic care in New South Wales are centralization versus decentralization and the employment of orthodontic registrars versus specialists. This investigation is restricted to the Newcastle clinic.

A user survey was considered the most appropriate method of investigation. Information from the patients, parents or guardians of patients aged 17 years and less and the supervisors of the service was collected by questionnaire and interview. The monetary cost of transport, lost income, and additional expenses, such as child care were considered for the users of the Service. Indirect costs, in the form of travel time, and missed activities as a result of attending appointments, were considered. It was assumed that consideration of fixed costs (the costs of consumables, transport and accommodation costs for clinicians, rent of premises, etc.) would not affect the outcome of the analysis, and so these were not considered.

It is more widely accepted that there are limited resources available for health care pursuits. Economic analysis ensures that these resources are deployed in a manner which will ensure a maximum yield of treatment for investment.

1 Health Economics

Economics has been defined as the study of the consequences of resource scarcity (Jacobs, 1980, referred to by Hall and Mooney, 1990). The purpose of analyzing the economic consequences of public investment is to improve decisions about how best to allocate scarce resources in the non-market sector of an economy, where profit maximization is not an available criterion (Doherty and Crakes, 1987). Fisher (1971, p. 7) saw the objective of analysis as the provision of a better basis for exercising judgement through the more precise statement of problems, the discovery and outlining of alternatives and the making of comparisons among alternatives. Fisher (1971, p. 5) considered the ideal prescription for resource allocation in a society to be maximization of a weighted sum of all objectives by an efficient allocation of resources. Such an ideal was unattainable.

The structure of the market determines to a large extent resource allocation. Grembowski et. al. (1988) described markets as allocative mechanisms for distributing scarce goods and services. In the traditional market, the supply of goods is linked to the demands of consumers by means of information conveyed by market signals (McGuire, Henderson and Mooney, 1988, p. 182). Demand is an expression of the consumers desire for a good. The satisfaction gained from the consumption of this good is referred to as utility. Supply refers to the amount of the goods available to be consumed. The cost of production is a factor in determining supply. As prices fall, the corresponding quantity demanded rises. This inverse relationship is known as the law of demand (McDermott, 1986).

The structure of a market is determined by the type of competition. This can range from a pure monopoly, where a single seller has great control over price, to perfect competition, where there are many independent buyers and sellers (Grembowski et. al., 1988)

Culyer (1976, p. 4) states that in the market place price fluctuations signal the priorities that individuals place upon changes in the distribution of a set of resources. In a competitive market, producers will increase output to the point where the cost of producing any extra good becomes equal to the market price for that good. In economic terms, this is the optimal level of output, and it occurs when the marginal value of the output is equal to the marginal cost. Williams and Anderson (1975, p. 13) define the marginal cost of the output as the cost of the extra output incurred by adding a further unit of the input to the pre-existing set of inputs. The utility gained by consuming an additional item is referred to as the marginal utility. As more of a particular good is consumed the utility obtained from each additional unit of consumption will tend to fall. This is referred to as diminishing marginal utility.

Prices are established in accordance with the type of market, decisions of buyers and sellers being based on cost-benefit comparisons. The choice to purchase a commodity occurs once anticipated benefits exceed their cost. Where continuous adjustment is possible, each participant moves toward behavioural equilibrium where anticipated marginal benefit equals marginal cost. In this economic model of a market situation, questions about the precise meaning of cost or of benefit need not arise. "The analysis offers a logic of rational individual decision, and cost is simply that which is foregone by positive choice, at the moment of choice itself" (Buchanan, 1969, 84).

1.1 Economics of Medical Care

The provision of health care in our society is a reflection of past circumstances, political ideals, the values of society and the changing pattern of disease. Administration must be concerned with all sorts of values, noneconomic, as well as economic, personal as well as social, measurable as well as intangible (Boggs, 1973). Policy makers are concerned with an equitable distribution of resources. Equity of access is fundamental to the reasonable distribution of resources. The market structure of medical care necessitates intervention to ensure that equity is being achieved. Markets operate by the laws of supply and demand.

There are unique characteristics to each of these as they relate to the medical care market. A consideration of these elements facilitates planning of medical care delivery.

In the early settlement of Australia, Governments regulated society so that all persons had opportunities to produce and acquire the commodities essential for well-being (Sax, 1984, p. 6). These commodities consisted of food, housing and medical care. The Benevolent Society of New South Wales was one of the first organizations to attract government support for provision of medical care. This became the prototype for public hospitals which today receive subsidies towards their maintenance from state governments. During the 30 years leading to federation of the colonies, governments only provided for regulated health services for those conditions which jeopardized the efficiency and growth of the workforce (Thame, 1974, referred to by Sax, 1984, p. 15). After the 1940's there was general acceptance of state responsibility for the control of acute infectious diseases. At present, the government's responsibility covers a much wider scope of medical and dental conditions. "The balance of activity may be shifting from cure to care, from extension of life to the alleviation of misery" (Klein, 1983, referred to by Sax, 1984, p. 186).

Sax (1990, p.14) believes that health care should be the amalgamation of two value systems. Current government policies reflect the acceptance of the philosophy that society has an obligation to those who are underprivileged. This concept exists alongside the traditional value system that emphasizes individual responsibility, personal initiative and free enterprise.

A fundamental aspect of public health care is equality. The major elements of equality relate to access and the market structure of the health care system.

Equity refers to the fairness of the distribution of the effects of an activity (Klarman, 1972, referred to by Horowitz and Heifetz, 1979). "Since the opportunity to plan and live one's life in the way one prefers is a rather basic, and equal, right of all, it follows that access to effective health care procedures that further this end should also be equal." (Culyer, 1976, p. 82). The elements that constitute equity encompass

expenditure, need, and access (Mooney, 1986, p. 108). Horowitz and Heifetz (1979) describe an equitable public health program as one that permits smaller benefits to be shared by more persons than one in which greater benefits accrue to a few. Steele (1981), referred to by Drummond and Mooney (1982), states that equity will be achieved when all regions can get equally down the listing of needs, assuming that needs can be ranked ordinally in descending order of priority to be met.

The private system rations care by ability to pay. Under the public system, rationing must occur since there is a limit to available resources. "In Britain rationing is achieved by knowledge, time and energy and above all, the ability to wait. Removal of the price barrier does not guarantee an equitable distribution of care, and even under a public system positive steps need to be undertaken to promote equity" (Drummond and Mooney, 1982). A private system of health care delivery has the disadvantage of leading to more decentralization, providing for less control over overall expenditure and the introduction of social priorities. Advantages include a wider range of treatment practices, the more rapid diffusion of treatment practices, the more rapid diffusion of new technologies (both good and bad), and more choice for those patients who can afford it (Drummond and Mooney, 1982).

Equity of access is a fundamental element of equality in the public health system. "Equal access means that two (or more) individuals face the same costs to themselves of using the health care facility. Whether they use it equally will be dependent on their valuation of that use, ie. their demand for health and health care" (Mooney, 1986, p. 108). Sax (1984, p. 186) defines access as consisting of availability within reasonable distance and the absence of barriers, such as prices beyond ability of pay, lack of amenity and courtesy, prolonged waiting for service, inconsistency and poor communications. Townsend (1974) links utilization of services to income and distance from the physician. The lower the income, the lower the utilization of medical services. A physician's services has been found to decrease with increasing distance to physician for all income groups.

Sax (1990, p. 54) discusses equity and access to health care. The provision of an adequate level of health care for every member of a society was not considered to be enough to constitute an acceptable health care system.

Burdens suffered in order to obtain care must be examined. Sax believes that what is considered an acceptable burden will vary from community to community and among different socio-economic classes. Where need for a product does not match the ability to pay for the product, the market solution is insurance. The cost of insurance may preclude its purchase, introducing another dimension to equitable access. Another method discussed was the reduction in the price of care provided to needy groups. Sax (1990, p. 56) regards the provision of equitable access as society's responsibility for three reasons. Firstly, an individual's demand for medical services is irregular and unpredictable. Secondly, difficulty may be encountered in meeting medical expenses by personal savings from income. Thirdly, the need for care is unevenly distributed and differences in health status are largely beyond the individual's control.

In the US, the Community Health Centre, Migrant Health Centre, and National Health Service Corps (N.H.S.C.) are undergoing change to address access-related health problems caused by economic disadvantage and health professional maldistribution. An increase in the number of health professionals and an increase in the number of these professionals connected with the N.H.S.C. have contributed to a reduction in distribution inequity. The N.H.S.C. has transferred manpower resources to areas that have not benefited from the changing distribution of health practitioners. Many of these professionals are completing service obligations incurred during their training as participants in the N.H.S.C.'s scholarship program. The Bureau of Health Care Delivery and Assistance has the responsibility for providing health services to special, non-Native American populations in the United States. The Bureau is encouraging some dentists to accept continued federal assignment with the N.H.S.C. after completion of their obligated service. These dentists, along with other career officers already serving with the Bureau, will make up the nucleus of a mobile force of officers willing to serve in remaining shortage areas (Schneider, 1985).

Regional variations in the allocation of financial resources was examined in the National Health Service by Noyce, Snaith and Trickey (1974). These workers found a high correlation between expenditure and the proportion of the population in the higher socioeconomic groups. In 1971 the Department of Health and Social Security introduced a new scheme in

order to remove inequalities of allocation. This scheme attempted to promote equity by allocating resources in relation to the need of the area. Factors considered were the presence of existing health services, such as the number of general practitioners and the population, with weighting for factors such as age group, population density, and the rate of population growth or decline.

The medical market differs from the economic market model in certain aspects. Demand is irregular and there is uncertainty regarding the quality of the product. Price competition is considered unethical. The responsibility for determining the desired consumption of health care, does not rest solely with the patient.

Arrow (1963), referred to by Singer (1985), suggests some of the major differences between the current medical care market and the usual commodity markets;

1. Demand for medical care is irregular and unpredictable.
2. Medical practitioners may not advertise and there is usually no open price competition among them.
3. The number of medical practitioners is controlled by non-profit institutions. For example, limited entry to medical school controls the number there will be in future years. "Thus, the supply of medical care is not directly affected by the profitability of providing it, as would be the case in a normal market."
4. Medical care is not refundable.
5. Objective comparisons regarding the quality of care received is difficult to determine.

Arrow (1963), referred to by Mooney (1986, p. 29), lists four ways in which the behaviour of a doctor would be expected to differ from a typical businessman;

1. Advertising and overt competition are removed.
2. Advice is supposed to be removed from self-interest.
3. Treatment is influenced by needs rather than solely by financial considerations.
4. The physician is relied upon for the correct conveying of information as distinct from attempting to please the customers.

Swan (1985) believes that in a free market system peoples' relative preferences for medical resources versus other things are made known through the operation of demand and supply. "Consumers voluntarily choose how much medical care to purchase, given the prices they must pay for it, versus what they must pay to produce other goods or services. Market prices will thus reveal the costs of obtaining resources to supply medical services. If the price of medical services is distorted, for example, by having a government provide the service at no cost, then people will consume more medical services than (in some sense) they really want."

Richardson (1985) questions the assumption that consumers are competent to judge how much medical care they should purchase to promote most favourably their own interests.

Singer (1985) argues that market considerations could undermine the relationship between doctor and patient. Facilities that provide care according to need rather than through market factors were said to foster an attitude of concern for fellow-citizens. He believes that a market system of distribution could threaten important values.

Buchanan (1985) introduces the term 'distributive justice' in his introduction to a collection of essays relating medical care to markets. The concept is one of transferring resources from one group of people to another. This introduces a conflict between freedom and equality. Parish notes that some methods of redistribution may be inherently unstable, resulting in greater inequality than if no deliberate interference in medical markets took place at all.

In summary, equality has been a fundamental concern for health care administrators. Equity refers to the removal of barriers to effective health care. In planning the allocation of health services, factors such as the rate of population growth, population density and services in existence are considered. Aspects unique to the medical market result in deficiencies in distribution if market mechanisms are allowed to operate without intervention.

1.2 Economics of Dental Care

The dental market varies from the classic economic market for various reasons (Grembowski et. al. 1988). Supply is controlled by limiting entry and graduation from dental school. Demand is distorted in the market place for reasons that will be discussed.

Birch (1985) outlines the argument for subsidization of the cost of dental treatment. Firstly, anything that delays the point at which the less informed individual seeks the advice of the more informed dentist may lead to an inefficient allocation of dental treatment resources. Secondly, the benefits produced by dental treatment do not fall entirely on the individual. Other members of society benefit in terms of their desire to see others relieved of illness and disease. The case for subsidizing health care provision therefore arises out of the presence of 'consumer ignorance' and 'external benefits'."

Lissau, Holst and Friis-Hasche (1989) studied the effect of the social environment, the individual and the delivery system on frequency of use of dental services among 756 Danish youths, aged 20 to 21 years, and 552 of their mothers. Significant predictors in the future frequency of dental visits were;

- 1) The regularity of dental visits of the mother and perceived economic barriers of the mother.
- 2) Assessment of the personality of the general dental practitioner.
- 3) The locus of control. The "internals" believe they control what happens to themselves. They tend to believe that ability and effort are important. Those that believe that events are largely a matter of chance or fate are named "externals". "Internals" were found to be more frequent users of dental services than "externals".

Manning et. al. (1985), referred to by Grembowski et. al. (1988), found that compared with individuals paying 95% of their dental bills out - of - pocket, free care boosts visits and dental expenses by 34 and 46%, respectively. Grembowski and colleagues refer to the findings of Mueller and Monheit (in press) who estimated that insurance increases the probability of use 20 to 25% relative to the uninsured.

McDermott (1986) considers price, or fee for dental service, to be the most important determinant of demand. However, non-price determinants are also of importance. This author lists the non-price determinants of demand for dental services as: the income of consumers, their tastes or preferences, the consumers' expectations with respect to future prices and incomes, the number of consumers in the market, third party payment schemes, and government funded dental service programs.

In summary, 'consumer ignorance' and 'external benefits are provided as arguments for the subsidization of dental care. However, other factors exist that influence the use of dental services such as, the locus of control of the patient, the assessment of the personality of the of the dental practitioner and the patient's tastes, preferences and expectations.

1.3 Economics of Orthodontic Care

"The structure of orthodontic services, which are only a small part of general dental and medical services, reflects the historical and political evolution of health care in each country rather than a specific, rational prospective design." (Shaw, 1983) The USA has a health care system with a large private market element whereas those of Eastern European countries are based largely on State provision. Comparisons must be viewed with caution, as dental health data varies between countries. (Holloway, Davies, and Downer, 1983)

In the United States dentistry is largely a private enterprise. Orthodontic care is provided mainly by practitioners in private practices (Grembowski, et. al., 1988). Between 1950 and 1982, the economic growth of dental care services in the United States exceeded the growth of the economy as a whole, medical care expenditures, and physician services (Dugoni, 1986). The introduction of a national health insurance program in the United States was proposed in 1943. Roemer (1988) supports this introduction for three reasons:

- 1) to assure access to health care for the total population;

2) to contain costs, as the Canadian health insurance system has demonstrated and;

3) to provide leverage for directing the health care system into more effective and efficient channels.

In 1979, Anderson and Vig foresaw the introduction of some form of national health insurance (NHI) which would involve the American orthodontist. The authors sought to obtain, identify and evaluate the attitudes of orthodontists toward NHI in view of the fact that "the cooperation of health care professionals is directly related to the success of any NHI program they design". North Carolina orthodontists agreed that some form of dental care should be provided if a national health insurance system were established, although this group disagreed that government health programs could provide more people with high-quality dental care (Niessen and Douglass, 1984).

In Norway the bulk of orthodontic care is undertaken by specialists operating in their own practices. While most medical and dental care is free of patient charges, substantial parental contributions are required to meet the cost of orthodontic treatment. Norway provides public health insurance reimbursement based on the severity of the case, determined by the treatment priority index. 100% of the cost is provided in severe cases, 25-50% in the majority of cases, and 0% for minor irregularities. There is no age limit and full travelling expenses can be claimed. There is no external assessment of the completed treatment. Shaw (1983) observed that standards were conspicuously high, with as many as 90% of specialist cases being treated with fixed appliances.

In the Netherlands, 70% of families are eligible for subsidized orthodontic care. As in Norway, the amount contributed to orthodontic costs is based on the severity of the case. 100% of the cost is met in severe cases, while 15-40% is provided in the majority of cases. In Denmark, orthodontics is provided free of patient charges to children aged 0-16 years (Shaw, 1983). In Sweden orthodontic treatment has been offered within the Public Dental Health Service since the mid-thirties. From 1974 the Public Dental Health Service has provided orthodontics for children up to 17 years free of charge. In 1974 the proportion of children in Sweden with orthodontic defects warranting treatment was estimated at 20-25 per cent (Linder-Aronson, 1974). In the age groups 7-16 years, it was found

that 11 per cent needed treatment by specialists. By calculating the number of patients in need of specialist treatment and the average treatment time per patient per annum, Linder-Aronson (1974) was able to estimate the need for full-time orthodontists at 337. This corresponds to a need for one orthodontist for every 3,500 children.

In England and Wales, orthodontic treatment is provided free in hospital and community clinics, and in private practices. Private practitioners are paid by the Health Service on completion of the case. The Dental Estimates Board figures for the general dental services show that in 1980, 9% of cases received some form of fixed appliance therapy. The fee for fixed appliance therapy is comparatively low, regarded as one of the factors encouraging the continued extensive usage of removable appliances (Shaw, 1983). Orthodontic standards and the delivery of orthodontic treatment in the United Kingdom are the topics of considerable debate. Clark and Elderton (1987) applied a modification of the Summer's Occlusal Index to 256 before- and after-treatment study models to assess the changes in the occlusions brought about by treatment. The results of treatment was found to be disappointing. "All but a few of the treatments were carried out in the upper arch only and, for the most part, between one and three upper removable appliances were used." The proportion of cases treated with some form of fixed appliance was estimated to be much less than the 9%. These authors attributed these findings to pressures in practice as a result of the method or level of remuneration. The fees payable for orthodontic treatment were seen as commensurate with low quality treatment.

In Britain, the Consultant Orthodontists Group was formed to further the development of orthodontic services in England and Wales. In 1971, Seel and Burke (1973) conducted a survey on behalf of the Consultant Orthodontists Group designed to measure the services provided by consultants in both quantity and quality. These authors defined quality of service as that which gives proper attention to the patient's needs. Convenience of travel and waiting time before consultation were measured, as these were considered important from the patient's point of view. Efficiency in orthodontics was defined as the ready availability of good treatment for patients at reasonable cost. Confidence was expressed by the group about the effectiveness of the hospital-based consultant

orthodontist in terms of service to both the public and the profession. Most patients were able to reach a hospital in less than half an hour, but an average of 7 per cent (with a range from 0 to 24 per cent) took more than one hour. Problems encountered were lack of supporting staff and a shortage of orthodontic skills.

The Netherlands and Scandinavia delegate much routine work to trained dental surgery assistants. In England and Wales, Shaw (1983) estimated the average case load of a full time orthodontic practitioner to be substantially larger than in Scandinavia and the Netherlands. This was in spite of the fact that the assistance of trained dental auxiliaries for intra-oral supporting tasks is not permitted. Following a comparison of the orthodontic services in England and Wales, the Netherlands and Scandinavia, Shaw (1983) proposed steps to improve the current service in England and Wales. These were;

1. The majority of treatment be undertaken by specialists.
2. Increase the availability of orthodontic manpower.
3. Extend the role of dental assistants.
4. Eliminate treatment of minor malocclusions.
5. Allocate fees appropriate to encourage high quality treatment.
6. Co-ordinate orthodontic services, considering effectiveness and efficiency.

"The fee for item of service in the NHS has been criticized for its emphasis on repair and neglect of prevention. Case load for the individual practitioner has an intimate relationship with the method of payment and without strict fiscal control of the quality of care or of the number of cases for whom completion fees can be claimed, potent economic incentives will operate to encourage quantity at the expense of quality. Furthermore, in an international variety of medical settings, over-prescription is seen to be a consequence of fee for item of service payments. Controls have been introduced to meet this problem. In the Netherlands, a regressive tariff operates such that lower fees are paid after a pre-set figure of annual case starts are reached. In Norway, fees are essentially calculated on the time it takes a specialist to treat a case properly" (Shaw, 1983).

In summary, access to orthodontic care in the United States is determined by the ability of the patient to meet the costs of treatment. In the Netherlands and Scandinavia, subsidization of orthodontic care is based on the severity of the case. Orthodontics is provided free of patient charge in England and Wales where treatment results have been found to be disappointing. This finding has been explained by the method and level of remuneration, the case load of practitioners and the illegal use of auxiliaries for performing intraoral tasks.

1.4 Cost

The conception of cost is complex. It includes both monetary and nonmonetary costs. It is useful in that it provides a criterion for choice.

Anthony (1970) describes the word 'cost' as having a vague and ill-defined meaning. This author defines cost as a measure of resource use. Williams (1974) defines cost as "foregone benefit", its value represented by the value of all the resources so employed.

Buchanan (1969, p. 42-43) distinguishes between cost in two economic theories, the predictive theory and the theory of choice. Within the predictive science of economics, individuals do not choose; "they behave predictably in response to objectively-measurable changes in their environment." Cost reflects the market prices for resource units. In the theory of choice, cost is defined as "that which the decision-maker sacrifices or gives up when he makes a choice. It consists in his own evaluation of the enjoyment or utility that he anticipates having to forego as a result of selection among alternative courses of action." Buchanan considers this concept to represent the actual market process. This author listed the implications of this concept of cost as:

1. Cost is borne exclusively by the decision-maker.
2. Cost is subjective.
3. Cost is based on anticipations. It is an *ex ante* concept.
4. Cost is never realized. That which is given up cannot be enjoyed.

5. Cost cannot be measured by someone other than the decision-maker because there is no way that subjective experience can be directly observed.
6. Cost can be dated at the moment of decision or choice.

Haller (1974) defines cost as the highest valued opportunity necessarily forsaken. This author recognized the following factors in cost analysis;

1. Cost and choice are inseparable and hence the meaning of cost depends on the alternatives involved.
2. The alternatives must be clearly defined. Where there are no alternatives, no costs exist.
3. Costs of alternatives not chosen are estimates. Hence, the relative nature, rather than the absolute nature of costs is important to the evaluator.

In recognition of the foregone alternatives that result from a decision, economists developed the term 'opportunity cost'. In the predictive theory, Buchanan (1969, p. 45-46) defines opportunity cost as reflecting the values of potential alternatives, measured objectively by money outlays. In the theory of choice, opportunity cost is the chooser's evaluation of the anticipated enjoyments that he must give up once the commitment is made, at the moment of choice itself. Once the choice is made, the opportunity cost is realized. This latter concept, according to Buchanan (1969, p. 47) is closer to the notion of real cost. Drummond and Mooney (1982) define the opportunity cost of pursuing an alternative as the benefit foregone in not pursuing another. Existing market prices are taken to reflect opportunity costs unless some reason exists to believe that such prices are distorted, such as the existence of subsidies or the lack of a market such as for housewives' services, voluntary labour and leisure time (Hall and Mooney, 1990). Bowman (1966, p. 422) sought a definition of cost that was independent of the economic system being considered. "The generalized concept of cost must be capable of adaptation for use in theories that seek to explain, interpret and predict behaviour in diverse institutional settings and in transitions from one economic and social structure to another." Bowman defines opportunity cost as what the individual or group or society gives up (or gave up) in making a choice. This author considers all costs to be opportunity costs.

Opportunity costs were described as measures of real costs. The following dimensions were ascribed to opportunity cost;

1. Who bears the cost.
2. The scale units in which the income alternatives are being measured.
3. The transferability potential.
4. The time dimension of the foregone opportunities. This encompasses cost variation with time and considers the extent to which present choices condition future alternatives.
5. The knowledge and uncertainty of perceived opportunities. This relates to theories of behaviour.
6. The institutional constraints assumed.

The concept of opportunity cost is not without its opponents. Bowman (1966, p. 426) groups these thoughts under three headings;

1. Classical-Marxist preferences for absolute definitions of 'real costs'.
2. Accounting conventions that include what is paid for in a market transaction but exclude most or all of what is only potentially marketable.
3. Conceptual and pragmatic measurement problems related to levels of cost aggregation and the purposes of such aggregation.

Costs that have been incurred are known as 'sunk costs' (Buchanan, 1969, p. 48). Since choice has been made, this cost is considered irrelevant in economic analysis, the exception being where choice alternatives are modified in the future.

The total costs of a program are the sum of the fixed and the variable costs. Doherty and Crakes (1985) differentiate between these costs in an effort to more accurately represent total costs. Variable costs are linked to output. Total fixed costs are constant during any specific time period. As output increases the average fixed costs (fixed costs per unit output) decrease. The rate of decrease is rapid initially and then diminishes as the costs are spread over greater outputs. This relationship is expressed in the equation

$$TC = F + V(Q)$$

where TC = total cost, F = fixed cost, and V(Q) is variable cost. These authors state that the conventional approach of extrapolating average

costs linearly from point estimates would, if used for planning, lead to a substantial misallocation of society's resources (Fig. 1). Costs for dental programmes are usually reported for a single point and provide little information about costs at other rates of output. These figures cannot indicate whether or not the observed rate of output represents efficient utilization.

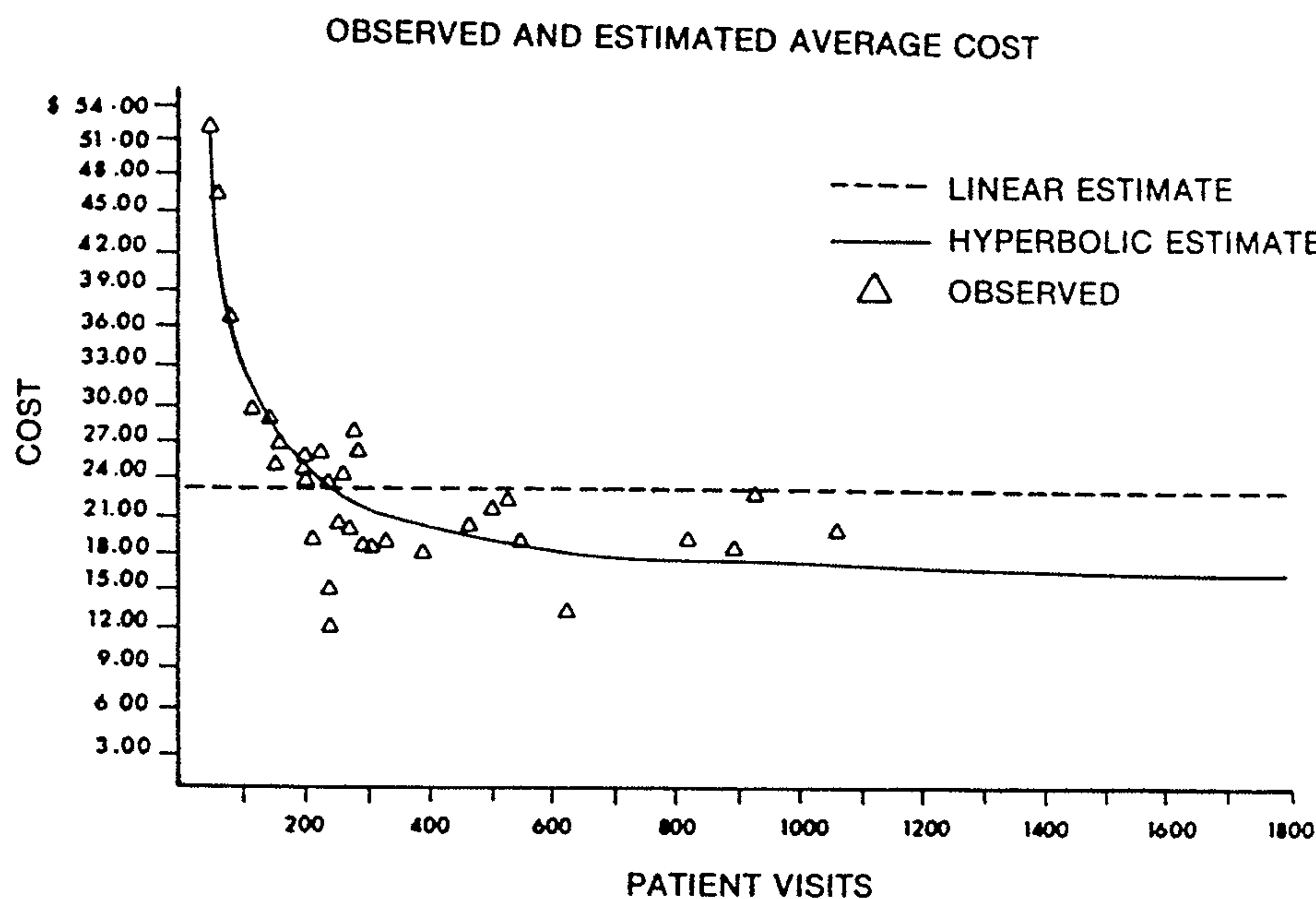


FIGURE 1

Estimated average total cost functions. The hyperbolic estimate represents the equation $TC = F + V(Q)$. The linear estimate was calculated by dividing total costs by total visits and extrapolating to all output levels. The observed costs of seven clinics by Doherty and Crakes (1985) support the hyperbolic estimate for cost estimates in dental programs.

