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PAPWORTH EVERARD  
CAMBRIDGE CB3 8RE

Our Ref. TAHE/SMF .....

TEL. HUNTINGDON (0480) 830541

EXT....210.....

CARDIOTHORACIC SURGICAL UNIT

29th May 1988.

The Rt. Hon. Mrs. Margaret Thatcher, M.P.,  
10 Downing Street,  
London SW1

*Dear Prime Minister,*

Your visit to Papworth on Friday was a most welcome event and much appreciated by all the patients and staff whom you met. Our Hospital, though far from perfect, sums up much of what is best in the N.H.S. and we were delighted you were able to see it on such a perfect summer's day.

Despite many of the recent problems, I am a firm believer in preserving the basic structure of the N.H.S. and my reasons for this were outlined in the recent Upjohn Lecture, a copy of which I enclose. I hesitated before adding to the immense amount of paper you must have to deal with every day. but you seemed so responsive to what we are trying to achieve that I thought I might be forgiven for adding to your burden.

The essence of my argument is contained in the first five and last two pages of the lecture and can be summarised as follows:-

- (a) That public expectations of what should be provided in terms of health care will always exceed the ability of the nation to afford them.
- (b) That the N.H.S. is a relatively efficient and cheap way of providing health care compared with other systems.
- (c) That, for a variety of reasons, the N.H.S. has been underfunded for the last few years and that this needs correction, after which a slightly higher proportion of G.D.P. should be spent on health than at present.
- (d) That thereafter the N.H.S. should be organised more on the basis of medically-defined needs than on consumer-led demands.
- (e) That, if this be accepted, then the medical profession and the D.H.S.S. will need to join together and define priorities, particularly in the acute hospital sector, much more explicitly than has been the case in the past.

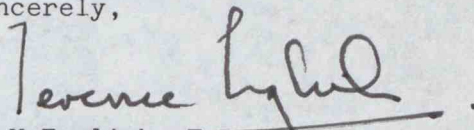
At one stage on Friday, you remarked: "Only doctors can decide what they should do." I am sure most of my colleagues would heartily endorse

this/...

this view. However, if we accept that the overall Health budget is always going to be finite, and if we accept that a substantial and appropriate proportion needs to be spent on what I call the humane (and often very cost-ineffective) component of the service, then surely more thought should be devoted to determining how the remaining part of the budget should be spent. In this regard, I believe that we should, as hospital doctors, be more prepared to submit our individual activities to systematic comparative cost-benefit analysis, in order that we can try and achieve maximum benefit to patients at minimum cost to the State. The introduction of performance indicators may be seen as a step in the right direction, but is, in my view, still too much related to efficiency savings rather than benefit analysis. This latter is much more difficult to define and achieve, not least because it implies an element of telling doctors what they may do on the basis of an assessment of information they have provided. I do not minimise the magnitude of such a task, but am of the firm belief that it could only be achieved within the context of a still largely tax-funded and State-salaried N.H.S.

I look forward to the publication of the present review of the N.H.S. with considerable interest and I thank you again for visiting Papworth.

Yours sincerely,

A handwritten signature in dark ink, appearing to read 'Terence English', with a horizontal line drawn underneath it.

T.A.H.English, F.R.C.S.  
Consultant Cardiothoracic Surgeon

HEART TRANSPLANTATION AND THE NATIONAL HEALTH SERVICE

A QUESTION OF PRIORITIES

THE 1988 UPJOHN LECTURE

Terence A H English, BSc (Engineering), MA, FRCS, FRCS (Ed), MRCP (Lond),  
FACC

Consultant Cardiothoracic Surgeon, Papworth and Addenbrooke's Hospitals,  
Director, British Heart Foundation Heart Transplant Research Group

## INTRODUCTION

When some months ago I was asked to give this lecture, it was indicated that whatever the subject matter it would be desirable to include some reference to health care funding and the problems of how the best use should be made of the limited resources available to the National Health Service. Little did I appreciate then that these issues would become so topical and so contentious during the intervening period. Nor, of course, did I realise that the lecture would be delivered at the same time as the Chancellor was presenting his budget to the nation and revealing whether or not part of his almost embarrassingly large surplus would be directed towards Health or whether it would go predominantly to further tax cuts.

The Health Service is, I believe, something of which this country can be justifiably proud. It is now in its fortieth year and during this time has assumed almost monolithic proportions, yet still manages to provide a comprehensive though often criticised service for the essential health needs of the nation. With 800,000 employees it is the country's largest employer and currently costs the taxpayer approximately £21 billion per annum. This figure needs to be seen in the context of a total Public Expenditure for the United Kingdom for 1987/88 of £147 billion <sup>(1)</sup>. This, in turn, represents 42% of the nation's Gross Domestic Product (GDP) which should be compared with a Public Expenditure of 9% of GDP a century ago. The other major spending departments are Social Security (£48 billion), Education and Science (£21 billion) and Defence (£19 billion).

When the National Health Service was introduced, there was inevitable controversy and formation of dissident groups opposed to it. However, the great majority of doctors and health workers gave their support to a service founded on the basis of social justice and which was warmly welcomed by the nation at large. The next few decades provided time for consolidation and as late as 1979 a Royal Commission on the National Health Service had no difficulty in recognising the value of a service that was national and funded from taxation, rather than from insurance or private contract between doctor and patient <sup>(2)</sup>.

The main drive of the government since 1979 has been to make the Health Service more efficient and it is calculated that during the last three years this systematic search for efficiency has released \$400 million in extra resources. However, the ravages of cash limits since 1980 and the failure of central government to cover full pay awards have meant that most of the 191 Health Districts in England and Wales are now at the end of their budgetary tethers. Public dissatisfaction with the shortcomings of the service and particularly the length of operating waiting lists, currently 687,000, has increased. In addition, the closure of hospital beds - no fewer than 1,400 of the 24,000 acute beds in London alone during 1987 (3) - and the failure to recruit and adequately reward nurses, medical secretaries, laboratory workers and other ancillary health-care workers has all resulted in a sense of crisis for the NHS. Professional bodies such as the Medical Royal Colleges, the British Medical Association, the Royal College of Nursing, as well as Health Unions, politicians and the public at large, have all become embroiled in the argument and offered opinion and advice as to how the problems should be resolved. So far as funding is concerned, the options proposed have varied between increasing public expenditure on the NHS, moving more towards involvement of the private sector as a source of alternative funding, or introducing various forms of voluntary or compulsory health insurance such as exist in the United States of America and in other European countries.

