which seems unlikely to change radically for many years, it seems hard to believe that any major decline in the incidence or severity of acute rheumatic fever and its consequences is imminent. If anything increasing urbanization, school attendance, and group organization may aggravate the situation further.

If rheumatic fever is different in the tropics it is in terms of incidence and severity, and this may be entirely a function of the streptococcus or it may, in addition, relate to host susceptibility.

It is these two facets, the streptococcus and host susceptibility, which deserve a major investment in research time and public health money. The rewards may be of universal benefit and not limited to the tropics.

Part II of these lectures will appear in next week's issue. A list of references will be given with Part IV.

Hospital Topics

Dialysis and Transplantation: The National Picture over the Next Five Years

S. C. FARROW, D. J. FISHER, D. B. JOHNSON

British Medical Journal, 1972, 3, 686-690

Now that haemodialysis and transplantation have become an accepted form of treatment for patients with "end-stage" renal failure we need to define the commitments in this field of medicine (in terms of numbers of patients and costs) within the different treatment programmes currently in use) for the next few years. In this paper we present some of the changes which we expect to occur, given that no immediate dramatic changes in dialysis and transplantation survival will take place. Our results have come from an analysis of data collected by the Joint Colleges Committee*¹ and from an examination of the returns made from units to the Department of Health and Social Security.² The Joint Colleges Committee data referred to patients accepted for treatment between 1 January 1967 and 1 May 1970. Replies were received from 29 centres in time for this analysis; a total of 1,120 patients were considered, and of these 365 received transplants and 246 died during the period of the survey.

Study of these data has enabled us to predict the number of patients undergoing treatment in five years' time. An estimate has also been made of the possible transplantation rates. We have also assessed the efficiency of the different treatment programmes currently in use in Britain in terms of patient survival, cost, and yearly intake of new patients.

Analysis

A comparison of dialysis and transplantation survival times taken from the Joint Colleges Committee data is shown in Fig. 1. Percentage survival is shown and the figures are given at monthly intervals. The top line represents survival on dialysis and includes both unit and home dialysis. Patients receiving transplants were excluded from subsequent analysis. Two-year

*The Joint Committee comprised representatives from the Royal College of Physicians of London, the Royal College of Surgeons of England, the Royal College of Obstetricians and Gynaecologists, the Royal College of Pathologists, the Royal College of Physicians of Edinburgh, the Royal College of Physicians and Surgeons of Glasgow, the British Paediatric Association, and the Renal Association. It was established in May 1970 under Lord Rosenheim's chairmanship.

London Hospital Medical College, London E.1
S. C. FARROW, M.B., B.CHIR., Medical Registrar
D. J. FISHER, M.B., M.R.C.P., Senior Medical Registrar
D. B. JOHNSON, M.Sc., Operational Research Scientist

FIG. 1—Joint Colleges Committee data on monthly survival of patients and grafts. Method of analysis involved calculating each month the proportion of patients who survived out of those who could have survived. (Not the actuarial method.) The two year survival figures of 75%, 55%, and 41% refer respectively to dialysis patients, transplant patients, and grafts and been obtained from computer-fitted curves derived from this data.

dialysis survival was 75%. The middle line represents survival of patients from the time of the first transplant. It does not refer to pretransplant or post-transplant dialysis survival, nor does it include second or third transplant survival. The two-year survival was 55%. The bottom line represents survival of the graft, and includes grafts in patients who died, whether or not deaths were due to graft failure. It would, however, be possible simply to omit these grafts from subsequent analysis when the patient died of other causes. This would involve very precise data on the exact state of the graft at the time of death, and this information is not at present available. The two-year graft survival was 41%.