Niessen and Douglass (1984) divide costs considered in program analysis into explicit and implicit. Explicit costs are the direct program expenditures for capital and operations, and implicit costs are the opportunity costs of resources donated or provided at no charge to the program. Often the implicit costs are ignored in the analysis. These authors are of the opinion that by including the implicit costs in the total cost of a program, one gains a clearer perspective of society's true economic commitment to a program.

Costs exist in all fields of human endeavour, including medicine. Drummond and Mooney (1982) state that economics is applied to humanitarian activities, "albeit frequently subconsciously and in ignorance of some of the implications of doing so. The benefits of health care are, of course, difficult to quantify and placing values on them, to make them comparable with costs, is even more problematical." Hall and Mooney (1990) divide the cost of illness into direct costs, indirect costs and intangible costs. The direct costs of a disease are the costs of its detection, treatment and the care of those who suffer with it. These include both health service and non-health service components. Non-health service costs include patients' travel to doctors or hospitals and the time that is spent by family members looking after patients. Indirect costs result through lost production due to the inability of afflicted individuals to work. "They are the opportunity costs of lost production as a result of premature mortality and morbidity". Social security benefits are not indirect costs. "Although these payments are costs to the government, from the viewpoint of society as a whole they do not represent a loss of production but a transfer of purchasing power from one group to another. These are known as 'transfer payments'" (Hall and Mooney, 1990). Intangible costs are the costs of a decrease in the quality of life, loss of emotional well-being and the ability to relate to and support others. "By their nature they are difficult, although not impossible, to identify and to measure" (Hall and Mooney, 1990).

Services free of patient charges still entail time and money costs which can be evaluated (Culyer, 1976; Williams and Anderson, 1975; Grembowski et. al., 1988). Time-cost encompasses such factors as office waiting time and travel time. Patients generally prefer shorter time costs, just as consumers prefer lower prices. Time-cost and money-cost are inversely related in the market, patients searching for optimal fee/time-cost combinations, not just the lowest fee possible (Grembowski et. al. 1988). A reduction in out-of-pocket costs improves access to dental care, which in turn improves oral health. Williams and Anderson (1975) suggest that by observing, in a systematic manner, the level of cost at which people decide that a service is worth having, a rough estimate of the marginal value of that service to these people can be determined.

Culyer (1976) conducted an analysis of the National Health Service (NHS) in England. In the NHS, the money cost to patients was zero. The time-cost consists of waiting time, travelling time and treatment time. Seldon (1967), referred to by Culyer (1976, p. 97-98), believes the waiting list is a consequence of zero money prices and suggests the introduction of a money price that would curb demand to meet supply. The English Ministry of Health in 1963, viewed the waiting list as a "backlog" of cases which which could be removed by determined short term efforts. Culyer (1976, p. 98-101) saw three major deficiencies in these ideas;

1. Doctors are operational in deciding need and also control supply. The separation of resource allocation into a demand side and a supply side ceases to be valid, "for the factors affecting one side can no longer be supposed to be independent of the factors affecting the other.
2. The principal concern has been with waiting lists rather than waiting time. Culyer sees the problem is to minimize the social costs of the average waiting patient.
3. The issue has been on the elimination of excess demand rather than on meeting need.

Culyer made the observation that allocation of funds showed marked per capita variations, no systematic relationship of provision with measured need and no trend in the long term for any improvement. In 1970-71 the Department of Health and Social Security, in an effort to alleviate these problems, composed a formula incorporating population, beds and case-flow. To avoid too large an impact, it was planned to take effect over the ten years 1971-72 to 1981-82.

Butt and Palmer (1985, p.11) consider that cost alone is invalid in the assessment of the value of a program. A consideration of quality and cost were seen as necessary in establishing economical services. The quality of materials requires specification. "An economical operation acquires resources in appropriate quality and quantity at the lowest cost." (Butt and Palmer, 1985, p. 10). Following this, management needs to ensure the materials are obtained at a minimum or 'acceptable cost'.

Health care is now a cost consideration in corporate America. Evans (1986) described illustrations of the ways in which business is attempting to cut and control health care costs. In 1985, IBM changed its medical plan to include a variable deductible based upon a worker's salary level.

To discourage unnecessary hospital stays, IBM workers also must pay 40 percent of the first day's room charge during a hospital stay.

In summary, cost is multifaceted. Opportunity costs represent the benefits foregone in making a choice. This description of cost is closest to the notion of real cost. In the analysis of health care, direct, indirect and intangible costs require consideration. When costs are examined for varying levels of output, both fixed and variable costs will influence the total cost.

1.5 Effectiveness

Resource evaluation has two elements; effectiveness and efficiency (Culyer, 1976, p. 5). Butt and Palmer (1985, p.10) define effectiveness as ensuring that the output from any given activity (or the impact that services have on a community) is achieving the desired results. To evaluate effectiveness it must be established that approved/desired goals are being achieved. A goal (or operating objective) may be defined as a concrete expression of a policy objective. Effectiveness refers to both the quantity and quality of the outcome. These authors define efficiency as maximizing output from the resources available, or, alternatively, minimizing the level of resources devoted to achieving a given level of output. Efficiency takes into account both costs and the effectiveness of different resource combinations. If several alternative ways exist for performing a task, all of which are equally effective, then the most efficient method is the one with the least cost. More frequently, effectiveness is not the same and the question arises as to whether a given change in effectiveness is justified for the change in cost.

An efficient procedure has three elements (Culyer, 1976, p. 56-57);

1. More improvement in outcome relative to alternatives.
2. The improvement is of social value.
3. Costs are lower than the social value of the improved outcomes.

The characteristics of an effective service are (Culyer, 1976, p. 57);

1. Positive probability of identifiable improvement.
2. Technically efficient ie. economical in relation to resources.

Efficiency in health care means producing the greatest health gain for the available health dollars. Hence, a discussion of efficiency must include evidence of a change in health status as a result of a new intervention. "It is wrong to label a treatment as 'efficient' relative to another treatment when only the costs are considered and not the outcomes." (Hall and Mooney, 1990)

If one of the objectives of a program is to provide comprehensive dental care a good measure of the effectiveness of the program or of individual providers might be the number of completed cases generated (Leverett, Handelsmann and Iker, 1977). This generates only quantitative measures. Although it is true that there is a quantitative element in quality, this system should be an adjunct to, rather than a substitute for, direct observation and peer review in the assessment of quality of care.

Measuring achievement involves comparison with a defined objective. The objective must be capable of achievement. Ideal standards are rarely a good measure to use. The 'reasonably possible' gives a fairer scale for judgement (Butt and Palmer, 1985, p. 48). Butt and Palmer note that care has to be taken in using performance measures in areas where a high degree of personal judgement is involved because morale and motivation may be destroyed by an over-emphasis on efficiency measures.

Performance measures have the following uses;

1. Evaluating services.
2. Monitoring the productivity and effectiveness of departments against predetermined targets and/or by reference to other authorities and past trends.

The objectives of measuring the performance of people and activities are (Butt and Palmer, 1985, p. 45);

1. Determining that the benefits and impact looked for are being obtained.
2. Getting assurance that goals are being met.
3. Monitoring and controlling progress against plans.
4. Justifying the use of resources.
5. Assessing the overall effectiveness and efficiency of the activity.
6. Providing a basis for calculating rewards and incentives.
7. To determine overall that value for money is being obtained.

Williams and Anderson (1975, p. 35) suggest that the 'output' of a service be measured in terms of the independent but effective functioning of the client in his day-to-day activities. These authors propose that the unit of output must be closely related to the objectives of the service. Butt and Palmer (1985, p. 82) note that quantitative measures are not always available in practice. Often the only means of assessing effectiveness is to ask a sample of users for their opinion of the service they have received. User surveys are techniques which have been used extensively in the USA and Canada (Butt and Palmer, 1985, p. 82).

Grogono and Woodgate (1971) stated that medicine is one of the largest industries in the United Kingdom and the United States, yet there is no rational basis upon which to organize and distribute resources. This was attributed in part to the absence of any method of measuring a patient's health before and after treatment.

Mooney (1986) has examined the measurement of health. This author describes the process of valuing health care outputs as technically difficult. Mooney (1986, p. 34) lists three reasons for the difficulty encountered when attempting to measure health;

1. Health is a value-laden concept.
2. Health is multi-dimensional.
3. Cardinal, rather than ordinal, measurement of health is required.

"The value system on which any health care service is based is exceedingly complex and indeed constitutes potentially a series of systems which may vary across different commodities within health care and across different cultures and time periods" (Mooney, 1986, p. 63).

Mooney (1986, p. 65) describes three methods of valuing health. The first method is known as the 'implied value approach'. This approach is based on observation of individuals' behaviour, referred to in economics as revealed preference. Through choice, individuals reveal their wants, desires and the relative weights they attach to them. The second approach is known as the 'human capital approach' which suggests that man may be valued in terms of his productive output. The third method of health valuation is the 'willingness to pay approach'. This method is linked to consumer sovereignty which has limitations in health care valuation. These limitations will be discussed latter in relation to demand.

The development of a measure of health precedes through stages (Mooney, 1986). Firstly, the dimension of measurement is chosen. This phase involves someone making value judgements. Secondly, a set of descriptive statements is developed by which more or less of the attribute being measured can be identified. Thirdly, a relative valuation of the units are identified and measured.

Culyer (1976, p. 33) lists the characteristics of an ideal health index as;

1. It should be reliable and reproducible.
2. It should measure what is purports to measure.
3. It should be capable of being related to some of the variables over which the researcher, practitioner, administrator, etc has some control.

Williams (1974) describes a health care system that provides maximum net benefit to the community it serves as one which is run in a manner which reflects the values of the community. He discusses the difficulty of uniting economic and medical concepts. Problems exist due to our ignorance of the psychological, and sociological influences affecting the efficacy of therapeutic or supportive activities. In costing the inputs into these activities we are often unclear at a conceptual level as to the proper realm of discourse. The concept of the community's preference function remains unclear.

Butt and Palmer (1985, p. 24-26) outline the main elements required of a programme in order for it to achieve value for money;

1. Clearly defined objectives. These are divided into overall aims and medium to short term operational objectives.
2. Introduce a comprehensive budgeting process. The budgetary process should provide management with the means of judging the effect of reducing, eliminating or increasing service levels in quantitative and qualitative terms.
3. Continuing critical review.
4. Establishment of an effective monitoring process.
5. Ensure effective use of the organization's resources.
6. Develop a strong management structure.

McGuire, Henderson and Mooney (1988, p. 76) distinguish between technical efficiency, allocative efficiency and social efficiency. Technical

efficiency refers to cost minimization for a specified level of output. Allocative efficiency exists where it is not possible to make any individual better off without disadvantaging another. Social efficiency implies maximization of the total value of outputs produced, without consideration of equity.

In regard to effectiveness, Butt and Palmer (1985, p. 13) state that management should primarily be concerned with the results obtained, irrespective of the resources. In some instances quantitative data may be available to measure effectiveness, whilst in other areas it may be that the perceived value of a service will have to be measured by indirect means, for example, via a user survey. "In the many instances when effectiveness can only be indicated by personal opinions or judgement, it is important to be seen to be taking reasonable steps to avoid bias. Management should endeavour to obtain their information from third parties such as independent specialists or by means of consumer surveys." These authors emphasize effectiveness over efficiency in programmes involved with sensitive social issues.

Butt and Palmer (1985, p. 99-108) list the following principles of effective management;

1. Ensuring skills are matched to work performed.
2. Overtime and Bonus Payments. Overtime and bonus payments often provide a fruitful source of saving and both should be carefully monitored. Persistent and excessive overtime is often a symptom of inefficient working methods or practices. It often raises the question as to whether or not productivity during normal working hours is as high as it should be.
3. Purchasing of Supplies and Services. Relatively small savings on specific items, rather than large dramatic discoveries makes the main impact. "Many studies in the private and public sectors have confirmed that more aggressive and skilful buying can reduce costs substantially."

Butt and Palmer (1985, p. 109) suggested the following initiatives;

- i) Changing the specification of the items purchased to eliminate excessive variety or to reduce unnecessarily high standards of design or material.
- ii) 'Shopping around' more aggressively for supplies.
- iii) Taking full advantage of purchasing scale.
- iv) Managing storage and distribution facilities more efficiently.

Clinical costing studies alone are insufficient to bring about improvements in efficiency (Wickings et. al., 1983). Myers and Schroeder (1981), referred to by Wickings et. al. (1983), have suggested the implementation of clinical budgeting. Clinical budgeting refers to a situation where the planning and administration of a budget and the spending of money are under the control of the same group of people. Direct control over the allocation of resources encourages responsible use. "Evidence is mounting that active participation of doctors and others in a prospective, budget setting exercise is more likely to improve effectiveness and efficiency than is the dissemination of historic cost data."

In the NHS, principles of management have been formed through analysis of pre-existing government funded health services. In 1974, a single administrative structure was introduced in an effort to provide more effective co-ordination between various parts of the NHS. Culyer (1976, p. 136) believes the sine quo non of efficient management remains the technology of monitoring and controlling the doctors. Culyer's analysis of the NHS suggests that matters such as judgement about which cares and cures are to be available, judgements about resource inputs should not be mainly a matter for doctors. Doctors should be concerned more with the monitoring of medical inefficiency, incompetence and carelessness, and with evaluation of the clinical and social effectiveness of clinical procedures.

Drummond and Mooney (1982) examined sources of inefficiency in the NHS. These authors considered that the biggest obstacle to a more efficient Health Service was the lack of incentives to the providers of care to seek out more cost-effective practices. This was seen as being due to the separation of control over resource deployment from accountability for resource use. Insularism was seen to discourage debate and growth in the understanding of the roles of the various participants (patients, doctors and institutions) play. The pervading view that all needs can be met was described as leading to inefficient practice. These authors considered an absence of evaluation through lack of consideration of objectives and measurement of health output, as not being conducive to constructive change.

Ideally, performance review committees should comprise a full-time multi-disciplinary unit of mature and experienced people. It should provide a blend of staff who understand the workings and background of the department under review combined with the objectivity of reasonably senior people outside it. Butt and Palmer (1985, p. 95-96) list a number of factors which conspire to prevent the public sector official from being motivated to initiate rigorous cost reduction programmes;

1. Absence of profit incentive.
2. Officials are not clearly accountable for the resources they consume.
3. The present system of annualized cash budgets, whereby if you do not spend money by the end of the year you forego it, does not exactly encourage thrift.
4. Officials in the public sector gain no reward for economizing.

In summary, an effective health care program is one which is achieving its' objectives. This program is efficient if a specific gain in health is provided using the least amount of resources. Effectiveness may be measured directly or indirectly. The complexities of measuring health present difficulties in obtaining quantitative data to measure effectiveness directly. User surveys are a means of establishing a programs effectiveness indirectly. Accountability for resource use has been suggested as a method of promoting cost-effective practices.

1.6 Program Analysis

Public programmes are becoming increasingly more accountable in an age aware of its limited resources. In the United States virtually every federal government conducts program evaluation (Butt and Palmer, 1985, p. 5). Legislation has been introduced in the UK, Sweden, Canada, Australia and California to provide auditors with wide powers to review the arrangements of public bodies for achieving value for money (Butt and Palmer, 1985, p. 4-5). Accountability involves a review of economy, efficiency, and effectiveness. "In today's social and economic climate it is necessary for politicians (and administrators) to have timely and accurate performance measurement of output to ensure that programmes are not

only economic and efficient but effective as well." (Butt and Palmer, 1985, p. 6).

Continued support from society can only be justified for effective community projects (Barenthin, 1975). The complexity and cost of orthodontic care is such that intuitive planning is not adequate, particularly when this care is of public interest and not merely between operators and patients. "The planners are becoming increasingly aware that additional expenditure for medical service will not itself guarantee a favourable return in health." Evaluation of a service and a judgement as to its worth is required. Bickner (1971), quoted by Haller (1974), defines cost analysis as consisting of the identification, measurement and evaluation of alternatives, but not necessarily in dollars. Yule, van Amerongen and van Schaik (1986) believe that economic evaluation is not an exact science. It is not possible to measure all costs and benefits, although an attempt should at least be made to list them.

Barenthin (1975) believes that one of the most crucial phases of evaluation is clarification of the program's goals. These goals should be realistic in terms of their achievement clinically and economically. Goals of a health service are derived from basic ethical norms and social values.

Evaluation is made difficult due to a lack of appropriate indicators to quantify the objectives and evaluate the impact of policy measures. Indicators should be consistent, dependable and accessible (Amerongen and Kalff, 1984).

A medical care system consists of three interrelated components; the people in need, the providers and the organizers (Sax, 1990, p. 116). The quality of a service is dependent on the quality of each component and the interrelationships between them. Quality of care is usually evaluated by three main approaches. These are the evaluation of structure, process and outcome. The appraisal of structure involves the evaluation of resources used to provide care and the way they are organized. In Australia, this is performed by the Australian Council of Health Care Standards. Evaluation of the process of care refers to the assessment of professional activities of health professionals. The difficulty in defining quality of care makes this step difficult. Outcome of medical care involves

the evaluation of some measurable aspect of health status which is influenced by a particular unit of care. Limitations are imposed to outcome evaluation due to the necessity to consider the many factors that contribute to the end result of care.

How program evaluation is defined will influence the method of research, including the evaluator's conception of cost. The dollar measurement of program costs may not be adequate for all evaluation purposes. Haller (1974) adopted the definition for program evaluation used by the Phi Delta Kappa (PDK) National Study Committee on evaluation; "the process of delineation, obtaining and providing useful information for judging decision alternatives". The purpose of conducting an evaluation, by this definition, is to improve decision making.

The choice of the particular method of cost measurement is dependent on the purpose of the investigation. "Some program costs can be measured in dollars, and others cannot." When costs can be measured in dollars Haller (1974) considers it desirable to do so because dollars, as a measuring device, provide a convenient, generalizable, and comparable estimate of the opportunity costs of a program. To insure the inclusion of all direct costs, Haller proposed the construction of a list of resources required to operate the program. Following this, a decision can be made as to which items are adequately measured in dollars and which must be measured in such other terms as square feet of space and hours spent travelling per day. A set of these components, divided into their respective functional categories, is referred to as an input structure. Any structure must be designed to facilitate comparisons. Haller does not recommend the use of a budget as the input structure. A budget does not provide an estimate of the cost of providing various services within the system. In addition, budgets are usually short-range documents, program evaluation requiring cost projection. Program costs usually fall under the following categories (Bickner, 1971, referred to by Haller, 1974);

1. Research and development (R & D) costs.
2. Investment costs.
3. Operating costs.

Research and development costs are incurred early in the development of a program to facilitate the program's introduction. Investment costs are necessary to implement the program and include equipment purchases

and training of staff. Operating costs are recurring costs required to operate the program over time. The relationship between these costs vary with the life cycle of a program (Fig. 2).

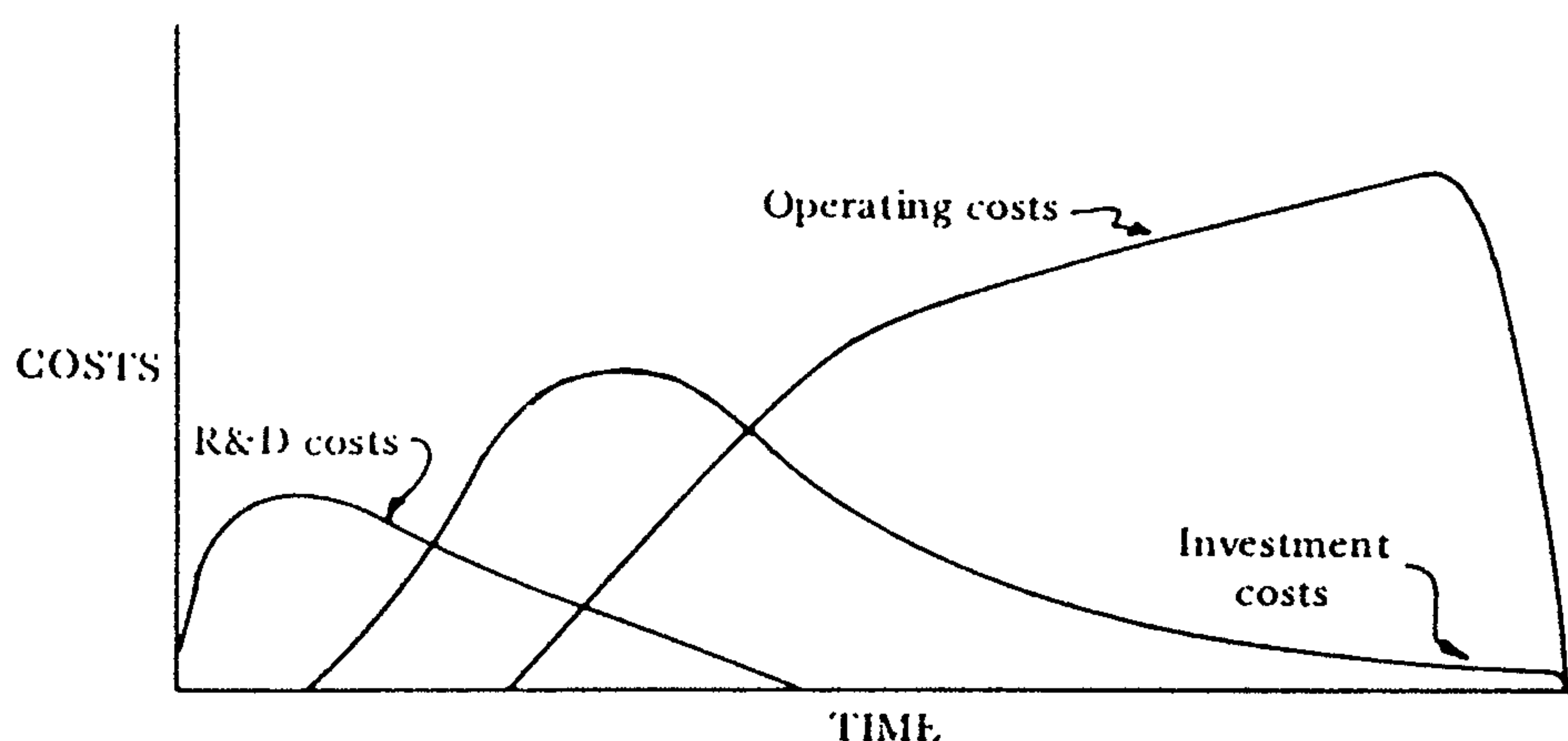


FIGURE 2

Relationship between costs and the life cycle of a program (Haller, 1974)

It was suggested that each of these categories be further divided into the following subheadings;

1. Time.
2. Space.
3. Equipment.
4. Supplies.

In this way, a check list is provided to ensure inclusion of aspects relevant to the analysis in a uniform structure to enable comparison between alternative programs. Haller suggests following the sequence listed below to analyse costs;

1. Describing the decision alternatives and develop an activities list. Where resources are limited in their application, few alternatives or opportunity costs exist. Realistic alternatives are thus an element in accurate assessment of cost.
2. Develop an input structure.

3. Determine relevant costs.
4. Measure and project costs.
5. Compare costs.

Hall and Mooney (1990) suggest measuring the amount of each input in its naturally occurring unit, for example, hours of nursing time, hours of physician time. Approximate estimates of the right amount of the input were seen as more useful than precise estimates of the wrong amount.

Where benefits and/or costs occur over different time frames, discounting is used for comparison (Niessen and Douglass, 1984).

The process of evaluation provides a basis for decision making, accounts for the use of resources and justifies the existence of a program.

Evaluation compares alternative methods of delivery. The purpose of the investigation will determine the indicators used for the output and input of a program.

1.7 Cost-benefit and Cost-effectiveness

Choosing between available options is made possible through evaluation of the alternatives in a way that facilitates comparison. Analysis requires that goals and objectives are made explicit, consequences of alternatives are weighed as objectively as possible, and that a systematic process is developed for decision-making. Boggs (1973) terms this "operations-research" and defines this as "the application of scientific methods and techniques to the study of complex systems for the purpose of 1) describing the system in order to understand it better and, 2) selecting one of several alternative courses for future action." Cost-benefit analysis and cost-effectiveness analysis represent two examples of operations-research used in the health field. Warner and Hutton (1980) describe these analysis as attempts to weigh logically the pros and cons of a decision in order to establish the appropriate balance between the costs of care and the amount and quality of care.

Crystal and Brewster (1966) attribute the following uses to these analyses;

1. The selection and development of programs along lines which will assure the greatest return for investment in health services.
2. Maximize the efficiency of both the programs which serve people and the administrative procedures which these programs dictate.

Boggs (1973) includes;

3. Its value for impressing federal and state legislators with the merits of the proposed health programs. "Legislators are more likely to fund a program which is based on sound technics of cost-effectiveness than one defended by opinion only."

"An important value is cost-benefit analysis. Much has been written about this ranging from strenuous moral objections to putting money value on human life and happiness to an affirmation that a decision which is not supported in cost-benefit terms cannot be corrected" (World Health Organization, referred to by Stead, 1977). Cost-benefit analysis is a formal and systematic way of selecting between alternative investments in public projects in which the benefits of a program are measured in monetary terms and related to the costs of achieving them (Klock, 1980). Cost-benefit analysis aims to do in the public sector what supply and demand analysis accomplishes in the private sector (Klarman, 1982, referred to by Horowitz and Heifetz, 1979). The cost-benefit approach examines the value of a project to society, not merely the most profitable alternative for a single person or group (McGuire, Henderson and Mooney, 1988, p. 75).

Cost-benefit studies are appropriate wherever resource-allocation decisions have to be made. Niessen and Douglass (1984) suggest that cost-benefit studies be concentrated where the reward is likely to be the greatest. Cost-benefit analysis includes all costs and benefits of a program "to whomsoever they accrue" and over a specified period appropriate to the program being analysed.

When the costs and benefits have been determined for various alternative activities they can be ranked according to the magnitude of the difference between the benefit and the cost, or as a ratio:

$$\text{cost-benefit ratio} = \frac{\text{cost}}{\text{benefit}}$$

Both benefit and cost are expressed in terms of monetary value (Leverett, Handelman and Iker, 1977). Either expression is known as the efficiency measure. The total costs of a disease per case serve as the measure of benefits derived from preventing that case (Klarman, 1965). Stead (1977) suggests that prevention should cost about half as much as the treatment that is saved. This would provide a cost-benefit ratio of 1:2.

To analysis the cost-benefit of a service the following possibilities must exist (Williams, 1974);

1. To separate one service from another service in a sensible way.
2. Various alternatives are available.
3. The ability to estimate the outcomes associated with each alternative service.
4. Valuation of the outcomes is possible.
5. Cost of the outcomes can be estimated.
6. Costs and benefits can be weighed against each other.

Boggs (1973) notes that ease and precision are enhanced when a limited number of variables are involved. In his experience, when many types of benefits and many different beneficiaries are included in an analysis, double-counting of benefits is difficult to avoid.

Cost-benefit analysis is concerned with medical or humanitarian benefits as well as with more material benefits. Medical benefits take the form of improved social function and absence of pain and distress. Material benefits for example would deal with the productive capacity of working individuals (Williams, 1974). A variety of benefit measures have been used in cost-benefit studies. Indicators that relate directly to health conditions of people avoids the incorporation of assumptions into the

analysis. Williams advises concentrating on indicators of social functioning as the key to benefit measurement.