As a result of these pressures, the Prime Minister has recently agreed to a closed but comprehensive review of the Health Service, which her Secretary of State seems to have been seeking. Mr Moore's deliberations will be supervised by a Cabinet Committee chaired by Mrs Thatcher herself, who, when recommending the review, announced: "When we are ready, we shall come forward with our proposals for consultation and, should they meet what the people want, we shall translate them into legislation".

All of us who are committed to the Health Service will await these proposals with great interest. I believe it would not be inappropriate at this stage of my lecture to declare what I would say to such an enquiry in the unlikely event of my views being sought. I would begin by stressing that expectations of what should be provided in terms of health care will always outstretch the ability of the nation to afford these. I would emphasise that the NHS has been a relatively cheap way of providing health care for the last 40 years but that, due to a whole variety of reasons, it has been seriously underfunded for the past few years. I would argue that this needs urgent correction and that thereafter we should spend slightly more on health than at present. Expressed as a proportion of the gross domestic product (GDP) Britain spends 5.9%, France 8.5%, Germany 9.5% and the USA 10.7%. However, once these corrections have been made, I would recommend that more energy be directed towards how the overall budget is spent than on trying to increase further the total amount of national resource spent on health. I would also argue that, whatever health care system we end up with, it should be organised more according to medically defined needs than consumer-led demands and that, if this be accepted, then the NHS must, in future, work from more precise information concerning the relative costs and benefits of the various types of treatment currently available to the public. This implies not only the need for better information and advice from the medical profession, but also the political will and executive power to translate that information into appropriate action so that we end up with a balanced and efficient health service in which the humane, and often highly cost-ineffective, component exists alongside and in correct proportion to the best of new technological developments, as well as the more proven and professionally accepted treatments which themselves have been rigorously subjected to comparative cost benefit analysis. Finally, I would express my belief that the ability to direct medical services in this sort of way, and hence retain an equitable and relatively cheap service, is more likely to be achieved if we retain the existing framework of a service predominantly funded from taxation than if we resort to the temptation of paying more of the service from the private sector or from insurance-based schemes.

Being neither a medical politician nor a health economist, I can only defend these views from the vantage point of those aspects of medicine which I know best. It has been my good fortune that my professional activities as a heart surgeon have coincided with the rapid growth and development of the specialty and the advent of several important new forms of surgical therapy. Two of these, namely coronary bypass graft surgery and heart transplantation, have interesting comparisons and contrasts. Both are wonderfully simple conceptually. One is based upon the restoration of a normal blood supply to the ischaemic heart muscle by using lengths of the patient's leg veins to bypass the atheromatous narrowings in his coronary arteries; the other on restoring a normal circulation to the whole body by replacing the patient's defective heart with one transplanted from another human being. Both operations were first accomplished approximately twenty years ago and were dependent on technological advances in both cardiac surgery and allied disciplines. The cost-effectiveness of coronary bypass graft surgery became apparent very quickly and this led to a dramatic increase in the number of these operations as reflected by the annual UK Cardiac Surgical Register which showed an increase from 3,040 bypass graft operations in NHS hospitals in 1977 to 12,020 in 1985. There remains, however, great variation in the provision of these services in different Health Regions in the UK <sup>(4)</sup> and the overall figures should be seen in the context of the stated DHSS objective of not less than 350 operations per million population per annum and a figure of approximately 800 operations per million in the USA during the year 1986. On the other hand, cardiac transplantation has taken much longer to get established. It has always been obvious that it would be a relatively expensive procedure and to begin with there were serious reservations as to whether the Health Service could afford such a costly programme which initially at least could only bring benefit to a very few patients. However, once the medical efficacy of the procedure, in terms of both relief of symptoms and extension of survival had been clearly defined, it was able to stand comparison with other forms of treatment provided by the Health Service and this has resulted in a planned expansion of transplant services available to the public.

Because of my involvement with heart transplantation during the last decade, I thought it might be instructive to outline some of the financial, organisational and medical problems that have had to be overcome and to use these to illustrate how a branch of high-technology medicine, costly in resource and staff time and providing a national service, came to be established within Regional services that were already hard pressed to keep up with the expanding demands placed upon them. I do so because I believe in a way this whole endeavour can be seen as a microcosm of the Health Service, in that what has been provided is of excellent quality but less in volume than ideally required and this has forced comparisons of cost and efficacy with older and more established medical procedures. Furthermore, the system of Supraregional designation and funding which the DHSS has devised to control the development of such specialised activities, although somewhat cumbersome and slow to respond to demands, has, I believe, allowed a more orderly provision of heart transplant services than in many other countries, where considerations of prestige and financial gain, either for institutions or individuals, may have had an undue influence on where and on how many centres have been established.

#### HISTORICAL PERSPECTIVES OF HEART TRANSPLANTATION

A historical perspective of cardiac transplantation is instructive in that it confirms a view expressed by Bryan Jennett <sup>(5)</sup> that, unless or until a branch of high technology medicine can be convincingly shown to be medically effective, it is unlikely to become accepted and funded as part of regular medical practice. In other words, a necessary, though not sufficient, requirement is that it should be demonstrably effective.



It is just over twenty years since Christiaan Barnard did the first human heart transplant in Cape Town in December 1967 (6). This gave rise to an extraordinary degree of public interest. His first patient lived only eighteen days but within a month Barnard performed a second transplant and the patient, Philip Blaaiberg, went on to live for nearly two years. There then followed an almost indecent rush by surgical teams all over the world to join the transplant bandwagon. Many were unprepared and had little understanding of the immunological problems involved and the great majority of these early operations were unsuccessful, as is illustrated by Table 1. Very few teams emerged with an enhanced reputation, with the notable exception of Dr Norman Shumway from Stanford University, who had been responsible for much of the basic research carried out during the preceding decade, and who was bitterly disappointed not to have performed the first human operation. In any event, by the end of 1970, the consensus was that heart transplants could not be justified and soon thereafter the DHSS placed a moratorium on further activity in the UK, there having been three unsuccessful attempts with survival of 45, 2 and 107 days.

My own interest in cardiac transplantation stemmed from a visit to Dr Shumway's Unit in 1973, when I saw for the first time patients who had obviously benefited from the procedure. I had recently been appointed a Consultant at Papworth Hospital and on my return entered into discussions with Professor Calne, who was already active in kidney and liver transplantation, and we agreed to explore the possibility of starting a heart transplant programme in Cambridge. Clinicians are often criticised for introducing expensive and untried new technology without regard to the consequences, both with respect to their own immediate colleagues and the wider medical community. This view was summarised by Richard Knox (7) in 1980, when he observed that there had never been a mechanism for regulating the diffusion rate of new medical technology once past the strictly investigational stage, other than the scepticism or enthusiasm of the doctors involved.