Data were analysed to ascertain the end result in patients with graft failure. The numbers of patients who were successfully returned to dialysis in terms of the length of time their transplants had been functioning are shown in Table I. Successful

TABLE I—Length of Time Graft had functioned before Patients returned successfully to Dialysis (Joint Committee Data on First-graft Failure)

	Transplant Function (Months)				Total
	1	2	3	4 and over	
No. of patients	48	28	12	26	114
No. (%) returning to dialysis	35 (73)	14 (50)	4 (33)	8 (31)	61

return to dialysis was defined as survival for 15 days on haemodialysis after the rejection, and 61 patients were in this category. Data from those rejecting within the first three months of transplantation are analysed separately and for the fourth and subsequent months are aggregated. Altogether 73% of the patients who rejected a graft within a month of transplantation were successfully returned to dialysis. This compared with 50% of those rejecting in the second month, 33% in the third month, and 31% in the fourth and subsequent months. Though the overall numbers were small these results suggest that for the first three months after transplantation the longer the graft is successful the less likely it is that eventual failure will be associated with successful return to dialysis.

The survival figures for patients returned to dialysis after graft failure over the course of the subsequent 12 months are given in Fig. 2. The probability of surviving one year after transplant failure was about 55%, and extrapolating from this the two year survival figure was 28%. The comparative pretransplant dialysis survival figures were 86% and 80% respectively.

FIG. 2—Survival of the 61 patients successfully returned to dialysis after graft failure (see Table I). (Joint Committee data on post-transplant haemodialysis survival.)

A separate study of the length of pretransplant dialysis treatment failed to show any effect on subsequent transplant graft survival.

Negative exponential curves were computer-fitted to these and other survival data and values calculated to represent probabilities of patient survival from one month to the next. The figures derived were 0.99 for dialysis survival (mean survival eight years), 0.98 for transplant graft survival (mean survival four years), and 0.95 for post-transplant dialysis survival (mean survival of 20 months). These values were then applied to a number of mathematical models. The first of these was constructed for our own unit at the London Hospital. This was a 26-state model based on a Markov Chain approach.³ The analysis was extended to accommodate the different types of treatment programme in use in Britain.

Treatment Programmes

As a preliminary step three models were constructed representing three types of treatment programme. Model 1 is a unit with no access to transplantation but which encourages home dialysis. Model 2 is a unit with active transplantation facilities but no home dialysis. Model 3 is a unit offering both home dialysis and transplantation. Within model 3 it has been postulated that some 95% of patients would accept transplantation if and when the opportunity arose. With these models various probabilities were calculated for the movement of the patient from one state to another, and a matrix of probabilities was derived which represented all the possible transitions from state to state. By matrix multiplication the numbers of patients could be predicted in the various states at any given number of months in the future. With continuous multiplication the system eventually

reaches a steady state where the numbers of new patients balance those who die. This enabled us to compare the three types of model in terms of cost, patient survival, and number of new patients taken on for treatment each year (Table II). Costs refer to annual maintenance only and were calculated on the basis of £2,500 per annum for unit patients, £1,500 for home dialysis patients, and £150 per annum for transplanted patients. This last figure represents the annual outlay for drugs for transplant patients, as it seems impossible to cost a transplant operation.

Model 1 (the unit without access to transplantation) has the highest average maintenance costs and the best mean survival time (Table II). Model 2 is cheaper to run, has an inferior patient survival to model 1, and can accept very few new

TABLE II—Comparison of the Three Treatment Models in the "steady state"

Treatment Model	Yearly Cost	Mean Survival (Months)	No. of Patients Accepted (Yearly)
1, Home dialysis	£1,575	104	44
2, Transplantation	£1,300	54	14
3, Home dialysis and transplantation	£900	54	74

patients each year. These results were calculated using a standard 10-bedded unit. Model 3 is cheapest to run and has an identical patient survival to model 2 and a higher intake of new patients than model 1.

With the current emphasis on regionalization of resources, the facilities of individual units were considered together when we attempted to assess the national requirements. At present of the 15 regions in England and Wales two have facilities similar to those available in model 1, one to model 2, and 12 to model 3.