Indirect and intangible benefits and costs that are difficult to quantify are left out of the analysis (Niessen and Douglass, 1984). Projects with abstract effects or outputs, the worth of which depend on value judgments, may not be accurately represented in the cost-benefit analysis. "In order to avoid the dilemma of assigning costs to indirect and intangible benefits, one may use cost-effectiveness analyses to determine the least expensive way of achieving a stated objective." (Horowitz and Heifetz, 1979)

"A confluence of contributions from such disciplines as engineering, physics, mathematics, theory of probability, and economic theory gave birth to the so-called cost-effectiveness analysis" (Boggs, 1973). Cost-effectiveness analysis is used to compare alternative means of achieving a desired outcome (Mitchell and Murray, 1989). It has the advantage that the outcome or benefit need not be defined in monetary terms. Yet the final outcome must be equivalent. In cost-effectiveness analysis, the costs are calculated in monetary terms while the benefits are measured in other terms (Klock, 1980, Niessen and Douglass, 1984). The units are dependant on the nature of the investigation. Only those parameters relevant to the system are incorporated, although in some cases it is difficult, or at times even impossible, to include all pertinent factors (eg. political constraints) (Tzukert, Sgan-Cohen and Call, 1986). In 1973, Boggs described the cost-effectiveness analysis as having been established approximately 20 years earlier for use in the research for defence at the beginning of World War II.

Crystal and Brewster (1966) view cost-effectiveness analyses as not being concerned primarily with cost reduction but with optimization of an approach to a specific goal or set of goals. These authors see this analysis as directed by two basic economic considerations:

1. A minimum expectation that in either social or economic terms, for the program being undertaken, there will be a dollar of return for each dollar of investment.
2. An optimal expectation that one dollar plus some additional increment of economic or social return will accrue for each dollar of investment.

Steps required in the development of a cost-effectiveness analysis are (Crystal and Brewster, 1966);

1. The establishment of the short and long range objectives of the program.
2. The alternatives available.
3. The resource needs for each alternative.
4. Cost-effectiveness models for each alternative.
5. Determination of the criteria to be used for the selection of the preferred alternative or alternatives.

In a cost-effectiveness study, benefits are held constant. Boggs (1973) believes that this is acceptable when;

1. The alternatives generate the same benefits.
2. The option of providing no treatment is not considered.

The cost-effectiveness model requirements includes measures of effectiveness, operational use, personnel and equipment cost, and consideration of cost factors. "The cost-effective technique is that which has the least cost out of the set that is relevant for the task in hand" (Culyer, 1976, p. 57). The cost-effective technique is not necessarily socially efficient since it always possible that we are doing something we should not be doing even if we are doing it in a highly cost-effective way. Cost-effectiveness tells us nothing about whether something should be done at all or, if it should be done, how much of it should be done. Warner and Hutton (1980) note that other factors, such as economic incentives, political concerns, etc., may dominate consideration of cost-effectiveness resulting in such analysis having little impact.

Cost-benefit (CBA) and cost-effectiveness analyses (CEA) are applicable in different situations. Crystal and Brewster (1966) state that cost-benefit analyses are appropriate when the magnitude of a disease or problem is to be measured, while cost-effectiveness studies estimate the anticipated return for the various alternatives. Mooney (1986, p. 15) states that the technique of cost-benefit considers how to maximize the benefit from available resources while cost-effectiveness considers how to meet a particular objective at least cost. Warner and Hutton (1980) analysed the growth and content of the health care CBA/CEA literature covering the period 1966 through 1978. During the period in question, growth of the

health care CBA/CEA literature was found to increase by a factor of 14 to 18 in comparison to a factor of 0.6 for total literature cited in the Index Medicus during the same period (Fig. 3). Cost-effectiveness analysis was found to be gaining acceptance relative to cost-benefit analysis. The authors suggested analysts use CEA because it is easier for the economic layperson to understand and to perform than CBA. Studies with a diagnosis or treatment focus increased more rapidly than those with a prevention theme.

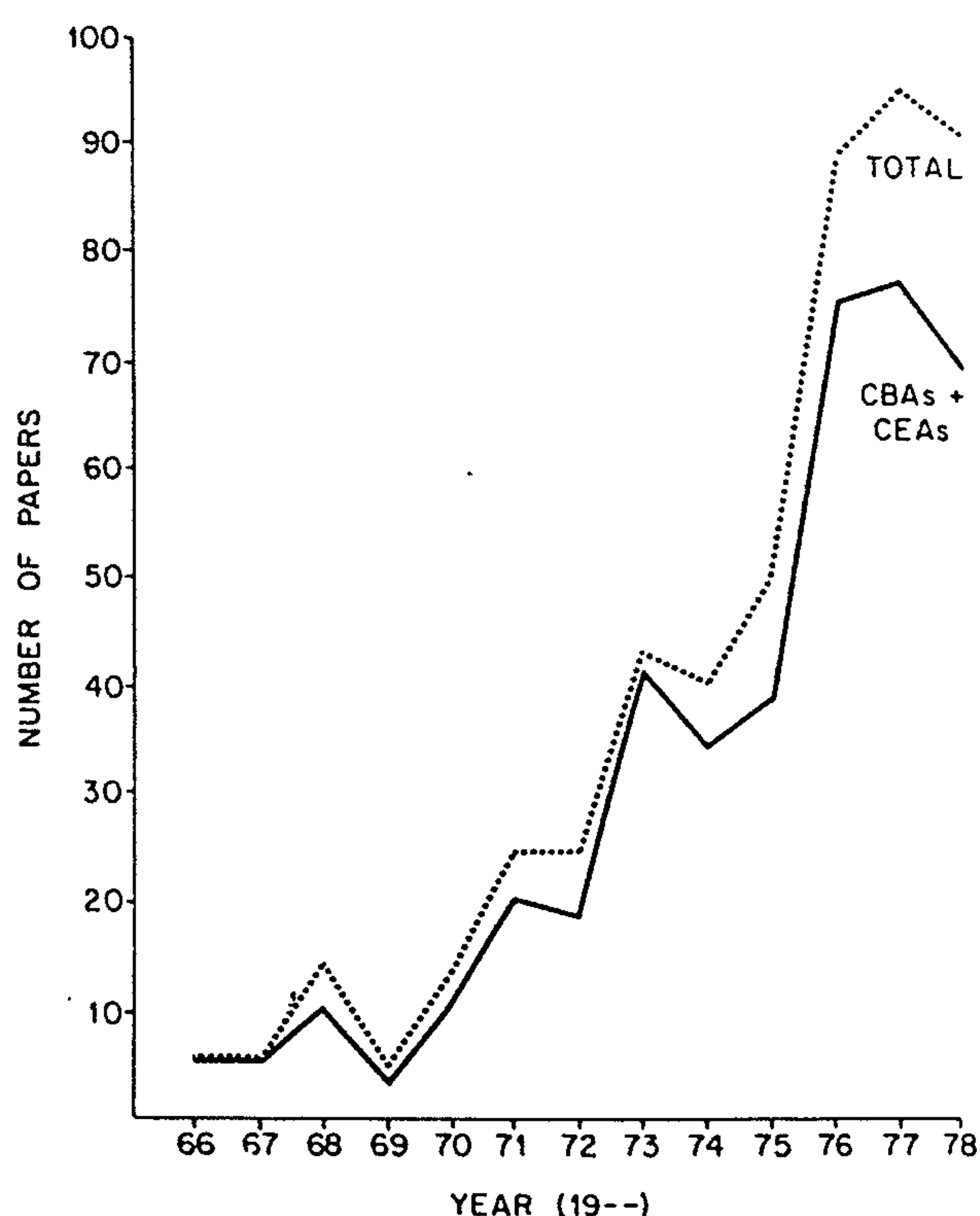


FIGURE 3

Growth of health care CBA/CEA literature for the period 1966 to 1978 (Warner and Hutton, 1980).

Yule, van Amerongen and van Schaik (1986) grouped economic studies in dentistry into three main categories: demand analyses (including the effects of out-of-pocket payments and insurance systems on demand), supply analyses (including the study of production functions and

remuneration systems) and the economic evaluation of specific treatments and care programmes. These authors considered that CEA was limited in that it required a detailed specified objective. It is not applicable if the form or level of the benefits from the alternatives under consideration differ in any significant respect. Another limitation is that it does not tell us whether the objective itself is worth pursuing. CBA attempts to do this by expressing all the costs and benefits of a project in money terms so as to allow their direct comparison. Cost benefit analysis addresses questions of social efficiency and cost effectiveness analysis addresses technical efficiency (McGuire, Henderson and Mooney, 1988, 90).

In summary, cost-benefit and cost-effectiveness analysis provide a systematic method of selecting between alternatives. In a cost-benefit analysis, benefits and costs are expressed in monetary terms. Difficulty in assigning dollar values to indirect and intangible benefits has lead to the cost-effectiveness analysis being favoured in the area of health care. In a cost-effectiveness analysis, the outcome or benefits are held constant and need not be defined in monetary terms. The cost-benefit analysis examines the value of a program to the community, while cost-effectiveness analysis ensures technical efficiency.

2 Need and Demand

Cooper (1979), referred to by Yule (1984), distinguishes between wants, needs and demands for dental care. 'Wants' are described as patients' perceptions of their own dental care needs. These depend on their oral health status, their perceptions of what is normal and what the possible benefits are, and factors such as social class and education. 'Demand' was described as wants which the patient turns into actions in the form of seeking the assistance of a dental practitioner. Need is distinct from both wants and demands. Culyer (1976) subscribes to the conception of need as being determined crucially by the judgement of a third party. Culyer, Lavers and Williams (1972), referred to by Culyer (1976, p. 13), have suggested that the term not be used in relation to public policy because of its ambiguity. Sax (1984, p. 197) defines "need" in terms of the amount of care that experts believe people should have to remain or become as healthy as possible, based on current knowledge and values. Drummond and Mooney (1982) consider the the only need that is absolute is the need to banish the view that the health service should be about meeting total need.

Sax (1990, p. 61-62) distinguishes between normative need and felt need. Normative need is the care considered necessary by experts or administrators based on experience. Felt need is that need expressed by a population, not accompanied by a willingness to pay. It differs from the economic concept of demand, which is a want for a service or good supported by a willingness to pay for it.

Culyer (1976, p. 19-22) describes the following characteristics of demand as;

1. Not all those who are "sick" demand medical care.
2. Sickness relates to social class. The population in the lower socio-economic groups usually have a higher incidence of sickness. As low-income societies become richer they tend to become healthier, at least up to the point at which the consumption effects begin to dominate the other effects that tend to promote better health.

"Only if patients perceive the benefits from professional care to exceed the costs will they seek care initially, and only if they perceive the benefits from undergoing treatment to exceed the costs will they comply with the course of treatment prescribed by their dentist." (Yule, 1984)

Need is expressed by patients who seek consultation. Unless a perceived need exists, patients will not contact their physician and there is little prospect of their receiving treatment. Yule (1984) discusses the limitations of using patients perceptions of need, or demand, as the sole means of allocating resources in dentistry. Patients were seen as having insufficient information to assess adequately the benefits from dental treatment. In addition, a willingness and ability to bear the expected costs of dental care is required of the patients. The demand for treatment of patients in low income groups was seen as being more responsive to changes in money and time prices. For this reason, using demand as an indicator of need tends to exclude those who regard themselves as being in need, but cannot afford treatment.

The dental care professionals concept of need was also seen as being limited. Sheiham (1982), referred to by Yule (1984), stated firstly, that dentists' assessments of treatment needs are not value-free. Secondly, clinical assessments of need ignore the functional and social dimensions of dental disease. Sax (1984, p. 197) stated that limitations in the knowledge of a population's state of health were reasons for not basing planning solely on estimates of need, due to the likelihood of providing either too few or too many resources. Sax continues to say that although free provision of health care provides equal access to the health care system without regard to ability to pay, consumption will be encouraged towards a level at which the marginal utility of the good to the consumer approaches zero. "In that case, if health care is supplied without rationing, demand will be inefficiently high. The dominant ethic of the profession is to do as much good for every patient as is within the practitioner's capacity."

What types and what degree of malocclusion should receive treatment is a question which is faced by physicians in the public health field (Fisk, 1963). Culyer (1976, p. 108-109) proposes a system where the priority of the patients is indexed. Short term efficiency could be achieved by "admitting patients in such a way as to maximize the daily reduction in

the total index of all waiting patients." Culyer lists the factors which should determine receipt of medical care as;

1. Factors related to income. Those with low earning power face lower real prices for access to medical care. Allocation by waiting discriminates more in favour of the poorer sections of the community.
2. Whether or not an effective and accepted regime of care exists.
3. Clinical urgency of a case.
4. The total characteristics of the patient should be considered.

As part of the development of a comprehensive dental programme for the children of the Province of British Columbia, Canada, Mc Combie (1979) conducted a survey in 1974 to assess the current and optimum annual utilization of dental services. It was noted that the relative child utilization rates by region exactly correlated in rank order with the relative dentist-total population ratios. A target was to raise the annual utilization rate from 60 percent to over 90 percent. Data presented for unmet need was recognized to comprise two elements, 'backlog' needs and annual 'maintenance' needs. The estimated cost of meeting the need was provided for four major types of delivery systems: a private practice model, a combined private practice and public service model, a public service programme based on large paediatric clinics and a school-based public service. The private practice model proved to be the most expensive delivery method, and the school-based public service model the least expensive. The relative costs were unaltered when the costs of education of the auxiliary personnel necessary to provide and maintain these services were considered.

Jenkins, Feldman and Stirrups (1984) highlighted the need to consider the dental awareness of the population considered. These authors divided patients attending the Orthodontic Department of Glasgow Dental Hospital over a 5 year period into social class. These authors found that in the lower social classes there were proportionally fewer patients with normal antero-posterior skeletal pattern, normal overjet, or aligned incisors. This was said to reflect a lower awareness of malocclusion in the lower social classes. It was concluded that an "increasing dental awareness among the lower social classes will result in more referrals for orthodontic advice. Thus staff and resources will need to be planned accordingly."

Fisk (1963) discussed methods of case selection in relation to malocclusion. This author considered that measurements should be based on the somatic, social and psychic significance of the malocclusion to the patient. The attitudes of the public and the relative importance that the public attaches to the varying types and degrees of malocclusion were seen as important in formulating standards for selecting those cases most in need of treatment.

Todd (1973) examined the mothers' views on orthodontics in the Child Health Survey carried out in four regions of England (the North, Midlands and East Anglia, Wales and the South West, and London and the South East). Three quarters of mothers said that it was very important to straighten teeth. 10% considered it of more importance if a girl had an orthodontic problem. The author found a large disparity existed between the number of children who had received orthodontic treatment compared to the incidence of malocclusion found by the survey dental examiners, despite treatment being available free of charge. The survey found that mothers do not recognize conditions which dentists consider to be worthy of treatment in a large number of cases.

"Parental background, experience and attitudes, especially those of the mother, have been implicated, with the suggestion that the desire for treatment may represent family needs which are unrelated to the severity of the child's dentofacial problem." Baldwin and Barnes (1966) reported on the psychological appraisal of the patient and his family in over 250 consecutive cases selected for treatment. The psychological significance of such factors as achievement need and social aspiration, disturbed self-image and identification with the child's malocclusion, as well as displacement of unresolved family problems onto the patients' orthodontic problem and treatment was demonstrated in the motivation of parents seeking treatment for their children.

Prahl-Andersen (1978), following a review of the literature relating to need for orthodontic treatment, concluded that the orthodontist, the patient, the significant others, and society at large probably define and interpret malocclusions and crainiofacial malformations quite differently. The author recommends that functional problems should be given priority over cosmetic problems. "Yet, it should be realized that a

malocclusion may become handicapping not because of the functional disability, but because it may adversely affect social relationships."

At what point, or at what "degree of severity" a malocclusion becomes "harmful to health", cannot be precisely determined (Godfrey, 1983). Although many serious attempts have been made to quantify severity of malocclusion, none has proved sufficiently objective to establish confidence in quantifying the health care requirements. Freer and Olive (1976) assessed the orthodontic need of 522 Brisbane school children. These observers judged 22 per cent of these children to have "severe handicap, treatment highly desirable", with a further 55 per cent having "definite malocclusion but treatment elective". Godfrey carried out a survey of school children at Tamworth, New South Wales in 1963, which showed that 50 per cent had moderate malocclusion, requiring treatment of a simple nature, whilst the remaining 20 per cent had a complex malocclusion needing treatment by a specialist (personal communication). A similar survey by Peel in 1973 produced comparable figures. A commonly accepted estimate of need for treatment is 50 per cent of 12 year old Australian children (O'Connor and Lee, 1979).

In summary, demand for treatment is determined by the patient and need is determined by a third party, often a health professional. Demand is associated with a willingness to pay and is therefore income dependant. Providing treatment free of charge will increase demand so that case selection is required. Malocclusion has both a physical and a psychological impact on an individual and both these aspects deserve consideration in deciding who should receive treatment.

3 The State Orthodontic Service

The provision of orthodontic care in New South Wales was examined by Godfrey (reported by Wright, 1984). At this time, the number of orthodontists employed in the private sector was in excess of 60, an increase of over 40 from 1964. The majority of orthodontists operated within the Sydney metropolitan area. Approximately 13 practised outside of Sydney. 30 country centres throughout the State (except for the Far West) had regularly visiting private orthodontists. The same 20 year period did not see a comparable growth in the number of public employed orthodontists. Attempts to recruit additional public orthodontists or replace resignations had been unsuccessful due in part to the financial rewards of private practice being more attractive. This information was used to support a proposal for salaried orthodontic registrars, involved in a university based course, who would provide treatment for eligible patients.

The State Orthodontic Service of New South Wales was established at the end of 1987 as the result of collaborative planning between the New South Wales Department of Health, the United Dental Hospital of Sydney, and the Department of Preventive Dentistry of the University of Sydney (Godfrey, 1989). The aims of the Service were;

1. To meet a growing demand for orthodontic care within the public sector which could not be met with existing resources.
2. Provide for the orthodontic needs of patients remote from present facilities.
3. To recruit and retain orthodontic specialists in the public sector. This is to provide for continuity of patient care and more cost-effective treatment.

These aims were proposed to be met by employing orthodontic registrars (with a background in public health dentistry) who would be willing to continue their involvement with public patients following completion of their orthodontic training. These registrars would be posted to satellite clinics for supervised experience, during their three years of specialist

training. Field supervision was necessary in order to satisfy the academic program within which the registrars were to work.

The State Orthodontic Service is an integral part of the Master of Dental Science (Orthodontics) academic program. It is composed of a central clinic and satellite clinics. The United Dental Hospital of Sydney represents the central clinic. The formal course structure, involving tutorials, clinics and research time, is provided at the Hospital. The geographically isolated areas are serviced by the satellite clinics. Each satellite clinic operates one week out of four. Satellite clinics are visited by two registrars. These clinics are visited by the same pair of registrars for the major part of each registrar's term of appointment (between 24 and 30 months out of three years of academic program).

The sites of the satellite clinics were determined by consideration of the following factors;

1. The orthodontic needs of the area.
2. The availability of clinical support, comprising:
 - a) personnel, including public health dental officer and auxiliary staff.
 - b) clinical facilities, including at least two available clinic positions (preferably three) with all usual services, including X-ray.
 - c) dental laboratory facilities for plaster work and cold-cure acrylic finishing.
 - d) records storage and office services.
 - e) Storage for special instruments and materials.
3. At least one, locally residing specialist who is able to act as supervisor for the visitation week.

The objectives of the State Orthodontic Service are (Godfrey, 1987);

1. To satisfy the orthodontic needs of eligible patients in the State of New South Wales.
2. To meet the subject's major expectation of treatment.
3. To provide treatment that is acceptable and manageable by the patient.
4. To remove the need for, or reduce the amount required of, any follow-up orthodontic care.
5. Train future specialists.
6. Provide in-service training and consultation for public dental personnel.

7. To provide a trial for the provision of orthodontic care community wide.

In June, 1987 the Chief Dental Officer to the New South Wales Minister for Health, Dr. W. Winspear, and Associate Professor Godfrey visited Royal Newcastle Hospital, and Dubbo (Orana-Far West Health Region) to assess their suitability as locations for the first satellite clinics. Selection of four orthodontic registrars was made in September, 1987. The registrars commenced initial training in November of that year. Following an examination of available equipment, supplies for the satellite clinics were purchased during the period January-April, 1988. The orthodontic clinics at Royal Newcastle Hospital and South Dubbo School Dental Clinic were opened in April, 1988, the two registrars working at each location for one week in each 4 weeks. In October, 1988 one additional trainee (supported by living-away allowance) was appointed to commence the operation of orthodontic clinics, each at Wagga Base Hospital and Tamworth Base Hospital. During this same month, two additional orthodontic registrars were selected and appointed to the United Dental Hospital and to participate in the orthodontic Master's degree commencing in February 1989. These registrars commenced their service in the satellite clinics in July, 1989.

Presently, four satellite clinics are currently in operation, each serviced by two students. These are located at Newcastle, Tamworth, Wagga and Dubbo and are in operation one week of every four. Associate Professor Keith Godfrey was appointed in 1987 to plan and then to implement the Service. Subsequently he has been appointed the director of the Service.

The orthodontic unit at Royal Newcastle Hospital services people with a health care card from the region bounded by Gosford, Scone, Muswellbrook and Kempsey. Eligibility for a health care card is determined by means testing carried out by the Department of Social Security. Patients reach the Department by way of referral from the Royal Newcastle Hospital dental officers, the school dental service, private general dental practitioners and orthodontists. The clinic at Newcastle operates a 4 day-week, comprising 7 clinic periods and one for office work and other preparations.

4 Orthodontic Treatment

A consideration of the clinical effectiveness of orthodontics is important for an analysis of cost-effectiveness. The effect of malocclusion will be examined in relation to dental health and psychological well-being. Lastly, the effects of orthodontic treatment will be reviewed.

4.1 Malocclusion and Dental Health

Malocclusion has been linked to plaque-related dental disease and pathology where occlusion is implicated as an etiological factor. " It is assumed that the mechanical removal of bacterial plaque, the major etiological factor in the development of chronic gingivitis, from malaligned teeth demands greater patient dexterity, which may not be achieved under normal circumstances. Furthermore, excessive occlusal forces placed on maloccluded teeth may result in accelerated periodontal breakdown." (Shaw, Addy and Ray, 1980). Gingival damage could result from the direct trauma of food or teeth. Orthodontic treatment has been justified on the consideration that correct proximal contacts and axial inclination of the teeth provide effective protection from food impaction and that malposed teeth may be associated with thin interproximal septum, dehiscence or fenestration which will increase the possibility that these teeth will succumb to periodontal breakdown (Kessler, 1976).

Studies examining the relationship between malocclusion and periodontal disease have produced conflicting results (Shaw, Addy and Ray, 1980; Ainamo, 1972). In a review of the literature, Shaw, Addy and Ray (1980) found considerable variation in the study groups used and the criteria for measurement employed which made comparison between studies difficult. These authors stated that many of the conflicting and contradictory findings arise from these variations in study design. Ainamo (1970) has shown that there is considerable variation in the

occurrence of periodontal disease in the different regions of the mouth, and that mean values from individual patients seldom represent relevant parameters for evaluation of potential correlations between different intraoral variables.

Ainamo (1972), examined the presence and degree of displacement or rotation for 4,316 fully erupted teeth of 154 Army recruits aged 19-22 years. The amount of plaque, gingival inflammation and calculus was determined clinically, and the amount of lost tooth attachment, in millimeters was determined clinically and radiographically. Ainamo found a positive association between malalignment and periodontal disease when oral hygiene was moderate and only in the anterior region. This lead to the conclusion that malalignment of the teeth does not enhance periodontal breakdown, as such, but that it decreases the effect of average oral hygiene measures. From this finding it was reasoned that exceptionally good oral hygiene measures or no oral hygiene measures at all, are thus less likely to reveal an association between malalignment and periodontal disease. "It seems justified to conclude that until more effective oral hygiene measures have been developed, malalignment of the teeth will, for most people, remain an aggravating factor in the process of periodontal breakdown" (Ainamo, 1972).

Buckley (1980) examined the relationship of irregular teeth and plaque, calculus and gingival disease in three hundred teenage subjects, evenly divided by age and sex. In the female population, the amount of plaque and prevalence of gingival disease was low compared to the male subjects. A relationship between irregular teeth, plaque and gingival disease existed in the female sample. No relationship was found in the male subjects despite a similar degree of tooth irregularity between male and female subjects.

Alexander and Tipnis (1970) investigated the effects on gingival health of tooth irregularity, and the degree of overbite and overjet in 200 dental students and 200 patients. Dental students with irregular teeth were found to have higher mean gingival inflammation scores than those who had regular teeth, but the difference was not statistically significant. In the patient group, irregular teeth had significantly higher mean gingival inflammation scores than regular teeth. Both groups showed little

evidence that the degree of anterior overbite and overjet had a significant effect on either the prevalence or extent of gingival inflammation.

Hellgren (1956) employed both inter-subject and intra-subject analysis in order to determine the relationship between crowding and gingivitis in 112 boys aged between 14 and 19. Inter-subject analysis found an association between crowding and gingivitis. No association was found in the intra-subject analysis. This lack of association was explained by the slight amount of crowding present on the affected side in most of the subjects. The consistent tendency in the inter-subject study for the gingivitis score to increase with the severity of the crowding lead the author to conclude that an association did exist between crowding and gingivitis. The results of the inter-subject study are represented graphically in Fig. 4. Hellgren felt there is probably some justification for orthodontic treatment of crowding as a prophylactic and therapeutic measure in respect of periodontal disease provided the advantages and disadvantages of each case are assessed individually.

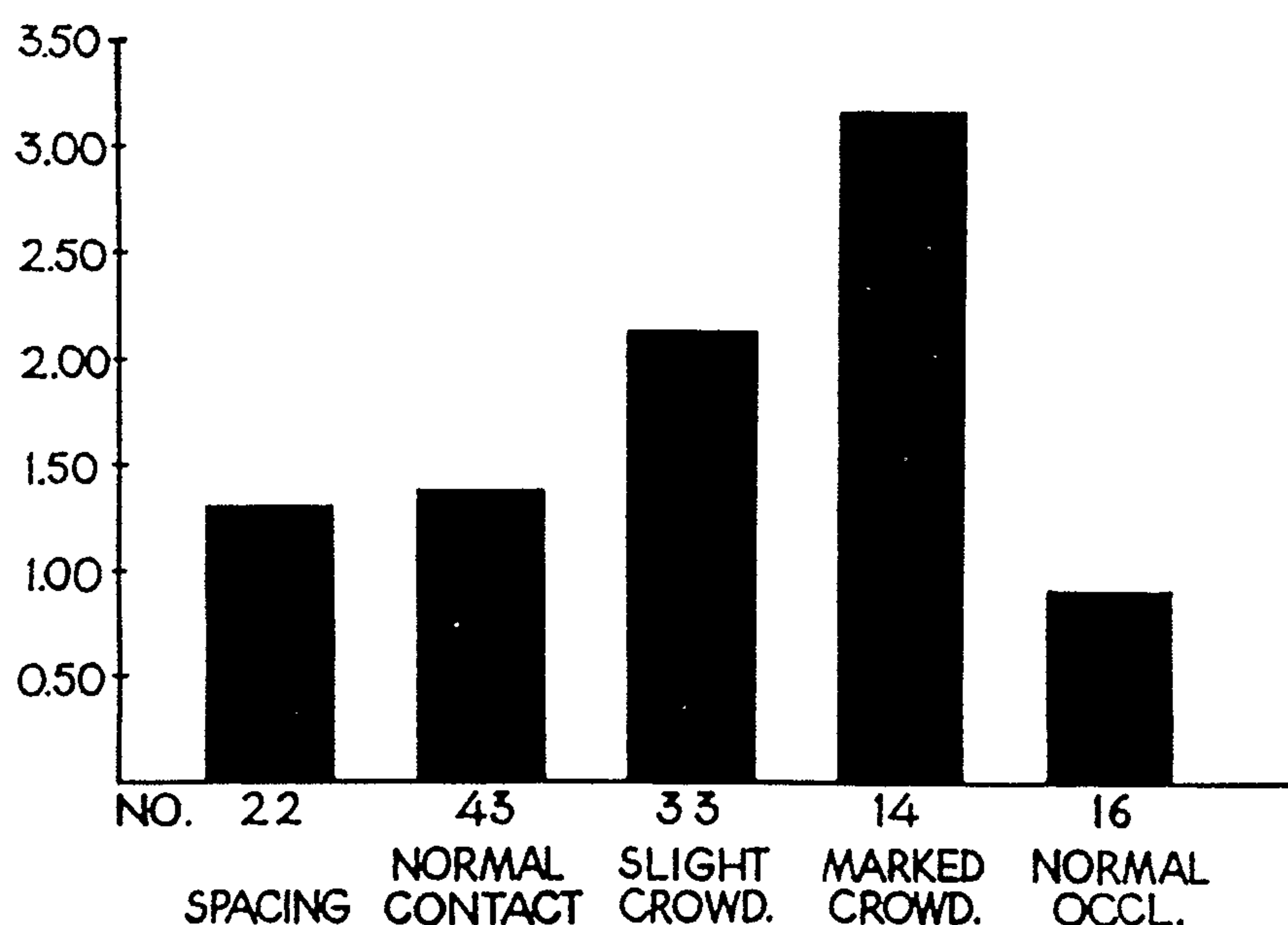


FIGURE 4

A histogram showing the mean values of the gingivitis score for the different groups of crowding considered (Hellgren, 1956).