However, I believe our own preparations for embarking on a new programme of heart transplantation were indeed responsible and it was not until 1977 that we felt ready to submit to the Transplant Advisory Panel of the DHSS a paper outlining why we thought that the moratorium on heart transplantation could no longer be justified and why we felt able to embark on this work in Cambridge. We drew attention to the improving results from Stanford, and the greater potential availability of cardiac donors that had followed the clarification of the diagnosis of brain death as a result of the report by the Medical Royal Colleges and their Faculties in 1976 (8). Our own experimental work on improved methods for preserving the donor heart (9) also confirmed the important concept of long distance procurement of donor organs (10), which was vital for a relatively isolated hospital such as Papworth.

Our case was listened to politely and with interest but it was made clear that the DHSS would not look favourably on any so-called one-off operation and that it would only sanction a continuing programme of heart transplants, but that there was no funding available for such a programme. We managed, however, to enlist the help of the Chairman and Officers of the then Cambridge Area Health Authority, who generously agreed to fund the first two transplants but made it clear that thereafter we would have to find alternative financial support.

Our first transplant in January 1979 died after 17 days, but the second patient, Keith Castle, recovered well from his operation and lived for 5 years. His cheerfulness and zest for life captured the public imagination and probably did more for gaining acceptance of heart transplantation at that time than any other factor. In retrospect we were fortunate in our early experience in that 4 of the first 6 patients lived for more than three years and two of these are still alive and well 8 years after transplantation. There is no doubt in my own mind that it was the survival of these early patients and the very evident and dramatic improvement in the quality of their lives that was a crucial factor in our obtaining temporary but invaluable funding from public benefactions and research organisations.

However, not all institutions were so fortunate and in February 1980, at the same time as Mr Yacoub was embarking on his first transplant at Harefield, the Trustees of the Massachusetts General Hospital, after months of deliberation, decided against allowing the hospital's cardiac surgical service to begin a limited programme of heart transplantation. In a statement to the New England Journal of Medicine, defending the Trustees' decision (1), Dr Alexander Leaf, Chief of the Medical Services at MGH, pointed out that the debate had centred around three essential issues, namely the therapeutic efficacy, the possible scientific benefits and the allocation of costly and limited resources. He went on to conclude "that physicians may not make independent decisions regarding what professional services they provide and that, if one considers that the medical profession has historically been fostered and supported to serve a societal need and not to supply physicians with a privileged status, one can find little argument with the course that the Trustees thoughtfully and responsibly followed". This decision, which made headlines all over the United States, caused considerable controversy within the medical profession and particularly the transplant fraternity, and elicited the laconic response from Dr. Shumway: "Maybe it has to be considered - perish the thought - that the MGH isn't the leading institution it used to be. Apparently somebody feels they just don't have the horses!".

FUNDING OF CARDIAC TRANSPLANTATION WITHIN THE NHS

In any event, our own work was able to continue with funds drawn from various quarters. In September 1979, on the basis of our experience with the first two patients, Mr T H Shipp, Treasurer of the Cambridgeshire Area Health Authority, and I prepared a paper on the estimated extra cost to the NHS of providing a service of ten heart transplants per year at Papworth Hospital. The methods used were based on standard NHS accounting practice and it was then that I realised how little was known about the detailed costs of our surgical activities. We used the concept of "additional costs" whereby anything that incurred extra costs solely because of the transplant programme was included. We applied this to the clinical stages of procedure, namely, the assessment of potential recipients, the donor and recipient operations, the postoperative inpatient treatment and the subsequent outpatients follow-up. The cost of all drugs, laboratory tests, radiological and other investigations were included, as was an allowance for additional key nursing and technical staff. The figure arrived at was £15,300 per patient transplanted (12) and these estimates were then used in our approach to various organisations for funding. The National Heart Research Fund paid for the next six operations, and in 1980 we also obtained a capital grant of £100,000 from the DHSS for upgrading of the intensive care unit and operating theatres. Some of this was used for revenue funding until we secured a generous benefaction of £300,000 from the late David Robinson, which allowed us to continue through 1981 and 1982. Between 1983 and 1984 we obtained further special grants from the DHSS supplemented by our own fund-raising activities, but it was not until 1985/86 that our financial situation became secure when we were designated for Supraregional funding by the DHSS. The annual revenue expenditure for the heart transplant programme at Papworth during these years is shown in Table 2.

I have described the evolution of our funding in some detail because I think it illustrates some of the non-medical hurdles that have to be overcome before such a costly and specialised service can be established within the NHS. The experience of Harefield Hospital, which started heart transplants in 1980, and more recently Newcastle, has been similar. These early restrictions on funding acted as a brake on developments in the United Kingdom compared with what was happening in other countries, so that, whereas when we started in 1979 there were only four other centres in the world practising heart transplantation (namely Stanford, Cape Town, Hopital Pitie in Paris and Richmond, Virginia), there are now over 120 centres in the United States alone and more than 60 in Europe, while there are still only five in the UK, of whom 4 are recognised and funded by the DHSS. Table 3 gives the number of heart transplants performed in these five centres since 1979 and the rapid increase in activity since 1985, coincidental with the introduction of Supraregional funding, is evident.

I believe that the concept of Supraregional designation of specialised services, first introduced in 1983 for the care of spinal injuries, paediatric renal failure, and the national poisons information services, is an excellent one and will have an important role in the protection and development of other specialised services in the future. It is based on the premise that the condition requiring treatment is, at the time of designation, sufficiently rare for each unit to service a potential population in excess of 5 million. Also, that in order to be clinically and economically viable, such services, which are by nature expensive, need to be concentrated in a few centres, and that their budget should not be at risk from competing claims within the Health Authority in which they happen to be situated. The designation of these services and the centres that provide them are at the discretion of the Secretary of State. He is advised by the Supraregional Services Advisory Group, which receives applications each year from the Regional and Special Health Authorities, and which can turn to the Royal Colleges and other bodies for professional advice. The Group then gives consideration to these and other matters, such as the optimum geographical siting of new units, before making its recommendations. The designation of services and the funding each has been allocated for 1988/89 is given in Table 4.