A typical region based on model 3 is shown in Fig. 3. There are usually up to three dialysis units within a region, one of

FIG. 3—Model 3, representing an average region. There are three dialysis units, one of which also has transplantation facilities.

which is also a designated transplantation centre. Each unit may encourage both home dialysis and transplantation. By using figures based on the Department of Health returns up to 31 July 1971 an average region had 41 patients on home dialysis, 40 in the dialysis units, and 23 in the transplanted groups. Similar regional models were constructed for the other two types of treatment programmes.

National Requirements

To assess the national requirements over the next five years two variables required careful investigation.

NEW PATIENTS

The numbers of patients taken on in England and Wales in the years 1968, 1969, and 1970 were 458, 565, and 480 respectively, which suggests that the present input rate of new patients is fairly static. However, this is contrasted with the input rate

which one would expect from the various British epidemiological surveys on the incidence of chronic renal failure.^{4 5 6} The most recent review⁷ suggests that in Scotland about 96 patients per million total population under the age of 65 die every year from chronic renal failure. Of these about 52 per million have no coexisting illness precluding them from haemodialysis or transplantation. About 63 patients per million under the age of 55 years die each year, of whom 38 appear to be acceptable for treatment. From the data it is possible to calculate the incidence of coexisting extrarenal diseases precluding them from treatment at the various ages: under 45 years this is 35%, from 45 to 54 years 49%, and from 55 to 64 years 56%.

The numbers of deaths a year from renal failure in England and Wales over the five-year period 1965-9 from the returns to the Registrar General are shown in Fig. 4. Superimposed on these are the numbers of patients who would be expected to have

FIG. 4—Registrar General's mortality figures for England and Wales 1965-9 for deaths from renal failure. The categories used were identical to the Joint Colleges Committee categories. Shaded areas represent actual number of patients where there was no co-existing medical disease. Proportions used were calculated from data in the Scottish survey.⁷ For patients over 65 the proportions were estimated from a study of the earlier proportions.

no coexisting extrarenal disease. The steepest rise in this incidence is in the range 45-65 years. Until a decision is taken on the upper age limit for accepting patients for dialysis the number of new patients each year who require treatment cannot be estimated accurately. From the Joint Colleges Committee data fewer patients between the ages of 45 and 50 were started on treatment than one would expect from the incidence shown from these epidemiological surveys, possibly because of reluctance to refer such patients on the grounds of age or through fears of coexisting diseases or worry about the success of treatment. From our analysis it appears that transplanted patients over the age of 40 have a two-year graft survival of 30% compared with 43% for those under 40. The two-year dialysis survival for patients over 40 was 70% compared with 77% for those under 40. Nevertheless, there are many instances of patients between the ages of 55 and 65 who successfully manage haemodialysis and transplantation.

EFFECTS OF WAITING TIME

Initial studies carried out in our own unit suggested that the models were not very sensitive to variations in waiting time for a kidney provided that patients were waiting on home dialysis. A further study of this waiting time was based on information on the national pool size from the transplantation immunology unit at the London Hospital. The probabilities of remaining in the pool but not being transplanted are shown in Fig. 5. The mean waiting time was calculated at 24.5 months. In fact, there is wide variation in the acceptance of kidneys from hospital to hospital, and the highly selective policy from some units with large

FIG. 5—Probability of remaining within recipient pool calculated on monthly basis. Based on London Hospital transplantation immunology data on 480 patients. Mean waiting time 24.5 months.

numbers of patients on home dialysis who are also in the transplant pool tends to distort the waiting time.