Gould and Picton (1966) examined eighty people, the sample having a range of ages, socio-economic groups and oral health. An orthodontic and periodontal assessment was made of each subject. Increased overjet, overbite and spaced teeth or teeth with poorly shaped contacts were associated with a poorer periodontal condition. No correlation was found to exist between periodontal disease and rotated, instanding, outstanding, mesially, or distally tipped teeth. Crossbite in the buccal segments was found not to be associated with periodontal status.

Beagrie and James (1962) examined the relationship between posterior tooth irregularity and periodontal disease on 42 patients aged 15 to 23. Subjects with unsatisfactory oral hygiene were not included in an effort to eliminate poor oral hygiene as an influential factor. There was no apparent association between disease and axial inclination of the teeth, nor was there an association between disease and displacement. A rotated tooth appeared to have a lessened susceptibility to disease. The authors concluded that no correlation exists between disease score and posterior tooth irregularity. "The part played by tooth irregularity may well be less than is at present generally accepted, at least in mouths with good oral hygiene."

Poulton and Aaronson (1961) measured the incidence of malocclusion and periodontal disease in 908 male subjects to establish whether a link exists between these conditions. Recordings were only made on the right side. These authors found a strong correlation between occlusion and periodontal status. Further investigation was suggested to establish if certain occlusal traits affected periodontal health more than others. Geiger and Wasserman (1977) examined the relationship between teeth in "normal" occlusion and those in various types of cross-bite. These teeth were compared for periodontal destruction, gingival inflammation and mobility. This study was complicated by the small number of teeth available for analysis. No consistent relationship was found between cross-bite and the periodontium. The authors did note that instances are seen in clinical practice where a cross-bite relationship undoubtedly contributes to the severity of the periodontal disease of the tooth and that such cases are obscured in large population studies.

Ramfjord and Ash (1981) reviewed the literature relating occlusion to the etiology and treatment of periodontal disease. These authors concluded that trauma from occlusion plays a minor role in the pathogenesis of early to moderate periodontitis. Active trauma tends to accelerate bone loss and pocket formation depending on the presence of local irritants and inflammation. No significant relationship exists between malocclusion, classified according to Angle, and the severity of periodontal disease but malocclusion may indirectly affect periodontal health when it is severe enough to interfere with plaque removal. Ramfjord and Ash listed conditions where orthodontic treatment may facilitate periodontal therapy as;

1. Impinging overbite with gingival trauma.
2. Lack of lip seal and mouth breather's gingivitis.
3. Functional anterior crossbite.
4. Tipped teeth.
5. Severe malposition of teeth in relation to the alveolar process.
6. Malposition of teeth in gingival fibromatosis.
7. Extensive openbite.
8. Extruded anterior teeth with advanced periodontal disease and teeth with infrabony pockets.

Dickson (1974) compared overjet, overbite and lower incisor crowding in 4 groups in an effort to determine the link between malocclusion and tooth loss. 100 sets of models were available from each of the following groups; adults over the age of 65 years who had 24 or more teeth, school children, dental students and naval personnel. Increased overjet or overbite was not associated with loss of incisors. There was no increased possibility of tooth loss even when the two factors of overbite and overjet were combined. Lower incisor crowding was comparable for all groups and therefore could not be implicated as a cause of tooth loss.

Kessler (1976) is of the opinion that there is no advantage in treating a deep overbite where the soft tissues are not being traumatized. This author states that where there is a true Class III skeletal discrepancy, the reverse deep overbite rarely causes symptoms to the temporomandibular joint or the periodontal investing tissues.

Emslie (1958) examined the incisal relationship of 804 patients referred for periodontal treatment and compared the findings to 118 controls. The amount of incisal overbite was not found to be an important etiological factor in periodontal disease. There were a few cases of extreme overclosure which resulted in trauma to the gingiva of the opposing jaw, although these were too few in number to affect the result. An excessive overjet was found to be associated with inflammatory periodontal conditions, explained by the lack of lip seal that is often present in these cases. Long clinical crowns of the incisor teeth, and a large inter-gingival distance between the upper and lower labial gingiva when the teeth were in centric occlusion were suggested as predisposing factors in Vincent's disease.

Orthodontic treatment may be conducted in conjunction with periodontal treatment in the belief that more favourable bone levels and contours will be obtained. Changes of osseous topography might be accomplished by moving teeth into an area of the arch that has a greater volume of bone, depressing extruded teeth and repositioning periodontally migrated teeth. Kessler (1976) states that "there is sufficient justification to say that osseous defects may be reduced or shallowed out by orthodontic treatment and that teeth can be placed in positions which enable subsequent periodontal, prosthetic, and restorative procedures to be accomplished much more readily."

Few studies have been performed to establish if a link exists between malocclusion and caries (Shaw, Addy and Ray, 1980). Adler (1956) reported on an examination of 4,876 subjects aged between 16 and 18 years in order to determine if there was an association between caries and malocclusion. The author found that groups of individuals with maloccluding dentitions display higher DMF indexes generally than those with normal occlusion. It was proposed that these findings point to the role of hereditary factors in caries susceptibility. Adler stated that these results may support dental caries as a causative factor of malocclusion.

Miller and Hobson (1961) conducted a ten year serial investigation of dental conditions in children aged 3 to 15 between 1950 and 1960. Caries and gingival health were assessed clinically at four intervals during this time. These authors found children with a malocclusion had poorer

gingival condition and higher caries rates than children with normal occlusion.

Katz (1978) conducted a comprehensive dental examination on 486 patients aged between 16 and 45 in order to establish if a link exists between various occlusal indices, cephalometric measures, periodontal disease and caries experience. The study tended to exclude persons in the upper range of severity for occlusion and periodontal disease. No relationship of clinical significance was shown between the measures of the occlusion and periodontal disease. An inverse relationship was established between caries and upper anterior crowding. Katz was cautious in interpreting the results due to the nature of the subjects studied.

Hixon, Maschka and Fleming (1962) compared two groups, one group composed of subjects with an excellent occlusion and the other group containing subjects with severe malocclusions, to determine if an association exists between malocclusion, caries experience and masticatory efficiency. The malocclusion group were found to have a greater caries experience. The authors examined a subsample of 20 selected cases with extremely irregular proximal contacts and found that caries activity was significantly less on the proximal surfaces of the upper posterior teeth with irregular contacts than where the contacts of adjacent teeth had a satisfactory relationship to each other. Only in the lower anterior area did the teeth with irregular contacts show a tendency toward more caries. Individuals with full-cusp Class I and Class II malocclusions were found to pulverize peanuts less well than those with excellent occlusions. Generalization was limited due the wide variability between individuals.

The etiology of temporomandibular disorders is presently recognized as multifactorial (Egermark-Eriksson, Carlsson and Magnusson, 1987). The role of malocclusion in the etiology of these disorders is contentious. Mohlin and Thilander (1984) examined 717 subjects in an effort to determine the relationship between malocclusion and mandibular dysfunction. The results showed that Angle Class III malocclusions were strongly correlated with the severity of clinical symptoms. Crossbite and frontal open bite were associated with mandibular dysfunction.

Bush (1985) examined 298 dental students in order to determine if a relationship exists between malocclusion and masticatory muscle and TMJ tenderness. Angle's classification, occlusal contacts at various jaw positions and tenderness of the masticatory muscles and TMJ to palpation were recorded. This author found no relationship between Angle's classification or specific occlusal contacts and muscle and joint tenderness. 93% of the subjects exhibited a slide between CR and CO leading Bush to contradict the notion that a minor slide contributed to marked clinical symptoms of dysfunction.

Riolo, Brandt and TenHave (1987), in a cross-sectional study of 1,342 subjects aged between 6 and 17 years, found an association between certain features of occlusion and temporomandibular joint (TMJ) dysfunction. Dysfunction was defined as pain associated with the TMJ, limited mandibular movement and sounds during mandibular movement. An association was found between joint and muscle tenderness and open bites, excessive or negative overjets, older subjects with a Class II or cusp-to-cusp molar relationship. Joint noise was found in association with buccal crossbites, Class II molar relationships and negative overjet. The strength of the statistical association was found to increase with age. These results must be viewed with caution as the sequence of cause and effect cannot necessarily be determined in a cross-sectional study.

Lieberman, Gazit, Fuchs and Lilos (1985) studied the association between various occlusal characteristics and symptoms of mandibular dysfunction in 369 children aged 10 to 18 years. No correlation was found between Angle's classification, crossbite and crowding and mandibular dysfunction. Occlusal wear and abnormal overbite were found to increase significantly the presence of dysfunction symptoms. These authors explained the lack of uniformity in studies comparing occlusal traits to mandibular dysfunction as being due to inadequate consideration of etiological factors, such as age.

Helm and Petersen (1989) examined the relationship of morphologic malocclusion to mandibular dysfunction in a longitudinal study of Danish subjects. In 1965-66 malocclusion was recorded in 176 adolescents. These persons responded to a questionnaire concerning symptoms of functional

disorders in 1981, and in 1986-87 malocclusion and signs and symptom were registered. The hypothesis that morphologic malocclusion predisposes to mandibular dysfunction was refuted following examination of the results. These authors concluded that orthodontic screening of morphologic malocclusion in childhood would seem of limited value in attempts to predict risks of functional disorders in adulthood.

Solberg, Flint and Brantner (1972) evaluated the anxiety level in matched symptom and control groups (29 each). They found both groups to be relatively free of anxiety, although approximately half of the symptom group showed clinical signs of greater anxiety than that found in the matched controls. It was suggested that the half of the symptom group which showed the greatest anxiety may be a sub-symptom group where anxiety and symptoms may be linked. These authors concluded that "the TMJ disorder is a highly complex phenomenon, which has intricate interactions all within the normal range, and that its interrelation with other stomatognathic disturbances is incompletely delineated."

In summary, the link between malocclusion and disturbances in dental health is not definitive. Malocclusion is associated with periodontal disease when the oral hygiene is moderate. When oral hygiene is poor or excellent, this relationship is less evident. However, most authors recognise that aberrant tooth positions can contribute to the severity of periodontal disease, this link being obscured in large population studies. The presence of malocclusion has been linked with a higher caries incidence, although caries may have been a factor in the development of the malocclusion. Certain aspects of malocclusion, such as Angle's Class III molar relationship, crossbite, frontal openbite, occlusal wear and deep overbite, have been implicated in the development of mandibular dysfunction. This association has not been supported by others.

4.2 Malocclusion and Psychological Well-Being

The significance of a malocclusion to the patient motivates him to seek treatment. The patient's felt-need may be disproportionate to the

physical aspects of the malocclusion. "While malocclusions admittedly are strictly physical abnormalities, their impact upon the patient is almost wholly psychological" (Fisk, 1963).

Macgregor (1970) discussed the impact of facial deformity on psychological and social well-being. This author defined disability as any condition which prevents an individual from performing the normal activities of daily living. The facially disfigured often are able to perform all the tasks required of daily living and it is possibly for this reason that their inability to lead normal lives tends to be overlooked. Macgregor is of the opinion that defects of the face can be among the most tragic handicaps a person can have. The author studied facially disfigured patients at the New York University College of Medicine from 1949 to 1952 and concluded that "for those whose deformities evoked ridicule, bordered on caricature, stimulated jokes, and were sources of amusements, the psychological impact was exceedingly great." The circumoral area has unique social and psychological meaning. Abnormalities in this area are easily recognized with consequent disturbance of social exchange and self-image. Macgregor refers to Goffman (1963) who states that "the closer the defect is to the communication equipment upon which the listener must focus his attention, the smaller the defect needs to be to throw the listener off balance."

Secord and Backman (1959) recognized the psychological aspects in relation to a malocclusion as;

1. The effect of the patient's malocclusion on the perception of the patient by other persons. "People attribute personal characteristics to others on the basis of facial characteristics."
2. The patient's reactions toward his malocclusion and toward the way others behave toward him.

A procedure was employed involving the comparison of memory of a person's face with ratings of his face when he was present. This experiment was based on the presumption that the more accurately judges were able to rate an individual on a particular physical attribute from memory, the more salient this characteristic was. Attributes pertaining to malocclusion were scattered through the rankings from high to low, protrusion of upper teeth and straightness of teeth being ranked

low. Using another method involving identification of persons according to their impressions of personality characteristics, these authors found that sincere, intelligent, conscientious, and good-looking are increasingly attributed to persons with more correctly aligned teeth.

Terry and Davis (1976) studied the contribution of various facial components to a person's perception of facial attractiveness. 50 subjects were asked to rate 10 portrait photographs and the respective facial components. The order of importance was found to be mouth, eyes, facial structure, hair and nose, lending support to the importance of the circumoral area in the perception of facial attractiveness.

Graber and Lucker (1980) examined self-evaluation and self-satisfaction with dental esthetics of 483 children aged 10 to 13 years. This consisted of a questionnaire and a comprehensive orthodontic examination for each subject. Scores on gingival health for girls who valued their teeth and felt positively toward them were significantly better than for those who felt negatively. This behavioural correlate was not demonstrated in the male group. Subjects were found to make fairly accurate self-evaluation of their own malocclusions. Overjet and its influence on facial features was important to females, while the more localized consideration of dental crowding is important to males. The authors explained this sex difference as being due to the fact that standards for acceptable facial form are more clearly defined for females and thus deviations in dental form that adversely influence facial outline are more important to girls than to boys.

Society harbours preconceptions towards those whose physical characteristics deviate from the majority. Stricker, et. al. (1979) believe that to measure the severity of dentofacial abnormalities as a health problem it may be necessary to devise two separate mechanisms: one encompassing the disfigurement and another considering the psychosocial disability. These authors state that malocclusion or any dentofacial deformity appears to have a direct bearing upon personality structure and attitudes toward one's self. "A poor self-image may not result from malocclusion or craniofacial malformation alone but also may be a function of our society which attaches a stigma to those who are different. The victim of any malformation may receive a negative social message,

and the result may be self-devaluation." This low self-esteem may, in turn, result in signs of psychological distress, for example depression and anxiety.

Cosmetic deformity may have as devastating an impact as physical incapacitation (Macgregor, 1951). Society places profound social significance on facial appearance. Macgregor observed that the response to facial disfigurement is not always in proportion to the severity of the defect. Minor deformity may evoke marked negativity. "Such value judgements or weighing processes in the social perception are seldom based on conscious rational thinking but are largely unconscious and intuitive." Just as the response of others is not always predictable, so is the severity of the disfigurement not always in direct proportional relationship to the degree of psychic distress suffered by the individual. Each case is unique, adjustment depending on such factors as personality configuration, family and social setting.

Shaw (1981) examined the influence of various dentofacial characteristics on perceived attractiveness, intelligence, desirability as friends and likelihood to behave aggressively. Black and white photographs of an attractive boy and girl and an unattractive boy and girl were obtained and modified so that, for each face, five different dentofacial arrangements were demonstrated. The dentofacial arrangements used were normal incisors, prominent incisors, a missing lateral incisor, severely crowded incisors, and unilateral cleft lip. Each group was viewed by a different group of forty-two children and forty-two adults, equally divided as to sex. Shaw found that children with more normal dental appearance were judged more socially attractive. Dentofacial anomalies detracted more from girls' attractiveness than from boys' attractiveness. The author concluded that dentofacial anomalies of sufficient severity to mar a child's facial attractiveness may represent an important social disadvantage. The influence of dentofacial appearance on the desire to be friends is shown in Fig. 5.

Cavior and Doeckki (1973) examined the relationship between physical attractiveness, academic achievement and perceived attitude similarity in two age groups. Each age group was further divided on the basis of whether they knew the subjects in the photographs used to elicit

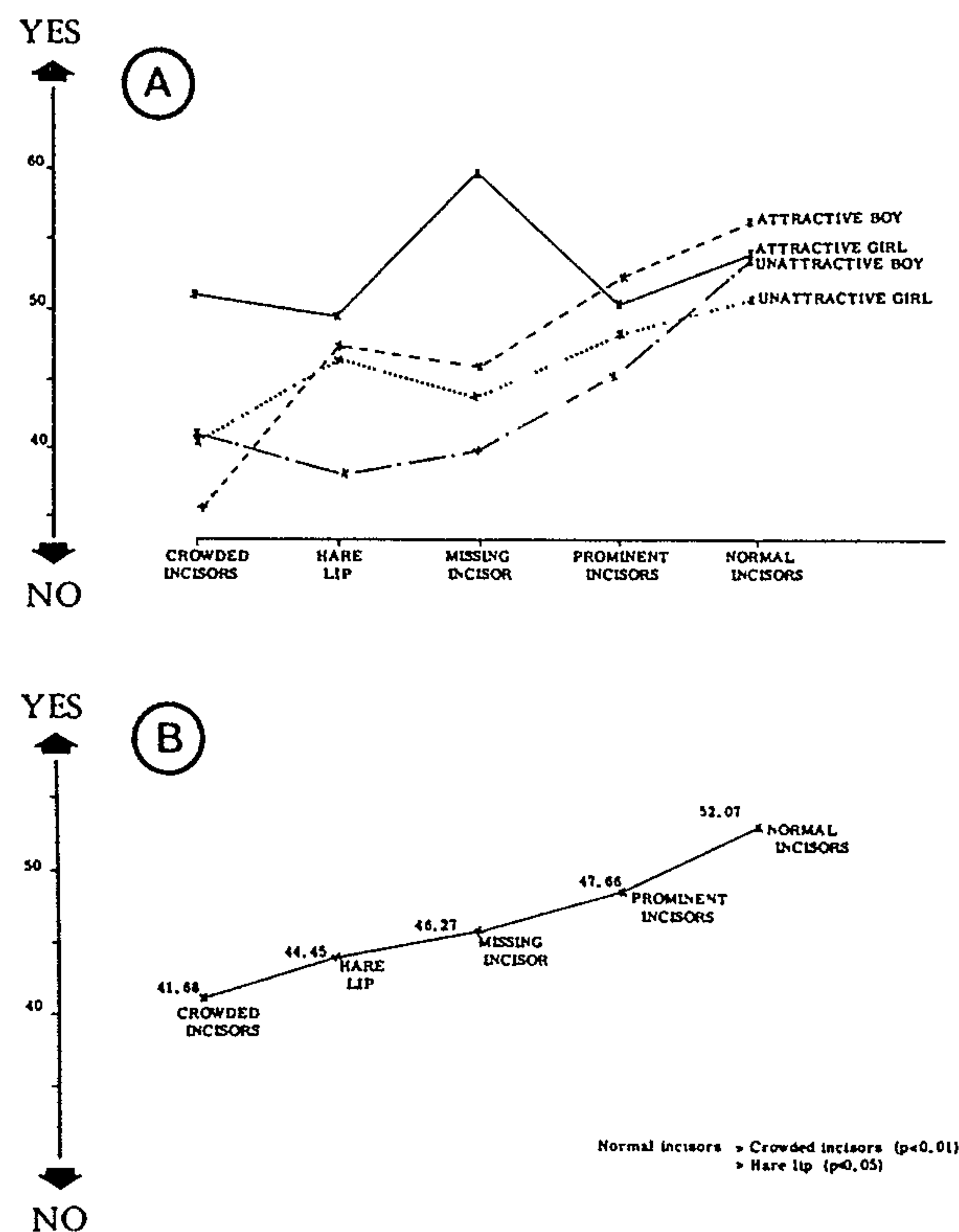


FIGURE 5

The influence of dentofacial appearance on the desire to be friends (Shaw, 1981). 'A' shows the results for each test photograph used. The averages of unattractive, attractive, boys and girls for each dental condition are shown in 'B'.

responses. The authors found a high interjudge agreement on physical attractiveness indicating that there are cultural definitions of physical attractiveness which are learned and used. Physical attractiveness was found to have a stronger effect on popularity than perceived attitude similarity. Academic performance contributed negligibly to interpersonal attraction. These authors concluded that in a social setting, adolescents place a high value on aesthetics.

Klima, Wittermann and McIver (1979) studied the relationship between orthodontic retention patients, prospective orthodontic patients, a population sample, and mothers of prospective patients with regard to body-image and self-concept satisfaction. These authors found no

difference in the perception of body image and self-concept satisfaction in patients presenting for orthodontic treatment compared with persons of comparable age in a general population. Girls scored significantly lower than the boys, and patients with Class III malocclusion scored significantly lower than other malocclusion groups, in both body-image and self-concept satisfaction.

Facial deformity has been linked to scholastic success and various explanations have been given to explain the findings. Shaw and Humphreys (1982) investigated the influence of a child's appearance on teacher evaluation. 320 teachers were asked to assess report cards, which included an attached portrait photograph. The photographs were modified portraits of selected subjects, illustrating a range of dental characteristics. The authors found that the appearance and sex of the child being evaluated play a negligible role in influencing teacher expectations.

Richman (1978) examined the effects of facial disfigurement in cleft children on the accuracy of teachers ratings of intellectual ability. 87 cleft patients, aged between 9 and 14 years, were divided into two groups, one group with relatively normal facial appearance and the other group consisting of all children with noticeable facial disfigurement. Each child's classroom teacher was asked to rate the child on a six point intellectual ability scale and results compared to an individual intelligence score for the child. These authors found that the teachers rate the intellectual ability of cleft children with more noticeable facial disfigurement less accurately than cleft children with relatively normal facial appearance. Within the group of cleft children with more noticeable facial disfigurement, teachers underestimated the ability of brighter children and overestimated the ability of less bright children. These authors explained the fact that teachers underestimated the ability of bright cleft children with relatively severe facial disfigurement by suggesting that the teachers are responding to a culturally conditioned stereotype relating physical unattractiveness to decreased intellectual ability.

In summary, the psychological impact of facial deformities is great. The perception of facial attractiveness is influenced to a large extent by the appearance of the circumoral area. Esthetic teeth are associated with

positive personality traits. Malocclusion may contribute to disturbances in social exchange and self image. Cosmetic handicaps do not interfere with the individuals ability to perform physical activities, although disturbances in facial attractiveness as a result of malocclusion may impart a significant social disadvantage.

4.3 Effects of Orthodontic Treatment

Orthodontic treatment has a wider range of effects than the establishment of an aesthetic dentition. Treatment has been advocated for the health of the periodontium, although the research is divided as to the benefit derived by the soft tissues from orthodontics. Other benefits attributed to treatment have included an increase in dental awareness and a higher level of oral hygiene. Orthodontic treatment carries associated risks, or costs. Histological changes consistent with inflammation have been demonstrated following tooth movement, while macroscopic changes in the form of root resorption have been reported in varying frequencies. The effect of orthodontic treatment on the health of the temporomandibular joint is contentious.

The following benefits have been attributed to orthodontic treatment:

1. A desire on the part of the patient to retain their teeth in preference to a prosthetic replacement (Shaw, Addy and Ray, 1980).
2. Patients are more likely to care for their teeth if they regard them as attractive (Shaw, Addy and Ray, 1980).
3. Greater dental knowledge (Linn, 1974).
4. Long-term improvement in oral hygiene (Feliu, 1982).
5. An increase in the width of keratinized gingiva (Coatoam, Behrents and Bissada, 1981; Dorfman, 1978).

The following risks have been linked with orthodontic treatment:

1. Root resorption (Pritchard, 1975; Tejedor and Sears, 1972; Zachrisson, 1975; Phillips, 1955; DeShields, 1969; Sjolien and Zachrisson, 1973; Stevik and Mjor, 1970).
2. Inadequate interalveolar space due to alterations in the ideal relationships of the long axes of the teeth (Pritchard, 1975).

3. Alveolar crest destruction (Kessler, 1976; Tejedor and Sears, 1972; Zachrisson and Alnaes, 1974; Sjolien and Zachrisson, 1973).
4. The creation of fenestrations and dihsences (Kessler, 1976).
5. More rapid progression of periodontal disease than would occur with chronic inflammation alone (Kessler, 1976; Stallard, 1968).
6. Gingival inflammation and hyperplasia during the active phase of treatment (Kloehn and Pfeifer, 1974; Zachrisson, 1972; Zachrisson and Zachrisson, 1972).
7. Loss of periodontal attachment (Zachrisson, 1973; Tejedor and Sears, 1972; Pearson, 1968).
8. Circulatory changes with the pulp (Stevik and Mjor, 1970).
9. A decrease in the width of the keratinized gingiva (Coatoam, Behrents and Bissada, 1981; Dorfman, 1978).

Benefits from orthodontic treatment accrue from a greater knowledge of dental health, improved oral hygiene with a reduction in plaque related disease. Risks associated with orthodontic treatment relate to the supporting structures of the teeth. The literature relating orthodontics and periodontics provides little evidence to link orthodontic correction with periodontal health (Kessler, 1976; Kloehn and Pfeifer, 1974; Sadowsky and BeGole, 1981; Zachrisson and Zachrisson, 1972). Zachrisson (1975) considered root resorption during orthodontic treatment not to be detrimental to the life span of the dentition. Studies examining the link between orthodontic treatment and temporomandibular joint function have failed to establish a conclusive relationship (Sadowsky and BeGole, 1980; Larsson and Ronnerman, 1981; Sadowsky and Polson, 1984; Dibbets and Van der Weele, 1987; Loft et. al., 1989; Smith and Freer, 1989). Studies concerning the health costs of orthodontic treatment show large individual variation (Zachrisson, 1973; Zachrisson and Alnaes, 1974) and suggest that many of these risks are avoidable (Dorfman, 1978; Zachrisson and Zachrisson, 1971; Jacobson, 1952; Coatoam, Behrents and Bissada, 1981).

5 Original Study

5.1 Objective

To analyse the cost-effectiveness of the State Orthodontic Service by estimating the cost per episode of treatment and defining effectiveness as it relates to the provision of orthodontic care.

The alternatives examined relate to the location of the clinic and the deliverers of orthodontic care.

Newcastle as the site of operation for an orthodontic clinic is compared to Sydney. The costs considered are those incurred by patients 17 years of age and less, their parents, and patients 18 years of age and over. This includes consideration of the monetary cost for transport, lost income, and additional expenses, such as child care. Indirect costs that are considered include travel time, and activities missed as a result of attending appointments. The operator alternatives considered are;

- i) Full time specialists employed in a public institution.
- ii) Visiting dental officer specialists employed in a public institution.
- iii) Specialists providing orthodontic care in private practice on a fee for service basis.
- iv) Registrars employed in a public institution. Alternative levels of supervision are considered for the registrars. At locations other than Newcastle, one to four clinic periods are supervised per visitation week. The alternatives of having one clinic supervised and of having all clinic sessions supervised are considered. For the alternative where one session is supervised, the cost of supervision is considered a fixed cost, and therefore not included in the calculations (see later). Each of the seven clinic periods is supervised in Newcastle. For this alternative, the cost of full-time supervision is included in the salary cost. Therefore, the cost with no supervision and with full-time supervision is determined.

The cost for each alternative is constructed by calculating the cost for specialists and students to complete an episode of treatment. The episode of treatment considered is a four premolar extraction case, treated with full upper and lower Begg appliances. Fixed costs for all options are not included. Fixed costs include the costs of consumables, transport and accommodation costs for clinicians, rent of premises, etc. It is assumed that inclusion of fixed costs will not affect the ranking of the options considered.