It is accepted that the demands for some services may increase to the extent in future they may need to be provided on a Regional basis, whereupon they would lose the protection afforded by Supraregional designation, and it is possible that this will happen to heart transplantation within the next decade. There is also provision for de-designation of individual units should the quality and cost-effectiveness of the service provided compare unfavourably with others similarly funded; this has already happened within the field of liver transplantation. The main disadvantage of the scheme, which is inherent in the way it has been devised, is its slow response time, as applications are only considered once a year. The policy for heart transplantation has been to build each unit up to its maximum capacity before designating additional units, whereas I believe it is necessary to increase the number of units rapidly to the maximum allowable under the scheme, namely nine, in order to meet the expanding demand for heart transplants.

### CLINICAL ASPECTS OF HEART TRANSPLANTATION

I now turn to a consideration of some clinical aspects of heart transplantation, using our experience at Papworth over the last nine years as illustrative material.

During the period January 1979 to December 1987 890 patients were referred to us for consideration of transplantation, of whom 534 were admitted to hospital for further assessment and, of these, 380 were accepted for heart transplantation (Table 5). All of these patients were suffering from terminal heart failure as a result of irreversible damage to the heart muscle; and all were considered to have a life expectancy of less than 6 to 12 months. The seriousness of their prognosis is confirmed by the fact that, of the 92 patients who died before a heart became available, the interval between being placed on the waiting list and death averaged 48 days. By contrast, the 247 patients who received transplants had to wait an average of 100 days (Table 6). These patients came from all over the United Kingdom and Figure 1 illustrates well the national nature of the service provided by our hospital. Because we suspected the demand for heart transplantation was always likely to exceed our capacity to meet it, we soon adopted a policy of not accepting patients for treatment from without the United Kingdom. For similar reasons, we chose not to accept private patients for transplants and I believe both of these decisions have been vindicated with the passage of time.

The two main causes of heart disease for which transplantation is indicated are cardiomyopathies and coronary heart disease. Both tend to affect men more than women and both can occur at a relatively young age, as is reflected by the age distribution of our patients illustrated in Figure 2. Initially we set upper and lower age limits of 50 and 15 years respectively (13). It soon became apparent that these arbitrary limits could not be justified on purely medical grounds and I have no doubt that patients in their 60's, if properly selected, do just as well as those 20 years younger. However, we tend to retain an upper age limit of approximately 60, which acts as a crude but effective filter, as otherwise it is likely we would end up with a waiting list of unmanageable proportions.

The operation itself has become standardised over the years and, providing a good donor organ of appropriate size-match is obtained and providing its function is well preserved between removal and subsequent transplantation, the operative mortality should be low. Despite the parlous condition of many of our recipients, the 30 day mortality, which includes all deaths at or within 30 days of operation, is 9.7%. Indeed one of the most striking impressions from our early experience was the rapid recovery made by some of these very sick patients once they had been provided with a strong heart and a normal circulation, and it was perhaps this more than any other factor which convinced me there must be a future for heart transplantation.

The patient's problems, however are by no means over once he has recovered from the immediate effects of the operation. The host sees the transplanted organ as foreign tissue and attempts to reject it. Our ability to control this immune response is as yet imperfect and, as rejection episodes are most frequent and vigorous in the first three months, it is during this period that most complications tend to occur and during which surveillance of the patient needs to be most careful. Because it is the same immune system which protects the body against infection, the suppression of the rejection response by immunosuppressive drugs also renders the patient more susceptible to infection. This is reflected in Table 7, from which it can be seen that no less than 35 of the 48 deaths (i.e. 73%) that occurred during the first 3 months after transplantation were attributable to these two complications. Thereafter the transplanted organ tends to be accommodated in a more or less stable state of symbiosis with the host, such that the intensity of immunosuppression can be reduced and these complications become less.

The ultimate goal must be to achieve specific immune suppression for donor antigens, so that the individual rejection response can be controlled without at the same time suppressing the entire immune system. This is unlikely to be realised within the immediate future but important advances in immunosuppression have been made in the last decade, the most noteworthy of which were the discovery of the immunosuppressive properties of Cyclosporine by Borel in 1976 (14) and its introduction to clinical transplantation by Calne and colleagues in 1978 (15).



Initially it was hoped that Cyclosporin would obviate the need for steroids and Azathioprine but this proved not to be the case and most immunosuppressive regimes now rely on a combination of all three agents. This allows for lower individual doses of each drug and consequently fewer toxic side effects, not least of which was the nephrotoxicity and hypertension induced by the larger doses of Cyclosporine used when it was the sole agent. Our own preference is to start Azathioprine and steroids immediately before transplantation and to cover the first few days with the prophylactic use of intravenous equine Anti-Thymocyte Globulin. We then gradually introduce Cyclosporine, building up to therapeutic levels during the first week. The Prednisolone is rapidly reduced during the first fortnight and then stopped altogether at three months, unless individual circumstances dictate otherwise. This regime has gradually evolved over the years but the impact of the advent of Cyclosporine in our own programme in March 1982 (16) can be seen from the survival statistics included in Figure 3, which show that the 1 and 5 year survival has improved from 52% and 31% pre-Cyclosporine to 75% and 58% respectively post-Cyclosporine.

After the first year the most important determinant of survival is the development in some patients of a form of accelerated coronary occlusive disease, the aetiology of which is not at all clear (17,18). It probably starts as an immune injury to the endothelium of the coronary arteries, which is the interface between donor antigens and circulating antibodies directed against these antigens. In the early stages these proliferative lesions, which can compromise the lumen of the vessels, may be, at least in part, reversible. However, even if this occurs, there is likely to be some residual damage to the vessel wall and this probably acts as a focus for the deposition of lipids and subsequent development of atheromatous lesions, which both macroscopically and histologically look not dissimilar to spontaneously occurring coronary atheromatous disease. The clinical significance of this disease, as well as the risk factors associated with it, have yet to be determined. Table 7 shows that 9 of the 13 late deaths in our patients were attributable to this phenomenon, and a further 5 patients have been re-transplanted because of it. In order to detect the onset of coronary occlusive disease and define its incidence in the donor hearts, our patients undergo coronary angiography at regular intervals after transplantation. The preliminary data show that 82% and 73% are free from angiographic evidence of the disease at 2 and 5 years respectively.