National Picture in 1976

This is depicted in Table III. In June 1971 there were 458 patients receiving unit dialysis, 586 on home dialysis, and 336 with functioning grafts. The picture in 1976 at the present rate of acceptance is based on an input of 462 new patients a year over the next five years. This figure is derived from the actual

TABLE III—National Position in June 1971 and Estimated for 1976 in Relation to Higher and Lower Intake of New Patients

	No. of Patients on Unit Dialysis	No. of Patients on Home Dialysis	No. of Patients on Functioning Graft	No. of New Patients Yearly
Position in June 1971	458	586	336	—
At present rate of acceptance, June 1976	410	1,275	470	462
Maximum rate of acceptance, June 1976	658	3,016	966	1,125

input over the past three years and is thought to be the lowest likely input. It will result in about the same number on unit dialysis, twice the number on home dialysis, and roughly a 40% increase in the transplanted group. The position in 1976 at the maximum rate of acceptance is based on a yearly input of 1,125 new patients a year. This figure was calculated by assuming that all regions maintain their present policies and that each runs to maximum capacity, with 95% certainty of not overcrowding the units. It seemed advisable to apply this restraint because the simultaneous rejection of several transplant grafts could lead to overcrowding in a unit. The result shows that with hospital units running to near maximum capacity there will be over 3,000 patients on home dialysis and nearly 1,000 transplanted patients.

At this stage it seemed worth while to examine the effect of reducing the time spent waiting for a transplant from two years to one (Table IV). Not only do some units question the value of

TABLE IV—Comparison of One-year and Two-year Wait for Transplant with Units Running at Maximum Capacity (1976 Prediction of National Picture)

	No. on Unit Dialysis	No. on Home Dialysis	No. of Functioning Grafts	Maximum Intake
2 Years	658	3,016	966	1,125
1 Year	733	3,374	1,035	1,444

tissue typing but possibly cadaver kidneys will become more readily available in the next five years. The positions in 1976 obtained with the one-year and two-year waits for a transplant and assuming a maximum possible intake of patients are compared in Table IV. With the one-year wait for a transplant the maximum possible intake increases by about a third, the home

dialysis commitments remain relatively stable, and there is a very small rise in the number of functioning grafts throughout the country.

We also calculated the average monthly transplantation rate for a region based on model 3 (Fig. 6). The effect of varying the waiting time for transplantation is reflected in the number of new

FIG. 6—Comparison of the effects of a one-year and two-year wait for donor kidneys with regard to the rates of transplantation and intake of new patients for the next five years in a "model 3" type of region.

patients accepted and the transplantation rate. With a two-year wait for transplantation two or three operations will be performed each month compared with four or five a month with a one-year wait for a transplant. As the waiting time gets shorter probably the number of transplants will increase to such an extent that several experienced surgeons will be required for each region, both to perform the transplant operations and to participate in kidney retrieval.

FINANCIAL ASPECTS

The cost of supporting these programmes will depend directly on the type of programme instituted and the number of patients treated. By using the costs given above we calculate that the annual cost of supporting the 1976 programme will fall between £3m and £6m depending on the input rates of new patients. This calculation is based on 1971 prices and does not include the initial outlay on dialysis monitors and kidney machines. The operational life of this equipment has not yet been established. In addition, allowances must be made for increasing demands on the ancillary services. A study of the extra laboratory facilities necessary to support these expanding programmes showed that transplanted patients require nearly double the number of investigations as patients on dialysis.⁸ Any expansion in transplantation programmes must take into account the increased laboratory work load.

Discussion

The Joint Colleges Committee data have shown that the survival of transplanted patients is inferior to that of patients on haemodialysis. There are several possible explanations. Firstly, probably lack of expertise in new units may account for some of the transplant deaths, though a similar lack of experience has existed in new dialysis units. Secondly, undoubtedly some patients were transplanted because other medical problems made haemodialysis either difficult or impossible. Thirdly, many of

the transplant deaths occurring in the survey could well be attributed to unsuccessful control of immunosuppressive treatment, especially during periods of rejection.