Definition of the elements that constitute an effective orthodontic service are examined by considering the following:

- i) The importance of various characteristics of an orthodontic service. The characteristics considered were such aspects as treatment standard, convenience to transport and treatment being free of charge.
- ii) Opinion of the effectiveness of the State Orthodontic Service as it operates at Newcastle.
- iii) The benefits and problems associated with orthodontic treatment as perceived by the patients.
- iv) The relative importance to the supervisors of the objectives of the State Orthodontic Service.
- v) The supervisors opinion of the cost-effectiveness of the State Orthodontic Service as it operates at Newcastle.

The response to the introduction of a user pays system is examined. The opinion of parents of patients 17 years of age and less, patients 18 years of age and over, and supervisors is sought. The amount willing to be paid by the patients and parents is gauged.

5.2 Method

Subjects

The subjects taking part in this survey comprised the following groups;

1. 67 patients aged 17 years or less. The average age was 15 years. There were 28 males and 39 females.

2. Parents/guardians of the patients aged 17 years or less. 68 subjects were surveyed. 3 did not respond. Where possible the mother was asked to participate.
3. 22 patients aged 18 or more. The average age of this group was 22 years. There were 5 males and 17 females.
4. All 7 supervisors. The average year of specialist qualification was 1981.
- 5 supervisors had been employed in a public hospital previously.

Four questionnaires were used as part of this investigation. A different questionnaire was constructed for each group. Questions sought information on costs and opinions relating to the State Orthodontic Service. (See Table 1 for the topics covered in each questionnaire and Appendix 1 for the questionnaire format).

Effort was made to reduce the response errors by considering the following:

1. Characteristics of the method. This refers to such factors as interviewer characteristics, question wording and question content. A discussion of the advantages and disadvantages of the questionnaire and interview follows.
2. Characteristics of the respondent, such as level of education, memory. The patients and parents/guardians in this survey had various educational backgrounds, although the majority had average to low levels of education. The questionnaire wording and interview structure allowed for the population characteristics. However, response error would be expected to be significant for these groups. The supervisors had a high level of education and response error would be expected to be minimal.
3. Some interaction between respondent and method characteristics. This is most evident in an interview situation, the effects being discussed in relation to interviews.

Other errors relate to issues of confidentiality and respondents' right to privacy, issues of cost and efficiency in obtaining data via sample surveys and use of computers to minimize errors in data collection, transcription and storage. Some respondents may have been sensitive to questions relating to lost income, eligibility for treatment being determined by means testing. The patient cost figure should therefore be viewed as a conservative estimate. Questionnaires were distributed at treatment

Sample	Topics
<u>Patients aged 17 years and less</u>	Age Sex Type of Treatment Duration of Treatment Characteristics of an Orthodontic Service Effectiveness of the Service at Newcastle Benefits of Orthodontic Treatment Problems associated with Orthodontic Treatment Missed activities
<u>Parents or Guardian</u>	Age Suburb or Town of Residence Relationship to the patient Number of children in the family receiving care Characteristics of an Orthodontic Service Effectiveness of the Service at Newcastle Eligibility for a concession on public transport Willingness to pay for treatment Travel time Frequency of attendance Mode of transport Distance traveled by car Missed activities Activities combined with appointments Additional expenses
<u>Patients aged 18 years and over</u>	Age Sex Children receiving orthodontic care Suburb or Town of Residence Type of treatment Duration of treatment Characteristics of an Orthodontic Service Effectiveness of the Service at Newcastle Benefits of Orthodontic Treatment Problems associated with Orthodontic Treatment Eligibility for a concession on public transport Willingness to pay for treatment Travel time Mode of transport Distance traveled by car Missed activities Activities combined with appointments Additional expenses

TABLE 1

The topics or questions asked of patients aged 17 years and less, parents/guardians and patients aged 18 years and over are listed. The topics in bold type were considered for both Newcastle and Sydney. See appendix for questionnaire format

Sample	Topics
Supervisors	Year of specialist qualification Previous public hospital experience Objectives of the State Orthodontic Service Characteristics of an Orthodontic Service Effectiveness of the Service at Newcastle Benefit perceived by public vs private patients User pays system Cost-effectiveness of the Service at Newcastle

TABLE 1 (Continued)

The topics asked of the supervisors are listed. See appendix for questionnaire format.

appointments in an effort to minimize cost, in terms of money and time, and achieve efficient distribution. Data analysis was performed using a Macintosh SE and the Works 1.1 program.

In following the cautions outlined by Berdie, et. al. (1986), Altschuld and Lower (1984), Arndt and Crane (1975), and Butt and Palmer (1985) care was taken to use a personal approach with emphasis on the relevance of questions for the respondents, careful wording and encouraging responses.

Attempts to minimize bias with the survey questionnaire was made by:

1. Conducting a pilot study.
2. Seeking feedback from peers and health professionals with experience in questionnaire construction.
3. Designing the questionnaire in collaboration with research workers from the Australian Bureau of Statistics.

Gorden (1975) attributed the following advantages to the personally administered questionnaire;

1. Anonymity can be retained by not having the respondents names on the questionnaires.
2. Spacing members of the group avoids respondents being influenced by the way others will answer questions.
3. Respondents can be motivated before they begin.
4. The order in which the respondents deal with the questions can be controlled by giving them one page to work with at a time.
5. The administrator can ask that each person complete all of the answers before leaving.
6. Efficient in its use of time compared with the interview.

Gorden (1975) recognized the following limitations;

1. The respondent must fill out the questionnaire while the field worker waits rather than in his leisure time.
2. No opportunity to probe for elaboration and clarification of the responses.

Duker (1948) noted further limitations;

3. Opinions are sought from those who have not been shown to be qualified to give such opinions.

4. The questionnaire invites self-serving statements as answers.
5. The non-respondent leads to questionable conclusions.

Where possible, the questionnaire was administered personally. The procedure of handing out a form at the site is generally superior to mailing if the survey population consists of the aged or the less educated (Sudman and Bradburn, 1984). Parents/guardians of patients aged 17 and less were asked to attend their child's appointment during the survey period to facilitate questionnaire distribution and interviewing. In cases where parents/guardians were not present at appointments, the questionnaire was returned with the patient with a self addressed stamped envelope. The personally administered questionnaire was selected in preference to the mailed questionnaire for the following reasons (Gorden, 1975);

1. Due to the lack of opportunity to persuade the respondent to cooperate, response rates may be poor and lead to a bias sample.
2. There is no way to detect whether the respondent actually understands the question or to correct his misinterpretations.
3. The questionnaire will be ignored by a portion of the population that is functionally illiterate. "If we are dealing with a sample of the poor, the mailed questionnaire would be valueless because of the sample-bias that would result" (Gorden, 1975).
4. Response is dependant on internal motivation and external social pressure.
5. The questionnaire may be completed by someone other than the intended person.

An interview was conducted to supplement information gained from the questionnaire on the advise of S. Rees, Professor of Social Work, University of Sydney. An interview guide served to standardize the interview format (See Appendix 2 for the interview format). Within this guide, questions were omitted or added to facilitate the pursuit of the subject. All interviews were taped with the permission of the interviewees to ensure accuracy of information, allow observation of the respondent and allow improvement in interview technique (Gorden, 1975).

Gorden (1975) attributed the following advantages to the interview;

1. The interview allows the respondent to be motivated to provide accurate and complete information.
2. More opportunity is available to ensure that the respondent has interpreted the question correctly. This becomes important where the literacy level of the respondents is lower.
3. Greater flexibility in questioning is facilitated.
4. Control over the interview situation ensures the answer given by the respondent is not influenced by others and that a sequence of questioning is followed.
5. Observation of the respondent's nonverbal response to questioning provides an opportunity to evaluate the validity of the information.

An effort was made to remove the tape recorder from the respondent's sight, explain its use in a matter-of-fact manner and show no awareness of the tape recorder's presence during the interview to facilitate optimal interpersonal relations. Despite precautions to ensure a nonthreatening atmosphere, the possibility that information may have been withheld or be false must be recognized.

A pilot study was conducted to ensure that the questionnaires were suitable. 28 subjects were issued with questionnaires over a three day period at the United Dental Hospital in Sydney. Following completion of the questionnaire, respondents were asked if all questions were clear. The time to complete the questionnaire was recorded. Examination of the completed questionnaires led to one question being eliminated because of its ambiguity and the format being altered to facilitate recording of responses. No pilot study was conducted for the questionnaire directed at the supervisors. Suitability of the questionnaire was determined by seeking opinions from orthodontists and students at the United Dental Hospital, Sydney.

Following verification of the suitability of the questionnaires in the pilot study, they were utilized in the clinic at Newcastle. All patients attending during the survey period were requested to complete the questionnaire when they attended for an appointment. Prior to the survey period, parents were requested to attend their child's next appointment, if possible, in-order to take part in this study. If a parent did not attend the appointment, the questionnaire was given to the child to give to their

parent. If it was not possible to return the questionnaire on the same day, a self-addressed stamped envelope was included with the questionnaire and a request made to return it as soon as possible. The name and questionnaire number for each participant was recorded. When the questionnaire was returned, this was noted adjacent to the respondent's name. The respondent's name was not identified with the particular questionnaire returned in order to preserve anonymity. The importance of the project was impressed on the participants in-order to obtain their involvement and cooperation (Berdie, Anderson and Niebuhr, 1986).

Interviews were conducted with 10 patients, 7 parents and all supervisors. The purpose of the interview was to record opinions of various aspects of the State Orthodontic Service that may not have been forthcoming in a questionnaire format. The patients were selected at random. Parents of patients aged 17 years or less were included in the interview. All interviews were taped with the permission of the subjects.

This Survey was conducted during the months of March, April and May 1990. All patients attending the State Orthodontic Clinic at Newcastle during this time who had commenced orthodontic treatment were surveyed. This effectively included all currently active patients and patients in retention on 3 monthly recall.

Location

The present site of operation, Newcastle, was compared with having the clinic located in Sydney. Alternatively, decentralization was compared with centralization. The costs to the users of the service were considered. The users of the service were divided into three groups;

1. Patients 17 years of age and less.
2. A parent or guardian of the patients aged 17 years and less.
3. Patients 18 years of age and over. It was assumed that patients in this age group attended appointments without an accompanying adult, so that the costs related to the parent or guardian were not considered.

Both direct and indirect costs were considered. The direct costs that were measured are as follows;

1. Transport costs. The cost of train, bus, and taxis were determined by questionnaire. Where the fare was not known, the return adult fare was

requested in writing from Metro Trips, North Sydney. This figure was halved if the participant was eligible for a concession. The return cost to travel to the clinic by car was calculated by multiplying the average cost to operate a car per kilometre by the number of kilometres traveled. An average of the cost to operate a 7 years old Ford Falcon, Holden Commodore and Toyota Camry per kilometre was used as the average cost to operate a car in this calculation. These figures were supplied by the National Roads and Motorists Association (N.R.M.A), Sydney, and included all running costs. Where the distance traveled by car was greater than 100 kilometres, or where it was not known, the distance by road from the suburb or town of residence to the orthodontic clinic was requested in writing from the N.R.M.A.. Where two or more children from the same family were receiving treatment, the cost for each child was assumed to be equal if traveling by bus or rail.

2. Lost income. The subjects recorded if they missed out on work as a result of attending orthodontic appointments. The amount that would have been earned during this time was given.

If the respondent does not receive income for the time away from the place of employment, the cost is shouldered by the individual. If the respondent receives an income when they are away from their place of employment, there is still a cost to the community through lost productivity. Who bears the cost is not considered in a cost-effectiveness study.

3. Additional expenses. This covered expenses such as child-minding, food and accommodation. The frequency that these expenses would need to be met was recorded.

Transport costs and lost income costs were measured in dollars. Parents were asked how often they accompanied their child (children) to their appointments and this proportion was multiplied by the parents' costs to give a corrected value. This corrected value for the parent was then added to the cost for the patient aged 17 years and less to give a total cost for this patient to attend each appointment. Where the primary mode of transport was by car, it was assumed that parents attended all appointments.

The lost income and transport costs for all patients were added to give an estimate of the total patient monetary cost for each location alternative. The average cost was calculated for Newcastle and Sydney. The average

cost was multiplied by the number of appointments to complete an episode of treatment to give the average patient cost for each location alternative for the active phase of Begg treatment considered. The number of appointments required by specialists and students was used to calculate the cost for each operator alternative.

Indirect costs included;

1. Travel time, measured in hours.
2. Activities missed as a result of attending appointments. The major areas of interest were work, education, leisure time and housekeeping. Activities that were combined with appointments were also considered. These would reduce the indirect cost by distributing the cost over a greater number of tasks. Activities considered were shopping and leisure time.

Operator Cost

The alternatives considered for the provision of orthodontic care were;

- i) Full time specialists employed in a public institution.
- ii) Visiting dental officers employed in a public institution.
- iii) Specialists providing orthodontic care in private practice on a fee for service basis.
- iv) Registrars employed in a public institution. The cost with no supervision and with full-time supervision was determined.

In order to calculate the monetary cost of each of these alternatives the following information was collected;

1. The time required to complete an episode of treatment by both specialists and registrars. The episode of treatment considered was a four premolar extraction case, treated with full upper and lower Begg appliances. The time for the registrars to treat one patient was estimated from an examination of treatment progress for patients seen in the Newcastle clinic and observation of the operation of the clinic. Records of 25 patients treated in the State Orthodontic Clinic at Newcastle with extraction of four premolars were examined. All patients had completed stage 1, 12 had completed stage 2, and no patients had yet completed treatment. The time for specialists to complete an episode of treatment was estimated from information determined by interviewing the supervisors of the service. Questions established the time required to

place appliances, perform a Stage 3, the average number of appointments to complete this case and the average appointment time. The assistance level was assumed to be that which currently operates at the Newcastle clinic.

2. The hourly rates for each alternative method of delivery. This information was supplied by the Australian Dental Association and the United Dental Hospital. The published hourly rates were adjusted to represent the real cost by taking into consideration leave, superannuation, and loading where it was applicable.

Fixed costs for all options were not included. Fixed costs take the form of rent, accommodation and transport costs for registrars, consumables, electricity, cleaning, water and gas rates. The inclusion of fixed costs does not usually affect the ranking of the options considered. The cost of food for the registrars represents a transfer cost, ie. the cost of which would have to be met irrespective of the location. The cost of instrumentation constitutes a sunk cost and is not considered in cost-effective analyses.

Effective Orthodontic Care Delivery

Aspects of orthodontic care and the delivery of this care were examined in order to establish what constitutes an effective orthodontic service. The elements considered were:

i) The importance of various characteristics of an orthodontic service. The characteristics considered were:

1. Convenience to transport
2. Treatment provided free of charge.
3. A high standard of treatment.
4. Patients being seen on time.
5. Having access to an orthodontic clinic located in the Health Region.
6. A short waiting list for treatment.
7. Being treated by the same operator for the duration of treatment.
8. A large number of patients treated.

All groups were asked to rank these according to their importance. Space was available for suggestion of other characteristics that should be considered.

- ii) Opinion of the effectiveness of the State Orthodontic Service as it operates at Newcastle was sought from all subjects.
- iii) The benefits and problems associated with orthodontic treatment as perceived by the patients were ranked. The benefits considered were:

1. Appearance.
2. Function.
3. Relief of pain.
4. Facilitation of oral hygiene.
5. To enhance confidence.
6. To widen the prospects for employment.

The problems covered were:

1. Appearance of the appliances.
2. The pain associated with treatment.
3. Having to avoid certain food types.
4. Difficulty in cleaning appliances.
5. Ridicule that the appliances may provoke.
6. Difficulty encountered with eating.

iv) The relative importance, to the supervisors, of the objectives of the State Orthodontic Service. This was performed to establish areas that require priority in an orthodontic service.

v) The supervisors' opinion of the cost-effectiveness of the State Orthodontic Service as it operates at Newcastle. The reasons for the response was recorded.

User Pays System

The user pays system refers to a service where a fee is charged to the user of the service. A patient charge may be introduced in order to raise the motivation of the patients and parents. A fee may be introduced as a means of funding the service. The opinions of all groups were sought. The amount willing to be paid by the patients and parents was gauged.

5.3 Results

Sample

Patients aged 17 years and less (Table 2).

This group of 67 patients had an average age of 15 years. The ratio of males to females was 1:1.4. 96% of patients had completed treatment, or were currently in treatment with fixed appliances. 22% patients had, or were wearing, a removable appliance. 67% of the patients had been in treatment for 6 to 18 months.

Parents/Guardians (Table 3).

65 parents/guardians of the patients aged 17 years and less were surveyed. 52% of the sample were aged between 35 and 44. 69% of this sample were mothers. 58% of the sample had waited 12 months or less for treatment of their children.

Patients aged 18 years and less (Table 4).

22 patients 18 years and over were surveyed. 68% were aged 19 years and less. The ratio of males to females was 1:3.4. 91% had experienced fixed appliance therapy, while 18% had the experience of wearing a removable appliance. 50% of the patients had waited less than 12 months for treatment. 77% of these patients had been in treatment for less than 18 months.

Supervisors (Table 5).

7 supervisors were surveyed. 71% received their specialist qualification earlier than 1985. Most had worked in a public hospital previously.

Student Appointment Number (Table 6)

From 158 patient records, 25 patients were found to have required upper and lower premolar extractions and were treated with Begg appliances. The number of appointments for each stage was recorded. All patients had completed Stage 1, the average number of appointments being 5, with a standard deviation of 3. 12 patients had completed stage 2. The average number of appointments to complete this stage was 5, with a

SAMPLE

PATIENTS 17 YEARS AND LESS

Age (Years)	13	14	15	16	17
Number	10	13	19	16	9
Sex	Male	28			
	Female	39			
Treatment experience	Braces	Plate	Other		
Number	64	15	0		
Time into treatment	< 6 mths	6 to 12 mths	12 to 18 mths	18 to 24 mths	> 24 mths
Number	10	25	20	10	2

TABLE 2

This table describes the patient sample aged 17 years and less. There were 67 patients in this group, the average age being 15 years. The ratio of males to females was 1: 1.4. The majority had been treated with fixed appliances. 67% of the patients had been in treatment for 6 to 18 months.

PARENTS/GUARDIANS

Age (Years)	< 34	35 to 39	40 to 44	45 to 49	50 <	
Number	7	16	18	7	5	
Relation to patient	Mother	Father	Guardian	Grandmother	Grandfather	Other
Number	45	9	2	0	0	0
Wait for treatment	< 6 mths	6 to 12 mths	1 to 2 years	2 to 3 years	> 3 years	
Number	13	25	10	4	4	

TABLE 3

This table shows the characteristics of the 65 parents/guardians surveyed. 52% of the sample were aged between 35 and 44. The sample was comprised largely of mothers. Most of the group waited from 6 to 12 months for treatment for their children.

SAMPLE

PATIENTS 18 YEARS AND OVER

Age (Years)	18	19	20	21	22	23	24	25+
Number	10	5	0	0	1	1	1	4
Sex	Male	5						
	Female	17						
Treatment experience	Braces							
	Plate							
Number	20	4	0					

Wait for treatment	< 6 mths	6 to 12 mths	1 to 2 years	2 to 3 years	> 3 years
Number	6	5	7	2	2
Time into treatment	< 6 mths	6 to 12 mths	12 to 18 mths	18 to 24 mths	> 24 mths
	2	8	7	4	1

TABLE 4

This table describes the characteristics of the 22 patients aged 18 and over, who were surveyed. 7 individuals (32%) were over 22 years of age. The ratio of males to females was 1: 3.4. Most patients had experienced fixed appliance treatment. 50% of this group waited over 12 months for treatment. The majority of these patients had been in treatment for between 6 and 18 months.

SUPERVISORS

Year of graduation	1970-74	1975-79	1980-84	1985-89
Number	1	2	2	2
Hospital experience	Yes	5		
	No	2		

TABLE 5

The year of specialist qualification and the number with previous hospital experience are shown. The majority of supervisors have been employed in a public hospital.

STUDENT APPOINTMENT NUMBER

Teeth Extracted	No of Appts	No of Appts	No of Appts	No of Appts
Upper/Lower	Stage 1	Stage 2	Stage 3	Completion
4/4	6	3		
4/4	1	6		
4/4	6			
4/4	8	3		
4/4	12			
4/4	7			
4/4	10	3		
4/4	4	4		
4/4	7	6		
4/5	12			
4/5	7			
4/5	4			
4/5	8			
4/5	3			
5/5	8			
5/5	3			
5/5	3	5		
5/5	3	7		
5/5	3			
5/5	4	3		
5/5	1	5		
5/5	3	13		
5/5	1			
5/5	2	4		
5/5	5			
			Estimate	Estimate
Average	5	5	5	15
Standard Deviation	3	3		

TABLE 6

The number of appointments taken to complete the Stages of Begg treatment for 25 cases commenced by the registrars at Newcastle, as at 30th April, 1990. The number of appointments to complete Stage 3 was estimated to be 5. The average number of appointments to complete a Begg case requiring extraction of four premolars was estimated at 15.

standard deviation of 3. No patients had completed stage 3. The number of appointments to complete this stage was estimated at 5. This provided an estimate of the total number of appointments for students to complete an episode of treatment at 15.

Specialist Treatment Time (Table 7)

The specialist treatment time was calculated from information acquired by interview with the supervisors. The appointment number was multiplied by the appointment time to give the total treatment time in minutes. Appointment times for the fitting of appliances and preparing a stage 3 were considered separately. The average treatment time for the supervisors was 264 minutes, with a standard deviation of 50 minutes.

Student Treatment Time (Table 8)

The routine appointment times required by the registrars for appliance placement, adjustments and stage 3 were recorded. 2 hours was allowed for appliance placement, 30 minutes for an adjustment and 1 hour for a stage 3. The estimated number of appointments to complete the specified episode of treatment was used to calculate the total treatment time. The time required for the registrars to complete the active phase of orthodontic therapy with Begg appliances in a case requiring the extraction of four premolar teeth was estimated at 570 minutes.

Salaries Cost (Table 9)

Using the salary scales published by the Health Administration Corporation (1990), Sydney University and the Australian Dental Association, the operator cost to treat one patient requiring four premolar extractions was calculated for the specialists and the registrars by employing the treatment times calculated above. The hourly rates for full-time employees used in these calculations represents the actual cost, taking into account annual leave, conference leave, sick leave, special leave, superannuation and supplementary payment to specialists in lieu of private practice. The lowest cost per treatment episode was for full-time specialists, for all grades. The cost per treatment episode varied from \$175 for 1st year specialists to \$202 for 5th year specialists. The cost for Visiting Dental Officer specialists with less than 4 years experience was slightly more at \$225. 3rd and 4th year Dental

SPECIALIST TREATMENT TIME

Supervisor	Placement time	Appointment No	Appointment time	Stage 3	Total Time (Mins)
1	60	11	10	20	170
2	90	12	20	20	310
3	90	12	13	30	250
4	105	10	15	20	245
5	90	18	11	45	311
6	45	14	15	40	265
7	90	14	15	30	300
				Average	264
				St Deviation	50

TABLE 7

Total treatment time was calculated from information acquired by interview. Placement time was added to the time required to perform a Stage 3. This was then added to the product of the appointment number, less two, and the appointment time. The average total treatment time was 264 +/- 50 mins.

STUDENT TREATMENT TIME

Students	Placement time	Appointment No	Appointment time	Stage 3	Total Time (Mins)
Frost/Lee	120	15	30	60	570

TABLE 8

Total treatment time was calculated from information acquired by observation of the operation of the clinic at Newcastle. Placement time was added to the time required to perform a Stage 3. This was then added to the product of the appointment number, less two, and the appointment time. The average total treatment time was 570 mins.

Classification	Grade	Hourly Rate	Cost per Patient
Specialists			
Full Time Specialists *	1st Year	\$39.74	\$174.86
	2nd Year	\$41.26	\$181.54
	3rd Year	\$42.78	\$188.23
	4th Year	\$44.39	\$195.32
	5th Year	\$46.01	\$202.44
Visiting Dental Officers *	< 4 years experience	\$51.07	\$224.71
	4 or more years experience	\$55.09	\$242.40
Fee for Service **		\$147.50	\$649.00
Students			
Without Supervision *	Dental Officer Grade 1: 3rd Year	\$23.81	\$226.20
	Dental Officer Grade 1: 4th Year	\$25.38	\$241.11
	Dental Officer Grade 1: 5th Year	\$26.95	\$256.02
	Dental Officer Grade 1: 6th Year	\$28.52	\$270.94
	Dental Officer Grade 1: 7th Year	\$30.09	\$285.86
	Dental Officer Grade 2 : 1st Year	\$31.27	\$297.07
	Dental Officer Grade 2 : 2nd Year	\$32.45	\$308.27
With Supervision ***	Special Clinical Supervisor Rates (University)	\$32.52	
	Dental Officer Grade 1: 3rd Year with Supervision	\$40.07	\$380.67
	Dental Officer Grade 1: 4th Year with Supervision	\$41.64	\$395.58
	Dental Officer Grade 1: 5th Year with Supervision	\$43.21	\$410.50
	Dental Officer Grade 1: 6th Year with Supervision	\$44.78	\$425.41
	Dental Officer Grade 1: 7th Year with Supervision	\$46.35	\$440.33
	Dental Officer Grade 2 : 1st Year with Supervision	\$47.53	\$451.54
	Dental Officer Grade 2 : 2nd Year with Supervision	\$48.71	\$462.75

TABLE 9

The cost for specialists and students to complete an episode of treatment appears in the table. The time for an operator to complete an episode of treatment was multiplied by the hourly rate to provide the cost per patient. The time required by the supervisors to complete a case was 264 minutes. The figure used for the treatment time for students was 570 minutes. * These figures are based on the hourly rates current as at 19th April, 1990. They represent the real cost, encompassing annual leave, sick leave, conference leave, superannuation and loading where appropriate. ** This figure was supplied by the Australian Dental Association. *** This figure was supplied by the University of Sydney. There is one supervisor for two students, so the hourly rate of supervision was halved before being used in the calculations.

Officers employed as orthodontic registrars, receiving no supervision, were the next options with the lowest cost at \$226 and \$241 respectively. Visiting Dental Officer specialists with more than 4 years experience were slightly higher at \$242. Dental Officers with more than 5 years experience ranged from \$256 to \$308. The cost per episode of treatment for students with supervision ranged from \$381 to \$463. Treatment conducted on a fee-for-service basis was the option with the highest cost at \$649.

Patient Cost (Table 10)

The total monetary costs of transport and lost income incurred by 63 patients aged 17 years and less to attend appointments at Newcastle is \$2218. If treatment were to be carried out in Sydney, this would increase to \$4993. These totals include the cost for parents to attend appointments, corrected in accordance with the frequency of their attendance. The cost for transport and lost income for patients 18 years and over to attend appointments at Newcastle is \$445 and, if treatment were to be carried out in Sydney the cost would be \$1016. The total cost for the 83 patients surveyed to attend an appointment at Newcastle is \$2663. The figure increased by 230%, to \$6009, if treatment were to be carried out in Sydney. The average cost for each patient to attend each appointment at Newcastle was \$32. This increased to \$72 should treatment be conducted in Sydney.

For the patient to receive treatment at Newcastle by a specialist, the average number of appointments being 13, the total cost would be \$417. The same treatment in Sydney would require \$941.

The estimated number of appointments needed to complete the same episode of treatment by students was 15, resulting in an increase in the cost to the patient. The average total cost for a patient treated by registrars at Newcastle was estimated to be \$481. This increased to \$1086 if treatment were to be carried out in Sydney.

It should be noted that the average cost to patients for the active phase of treatment is greater than the cost for the operator to perform the treatment if this treatment were to be carried out in Sydney.