### QUALITY OF LIFE AFTER CARDIAC TRANSPLANTATION

Thus far, I have said something about the cost of cardiac transplantation and of what might be anticipated in terms of crude survival, but what of the other component in the cost-benefit equation, namely that of improved health status after transplantation? This was to a large extent unknown when we started in 1979, although we could extrapolate to a certain extent from experience with kidney transplants and we also had some information from the heart transplant activity at Stanford University. With respect to the latter, it seemed to me that the quality of medium-term survival was likely to depend to an extent on the Unit's "philosophy" towards immunosuppression and particularly with regard to the treatment of recurrent acute rejection. If, as at Stanford, it was accepted policy that "no patient was allowed to die from rejection", one might expect to see more complications amongst the survivors from immunosuppressive therapy, and particularly steroid therapy, than in a centre using less immunosuppression, where, in turn, there might be rather more deaths due to rejection but less infectious complications. In the face of early criticism from some quarters that "the treatment was probably going to be worse than the disease", the need for early survivors to have a good quality of life was strong and so we adopted the latter policy and have had few regrets as a result of doing so.

I have already alluded to the excellent recovery made by some of our early patients and the much improved functional state which they subsequently enjoyed. However, something more scientifically valid was needed to attest to their improved quality of life than our clinical impressions, which could understandably be attributed to subjective bias. It was therefore with considerable enthusiasm that we welcomed the approach in 1981 by Professor Roy Acheson from the Department of Community Medicine in the University of Cambridge and Martin Buxton from the Department of Health Economics at Brunel University to conduct an independent survey on the costs and benefits of the heart transplant programmes at Papworth and Harefield Hospitals. They obtained research funding from the Office of the Chief Scientist at the DHSS and planned a three year prospective study to identify and carry out a detailed analysis of the resource requirements and thus costs of the two transplant programmes and related these to "appropriate indicators of patient benefits".

It is to their credit that the researchers pressed the Department to provide funding for the inclusion of an analysis of outcome in the project, as it would not be unfair to say that initially at least the Department's main interest was in defining the resource costs within each hospital and the extra NHS costs incurred outside the two centres by patients involved in the transplant programmes.

Quality of life has always been difficult to measure, comprising, as it does, a large subjective element. In this respect, the UK study sought to answer two basic questions; namely, is transplantation associated with a significant and sustained improvement in the recipient's quality of life, and how does this compare with a normal healthy population? After a review of the instruments available, the research team chose the Nottingham Health Profile (NHP) which is a questionnaire that had been fairly widely used and tested to measure patients' subjective perceptions of their health state (19). The questionnaire includes statements relating to six dimensions of social functioning: energy, pain, emotional reactions, sleep, social isolation, and physical mobility. After appropriate weighting for the respective questions, a profile of each of these six dimensions is constructed such that a score of zero indicates the absence of limitations and a score of 100 the presence of all limitations listed.

The questionnaire was administered to all patients at the time of their assessment and thereafter at regular intervals both before and after transplantation. Over 1,000 completed profiles were obtained for analysis and these indicated a pattern of rapidly decreasing quality of life before transplantation, followed by a sharp improvement 3 months after operation, which then appeared to be maintained (Figure 4).

These studies were subsequently extended (20) and a correlation demonstrated between pre-transplant NHP scores and the clinical grading of the patient's prognosis as characterised by their assignment to the provisional or definite waiting list. NHP scores for males one or two years after transplantation were also compared with a "normal" population from a random sample in Nottingham, and both sets of population means appeared similar, particularly in the age group 40-50 years where most observations were available.

The conclusions of the final report which was published in 1985 (21) were favourable and it also indicated that the cost of the investment represented by the transplant operation and hospital care seemed to be falling, while the returns in the form of patient length and quality of life were increasing. It was, I believe, particularly the latter which had an important influence in gaining political approval and subsequent Supraregional designation and funding for the two transplant programmes.

### CONCLUSION: COST-BENEFIT ANALYSIS AND THE DEFINITION OF PRIORITIES

At almost the same time as the evaluation of the UK heart transplant programme was taking place, a similar National Heart Transplantation Study had been commissioned by the Health Care Financing Administration of the United States, which was faced with the dilemma of whether the Medicare Program should reimburse heart transplant patients. Their report was published at the end of 1984 (22) and they concluded that the annual cost per case of heart transplantation compared well with that of other forms of life-saving therapy such as kidney dialysis, management of the cancer patient, and total parenteral nutrition. The report also stated: "If we decide we cannot or do not want to afford a new technology such as heart transplantation, then it is only fair that we reconsider other accepted therapies that have lesser or equal benefits".

It is this concept of comparative cost-benefit analysis, with which we have become familiar in heart transplantation, that should, I believe, be extended not only to other forms of new technology but to many of the existing services provided within the NHS. There is no doubt that the problems of methodology are formidable. We have been taught that the true cost of heart transplantation, known to health economists as the opportunity cost, is not what appears on the bottom line when all the bills have been paid, but rather the value of what must be sacrificed to make room for transplantation (23). The same should apply in the analysis of any other medical activity. Likewise there are difficulties in devising a method for evaluating the benefits that patients receive from their treatment. It has been suggested by Alan Williams that, in order to be able to compare treatment benefits, these should be measured in terms of the effect on life expectancy adjusted for the quality of life (24).

From this has evolved the concept of quality adjusted life years, or QUALY'S, which is an attempt to integrate quantity and quality of life into a single index. Individual patients and doctors, however, may place very different values on these two dimensions of health, and how, for example, are we to ascribe QUALY's to a hip replacement operation, which does not extend life at all but which may greatly improve the quality of remaining life.

Such criticisms are not intended to devalue the principle of cost-benefit analysis, which, I believe, is one of the most urgent tasks facing the Health Service at present. I am convinced that, in order to ensure that as much benefit as possible is obtained from the resources available to us, it is essential that the NHS should work from more precise figures, indicating which patients should be treated and by what method and thereby trying to get a balance between the minimum cost and the maximum benefit in health status to the public. I am aware that such sentiments may be regarded as a dangerous threat to clinical freedom by many of my professional colleagues. I am also aware of the natural reluctance of the Department of Health to infringe on the clinical freedom of doctors. However, in the context of a finite health budget already referred to at the beginning of this lecture, I believe it is the responsibility of the medical profession and the DHSS to join together and define priorities much more explicitly than has been the case in the past. And I see no way of achieving this other than by developing systems of comparative cost-benefit analysis that are as accurate and relevant as possible to help guide us to provide for the many and varied needs of our patients.