Though the overall number of patients who rejected their kidney grafts was relatively small, for patients rejecting within three months of transplantation the longer the graft survived the less chance a patient had of successfully returning to haemodialysis. In the fourth and subsequent months return to haemodialysis was 31%. These figures may indicate excessive immunosuppression in patients with failing grafts, and possibly earlier transplant nephrectomies should be considered. Also, though we have no direct knowledge of this, some units may have been unable to accept patients back into dialysis programmes for medical, social, or logistical reasons.

Study of the survival of patients who returned successfully to haemodialysis after graft rejection showed a "post-transplant" haemodialysis two-year survival of 28%, compared with a "pre-transplant" figure of 80%. Again, the effect of immunosuppression and patient selection is uncertain though both probably had some influence on these results. Though transplanted patients undoubtedly have a superior quality of life probably for several reasons they have a poorer life-expectancy than patients on haemodialysis. Because of this we feel that the present indications for transplantation are those of failure of haemodialysis on medical, social, or psychological grounds. Though these conclusions have been drawn from data nearly two years old there has been no recent wide-scale survey which shows a dramatic increase in transplant graft survival.⁹

From the observation that transplant survival was essentially the same in patients who had received dialysis either for less than or more than six months (up to 18 months in this study) before transplantation, it is reasonable to conclude that long-term dialysis does not impair survival after transplantation.

Our results indicate that even by halving the time spent waiting for a kidney there will be very few more transplanted patients alive in five years' time: many will have died and others will have returned to dialysis. This raises the question whether we are justified in strenuously persuading the general public to support a national kidney donation scheme when we might be better advised to wait until patient and graft survival improve with the advances that seem bound to come.

We should like to comment on the various treatment programmes examined. Units capable of offering a combination of home dialysis and transplantation are the least expensive and can accept most new patients each year. Within any region this policy should be possible for all units who are willing to participate in the regional sharing of specialist resources, and this would be in agreement with the suggestions of the Consultative Document.

Finally, we have been unable to explain the discrepancy between the number of patients actually taken on for dialysis and the number suggested by the various epidemiological surveys mentioned. Fewer patients are accepted over the age of 45, despite the fact that this is within the age range where the incidence of death is rising most steeply. Raising the upper age from 50 to 51 years would have a similar effect in terms of numbers as lowering the age of acceptance from 15 years to 5. In both cases this would result in about 50 new patients each year. We believe that physicians may be reluctant to refer older patients, either because of coexisting medical problems or because of worries about the patient's ability to withstand treatment. Many older patients do remarkably well both on haemodialysis and after transplantation. If this is confirmed with larger numbers we shall seriously have to examine the age criteria for accepting patients as well as our ability to cope with the increase in demands for facilities. Moreover, some of the discrepancy between the number of patients taken on and the number that appear to need treatment based on the epidemiological surveys may arise from geographical variations in the incidence of renal failure, and we feel that a further survey in England is required.

We would like to express our gratitude to Professor J. M. Ledingham, for his help in preparing the manuscript, and also to Mrs. Linda Allars for her secretarial help.

References

- ¹ Report of the Joint Committee on Maintenance Dialysis and Transplantation in the Treatment of Chronic Renal Failure. London, Royal College of Physicians, 1972.
- ² Department of Health and Social Security, *Annual Reports of the Chief Medical Officer*, 1968, 1969, and 1970. London, H.M.S.O.
- ³ Farrow, S. C., Fisher, D. J. H., and Johnson, D. B., *British Medical Journal*, 1971, 2, 671.
- ⁴ De Wardener, H. E., in *Ethics in Medical Progress*, ed. G. E. W. Wolstenholme and M. O'Connor, p. 104. London, Churchill, 1966.
- ⁵ Branch, R. A. et al., *British Medical Journal*, 1971, 1, 249.
- ⁶ McGeown, Mary G., *Lancet*, 1972, 1, 307.
- ⁷ Pendreigh, D. M. et al., *Lancet*, 1972, 1, 304.
- ⁸ Fisher, D. J. H., Farrow, S. C., and Johnson, D. B., in *Proceedings of the European Dialysis and Transplant Association*, vol. 8, p. 34. London, Pitman, 1971.
- ⁹ See *British Medical Journal*, 1972, 3, 251.