PATIENT COST

Patients	No	Cost	Cost
		Newcastle	Sydney
Total cost for patients 17 years and less/Visit	62	\$2218.21	\$4992.59
Total cost for patients 18 years and over/Visit	21	\$445.25	\$1016.24
Total cost for all patients/Visit	83	\$2663.46	\$6008.83
Average patient cost/Visit		\$32	\$72

Operator	Average Cost	Average Cost
	Newcastle	Sydney
Specialists	\$417	\$941
Students	\$481	\$1086

TABLE 10

The monetary cost of transport and lost income incurred by the patients are shown. The column entitled 'Newcastle' shows costs that are incurred by local patients using the State Orthodontic Service clinic at Newcastle. The 'Sydney' column shows the cost to patients should treatment be performed at the United Dental Hospital in Sydney. The total costs for patients aged 17 years and less, patients 18 years and more, and the combined figure are shown for both locations. The cost for parents to attend appointments was included for patients aged 17 years and less. The average cost for a patient to attend an appointment was calculated by dividing the total cost by the number of patients. This was multiplied by the number of appointments needed to complete an episode of treatment to give the total cost to the patient for the active phase of treatment. Figures are shown for both specialists and students.

Travel time alternatives (Table 11)

85% of the parents/guardians and 100% of the patients aged 18 years and over responded to this question. The information provided by the parents/guardians is representative of the patients aged 17 years and less. 15% of this group travels over 3 hours to attend orthodontic appointments in Newcastle. This figure would increase to 49% if treatment were to be conducted in Sydney. No patients aged 18 years and over traveled more than 3 hours to appointments in Newcastle. If treatment were to be carried out in Sydney, this figure would change to 36%.

Effectiveness of the State Orthodontic Service (Table 12)

All groups were asked to gauge the effectiveness of the State Orthodontic Service at Newcastle. 66 of the patients aged 17 years and less, 55 of the parents/guardians, 22 patients aged 18 years and over and 7 supervisors provided a total group of 150 responses. 1 parent disagreed and another parent disagreed strongly that the service was effective. The reasons given for their responses related to general care provided by the School Dental Service rather than the State Orthodontic Service at Newcastle. All other participants either agreed or strongly agreed that the service is effective. 56% of patients aged 17 years and less, 67% of parents/guardians, 59% of patients aged 18 years and more, and 29% of the supervisors strongly agreed that the Service is effective.

Objectives of the State Orthodontic Service (Table 13 and 14)

The supervisors were asked to rank the objectives of the State Orthodontic Service. To meet a growing demand for orthodontic care and provide for the orthodontic needs of the area were considered the most important objectives. The training of registrars, the provision of acceptable treatment, meeting the patients major expectations for treatment and providing continuity of patient care followed in importance. In-service guidance and the recruitment of orthodontic specialists received the lowest ranks.

The supervisors were asked if they considered the objectives of the State Orthodontic Service were being met at Newcastle. 86% of the supervisors either agreed or strongly agreed the service is meeting its objectives.

TRAVEL TIME ALTERNATIVES

PARENTS/GUARDIANS

Newcastle	< 1 hr	1 to 2 hrs	2 to 3 hrs	3 to 4 hrs	4 to 6 hrs	> 6 hrs
Number	35	8	5	7	1	0
Sydney	< 1 hr	1 to 2 hrs	2 to 3 hrs	3 to 4 hrs	4 to 6 hrs	> 6 hrs
Number	0	2	26	12	12	3

PATIENTS 18 YEARS AND OVER

Newcastle	< 1 hr	1 to 2 hrs	2 to 3 hrs	3 to 4 hrs	4 to 6 hrs	> 6 hrs
Number	17	2	3	0	0	0
Sydney	< 1 hr	1 to 2 hrs	2 to 3 hrs	3 to 4 hrs	4 to 6 hrs	> 6 hrs
Number	0	3	11	2	5	1

TABLE 11

The travel times for the alternatives clinic locations is illustrated. The response from parents/guardians is shown in the top table. 55 (85% of the sample) responded. This information is representative of the patients aged 17 and less. 15% travel over 3 hours to this clinic. If treatment were to be conducted in Sydney, this figure increases to 49%. The response for patients 18 years and over is shown in the lower table. 22 (100% of the sample) responded to this question. No patients traveled over 3 hours to attend the Newcastle clinic. This figure changed to 36% if treatment were to be conducted in Sydney.

EFFECTIVENESS OF SOS JUDGED

Sample	Strongly Agree	Agree	Disagree	Stongly Disagree
Pts 17 years and less	37	29	0	0
Parents/Guardians	37	16	1	1
Pts 18 years and over	13	9	0	0
Supervisors	2	5	0	0
Total	89	59	1	1

TABLE 12

All groups were asked to gauge the effectiveness of the State Orthodontic Service as it operates at Newcastle. The response from 66 patients (pts) aged 17 years and less, 55 parents/guardians, 22 patients (pts) aged 18 and over, and 7 supervisors is recorded in the table.

SUPERVISORS

FREQUENCY OF RESPONSES TO RANKING OF SOS OBJECTIVES

Ranking	1	2	3	4	5	6	7	8	Av	SDev
Train future specialists	1	0	1	3	1	0	1	0	4.0	0.6
Meet patients major expectation	0	2	0	0	3	0	1	1	4.9	0.8
Provide treatment that is acceptable	2	0	1	0	1	1	1	1	4.4	0.4
To recruit orthodontic specialists	0	0	0	0	0	2	2	3	7.1	1.3
Provide continuity of patient care	0	0	1	2	1	2	1	0	5.0	0.6
Provide for the orthodontic needs	2	1	3	0	0	1	0	0	2.7	0.5
Meet a growing demand for orthodontic care	2	4	0	1	0	0	0	0	2.0	0.4
In-service guidance	0	0	1	1	1	1	1	2	5.9	0.7

TABLE 13

The ranking of the objectives of the State Orthodontic Service by the 7 supervisors is shown above. A ranking of 1 indicates the most important, while a ranking of 8 indicates the objective considered least important. To meet the need and demand of the area serviced were considered most important. The recruitment of orthodontic specialists was considered the least important.

OBJECTIVES OF THE SOS BEING MET

Objectives met	Strongly Agree	Agree	Disagree	Strongly Disagree
Number	1	5	1	0

TABLE 14

The opinions of the 7 supervisors as to whether the objectives of the State Orthodontic Service (SOS) are being met is shown above. 86% either agreed or strongly agreed that these objectives are being met.

Cost-effectiveness of SOS (Table 15)

6 supervisors responded to a question asking if they considered the State Orthodontic Service to be cost-effective at Newcastle. 67% either agreed or strongly agreed that the service is cost-effective, 33% disagreeing with this statement. Allowance for the training of the registrars, the time required for appointments, the use of facilities and staff, a reduction in the waiting list, the number of patients seen and the quality of patient care were the aspects considered by various supervisors in arriving at a decision.

Public patients value of treatment compared to private patients (Table 16)

The supervisors were asked if they considered public patients to value treatment less than patients treated privately. 71% considered this to be the case.

Missed Activities

Patients aged 17 years and less (Table 17).

96% of patients 17 years and less responded to this question. School was the most frequently missed activity for both location alternatives. Study time and leisure time would be missed more frequently if treatment were to be conducted in Sydney.

Parents/Guardians (Table 18).

94% of the sample surveyed responded to this question. Housework was the most frequently missed activity for both options. Work and leisure time were missed more frequently if treatment were carried out in Sydney.

Patients 18 years and over (Table 19).

100% of this group responded to this question. Education, leisure time and house work would be missed more frequently if treatment were to be carried out in Sydney.

Tasks Combined with Visits

Parents/Guardians (Table 20).

80% of this sample stated that appointments were combined with other activities. Appointments in Newcastle are mostly combined with

SUPERVISORS

COST-EFFECTIVENESS OF SOS

Cost Effective	Strongly Agree	Agree	Disagree	Strongly Disagree
Number	1	3	2	0

TABLE 15

6 supervisors gave their opinion as to whether they considered the State Orthodontic Service (SOS) at Newcastle to be cost-effective. 67% either agreed or strongly agreed that the service was cost-effective, while 33% disagreed.

PUBLIC PATIENTS VALUE OF TREATMENT COMPARED TO PRIVATE PATIENTS

Yes	5	No	2
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TABLE 16

All supervisors were asked if they considered public patients to value treatment less than patients seen in private practice. Their responses are shown above. Most considered that public patients valued treatment less than patients treated privately.

MISSED ACTIVITIES FOR LOCATION ALTERNATIVES

PATIENTS 17 YEARS AND LESS

Newcastle	School	Study	Leisure time	Work	Other
Number	53	15	18	6	0
Sydney	School	Study	Leisure time	Work	Other
Number	54	35	31	6	0

TABLE 17

The missed activities of the 64 patients aged 17 years and less who responded to this question, are recorded in the table. School is the predominant forgone activity for both location alternatives. Treatment in Sydney results in a reduction in the time for study and leisure.

PARENTS/GUARDIANS

Newcastle	Work	Education	Free time	House work	Other
Number	10	14	18	31	2
Sydney	Work	Education	Free time	House work	Other
Number	14	14	21	33	1

TABLE 18

The missed activities of the 61 parents/guardians who responded to this question are recorded above. House work is the most frequently missed activity for both locations. This is most likely a reflection of the large percentage (69%) of mothers in this group. Work, leisure time and house work are more frequently foregone if treatment were to be carried out in Sydney.

PATIENTS 18 YEARS AND OVER

Newcastle	Work	Education	Free time	House work	Other
Number	5	8	7	3	0
Sydney	Work	Education	Free time	House work	Other
Number	5	9	11	9	0

TABLE 19

The missed activities of 22 patients aged 18 years and over are recorded in the table. Treatment conducted in Sydney would result in education, leisure time and house work being forgone more frequently.

COMBINED ACTIVITIES FOR LOCATION ALTERNATIVES

PARENTS/GUARDIANS

Newcastle	Shopping	Leisure time	Other
Number	17	11	4
Sydney	Shopping	Leisure time	Other
Number	9	15	1

TABLE 20

This table shows the activities that would be combined with appointments for 50 parents/guardians, for each of the alternative clinic locations considered. There would be an overall reduction in the number of activities that would be combined with appointments if treatment were to be carried out in Sydney.

PATIENTS 18 YEARS AND OVER

Newcastle	Shopping	Leisure time	Other
Number	9	10	2
Sydney	Shopping	Leisure time	Other
Number	8	8	2

TABLE 21

This table shows the activities that are combined with appointments for 20 patients aged 18 years and over. This group considered that there were less activities that could be combined with appointments if treatment were to be carried out in Sydney.

shopping. In Sydney, appointments would be combined largely with leisure time. The overall number of activities that parents/guardians combined with visits decreased when the alternative location of Sydney was considered.

Patients 18 years and over (Table 21).

91% of this sample combined other activities with appointments.

Shopping and leisure time were evenly divided as tasks combined with appointments in both Newcastle and Sydney. The number of opportunities available when attending appointments in Sydney decreased slightly from the number of opportunities in Newcastle.

Additional Expenses

Parents/Guardians (Table 22).

Food was considered the most significant additional expense incurred for both location alternatives. The cost of food would have to be met in whatever situation is being considered, and in this respect is not usually considered in a cost-effective analysis. The largest increase in additional expenses occurred in the need for accommodation. The need for childminding also increased almost to the same extent.

Patients 18 years and over (Table 23).

Food was seen as the most frequently needed additional expense for both location alternatives. If treatment were to be carried out in Sydney, 9 patients would require accommodation compared with 2 when treatment is conducted in Newcastle. 2 additional patients would require childminding if treatment were to be carried out in Sydney. This minimal increase would be expected when the age distribution of this group is considered.

Willingness to Pay

Parents/Guardians (Table 24).

80% of the sample responded to this question. 79% of the sample that responded were prepared to meet a monetary cost for treatment. 56% were prepared to pay a charge for treatment if it was less than \$100.

Patients 18 years and over (Table 25).

100% of the sample responded to this question. 91% were prepared to pay

ADDITIONAL EXPENSES FOR LOCATION ALTERNATIVES

PARENTS/GUARDIANS

Newcastle	Childminding	Food	Accommodation	Other
Number	4	27	2	1
Sydney	Childminding	Food	Accommodation	Other
Number	21	44	26	2

TABLE 22

The additional expenses for 62 parents/guardians for each clinic location are recorded in the table. There would be an increase in the requirement for childminding, food and accommodation if treatment were to be carried out in Sydney. The largest increase occurred in the number of people requiring accommodation.

PATIENTS 18 YEARS AND OVER

Newcastle	Childminding	Food	Accommodation	Other
Number	1	10	2	1
Sydney	Childminding	Food	Accommodation	Other
Number	3	17	9	1

TABLE 23

This table shows the additional expenses that are incurred by the patients aged 18 years and over as a result of attending their orthodontic appointments. Alternative clinic locations are considered. There would be an increase in the number of patients requiring childminding, food and accommodation if treatment were to be carried out in Sydney.

WILLINGNESS TO PAY FOR TREATMENT

PARENTS/GUARDIANS

Pay	Yes	41		
	No	11		
Amount	< \$100	\$100 to \$300	\$300 to \$500	> \$500
Number	23	15	3	0

TABLE 24

The table above shows the willingness of 52 parents/guardians to pay for the treatment of their children at the State Orthodontic Clinic. 79% were willing to pay for treatment. The amount these people would be willing to pay is listed.

PATIENTS 18 YEARS AND OVER

Pay	Yes	20		
	No	2		
Amount	< \$100	\$100 to \$300	\$300 to \$500	> \$500
Number	6	8	4	2

TABLE 25

The table above shows the willingness of 22 patients aged 18 years and over to pay for their treatment at the State Orthodontic Clinic. 91% were willing to pay for treatment. The amount these people would be willing to pay is listed.

a charge for treatment. 30% were prepared to pay this charge if the amount was less than \$100.

Qualities of an Orthodontic Service

Patients 17 years and less (Table 26).

94% of the sample answered this question. Those aspects of an orthodontic service that affect this group most directly were given the highest ranking. Treatment of a high standard and seeing the same orthodontist for the entire treatment were considered most important. Treatment being free of charge and patients being seen on time followed in importance. Having a clinic located close to home and a short waiting list for treatment received equal ranking. Convenience to transport and a clinic that caters for a large number of patients were considered the least important qualities.

Parents/Guardians (Table 27).

80% of this sample answered this question. Treatment that is of a high standard and that is free of charge were considered the most important aspects of an orthodontic service to this group. Seeing the same orthodontist and having a clinic in the region were the next most important aspects. Patients being seen on time followed. Convenience to transport ranked sixth and a short waiting list for treatment ranked seventh. A clinic where a large number of patients were seen ranked lowest.

Patients 18 years and over (Table 28).

95% of this group answered this question. In order of importance, this group considered treatment of a high standard, seeing the same orthodontist for the entire treatment and treatment free of charge most important. Convenience to transport and a clinic in the region were given equal ranking. A short waiting list for treatment was ranked sixth. Patients being seen on time and a clinic that caters for a large number of patients were considered least important.

Supervisors (Table 29).

100% of this group answered this question. Treatment of a high standard was ranked highest. Seeing the same orthodontist for the entire treatment was ranked second, followed by a short waiting list for treatment.

Convenience to transport and a large number of patients seen were given equal fourth ranking. A clinic in the region was ranked next. Treatment free of charge and patients being seen on time were considered least important.

Reproducibility (Table 30).

25 subjects were asked to repeat their ranking of the qualities of an orthodontic service. Treatment of a high standard, seeing the same orthodontist for the entire treatment and treatment free of charge were consistently ranked most important in this order. A clinic where a large number of patients were seen ranked lowest in each instance. The ranking of other qualities varied, casting doubt on conclusions drawn in relation to the importance of these characteristics.

Benefits of Orthodontic Treatment

Patients 17 years and less (Table 31).

94% of this group responded correctly to this question. To look better was considered the greatest benefit of orthodontic treatment. Greater confidence was ranked second. This was followed by being able to eat better, freedom from pain and ease of brushing teeth. Ease of finding employment was ranked lowest.

Patients 18 years and over (Table 32).

95% of this group responded to this question. An improvement in appearance and improved confidence were ranked highest. Ease of brushing teeth followed in the ranking. To eat better and freedom from pain received equal rankings. Ease of finding employment was ranked lowest.

Reproducibility (Table 33).

11 patients repeated their ranking of the benefits of orthodontic treatment to determine the reproducibility of the method. Improved appearance and greater confidence ranked highest in both instances. Ease of finding employment consistently ranked lowest. The other qualities varied. This may demonstrate that the eating better, freedom from pain and ease of tooth brushing assume similar valuation.

Problems of Orthodontic Treatment

Patients 17 years and less (Table 34).

Not being able to eat certain foods was considered the greatest problem by this group. Difficulty eating and poor appearance received the next ranking. Pain and difficulty with tooth brushing were ranked fourth and fifth. People teasing the patient wearing appliances was considered to be the problem of least significance.

Patients 18 years and over (Table 35).

Not being able to eat certain foods was considered the greatest problem of orthodontic treatment. Pain and poor appearance ranked second and third. Difficulty with tooth brushing and eating received the same score. People teasing the patient about wearing appliances was considered to be the problem of least significance in this group also.

Reproducibility (Table 36).

11 patients repeated their ranking of the problems of orthodontic treatment to determine the reproducibility of the method. Difficulty with eating was consistently ranked second and people making fun of the patient was consistently ranked lowest. The order of all other problems varied. This may indicate that these problems assume similar proportions to patients.

FREQUENCY OF RESPONSES TO RANKING THE QUALITIES OF AN ORTHODONTIC SERVICE

PATIENTS 17 YEARS AND LESS

Ranking	1	2	3	4	5	6	7	8	Av	SDev
Convenient to transport	1	4	9	8	6	15	9	11	5.4	0.5
Treatment is free of charge	17	9	10	12	4	3	7	1	3.3	0.2
Treatment is of a high standard	15	20	12	9	5	1	1	0	2.6	0.2
Patients are seen on time	1	8	8	10	7	12	8	9	4.9	0.4
Clinic in your region	5	4	7	8	11	9	11	8	5.1	0.4
Short waiting list for treatment	7	4	4	5	16	11	10	6	5.1	0.6
Seeing the same orthodontist for the entire tx	17	14	10	7	7	3	5	0	3.0	0.1
Large number of patients are seen	0	1	1	4	8	9	12	28	6.7	0.5

TABLE 26

The ranking of the qualities of an orthodontic service by 63 patients aged 17 and less is shown above. A ranking of 1 indicates the most important, while a ranking of 8 indicates the quality considered least important. Treatment of a high standard and seeing the same orthodontist for the entire treatment were considered the most important qualities by this group. A clinic where a large number of patients were seen was considered least desirable.

PARENTS/GUARDIANS

Ranking	1	2	3	4	5	6	7	8	Av	SDev
Convenient to transport	2	2	5	7	7	11	10	8	5.5	0.5
Treatment is free of charge	18	10	12	6	2	4	0	0	2.5	0.2
Treatment is of a high standard	19	15	11	3	4	0	0	0	2.2	0.3
Patients are seen on time	0	2	5	13	6	11	11	4	5.3	0.6
Clinic in your region	3	4	11	8	7	9	7	3	4.6	0.4
Short waiting list for treatment	0	0	1	6	15	11	10	9	6.0	0.7
Seeing the same orthodontist for the entire tx	10	19	7	8	4	1	3	0	2.8	0.2
Large number of patients are seen	0	0	0	1	7	5	11	28	7.1	0.6

TABLE 27

The ranking of the qualities of an orthodontic service by 52 parents/guardians is shown above. A ranking of 1 indicates the most important, while a ranking of 8 indicates the quality considered least important. Treatment that is free of charge and of a high standard were considered the most important qualities by this group. A clinic where a large number of patients were seen was considered least desirable.

FREQUENCY OF RESPONSES TO RANKING THE QUALITIES OF AN ORTHODONTIC SERVICE

PATIENTS 18 YEARS AND OVER

Ranking	1	2	3	4	5	6	7	8	Av	SDev
Convenient to transport	1	2	3	3	5	4	2	1	4.6	0.4
Treatment is free of charge	4	5	3	3	2	1	1	2	3.5	0.1
Treatment is of a high standard	8	5	1	4	1	1	1	0	2.6	0.2
Patients are seen on time	1	0	4	0	2	5	4	5	5.8	0.6
Clinic in your region	0	3	4	4	4	1	4	1	4.6	0.5
Short waiting list for treatment	1	0	1	4	6	2	5	2	5.4	0.7
Seeing the same orthodontist for the entire tx	6	5	5	2	0	2	1	0	2.8	0.2
Large number of patients are seen	0	1	0	1	1	5	3	10	6.8	0.6

TABLE 28

The ranking of the qualities of an orthodontic service by 21 patients aged 18 or more is shown above. A ranking of 1 indicates the most important, while a ranking of 8 indicates the quality considered least important. Treatment of a high standard and seeing the same orthodontist for the entire treatment were considered the most important qualities by this group. A clinic where a large number of patients were seen was considered least desirable.

SUPERVISORS

Ranking	1	2	3	4	5	6	7	8	Av	SDev
Convenient to transport	0	1	1	0	4	0	0	1	4.7	1.0
Treatment is free of charge	1	0	1	1	0	0	0	4	5.7	1.6
Treatment is of a high standard	4	2	1	0	0	0	0	0	1.6	0.3
Patients are seen on time	0	0	1	0	0	4	2	0	5.9	1.3
Clinic in your region	1	0	0	2	0	2	2	0	5.0	0.9
Short waiting list for treatment	1	0	0	3	2	0	1	0	4.3	0.7
Seeing the same orthodontist for the entire tx	0	2	1	1	1	1	1	0	4.1	0.4
Large number of patients are seen	0	2	2	0	0	0	1	2	4.7	0.8

TABLE 29

The ranking of the qualities of an orthodontic service by the 7 supervisors is shown above. A ranking of 1 indicates the most important, while a ranking of 8 indicates the quality considered least important. Treatment of a high standard was considered the most important qualities by this group. A clinic where patients were seen on time was considered least important.

REPRODUCIBILITY OF RANKING THE QUALITIES OF AN ORTHODONTIC SERVICE

INITIAL

Ranking	1	2	3	4	5	6	7	8	Av	SDev
Convenient to transport	0	0	4	4	6	8	3	0	5.1	0.7
Treatment is free of charge	6	6	4	5	2	0	1	1	3.0	0.2
Treatment is of a high standard	5	10	5	4	1	0	0	0	2.4	0.3
Patients are seen on time	0	1	4	3	3	4	9	1	5.4	0.9
Clinic in your region	1	1	7	4	5	1	2	4	4.7	0.4
Short waiting list for treatment	1	1	0	3	4	7	5	4	5.8	0.7
Seeing the same orthodontist for the entire tx	12	6	1	2	2	1	1	1	2.3	0.1
Large number of patients are seen	0	0	0	0	2	4	4	14	7.3	0.5

SECOND

Ranking	1	2	3	4	5	6	7	8	Av	SDev
Convenient to transport	3	2	1	1	3	4	8	2	5.0	0.8
Treatment is free of charge	8	5	4	1	2	2	1	1	2.8	0.1
Treatment is of a high standard	7	6	6	2	2	0	1	0	2.5	0.2
Patients are seen on time	1	1	2	8	2	8	1	1	4.6	0.7
Clinic in your region	0	2	3	4	6	4	3	2	4.8	0.4
Short waiting list for treatment	0	2	3	3	7	2	3	4	5.0	0.5
Seeing the same orthodontist for the entire tx	4	6	5	4	2	0	2	0	2.8	0.2
Large number of patients are seen	0	0	0	1	0	4	5	14	7.0	0.6

TABLE 30

25 subjects were asked to repeat their ranking of the qualities of an orthodontic service to determine the reproducibility of the method. The results are shown above. Treatment free of charge, treatment of a high standard, and seeing the same orthodontist for the entire treatment were considered the most important in both instances. A clinic which treats a large number of patients was consistently rated least desirable. The order of the other qualities varied.

FREQUENCY OF RESPONSES TO RANKING THE BENEFITS OF ORTHODONTIC TREATMENT

PATIENTS 17 YEARS AND LESS

Ranking	1	2	3	4	5	6	Av	SDev
Look better	47	9	6	1	0	0	1.4	0.3
Eat better	1	14	18	15	12	3	3.5	0.4
Freedom from pain	7	7	9	9	21	10	4.0	0.6
Easier to brush teeth	1	3	18	17	16	8	4.1	0.5
Greater confidence	7	30	5	13	7	1	2.8	0.4
Easier to find a job	0	0	7	8	7	41	5.3	1.5

TABLE 31

The ranking of benefits of orthodontic treatment by 63 patients aged 17 years and less, is shown. A ranking of 1 indicates the most important, while a ranking of 8 indicates the benefit considered least important. Looking better and greater confidence were the benefits considered most important. Ease in finding a job was considered least important.

PATIENTS 18 YEARS AND OVER

Ranking	1	2	3	4	5	6	Av	SDev
Look better	13	4	2	1	1	0	1.7	0.2
Eat better	1	3	4	6	4	3	3.9	0.4
Freedom from pain	3	1	4	4	5	4	3.9	0.5
Easier to brush teeth	0	3	7	5	5	1	3.7	0.5
Greater confidence	4	9	1	5	2	0	2.6	0.4
Easier to find a job	0	1	3	0	4	13	5.2	1.4

TABLE 32

The ranking of benefits of orthodontic treatment by 21 patients aged 18 years and over, is shown. A ranking of 1 indicates the most important, while a ranking of 8 indicates the benefit considered least important. Looking better and greater confidence were considered most important. Ease of finding a job was ranked lowest.

REPRODUCIBILITY OF RANKING THE BENEFITS OF ORTHODONTIC TREATMENT

INITIAL

Ranking	1	2	3	4	5	6	Av	SDev
Look better	7	2	2	0	0	0	1.5	0.3
Eat better	1	1	2	1	4	2	4.1	0.7
Freedom from pain	1	1	2	0	4	3	4.3	0.8
Easier to brush teeth	0	1	4	5	1	0	3.5	0.7
Greater confidence	2	5	0	3	0	1	2.7	0.5
Easier to find a job	0	1	1	2	2	5	4.8	1.0

SECOND

Ranking	1	2	3	4	5	6	Av	SDev
Look better	8	2	1	0	0	0	1.4	0.3
Eat better	0	1	4	4	2	0	3.6	0.6
Freedom from pain	0	2	3	1	2	3	4.1	0.6
Easier to brush teeth	0	0	2	2	5	2	4.6	0.8
Greater confidence	3	5	0	1	1	1	2.5	0.3
Easier to find a job	0	1	1	3	1	5	4.7	1.0

TABLE 33

11 patients were asked to repeat their ranking of the benefits of orthodontic treatment to determine the reproducibility of the method. The results are shown above. Improved appearance and greater confidence were considered the most important in both instances. Ease in finding a job consistently rated lowest. The order of the other qualities varied.

FREQUENCY OF RESPONSE TO RANKING THE PROBLEMS OF ORTHODONTIC TREATMENT

PATIENTS 17 YEARS AND LESS

Ranking	1	2	3	4	5	6	Av	SDev
Looks bad	16	9	10	10	9	9	3.2	0.2
It hurts	17	7	10	9	10	10	3.3	0.3
Can't eat certain foods	11	15	8	17	9	3	3.1	0.3
More difficult to brush teeth	6	15	8	12	17	5	3.5	0.4
People make fun of you	5	5	8	5	8	32	4.6	1.1
More difficult to eat	8	12	19	10	10	4	3.2	0.3

TABLE 34

The ranking of problems associated with orthodontic treatment by 63 patients aged 17 years and less is shown above. A ranking of 1 indicates the most important, while a ranking of 8 indicates the problem considered least important. The problems were ranked closely. A limited diet was ranked the greatest problem and people making fun of patient was ranked the lowest.

PATIENTS 18 YEARS AND OVER

Ranking	1	2	3	4	5	6	Av	SDev
Looks bad	3	5	4	1	6	2	3.4	0.5
It hurts	8	3	1	6	2	1	2.7	0.4
Can't eat certain foods	6	9	3	3	0	0	2.1	0.3
More difficult to brush teeth	2	1	7	5	4	2	3.7	0.4
People make fun of you	0	2	1	0	2	16	5.4	1.8
More difficult to eat	2	1	5	6	7	0	3.7	0.7

TABLE 35

The ranking of problems associated with orthodontic treatment by 21 patients aged 18 years and over is shown above. A ranking of 1 indicates the most important, while a ranking of 8 indicates the problem considered least important. A limited diet was ranked the greatest problem and people making fun of the patient was ranked the lowest.