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TABLE 1

EARLY HEART TRANSPLANTS: 1968 - 1970

YEAR	TRANSPLANTS	PATIENT SURVIVAL		
		1 MONTH	1 YEAR	2 YEARS
1968	102	54	19	10
1969	48	28	7	6
1970	16	10	4	3
	<hr/>	<hr/>	<hr/>	<hr/>
	166	92	30	19
		(55%)	(18%)	(11%)

TABLE 2

HEART TRANSPLANT FUNDING

PAPWORTH HOSPITAL

REVENUE EXPENDITURE

YEAR	AMOUNT (£)
1979	35,000
1980	105,000
1981	130,000
1982	170,000
1983	200,000
1984/85	270,000
1985/86	800,000
1986/87	1,052,000
1987/88	1,310,000
1988/89	1,986,000

TABLE 3

## NUMBER OF HEART TRANSPLANTS - U.K. 1979-1987

(TOTAL - 814)

	1979	1980	1981	1982	1983	1984	1985	1986	1987
PAPWORTH	3	11	13	16	19(1)	39(3)	44(1)	52(1)	58(2)
HAREFIELD	14	13(2)	20	34	77(1)	89	111(3)	138(2)	
NEWCASTLE					5	11(1)	23		
MANCHESTER									10
ST. GEORGE'S*						2	12		
	3	25	26	36	53	116	138	176	241

Figures in brackets denote number of retransplants.

\*Not designated for supra-regional funding.

TABLE 4

## SUPRA-REGIONAL SERVICES

## 1988/89 REVENUE ALLOCATION

£Million

Spinal injuries	13.7
Infant cardiac surgery	8.9
Poisons information service	0.3
Chorioncarcinoma	0.6
Specialised liver services	2.1
Liver transplantation	4.0
Heart transplantation	6.8
Endoprosthetic bone tumours	1.7
Psychiatric service for deaf people	1.3
Craniofacial surgery	0.4
	<hr/>
TOTAL	39.8
	<hr/>
1988/89 CAPITAL ALLOCATION	1.4
TOTAL	41.2

TABLE 5

CARDIAC TRANSPLANTATION PAPWORTH HOSPITAL

December 1987

REFERRALS

890

ASSESSMENTS

534

Accepted for transplantation

380

Accepted to provisional category

78

Offered conventional cardiac surgery

40

Rejected

95

TABLE 6

CARDIAC TRANSPLANTATION PAPWORTH HOSPITAL

PATIENTS ACCEPTED December 1987

Transplanted Died waiting

PATIENTS 247 92

Age mean 39  
range 6-58 41  
15-57

Diagnosis

Cardiomyopathy 115 36  
I.H.D. 122 50  
Other 10 6

Waiting Times

mean 100 days 48 days

TABLE 7

## CARDIAC TRANSPLANTATION

PAPWORTH HOSPITAL

CAUSES OF DEATH	December 1987			
	0-90 days	90 -1 year	December days	> 1 year
Rejection	20	8	-	-
Infection	15	5	-	2
Coronary Occlusive Disease	-	1	-	9
Donor Heart Failure	4	-	-	-
Multifactorial	3	-	-	-
Pulmonary Carcinoma	-	-	-	2
Lymphoma	1	-	-	-
Cerebrovascular Event	3	-	-	-
Raised PVR	1	-	-	-
Intestinal Infarction	1	-	-	-
Operative Haemorrhage	1	-	-	-
TOTAL	48	15		13