Emotional Problems in Childhood and Adolescence

The Anxious Child

ANNE BOLTON

British Medical Journal, 1972, 3, 690-692

Anxiety is an appropriate reaction to some circumstances of stress and danger, when the traditional "fight or flight" behaviour serves a useful purpose. Indeed, in man a conspicuous absence of anxiety when it would normally be expected is regarded as pathological. Thus, such an absence may denote either the excessive use of defence mechanisms or a diminished awareness or appreciation of a reality-based threat—a feature which may occur in some organic or psychotic states. In adults the ego is protected from anxiety that it would find intolerable by the development of defences: repression, denial and rationalization, displacement and projection, and reaction formation. In childhood these mechanisms are also used. Nevertheless, the immature organism can cope less well with abnormal stimuli and with anxiety-provoking situations, and one of the important functions of parent figures is to monitor these for the child so that he is not overwhelmed.

Abnormal Anxiety

Anxiety reactions in childhood may be regarded as abnormal when they cause appreciable and continued distress to the child, or to those concerned with him, or to both. They may result from essentially "normal" anxiety-provoking stimuli—that is, those which are ordinarily accepted as being stressful but which most children can tolerate. Examples of these stimuli include short separations for children who are old enough to bear them, new group adjustments such as school changes, or test situations such as examinations.

Some children are more vulnerable than others and will react excessively to such stresses. This vulnerability may arise in several ways: it may be the result of concomitant mental or physical handicap, of traumatic previous experience, of the lack of an adequate supportive environment, or of internalized emotional problems. On the whole the reactions of such children to "understandable" stresses of this kind are fairly readily tolerated by parents and others around them—even if these reactions take a covert form and are expressed by somatic symptoms or by mild behaviour difficulties. Most of them do not require specific treatment and the majority respond to accept-

ance and reassurance, often with some explanation of the symptoms to the child and to his parents.

More serious are the expressions of anxiety that is either not related to external situations or that is aroused by situations which do not usually produce anxiety, such as panic in the face of minor environmental change, persistent concern over attendance at school, or fear of a non-threatening animal. There is, of course, a wide variation in the individual threshold of anxiety. To some extent this may be constitutionally determined, though the environmental effects on a child of living in an anxiety-laden household may well be more important than any supposed genetic factor. The variation also depends on the child's degree of maturity and on his previous or continuing experience in terms of relationships. Over-protection which fosters over-dependence will increase anxiety—as will insecurity about acceptance and identity in the family. Identification with over-anxious or with damaged parents—whether this damage is real (in terms of illness or disability) or whether it is fantasied (in terms of the child's fears for his parents' safety)—may give rise to severe and longstanding anxiety.

Expressions of Anxiety

Anxiety may be expressed directly, in which case the child both feels and appears anxious. He may also show some of the physical symptoms of sympathetic activity which are regarded as normal concomitants, though these may be exaggerated—for example, sleeplessness, frequency of micturition, nausea, vomiting, and headache. Indirect expressions of anxiety may take the form of behaviour disorders, which often give a picture of a regressive clinging or of an aggression directed towards the object or producer of the anxiety; of somatic symptoms; or of neurotic manifestations, such as phobic symptoms, obsessional behaviour, or hysterical conversion symptoms.

BEHAVIOURAL SYMPTOMS

Within the framework of the regressive or aggressive behaviour, or both, there may be many disturbances of function. Sleep is often affected by anxiety and the typical pattern is one of a child who seems afraid to go to sleep. He may be obviously afraid of the dark, demanding to have the light on, or he may need constant reassurance of his mother's presence—either repeatedly calling out to her or insisting that she remain with him until he