REPRODUCIBILITY OF RANKING THE PROBLEMS OF ORTHODONTIC TREATMENT

INITIAL

Ranking	1	2	3	4	5	6	Av	SDev
Looks bad	2	0	2	2	3	2	3.9	0.5
It hurts	5	0	0	3	1	2	3.1	0.5
Can't eat certain foods	1	4	1	3	2	0	3.1	0.5
More difficult to brush teeth	2	4	1	2	2	0	2.8	0.4
People make fun of you	0	0	3	0	1	7	5.1	1.5
More difficult to eat	1	3	4	1	2	0	3.0	0.4

SECOND

Ranking	1	2	3	4	5	6	Av	SDev
Looks bad	2	2	1	1	4	1	3.5	0.6
It hurts	3	0	1	3	1	3	3.7	0.6
Can't eat certain foods	2	4	2	1	2	0	2.7	0.3
More difficult to brush teeth	1	3	4	1	1	1	3.1	0.3
People make fun of you	0	0	2	2	1	6	5.0	1.2
More difficult to eat	3	2	1	3	2	0	2.9	0.4

TABLE 36

11 patients were asked to repeat their ranking of problems of orthodontic treatment to determine the reproducibility of the method. The results are shown above. The order varied. Difficulty with eating was ranked second in both situations. The appearance of the appliances and the comments made by others about the appliances were consistently ranked low.

Written responses to questionnaires

Few patients and parents/guardians responded to questions requiring written answers. As these questions all related to the provision of orthodontic care, the answers have been grouped together for descriptive purposes.

Patients aged 17 years and over.

The patients aged 17 or less were generally happy with the service and expressed an aversion to having to travel to Sydney. Four individuals expressed a wish for a service on the north coast. A few individuals described traveling as a problem. There were requests for shorter treatment time, a reduced waiting list and being seen on time. One respondent felt that they did not know enough about orthodontics to record an answer.

Parents/Guardians.

In some respects, the parents/guardians answers were similar to the answers given by patients 17 years and less. Five recorded that their child would not have treatment if the clinic was located in Sydney. There was an interest in having a clinic located on the north coast. Taree and Kempsey were suggested. One parent suggested co-ordinating appointments for patients from the same area to facilitate shared transport. A few were of the opinion that the service should be available more than one week a month. Appointments outside school hours were desired. Feedback from the orthodontist regarding treatment options and progress was considered important. Two individuals disagreed that the State Orthodontic Service provided an effective service. Reasons given both related to the School Dental Service rather than the clinic at Royal Newcastle Hospital.

Patients aged 18 years and over.

Patients aged 18 and over were generally positive regarding the service. The importance of explaining aspects of treatment was emphasized. One patient was of the opinion that the service should be available in Newcastle more frequently.

Supervisors.

Most supervisors completed all questions requiring a written response. For this reason, each written question is discussed individually.

The lack of involvement of hospital dentists, the uncertainty of continuity of patient care once the current registrars have completed their training, and the remaining unserved areas of N.S.W. were considered by some to be unmet objectives of the State Orthodontic Service.

Other qualities that were desired in an orthodontic service were an extended role for hygienists and dental therapists, effective screening of patients on a need priority basis and patient selection to ensure cooperation is present throughout treatment.

An effective service was equated with the presence of a full time orthodontist. One supervisor was of the opinion that the service would become more effective with time, presumably as the registrars gain more experience. Concern was once again expressed over the issue of continuity of treatment once the current registrars complete their training.

Two of those who thought that there was little difference of attitude between patients who paid a fee for treatment and those who received treatment for free considered that often the patients are not the ones paying so no difference would be expected. The remaining supervisors considered that the absence of a charge for treatment was associated with a blase attitude adopted by the patient to treatment, a lack of responsibility on behalf of patient, and treatment perceived as second rate. Those who agreed with introduction of patient charges suggested that the fee be set at a low rate, and that recovery of the fee be instituted over time to facilitate recovery. A fee was equated with more value being placed on treatment by the patient, and greater motivation by the patient. The need to introduce a charge that was fair and that could be instituted efficiently was mentioned. A problem was anticipated in the justification of a patient charge in one area of dentistry alone. One supervisor saw the introduction of fees as defeating the purpose of public health orthodontics.

Those who disagreed that the service was cost-effective based their opinions on the time allocated for appointments, the use of facilities and staff, the communications required and the fact that the registrars are in training. The supervisors who thought that the service was cost-effective considered the costs of operating the clinic, the quality of care, the number of patients seen, the regularity of attendance of the group, the minimal cost of supervision and a reduction in the waiting list in formulating their decision. One supervisor considered that there was not enough information available to arrive at a conclusion.

Further comments were diverse. One supervisor expressed difficulty in defining effectiveness. It was suggested that discussions between the registrars and the co-ordinator on aspects of the service would facilitate constructive change. Informative feedback from those concerned with the running and funding of the service was seen to be of value. One supervisor commented that patient satisfaction was evident.

Interviews

Patients.

Ten patients were interviewed. Parents of patients aged 17 or less were included in the interview. The average wait for treatment was 2 years, with a range from 4 months to over 10 years. One patient was being treated with a removable appliance. The remaining patients were under treatment with fixed appliances. All patients interviewed saw the main benefit of orthodontic treatment was to improve their appearance. An improvement in appearance was equated with greater confidence, acceptance by peers, ease in finding employment and not being called names. Patients' motive to improve their appearance came from a desire to satisfy themselves rather than others. Parents shared their child's opinions as to the benefits of orthodontic treatment. Problems associated with orthodontic treatment included pain, difficulty eating and speaking, appearance of the appliances, necessity of having extractions, breakage of appliances and difficulty with cleaning teeth. Parents saw the problems of treatment as difficulty with transport, the necessity to organize alternative arrangements at work, the complaints of pain and the need to encourage their child to wear elastics and persevere with treatment. Qualities that were desired in an orthodontic service varied. Most requested friendly staff. Other qualities noted were a clinic located close

to home, ideally no wait, flexible appointments, treatment seen to progress, high standard of treatment, preferably same operator throughout treatment, high standard of hygiene, time available to discuss treatment progress with child and visual material to distract the patients attention from treatment procedures. All people interviewed were satisfied with the clinic as it presently operates, with the exception of flexibility of appointments and difficulty with parking.

The patients interviewed saw various options if the service was not available. Four patients would have attempted to have treatment carried out in Sydney. Three patients would have waited until they were in a financial position to obtain treatment privately. Three patients saw no alternative available to them.

Supervisors.

All seven supervisors were interviewed. The questions related to two themes. Firstly each supervisor was questioned on the average time for him to treat a four premolar extraction case given an equivalent assistance level to the S.O.S. clinic at Newcastle. The average number of appointments to complete the active phase of treatment was 13. On average, adjustments took 15 minutes. Those who had a separate appointment for stage 3 allowed 35 minutes on average. The variation in the number of appointments ranged from 7 to 24. Appointment times ranged from 45 minutes to 5 minutes. Reasons given for variation in treatment time included patient co-operation, the type of case, and the number of broken brackets and arch wires.

The second part of the interview involved collecting opinions on various aspects of the SOS. The main objectives of the S.O.S. were seen as providing an orthodontic service to eligible patients and creating an opportunity for orthodontic training. One supervisor defined an effective service as one which provides a reasonable aesthetic result for the maximum number of people. Another supervisor stressed in-service guidance to dental officers as a main objective.

The supervisors were asked who should determine the effectiveness of the S.O.S.. The response was divided. Most believed that whoever is providing the funds should make this evaluation, while others felt that group evaluation, consisting of supervisors and registrars, with or without

patient/parent involvement, would be the most appropriate. All supervisors were of the opinion that the S.O.S. is an effective service. Cost-effectiveness meant a variety of things to different people. Value for money, efficient service at low cost, maximum return for each dollar spent, the benefit of the service compared to the costs and treating more patients at a lower cost than would be the case in private practice were examples of the responses. Characteristics of a cost-effective service were staff who made efficient use of their time, were aware of costs and finite resources, satisfied patients, all staff working well as a team at maximum capacity. Four supervisors felt the service was cost-effective. Two were of the opinion that the service was not cost-effective. The reasons given for this latter response were the inadequate number of nursing staff and the combination of training in addition to the service provided. All supervisors were of the opinion that patients should be selected on a need/priority basis. Functional problems should be given the highest priority followed by an objective ranking of patients with aesthetic problems.

Five of the supervisors were of the opinion that not all patients should be treated with full comprehensive treatment. These operators felt treatment guide-lines should reflect the patients' desire for treatment, not cause harm, encompass informed consent, and enable the maximum number of patients to receive some benefit. Compromise treatment was seen as acceptable by these operators and was defined as the best treatment under the circumstances. Two supervisors believed that comprehensive treatment should be performed for all patients where it is practicable. Compromise treatment was associated with poor public perception of the service and an increased likelihood of relapse. All supervisors, bar one, were in favour of the proposal that "the user pays". It was envisaged that patient co-operation would be improved through a higher value being placed on treatment by the patient. One supervisor was concerned that no patient should be precluded treatment and hence was cautious regarding fee introduction. One supervisor could not see the advantage of introducing a fee. Patients who are currently eligible for treatment should be those people who require financial assistance. In these circumstances a fee was not seen to be appropriate. Those who approved of the introduction of a fee suggested it be variable,

depending on family income, patient co-operation, degree of difficulty of the case and treatment type.

Final points raised were that the success of the service will be dependent on the registrars and the importance of a team approach to meeting the objectives of the service.

6 Discussion

The cost per episode of treatment and the qualities considered important in the provision of orthodontic care are discussed in order to establish the cost-effectiveness of the State Orthodontic Service at Newcastle.

Limitations of this study relate to the assumptions made and to the imperfections associated with the use of questionnaires and interviews. The validity of using estimates is discussed and a sensitivity analysis is suggested to establish if closer approximations would be beneficial in future analysis.

The results of any study must be viewed in the light of the method. Whether the assumptions are considered appropriate will influence the validity of the study. The assumptions made in this analysis were that the parents/guardians of patients aged 18 years and over did not attend with their children and that the inclusion of fixed costs would not influence the ordering of the operator alternatives considered appreciably.

In some cases, patients aged 18 years and over attended with a parent/guardian. This would increase the average cost per patient. The influence that this would have on the results is proportional to the size of this group. Patients aged 18 years and over comprised 25% of the total patients surveyed. The necessity of this attendance comes into question beyond the age of 18 years, an age which society endows with responsibility and independence. Consideration of these factors would indicate that this assumption is valid.

Consideration of fixed costs have been excluded from this analysis. Hall (personal communication, 1990) stated that inclusion of fixed costs often influence the results only minimally, and become significant only where the costs for the alternatives considered are similar. Assuming the same level of assistance, the cost for visiting dental officer specialists and the cost for registrars with minimal supervision to perform an episode of treatment were similar and differentiation between these alternatives may be based on consideration of fixed costs. As the contribution of fixed

costs to the treatment cost is related to operator treatment time, consideration of fixed costs would favour visiting dental officers as the least costly alternative.

Alwin (1977) divides errors in surveys into those occurring at the data collection stage and those involving the analysis of the collected data. Sample bias may be introduced at the data collection stage. This is a function of the following;

1. The completion rate. The completion rate of a survey is the total sample minus all uncompleted interviews (regardless of the cause) divided by the total sample. All patients and supervisors in this survey completed the questionnaire. The completion rate for parents/guardians was 95%.

2. The nonresponse rate. Nonresponse refers to missing interviews from among the covered (or contracted sample elements). The response to individual questions within the questionnaires ranged from 80% to 100%. The nonresponse to the written questions was high, and bias must be suspected in these responses.

3. Sample coverage. The uncovered portion of the sample must either be held to an absolute minimum, or measures must be taken to correct for the resulting bias. This survey was conducted over a three month period, the aim being to include all patients currently under treatment. In other words, survey design sought total sample coverage.

The high completion rate, response rate and sample coverage would indicate that the results of the questionnaire, with the exception of the written responses, are representative of the population surveyed.

Bias may exist for several reasons. The respondent may be more concerned with pleasing the interviewer than giving accurate responses. Different interpretations of questions in a poorly constructed survey may lead to bias. Sudman and Bradburn (1984) report that reactions are likely to be slightly more favourable at the service site than they are if the interview is conducted in the recipient's home.

"A common objection to all the foregoing means of eliciting people's valuations is that they rely on statements of opinion, and it has been observed that what people say and what people do are often rather different." (Williams and Anderson, 1975)

The treatment cost for each alternative was estimated from information collected from interview and observation of the operation of the Newcastle clinic and patient records. The limitations associated with interviews has been discussed earlier. The validity of the estimate for the cost for students to perform an episode of treatment requires consideration of the validity of estimation of the student treatment time and student appointment number. The student treatment time was estimated from observation of the operation of the Newcastle clinic. The number of appointments for the students to complete the first two stages of Begg treatment showed considerable variation. The average number of appointments for both stage 1 and 2 was 5, with a standard deviation of 3. The magnitude of the standard deviation provides an indication of the large distribution about the mean. The number of appointments to complete stage 3 was estimated, introducing further uncertainty into the student appointment number used in the treatment cost calculations. Accuracy would be improved if a number of completed cases were considered. Data would become increasingly available with continued operation of the clinic.

In cost studies estimates are often used. The alternative is to ignore various costs which introduces greater inaccuracy than if an estimate of the costs is included. Where the value of key parameters is very uncertain, a sensitivity analysis may be appropriate. Instead of using the mean values for these parameters, the analyst may successively use several values (say, high, medium, and low) in an attempt to see how sensitive the results (the ranking of the alternatives being considered) are to variations in the uncertain parameters (Fisher, 1971). "If the outcome of the analysis is noticeably affected by the values used, more accurate estimates or 'better guesses' are required" (Yule, van Amerongen and van Schaik, 1986). "The sensitivity analysis will determine how large a change in a variable can be, before it affects the rank ordering of program analysis outcomes" (Niessen and Douglass, 1984). This analysis would be appropriate in further analysis of treatment cost in order to allow for the uncertainty of the parameters used in the calculations and to establish the influence of certain parameters on the the results.

"Money-outlay measures of costs are also inherently loaded with inconsistencies" (Bowman, 1966). The results indicate that employment of

full-time specialists in a public institution is the alternative with the lowest monetary cost. However, the recruitment of full-time orthodontists into the public service has been difficult due to the higher monetary incentives offered in the private sector. Assuming the same level of assistance, visiting specialists and registrars with minimal supervision supplied treatment at a similar cost. Supervision increased the cost for the registrars to perform an episode of treatment. Two aspects require discussion in the area of supervision. Firstly, the State Orthodontic Service is both a provider of orthodontic care to eligible patients and education for future specialists. The supervisors ranked these objectives of the service as the most important. Aspects relating more specifically to treatment, in-service guidance and the recruitment of specialists were ranked lower. It then is reasonable to view the cost of the registrars as containing both a treatment and an educational component. The cost of supervision is included in the educational fraction. Secondly, the number of supervised sessions in Newcastle varies from the number in the other State Orthodontic Service clinics. Each session is supervised at Newcastle, due to the availability of local orthodontists. The other clinics have one to four supervised sessions each week with input from local orthodontists if available and any emergency arises. The question of supervision is an educational one. A factor to consider is the experience of the registrars, the gain from supervision being inversely proportional to the educational level of the registrars. The provision of service in private practice on a fee for service was associated with the highest cost. Doherty (1978) has shown that the public clinics provide equivalent quality care at significantly lower cost to society than do private offices.

The monetary costs incurred by patients proved to be significant for both location alternatives. The cost for patients to attend appointments in Sydney was greater than the operator costs for all alternatives. Having the clinic located in Newcastle as opposed to having the clinic located in Sydney reduced the patient monetary cost by 57%. Decentralization has a large impact on the patient costs associated with orthodontic treatment.

The patient's monetary cost is reduced when treatment is performed by a specialist compared to the registrars in proportion to the number of

appointments to complete treatment. The cost is reduced by 13%. This effect is minimal when compared to the effect of decentralization.

Travel time is reduced by decentralization. The number of patients that would need to travel for over 3 hours to attend appointments would increase by approximately 35% if treatment were conducted in Sydney as opposed to Newcastle. Patients miss out on education and parents are removed from their other responsibilities if a policy of decentralization is not adopted. In an unfamiliar environment, less opportunities are envisaged. This is evident in the reduction of activities that would be combined with appointments if treatment were to be carried out in Sydney. Most reported that a trip to Sydney would be restricted to the orthodontic appointment only. For the patients who traveled the greatest distances, accommodation would be required, the need increasing fourfold over the number requiring accommodation if treatment were to be conducted in Sydney.

Opportunity costs, monetary and other, increase greatly when treatment is restricted to a central supplier. Indeed, the cost may be so great that many patients would not seek treatment (Frost, 1987). Seel and Burke (1973) recognized the significance of patient cost. "Ability to pay for the treatment is not a factor in the British NHS situation, but ability to afford the considerable expense of loss of earnings and traveling expenses often incurred by parents of children who require treatment can be very important".

The aspect of an orthodontic service that was considered most important by all groups was that treatment should be of a high standard. The patients and supervisors ranked seeing the same orthodontist for the entire treatment as the second most important quality of an orthodontic service. Continuity of patient care is seen as being a greater benefit than patients being seen on time, having a clinic in the region and a short waiting list for treatment by these groups. Fisher (1971) suggested allocating resources in accordance with weighted objectives. Williams (1974) equates maximal benefit with a service that reflects community values. This would indicate that establishing a high standard of treatment and maintaining the same operator for the period of treatment should be given high priority in resource allocation.

The supervisors considered the main objectives of the State Orthodontic Service were to meet a growing demand for orthodontic treatment and provide for orthodontic needs in the public system. Armstrong (1966) proposed ruthless selection of patients as a means of dealing with a situation where demand far outweighs supply. Malocclusions with a potential for harm were considered by the supervisors as more worthy of treatment than patients with an aesthetic problem only. Harm resulting from a malocclusion may be physical or psychological. Fisk (1963), Armstrong (1966) and Prahl-Andersen (1978) recognize the importance of considering both these elements in case selection. However, the number of patients presenting with conditions causing physical harm were seen by the supervisors to be in the minority. The views of the supervisors concerning patient selection must be considered with the knowledge that being largely involved in private practice, they are not faced with having to consider the respective worthiness of different people's request for treatment.

All patients ranked an improvement in appearance as the most important benefit of orthodontic treatment. Greater confidence was consistently ranked second in importance in preference to improved function, improved oral hygiene, freedom from pain and improved occupational prospects. The majority of patients surveyed were teenagers. This time of adolescence is associated with the acquisition of personal identity and the increasing importance of the peer group (Proffit, George and McIver, 1986). Cavior and Doeckci (1973) found that adolescents place a high value on aesthetics. It would then be expected that dentofacial deformity would have a significant effect on the self-image of a person in this age group (Stricker, et. al., 1979). The high ranking of greater confidence associated with orthodontic treatment may relate to increased acceptance by peers and an improvement in self-image through the gaining of a better appearance. The psychological impact of malocclusion and facial deformity has been acknowledged by many workers (Fisk, 1963; Macgregor, 1951, 1970; Secord and Backman, 1959; Stricker, et. al., 1979).

Shaw, Gabe and Jones (1979) administered a questionnaire to 200 orthodontic patients and their parents in South Wales and compared their findings with a similar study in St. Louis, Missouri. Both groups had

similarly high expectations of improved appearance and benefits. Improvements in dental health, mastication and speech were expected. Approximately 2/3 of the parents of girls in both groups thought that straight teeth would enhance the child's popularity. 20 to 40% of the parents thought straightened teeth important for their childrens' future occupational success. "Although anonymous, the questionnaires were administered in a dental setting and respondents might have been inclined to select perceived 'right' answer, while the 'select reply' format inevitably inhibits free expression." (Shaw, Gabe and Jones, 1979)

If improved popularity, referred to by Shaw, Gabe and Jones, was associated with greater confidence this would support the finding found in this survey. The high percentage of parents who thought orthodontic treatment would improve their child's occupational success in the South Wales and Missouri surveys does not agree with the patients' perceptions of orthodontic treatment in this survey. Ease of employment was consistently ranked lowest by both Newcastle patient groups, yet an improvement in appearance was ranked highest. This may highlight differences in motivation between patients and parents.

Patients aged 17 years and less ranked ease of tooth brushing the fifth most important benefit of orthodontic treatment. The patients aged 18 years and over saw more benefit to oral hygiene from orthodontic treatment, ranking this benefit third from the options provided. The literature supports an association between certain aspects of malocclusion and plaque-related diseases. Tooth irregularity combined with average oral hygiene methods has been associated with gingival inflammation (Ainamo, 1972; Buckley, 1980; Alexander and Tipnis, 1970; Hellgren, 1956; Gould and Picton, 1966). At the extremes of oral hygiene, in the posterior part of the mouth, this correlation is less evident (Beagrie and James, 1962) suggesting the association is weak. An association is evident between malocclusion and caries (Miller and Hobson, 1961; Adler, 1956). This has been disputed by others (Katz, 1978). Adler (1956) proposed caries as a causative factor in the development of malocclusion, rather than being a result of malocclusion.

Improved function and freedom from pain were ranked third and fourth respectively by the patients aged 17 years and less. These same factors

were ranked equally at fourth in importance by the patients 18 years and over. Hixon, Maschka and Fleming (1962) support the finding of masticatory efficiency in subjects with excellent occlusions compared to those with Class I and Class II malocclusions. The relationship between pain in the form of temporomandibular disorders and malocclusions is contentious. A link has been established between openbites and negative overjets by some (Mohlin and Thilander, 1984; Riolo, Brandt and TenHave, 1987). Others have found no relationship between malocclusion and mandibular dysfunction (Bush, 1985; Lieberman, Gazit, Fuchs and Lilos, 1985; Helm and Petersen, 1989). Proffit (1986) suggests that malocclusion coupled with increased oral muscle activity will provoke symptoms of the temporomandibular complex.

Appearance of appliances was ranked as the second greatest problem with orthodontic treatment by patients aged 17 years and less and the third greatest problem by patients 18 years and over. Restriction of the type of foods that could be eaten was considered a greater disadvantage by both groups. Patients 18 years and over considered pain associated with treatment more of a problem than the appearance of the appliances. These findings are in agreement with Linn (1974) who found that 71 percent of teen-agers currently in treatment were satisfied with the general appearance of their teeth, leading this author to conclude that the wearing of appliances is not considered to be a hindrance to appearance.

Orthodontic treatment has been associated with alveolar crest destruction (Kessler, 1976) and accelerated progression of periodontal disease in the presence of inflammation (Kessler, 1976; Stallard, 1968). Some authors have stated that the change in periodontal status with orthodontic treatment is reversible (Kloehn and Pfeifer, 1974), while others have found significant loss of gingival attachment with treatment (Zachrisson, 1973; Zachrisson and Alnaes, 1974). The controversy that exists concerning the effects of orthodontic treatment on the periodontium suggest that the changes are minimal. Zachrisson and Zachrisson (1971) found no increase in caries experience associated with orthodontic treatment, although the areas affected by caries shifted from the proximal to the vestibular and lingual areas. Root resorption has been associated with treatment (Zachrisson, 1975; Sjolien and Zachrisson, 1973). However, the life span of the the teeth affected by resorption is

said to remain unaffected (Zachrisson, 1975; Phillips, 1955). Some patients showed a predisposition to root resorption (DeShields, 1955); anterior teeth and traumatized teeth were most commonly affected (Phillips, 1955) and certain treatment modalities were associated with resorption (DeShields, 1969). The incidence of temporomandibular dysfunction in orthodontic patients has been examined. Larsson and Ronnerman (1981) suggest that orthodontic treatment is protective, while Sadowsky and Polson (1984) found no difference with treatment.

Treatment being free of charge was valued highly by patients and parents/guardians. This aspect of an orthodontic service was ranked third in importance by both patient groups. Parents/guardians ranked this aspect of treatment as second in importance. When parents/guardians and patients aged 18 years and over were asked if they would be willing to meet a fee for treatment if the amount were small, 79% and 91% of each group agreed respectively. However, the majority (93% of parents/guardians and 70% of patients 18 years and over) were prepared to pay provided the amount were less than \$300. This response must be viewed with the knowledge that the respondents were asked to give their response in retrospect and that what was agreed to in the questionnaire may not represent the response in actuality.

Evans (1986) stated that the challenge for publicly funded programs is to be competitive while simultaneously satisfying the need to provide vital health services to the needy. This author suggested that one way to meet these goals would be to attract paying patients who generate revenue to support more traditional publicly funded health services. A fee for treatment would be introduced for three reasons. Firstly, a charge would be seen as a means of increasing the value placed on treatment by the parties involved. Paying patients were associated with a higher level of cooperation by the majority of supervisors. The amount of the charge need only be significant to foster greater responsibility on the part of the patient and parent/guardian. Secondly, the charge may be introduced in order to meet part, or all of the monetary costs of treatment. \$300 would meet the operator costs for the episode of treatment considered for all alternatives with the exception of registrars paid as Dental Officers Grade 2: 2nd year, registrars receiving supervision and specialists paid on a fee for service basis operating in private practice. However, the costs

considered in a cost-effective analysis do not examine the total costs of treatment. Costs are examined for alternative methods of service delivery. Therefore, it must be recognized that \$300 would meet only a portion of the total cost. Thirdly, a charge for treatment would curb demand. Where the money price to the consumer at the time of receiving health care is close to zero, as in the NHS and with health insurance, one of the benefits a market system - the consumer carefully scrutinizing the product and then deciding whether it is worth the cost - disappears. It is argued that consumption of care would occur past the point where the benefit from the last unit of care is less than its opportunity cost to the community.

A fee for treatment was seen as unnecessary by one supervisor. Patients who were eligible for treatment were considered in need of assistance. In this instance, a charge for treatment would be counterproductive because the fee would likely discourage those most in need. It should be noted here that patients do pay a significant amount for treatment in the form of transport costs and lost income. The monetary cost to the average patient is greater than the operator costs for most alternatives considered. Other aspects of the introduction of fees that deserve consideration are the mechanics of collection and the increase in responsibility associated with a treatment charge. Fee collection would have to be such that the cost of collecting the fee would be minimal in order to ensure efficient use of the funds. Since payment of fees by instalments would be necessary in most cases, much of the funds raised through the introduction of fees would be required in the administration of fee collection. A charge for treatment would be associated with a greater input from the paying parties with increased responsibility being placed on the operator.

C o n c l u s i o n

"In 1984, the United States spent an estimated \$387 billion on health care, an amount equal to 10.6 percent of the gross national product (GNP). Dental care expenditures exceeded \$25 billion in 1984 and represented approximately 6.4 percent of all health care costs." (Evans, 1986) "It must be accepted that limits exist on what any society can or will spend on health services." (Hall and Mooney, 1990) The unique market structure of the health services requires that resources be allocated by economic analysis, the most commonly used in medical industries being the cost-effectiveness analysis. Cost-effectiveness analysis is a systematic method of selecting between alternative means of delivering a service. In performing a cost-effective analysis, it is hoped that preconceived value judgements are set aside (Grainger, 1973), activities are viewed more objectively, real issues that affect future decisions are identified (Horowitz and Heifetz, 1979) and a framework is constructed through which the maximum effect can be delivered with the minimum effort on the part of the community (Fuller, 1974). Drummond and Mooney (1982) suggest that priorities be set in a economic framework, providing incentives for efficiency and strengthening the role of evaluation. "As government funds become scarcer, policy may dictate that funds be targeted to those programs that provide maximum benefits for the resources expended." (Niessen and Douglass, 1984).

The cost-effectiveness of the State Orthodontic Service at Newcastle was analysed by estimating the cost to perform the active phase of Begg appliance treatment for a patient requiring extraction of first premolars and defining effectiveness as it relates to the provision of orthodontic care. Newcastle as the site of operation for an orthodontic clinic was compared to Sydney. The costs considered were those incurred by patients 17 years of age and less, their parents, and patients 18 years of age and over, the patients being those currently in treatment at Newcastle at the time of this survey. The monetary cost for transport, lost income, and additional expenses, such as child care were considered. Indirect costs in the form of travel time, and activities missed as a result

of attending appointments were assessed. The operator alternatives considered were:

- i) Full time specialists employed in a public institution.
- ii) Visiting dental officers employed in a public institution.
- iii) Specialists providing orthodontic care in private practice on a fee for service basis.
- iv) Registrars employed in a public institution. The cost with and without supervision was calculated.