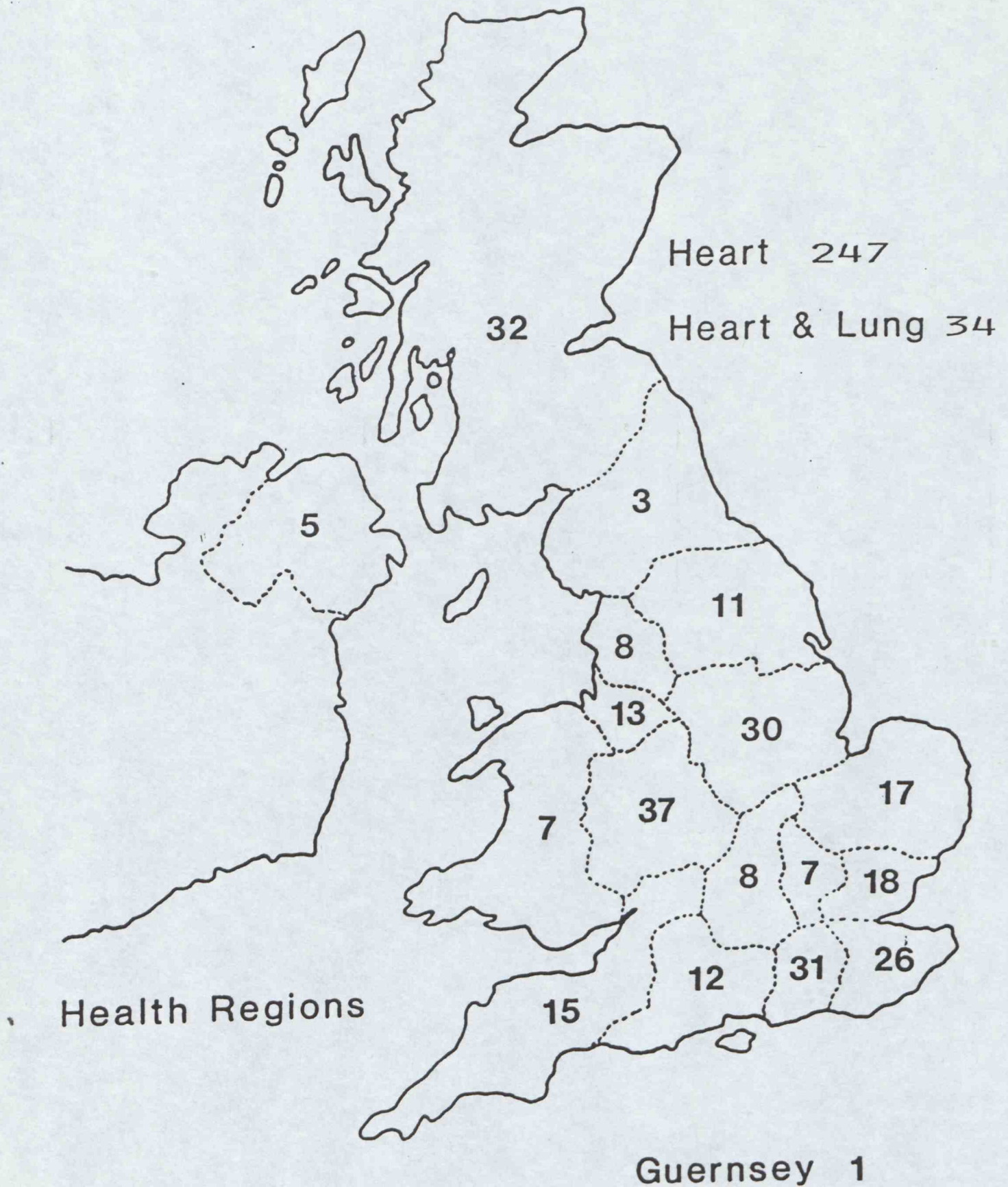


FIGURE 1

RECIPIENTS

HEART and HEART & LUNG

PAPWORTH HOSPITAL - DECEMBER 1987



CARDIAC TRANSPLANTATION  
PATIENT AGE DISTRIBUTION (n=247)

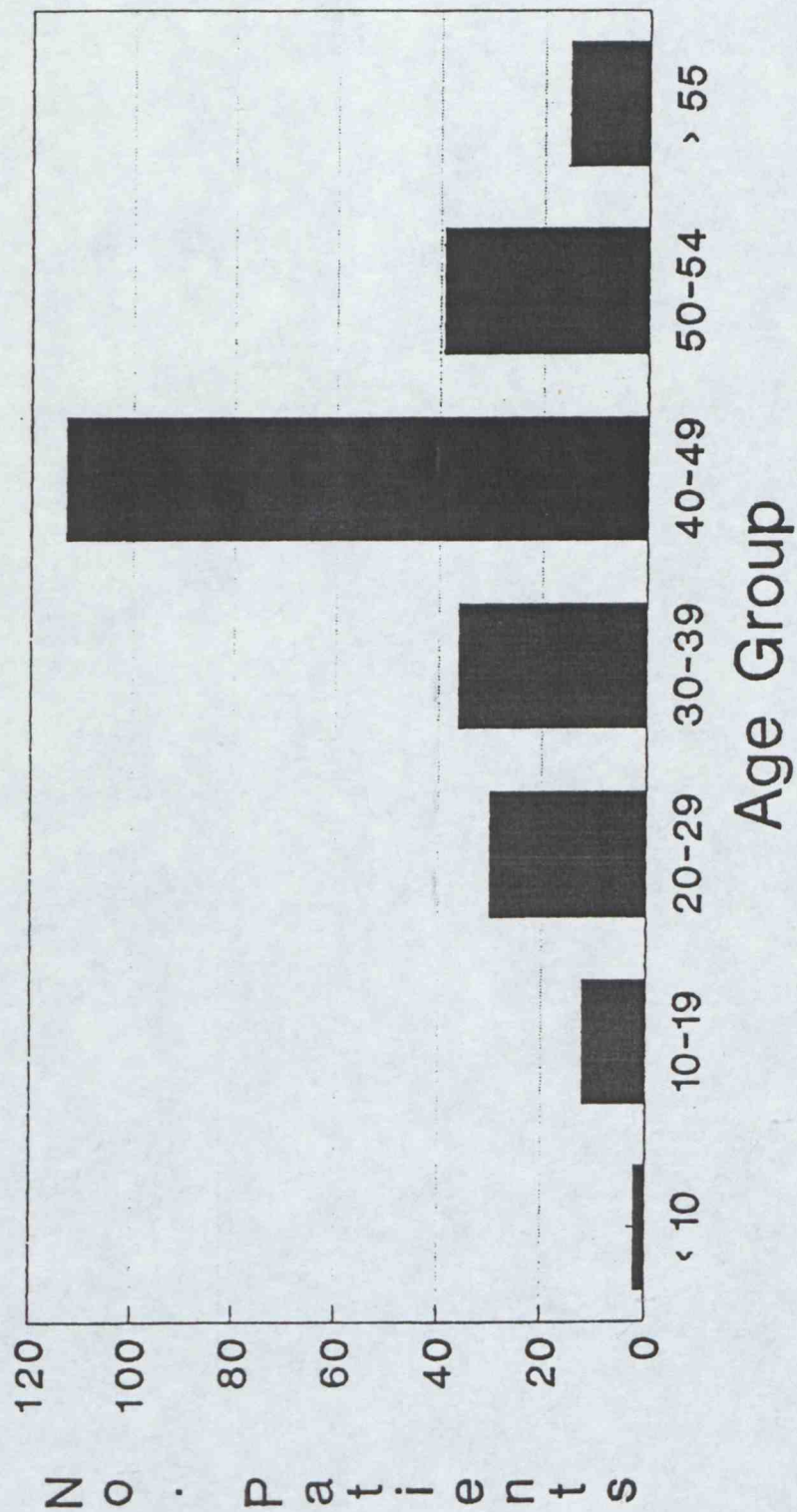
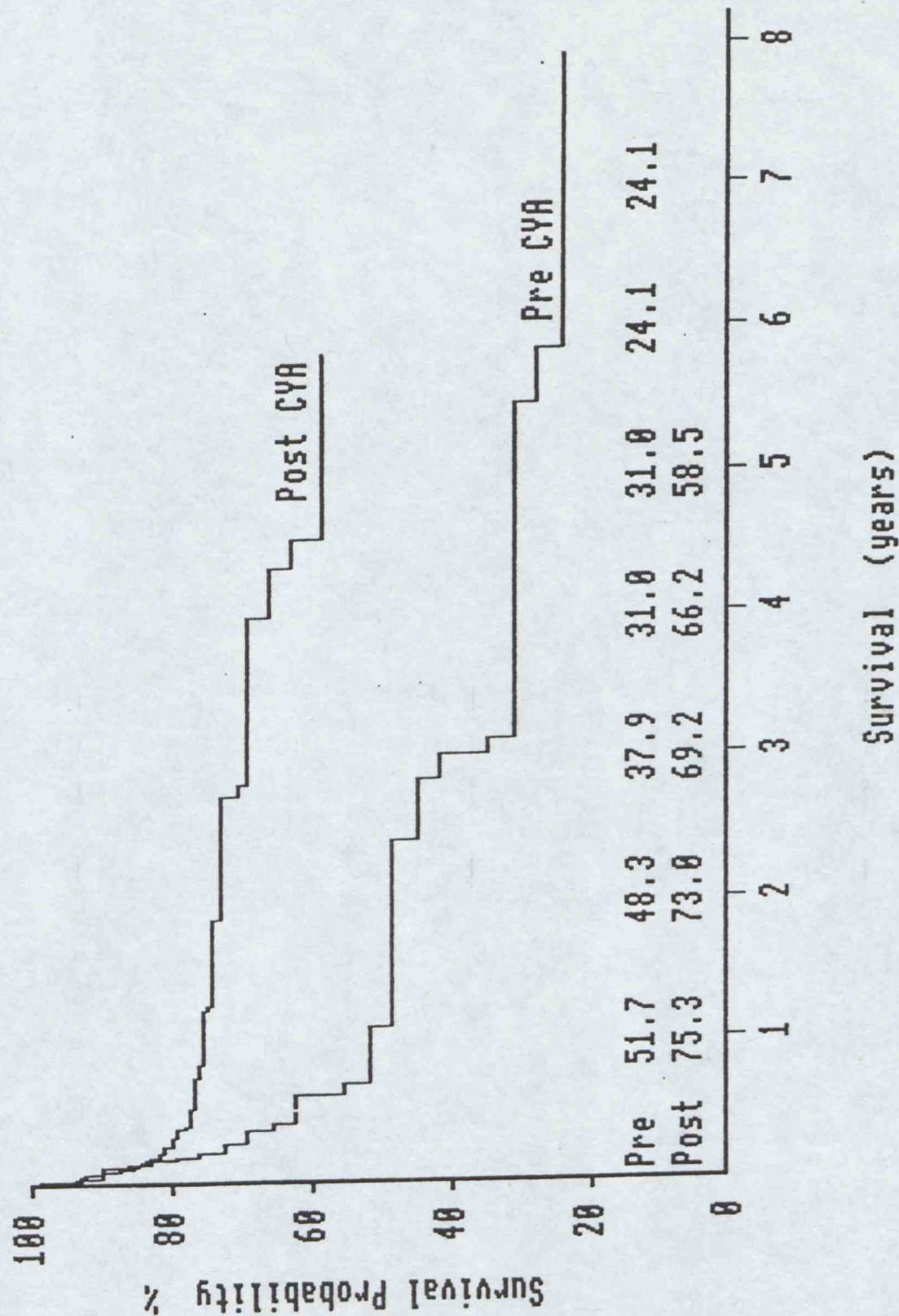


FIGURE 2

FIGURE 3

PAPWORTH HOSPITAL: Cardiac Transplant Patient Survival

December 1987 Pre and Post Cyclosporin



# NOTTINGHAM HEALTH PROFILE

Mean Scores Before and After Transplant

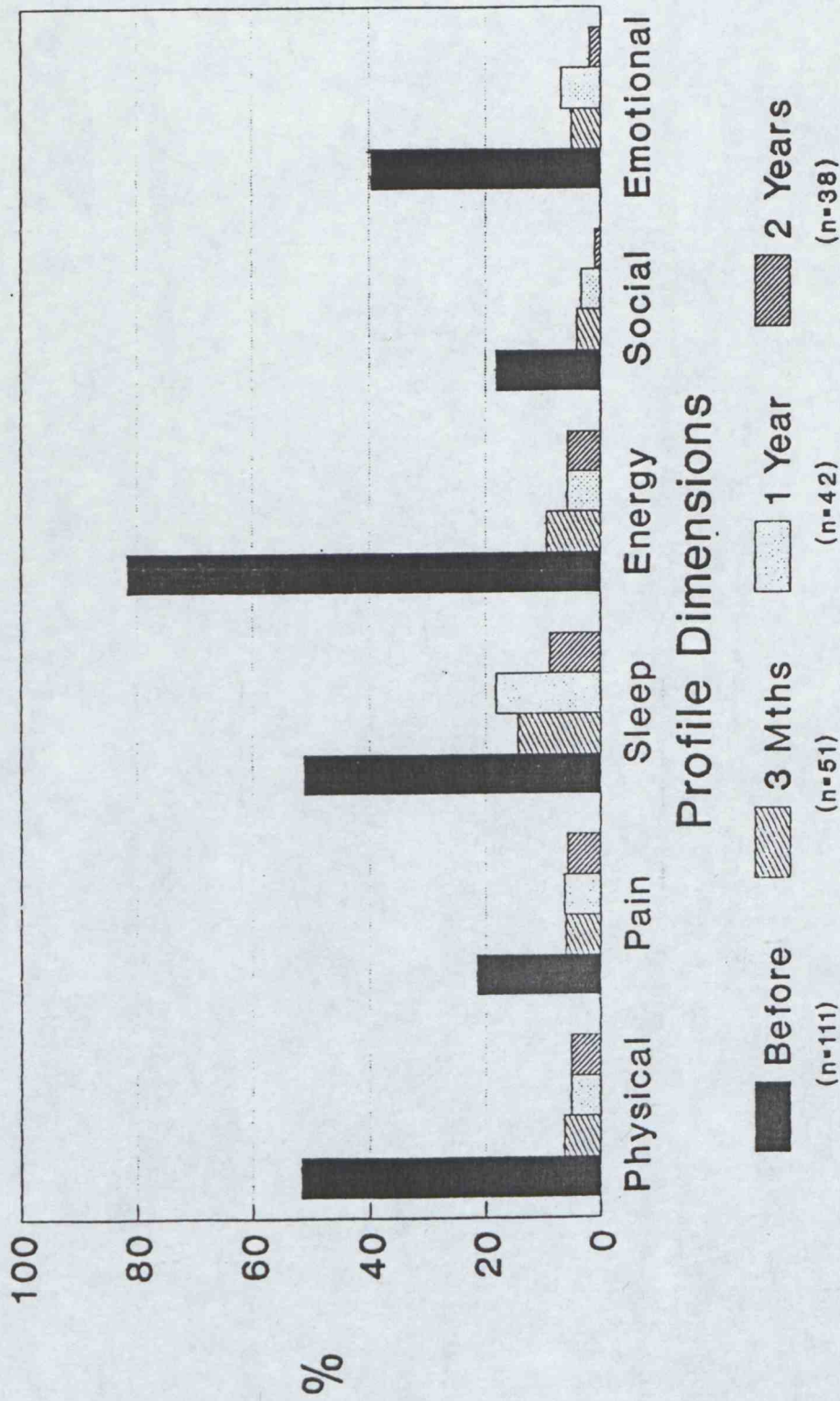


FIGURE 4