Fixed costs for all options were not included.

In an effort to gauge the satisfaction of individuals to different ends, those groups most closely associated with the Newcastle clinic were asked to consider the elements that constitute an effective orthodontic service, in accordance with the suggestion by Buchanan and Prior (1985). The following were considered;

- i) The importance of various characteristics of an orthodontic service. The characteristics considered were such aspects as treatment standard, convenience to transport and treatment being free of charge.
- ii) Opinion of the effectiveness of the State Orthodontic Service as it operates at Newcastle.
- iii) The benefits and problems associated with orthodontic treatment as perceived by the patients.
- iv) The relative importance to the supervisors of the objectives of the State Orthodontic Service.
- v) The supervisors opinion of the cost-effectiveness of the State Orthodontic Service as it operates at Newcastle.

The response to the introduction of a user pays system was examined. The opinion of parents of patients 17 years of age and less, patients 18 years of age and over, and supervisors was sought. The amount willing to be paid by the patients and parents was gauged.

From the alternatives considered, the operator costs to perform the episode of treatment, in order of increasing cost were;

- i) Full time specialists, all grades.
- ii) Registrars without supervision, Grade 1, 3rd to 4th year.
- iii) Visiting Dental Officer Specialists, all grades.
- iv) Registrars without supervision, Grade 1, 5th year and above.

- v) Registrars with full-time supervision.
 - vi) Specialists employed on a fee for service basis in private practice.
- The salary cost ranged from \$175 for a 1st year full time specialist to \$649 for a specialist employed on a fee for service basis in private practice.

Aspects relevant to the provision of orthodontic care were examined in an effort to define what constitutes an effective orthodontic service. The areas considered were:

- i) Characteristics of an orthodontic service. Treatment that is of a high standard was the quality consistently given the highest priority by all groups surveyed. To retain the same operator throughout treatment was ranked second by patients and supervisors.
- ii) Effectiveness of the State Orthodontic Service. 59% of all groups surveyed strongly agreed that the State Orthodontic Service as it operates at Newcastle is effective.
- iii) The benefits and problems associated with orthodontic treatment as perceived by the patients. Patients considered the major benefits of treatment were the improvement in appearance and the gaining of confidence. Patients considered a restriction in the type of foods consumed and difficulty with eating the main problems, although there was not clear differentiation between the problems considered.
- iv) The relative importance to the supervisors of the objectives of the State Orthodontic Service. The objectives, in order of priority were;
 - a) Meet a growing demand for orthodontic care.
 - b) Provide for the orthodontic needs.
 - c) Train future specialists.
 - d) Provide treatment that is acceptable.
 - e) Meet patients major expectations for treatment.
 - f) Provide continuity of patient care.
 - g) In-service guidance.
 - h) Recruitment of orthodontic specialists.
- v) The supervisors opinion of the cost-effectiveness of the State Orthodontic Service as it operates at Newcastle. 67% of the supervisors were of the opinion that the service is cost-effective.

Having the clinic located in Newcastle as opposed to having the clinic located in Sydney reduced the patient monetary cost by 57%. The number

of patients that would need to travel for over 3 hours to attend appointments increased by approximately 35% if treatment were conducted in Sydney as opposed to Newcastle. Patients missed out on education and parents were removed from their other responsibilities when treatment in Sydney was envisaged. For the patients who traveled the greatest distances, accommodation was required, the need increasing fourfold for the number requiring accommodation if treatment were to be conducted in Sydney.

The response to the introduction of a user pays system was examined. Treatment being free of charge was valued highly by patients and parents/guardians. However, the majority of patients stated that they were prepared to pay a fee for treatment provided this was less than \$300.

"There is no general agreement on how best to deliver health care" (Mooney, 1986, p. 31). Progress in the area of health delivery may best be made by 'piecemeal social engineering'. Planning is a continuous process, based on information that is current, reflecting changes in disease prevalence (Beck, 1987). "The pace of change in scientific and social development is such that rigid planning may restrict future capacity to respond to new opportunities" (Barenthin, 1975).

"The influence for change is, and will continue to be, economic. Until quite recently, health care was considered more in terms of social and ethical issues. We debated whether health care was a right or a privilege. Today, the debate is over cost containment; at the federal level, health care is viewed as part of the budget-deficit problem" (Evans, 1986).

The State Orthodontic Service at Newcastle proved to a highly acceptable method of delivering orthodontic care. During the past three years, the development of the State Orthodontic Service has served to increase the availability of orthodontic care to the eligible population of New South Wales. This has been possible due to the availability of orthodontic registrars. Formal requests have been made to further the Service. However, expansion of the Service is difficult to envisage due to the lack of additional registrar posts or trained specialists in the foreseeable future.

Further Investigation

The opportunities for the use of economic appraisal "in assessing new technologies, health authority plans and clinical choices are greatly underdeveloped" (Drummond and Mooney, 1982). Further investigation in the form of a cost-benefit analysis in the area of orthodontics would define the benefits of treatment to society.

A cost-benefit analysis would require a monetary value to be placed on the benefits derived from treatment. This is complex for reasons outlined earlier. Health economists are active in the area of valuing intangible commodities. The valuation of human life is an example (McGuire, Henderson and Mooney, 1988, p. 84-89). Placing a monetary value on the benefits of orthodontic treatment would require consideration of the approaches outlined earlier in relation to health care. Patients considered ease of employment the least important benefit of treatment, making the 'human capital approach' to valuation of treatment the unlikely method of choice. The 'implied value approach' or the 'willingness to pay approach' may provide a method of valuation. The latter is currently favoured by the majority of economists (McGuire, Henderson and Mooney, 1988, p. 88).

Health economics is a rapidly growing field. A cost-benefit analysis of the State Orthodontic Service, possibly using the 'willingness to pay' approach for health care valuation, would lead to more equitable distribution of the limited resources available to the community.

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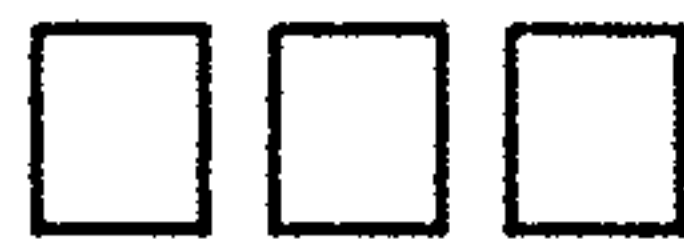
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Appendix 1

Questionnaires

The questionnaires used in this survey were designed in collaboration with the Australian Bureau of Statistics. The questionnaires are in the following order;

1. Patients aged 17 years and less.
2. Parents/guardians.
3. Patients aged 18 years and over.
4. Supervisors.



~~STATE ORTHODONTIC SERVICE~~
~~SURVEY~~

PATIENTS VIEW

Dear Patient,

A survey is being conducted during March and April to determine the value of having an orthodontic service at Newcastle. All patients having orthodontic treatment are being asked to take part in this survey. For this survey to be successful, it is important that all questionnaires be completed and returned to us as soon as possible. As you can see, your questionnaire is identified only by a number, so any information you supply will be completely confidential.

This orthodontic service at Newcastle is provided by the State Orthodontic Service. Information from this survey will be used to improve the service.

1. What is your age as at last birthday? _____ yrs.

2. Please tick the appropriate box.

Male ☐ 1

Female ☐ 2

3. What has your treatment involved? Tick all those that apply.

Braces ☐ 1

Plate ☐ 2

Other ☐ 3 Please specify _____

4. How long since treatment started? Please tick one box.

- Less than 6 months ☐ 1
- 6 to 12 months ☐ 2
- 12 to 18 months ☐ 3
- 18 to 24 months ☐ 4
- More than 24 months ☐ 5

5. Please rank the following qualities of an orthodontic service in order of importance. (Place the numbers 1 to 8 in the boxes provided. A "1" indicates "most important" and a "8" indicates "least important")

- Convenient to transport ☐ 1
- Treatment is free of charge ☐ 2
- Treatment is of a high standard ☐ 3
- Patients are seen on time ☐ 4
- Clinic is in your region ☐ 5
- Short waiting list for treatment ☐ 6
- Seeing the same orthodontist for the entire treatment ☐ 7
- Large number of patients are seen ☐ 8

6. What other qualities would you like to see in an orthodontic service?___

7. Please indicate how strongly you agree or disagree with the following statement;

"The State Orthodontic Service at Newcastle provides an effective service."

(Tick one box only)

- | | |
|-------------------|----------------------------|
| Strongly agree | ☐ 1 |
| Agree | ☐ 2 |
| Disagree | ☐ 3 |
| Strongly disagree | ☐ 4 |

Comments _____

8. Number the following benefits of orthodontic treatment in order of importance. (Place the numbers 1 to 6 in the boxes provided. A "1" indicates "most important" and a "6" indicates "least important")

- | | |
|-----------------------|----------------------------|
| Look better | ☐ 1 |
| Eat better | ☐ 2 |
| Freedom from pain | ☐ 3 |
| Easier to brush teeth | ☐ 4 |
| Greater confidence | ☐ 5 |
| Easier to find a job | ☐ 6 |

9. Number the following problems of orthodontic treatment in order of importance. (Place the numbers 1 to 6 in the boxes provided. A "1" indicates "most important" and a "6" indicates "least important")

Looks bad

 1

It hurts

 2

Can't eat certain foods

 3

More difficult to brush teeth

 4

People make fun of you

 5

More difficult to eat

 6

10. When you come to your orthodontic appointments, what do you miss out on? Tick all those that apply.

School

☐ 1

Study/Homework

☐ 2

Free time(leisure time)

☐ 3

Work

☐ 4

How much would you earn during this time?

\$_____

Other

☐ 5

Please specify_____

11. If your orthodontic appointments were in Sydney, what would you miss out on? Tick all those that apply.

School

☐1

Study/Homework

☐2

Free time(leisure time)

☐3

Work

☐4 How much would you earn during this time?

\$_____

Other

☐5 Please specify_____

12. Please make further comments if you wish.

Orthodontic Dept.,
United Dental Hospital,
2 Chalmers St.,
Surry Hills NSW 2001

Tel: (02) 2820388

To whom it may concern,

A survey is being conducted during March and April to determine the value of having an orthodontic service at Newcastle.

A parent or guardian of all patients having orthodontic treatment are being asked to take part in this survey. For this survey to be successful, it is important that all questionnaires be completed and returned to us as soon as possible. As you can see, your questionnaire is identified only by a number, so any information you supply will be completely confidential.

This questionnaire should only take a short time to complete. If you have any questions please don't hesitate to ask, or ring me at the above number.

This orthodontic service at Newcastle is provided by the State Orthodontic Service. Information from this survey will be used to improve the service.

Your help is much appreciated.

Yours sincerely,

Peter Frost.
Orthodontic Registrar.

☐ ☐ ☐

~~STATE ORTHODONTIC SERVICE
SURVEY~~

PARENTS / GUARDIANS VIEW

1. What is your age as at last birthday? _____ yrs.

2. In which suburb or town do you live? _____ 1

What is the postcode? ☐ ☐ ☐ ☐ 2

3. What is your relationship to the patient? Please tick one box.

- | | |
|-------------|---|
| Mother | ☐ 1 |
| Father | ☐ 2 |
| Guardian | ☐ 3 |
| Grandmother | ☐ 4 |
| Grandfather | ☐ 5 |
| Other | ☐ 6 Please specify _____ |

4. How many patients, aged 17 or less, are there in the family having orthodontic treatment at this clinic? Please tick one box.

- | | |
|---------------|----------------------------|
| One | ☐ 1 |
| Two | ☐ 2 |
| Three or more | ☐ 3 |

5. How long did you wait for treatment? Please tick one box.

- Less than 6 months ☐ 1
- 6 months to 1 year ☐ 2
- 1 to 2 years ☐ 3
- 2 to 3 years ☐ 4
- Greater than 3 years ☐ 5

6. Please rank the following qualities of an orthodontic service in order of importance. (Place the numbers 1 to 8 in the boxes provided. A "1" indicates "most important" and a "8" indicates "least important")

- Convenient to transport ☐ 1
- Treatment is free of charge ☐ 2
- Treatment is of a high standard ☐ 3
- Patients are seen on time ☐ 4
- Clinic is in your region ☐ 5
- Short waiting list for treatment ☐ 6
- Seeing the same orthodontist for the entire treatment ☐ 7
- Large number of patients are seen ☐ 8

7. What other qualities would you like to see in an orthodontic service?__

8. Please indicate how strongly you agree or disagree with the following statement;

"The State Orthodontic Service at Newcastle provides an effective service."

(Tick one box only)

Strongly agree ☐ 1

Agree ☐ 2

Disagree ☐ 3

Strongly disagree ☐ 4

Comments _____

9. How long does it take to travel from your home to this clinic? Please tick one box.

Less than 1 hours ☐ 1

1 to 2 hours ☐ 2

2 to 3 hours ☐ 3

3 to 4 hours ☐ 4

4 to 6 hours ☐ 5

More than 6 hours ☐ 6

10. How long would it take to travel from your home to Sydney? Please tick one box.

- | | |
|-------------------|----------------------------|
| Less than 1 hours | ☐ 1 |
| 1 to 2 hours | ☐ 2 |
| 2 to 3 hours | ☐ 3 |
| 3 to 4 hours | ☐ 4 |
| 4 to 6 hours | ☐ 5 |
| More than 6 hours | ☐ 6 |

11. How often does someone accompany your child to their orthodontic appointments? Please tick one box.

- | | |
|---------------------|----------------------------|
| 3 in 3 appointments | ☐ 1 |
| 2 in 3 appointments | ☐ 2 |
| 1 in 3 appointments | ☐ 3 |
| Rarely | ☐ 4 |

12. If treatment were to be carried out in Sydney, how often would someone accompany your child to their orthodontic appointments? Please tick one box.

- | | |
|---------------------|----------------------------|
| 3 in 3 appointments | ☐ 1 |
| 2 in 3 appointments | ☐ 2 |
| 1 in 3 appointments | ☐ 3 |
| Rarely | ☐ 4 |

13. Do you obtain a concession on public transport?

- | | |
|-----|----------------------------|
| Yes | ☐ 1 |
| No | ☐ 2 |

14. Does your child obtain a concession on public transport?

Yes ☐ 1

No ☐ 2

15. How do you usually travel to appointments? Please tick one box.
Record the return fare where requested.

- Bus ☐ 1 Your fare \$ _____
Your child's fare \$ _____
- Train ☐ 2 Your fare \$ _____
Your child's fare \$ _____
- Taxi ☐ 3 Fare \$ _____
- Private car ☐ 4
- Other ☐ 5 Please specify, including cost _____
-

16. How would you usually travel to appointments if they were in
Sydney? Please tick one box. Record the return fare where requested.

- Bus ☐ 1 Your fare \$ _____
Your child's fare \$ _____
- Train ☐ 2 Your fare \$ _____
Your child's fare \$ _____
- Taxi ☐ 3 Fare \$ _____
- Private car ☐ 4
- Other ☐ 5 Please specify, including cost _____
-

17. If you travel by car, how many kilometers do you drive? Please tick one box.

- Less than 5 kms ☐ 1
- 5 kms to 15 kms ☐ 2
- 15 kms to 25 kms ☐ 3
- 25 kms to 50 kms ☐ 4
- 50 kms to 100 kms ☐ 5
- Greater than 100 kms ☐ 6

18. If you would travel by car to Sydney, how many kilometers would you drive? Please tick one box.

- Less than 5 kms ☐ 1
- 5 kms to 15 kms ☐ 2
- 15 kms to 25 kms ☐ 3
- 25 kms to 50 kms ☐ 4
- 50 kms to 100 kms ☐ 5
- Greater than 100 kms ☐ 6

19. When you come to the orthodontic appointments, what do you miss out on? Tick all those that apply.

- Work ☐ 1 How much would you earn during this time?
\$_____
- Education ☐ 2
- Free time(leisure time) ☐ 3
- Housekeeping ☐ 4
- Other ☐ 5 Please specify_____
-

23. Besides travel, what additional expenses do you have to enable your child's attendance? Tick all those that apply.

- Childminding ☐ 1
- Food ☐ 2
- Accommodation ☐ 3
- Other ☐ 4 Please specify _____
-

24. Besides travel, what additional expenses would you have if treatment was carried out in Sydney? Tick all those that apply.

- Childminding ☐ 1
- Food ☐ 2
- Accommodation ☐ 3
- Other ☐ 4 Please specify _____
-

25. If you had to pay a small amount would your child still have started orthodontic treatment? Please tick one box.

- Yes ☐ 1
- No ☐ 2

If you answered yes, what amount would you be willing to pay?

- Less than \$100 ☐ 3
- \$100 to \$300 ☐ 4
- \$300 to \$500 ☐ 5
- More than \$500 ☐ 6

26. Please make further comments if you wish.



~~STATE ORTHODONTIC SERVICE~~
~~SURVEY~~

PATIENTS VIEW

Dear Patient,

A survey is being conducted during March and April to determine the value of having an orthodontic service at Newcastle. All patients having orthodontic treatment are being asked to take part in this survey. For this survey to be successful, it is important that all questionnaires be completed and returned to us as soon as possible. As you can see, your questionnaire is identified only by a number, so any information you supply will be completely confidential.

This orthodontic service at Newcastle is provided by the State Orthodontic Service. Information from this survey will be used to improve the service.

1. What is your age as at last birthday? _____ yrs.

2. Please tick the appropriate box.

Male ☐ ₁

Female ☐ ₂

3. Are you the parent of a patient, aged 17 or less, who is having orthodontic treatment at this clinic? Please tick one box.

Yes ☐ ₁

No ☐ ₂

4. In which suburb or town do you live? _____ 1

What is the postcode? 2

5. What has your treatment involved? Tick all those that apply.

Braces ☐ 1
Plate ☐ 2
Other ☐ 3 Please specify _____

6. How long did you wait for treatment? Please tick one box.

Less than 6 months ☐ 1
6 months to 1 year ☐ 2
1 to 2 years ☐ 3
2 to 3 years ☐ 4
Greater than 3 years ☐ 5

7. How long since treatment started? Please tick one box.

Less than 6 months ☐ 1
6 to 12 months ☐ 2
12 to 18 months ☐ 3
18 to 24 months ☐ 4
More than 24 months ☐ 5

8. Please rank the following qualities of an orthodontic service in order of importance. (Place the numbers 1 to 8 in the boxes provided. A "1" indicates "most important" and a "8" indicates "least important")

Convenient to transport	1
Treatment is free of charge	2
Treatment is of a high standard	3
Patients are seen on time	4
Clinic is in your region	5
Short waiting list for treatment	6
Seeing the same orthodontist for the entire treatment	7
Large number of patients are seen	8

9. What other qualities would you like to see in an orthodontic service?__

10. Please indicate how strongly you agree or disagree with the following statement;

"The State Orthodontic Service at Newcastle provides an effective service."

(Tick one box only)

- Strongly agree ☐ 1
- Agree ☐ 2
- Disagree ☐ 3
- Strongly disagree ☐ 4

Comments _____

11. Number the following benefits of orthodontic treatment in order of importance. (Place the numbers 1 to 6 in the boxes provided. A "1" indicates "most important" and a "6" indicates "least important")

- Look better ☐ 1
- Eat better ☐ 2
- Freedom from pain ☐ 3
- Easier to brush teeth ☐ 4
- Greater confidence ☐ 5
- Easier to find a job ☐ 6

12. Number the following problems of orthodontic treatment in order of importance. (Place the numbers 1 to 6 in the boxes provided. A "1" indicates "most important" and a "6" indicates "least important")

- | | |
|-------------------------------|----------------------------|
| Looks bad | ☐ 1 |
| It hurts | ☐ 2 |
| Can't eat certain foods | ☐ 3 |
| More difficult to brush teeth | ☐ 4 |
| People make fun of you | ☐ 5 |
| More difficult to eat | ☐ 6 |

13. How long does it take to travel from your home to this clinic? Please tick one box.

- | | |
|-------------------|----------------------------|
| Less than 1 hours | ☐ 1 |
| 1 to 2 hours | ☐ 2 |
| 2 to 3 hours | ☐ 3 |
| 3 to 4 hours | ☐ 4 |
| 4 to 6 hours | ☐ 5 |
| More than 6 hours | ☐ 6 |

14. How long would it take to travel from your home to Sydney? Please tick one box.

- | | |
|-------------------|----------------------------|
| Less than 1 hours | ☐ 1 |
| 1 to 2 hours | ☐ 2 |
| 2 to 3 hours | ☐ 3 |
| 3 to 4 hours | ☐ 4 |
| 4 to 6 hours | ☐ 5 |
| More than 6 hours | ☐ 6 |

15. Do you obtain a concession on public transport?

Yes ☐ 1

No ☐ 2

16. How do you usually travel to appointments? Please tick one box.
Record the return fare where requested.

Bus ☐ 1 Fare \$ _____

Train ☐ 2 Fare \$ _____

Taxi ☐ 3 Fare \$ _____

Private car ☐ 4

Other ☐ 5 Please specify, including cost _____

17. How would you usually travel to appointments if they were in
Sydney? Please tick one box. Record the return fare where requested.

Bus ☐ 1 Fare \$ _____

Train ☐ 2 Fare \$ _____

Taxi ☐ 3 Fare \$ _____

Private car ☐ 4

Other ☐ 5 Please specify, including cost _____

18. If you travel by car, how many kilometers do you drive? Please tick one box.

- Less than 5 kms ☐ 1
- 5 kms to 15 kms ☐ 2
- 15 kms to 25 kms ☐ 3
- 25 kms to 50 kms ☐ 4
- 50 kms to 100 kms ☐ 5
- Greater than 100 kms ☐ 6

19. If you would travel by car to Sydney, how many kilometers would you drive? Please tick one box.

- Less than 5 kms ☐ 1
- 5 kms to 15 kms ☐ 2
- 15 kms to 25 kms ☐ 3
- 25 kms to 50 kms ☐ 4
- 50 kms to 100 kms ☐ 5
- Greater than 100 kms ☐ 6

20. When you come to the orthodontic appointments, what do you miss out on? Tick all those that apply.

- Work ☐ 1 How much would you earn during this time?
\$_____
- Education ☐ 2
- Free time(leisure time) ☐ 3
- Housekeeping ☐ 4
- Other ☐ 5 Please specify_____
-

24. Besides travel, what additional expenses do you have to enable your attendance? Tick all those that apply.

- Childminding ☐ ₁
- Food ☐ ₂
- Accommodation ☐ ₃
- Other ☐ ₄ Please specify _____
-

25. Besides travel, what additional expenses would you have if treatment was carried out in Sydney? Tick all those that apply.

- Childminding ☐ ₁
- Food ☐ ₂
- Accommodation ☐ ₃
- Other ☐ ₄ Please specify _____
-

26. If you had to pay a small amount would you have started orthodontic treatment? Please tick one box.

Yes ☐ ₁

No ☐ ₂

If you answered yes, what amount would you be willing to pay?

- Less than \$100 ☐ ₃
- \$100 to \$300 ☐ ₄
- \$300 to \$500 ☐ ₅
- More than \$500 ☐ ₆

27. Please make further comments if you wish.

~~STATE ORTHODONTIC SERVICE~~
~~SURVEY~~

SUPERVISORS VIEW

1. Which year did you receive your orthodontic degree?_____

2. Have you been employed in a public hospital previously? Please tick one box.

Yes ☐ 1

No ☐ 2

3. The objectives of the State Orthodontic Service are given below. Please rank these according to their importance. (Place the numbers 1 to 8 in the boxes provided. A "1" indicates "most important" and a "8" indicates least important")

Train future specialists

☐ 1

Meet patients major expectation for treatment

☐ 2

Provide treatment that is acceptable and manageable by the patient

☐ 3

To recruit and retain orthodontic specialists in the public sector

☐ 4

Provide continuity of patient care

☐ 5

Provide for the orthodontic needs of geographically isolated patients

☐ 6

Meet a growing demand for orthodontic care in the public sector

☐ 7

In service guidance

☐ 8

4. Please indicate how strongly you agree or disagree with the following statement;

"The objectives of the State Orthodontic Service are being met."

(Tick one box only)

Strongly agree ☐ 1

Agree ☐ 2

Disagree ☐ 3

Strongly disagree ☐ 4

Comments _____

5. Please rank the following qualities of an orthodontic service in order of importance. (Place the numbers 1 to 8 in the boxes provided. A "1" indicates "most important" and a "8" indicates "least important")

Convenient to transport ☐ 1

Treatment is free of charge ☐ 2

Treatment is of a high standard ☐ 3

Patients are seen on time ☐ 4

Clinic is in your region ☐ 5

Short waiting list for treatment ☐ 6

Seeing the same orthodontist for the entire treatment ☐ 7

Large number of patients are seen ☐ 8

6. What other qualities would you like to see in an orthodontic service?__

7. Please indicate how strongly you agree or disagree with the following statement;

"The State Orthodontic Service at Newcastle provides an effective service."

(Tick one box only)

- | | |
|-------------------|----------------------------|
| Strongly agree | ☐ 1 |
| Agree | ☐ 2 |
| Disagree | ☐ 3 |
| Strongly disagree | ☐ 4 |

Comments_____

8. Do patients who receive treatment free of charge value treatment less than those who pay for treatment?

Yes ☐ ₁

No ☐ ₂

Comments _____

9. What do you think of the proposal that "the user pays" for orthodontics in public health services, even if it is at reduced rates? _____

10. Please indicate how strongly you agree or disagree with the following statement;

"The State Orthodontic Service at Newcastle is cost-effective".

(Tick one box only)

Strongly agree ☐ 1

Agree ☐ 2

Disagree ☐ 3

Strongly disagree ☐ 4

What factors have you considered in the rating given?_____

11. Do you wish to add any further comments?_____

Appendix 2

I n t e r v i e w s

Interviews were conducted with the purpose of expanding on issues covered in the questionnaire and to examine questions more suited to an interview situation. The following questions served as outlines during the interview.

Patient aged 17 years and less with Parent

1. Patients Name/Age.
2. Parents Name/Age (Relationship to patient).
3. Suburb or town (Postcode).
4. How long did you wait for treatment (Parent)?
5. What has your treatment involved (Child)?
6. What do you see as the benefits of orthodontic treatment (Child)?
(Parent)?
7. What do you see as the problems of orthodontic treatment (Child)?
(Parent)?
8. What qualities would you like in an orthodontic service (Child)?
(Parent)?
9. To what extent are these qualities found in this clinic (Child)?
(Parent)?
10. If this service was not available, what would you see as your alternatives?
11. If you had to pay a small amount would your child still have started orthodontic treatment?
12. What do you consider to be a small amount?
13. Do you wish to add anything?

Patient aged 18 years and over

1. Patients Name/Age.
2. Suburb or town (Postcode).
3. How long did you wait for treatment?
4. What has your treatment involved?
5. What do you see as the benefits of orthodontic treatment?
6. What do you see as the problems of orthodontic treatment?
7. What qualities would you like in an orthodontic service?
8. To what extent are these qualities found in this clinic?
9. If this service was not available, what would you see as your alternatives?
10. If you had to pay a small amount would you still have started orthodontic treatment?
11. What do you consider to be a small amount?
12. Do you wish to add anything?

Supervisor

1. With an assistance level comparable to this clinic, how much time would you allow for placement of Begg appliances on both arches for a patient who has had premolars extracted?
2. How much variation is there in the number of appointments for you to treat such a case?
3. How much variation is there in the time for each appointment for you to treat such a case?
4. What are the reasons for this variation?
5. What do you see as the main objectives of the State Orthodontic Service at Newcastle.
6. Who should determine the effectiveness of the Service at Newcastle?
7. Do you consider the State Orthodontic Service at Newcastle to be effective?
8. What does the term cost-effectiveness mean to you?
9. What do you consider to be the characteristics of a cost-effective orthodontic service?
10. Do you consider the State Orthodontic Service at Newcastle to be cost-effective?
11. How should patients be selected for treatment?
12. Should all patients be treated with full comprehensive treatment?
13. What do you think should be the guide-lines for orthodontic treatment in this clinic.

14. What do you think of the proposal that "the user pays" for orthodontics in public health services, even if it is at reduced rates?
15. If a fee was introduced for public orthodontic care, should it be fixed or variable/how should the amount be determined?
16. Do you wish to add anything?