Transition to adult services for children with renal failure: age or ability to cope?

Established renal failure is a manageable but incurable problem. Safely transitioning young people from paediatric to adult services remains a major challenge.

Patients with diseases that lead to established renal failure have a reduced life expectancy. Mortality is significant and is usually related to either the renal failure itself or comorbidity associated with renal failure.

Children with established renal failure have a lifetime of renal failure management ahead of them. They will have frequent hospital visits, need to take medications and have to restrict their lives in other ways quite foreign to normal children, such as having specific dietary limitations or a fluid restriction. Life for children with these problems is dominated by their medical condition. This impacts upon both their family life and educational achievement. The incurable nature of renal failure means that all these children who survive through to adulthood (and survival is not a given in these circumstances) will need to be transitioned from the paediatric clinic environment into the adult arena for ongoing management.

This period of transition to adult services is dangerous for young people with established renal failure. Articles written more than two decades ago highlighted the problems of transition to adult services and proposed structures for transfer (Armstrong and Weiner, 1981; Cameron, 1985). Watson (2000) looked at the rate of allograft loss in patients undergoing transition and found it to be unacceptably high. He suggested having a long build up to transition, the use of a transition clinic, and transfer at both the nursing and social work level in addition to medical transfer. This presupposes that the same support services exist in the adult arena as in the paediatric environment.

Age is clearly a key factor in defining the point at which transition should occur. Standard 4 in the UK Department of Health and Department for Education and Skills (2004) *National Service Framework for Children, Young People and Maternity Services* states: 'All young people have access to age-appropriate services which are responsive to their specific needs as they grow into adulthood'. However, in practice, the age at which transition occurs varies greatly from country to country. In developing nations children often become 'adult' at about 14 years of age. Within the UK the age of consideration for movement to adult services is between 16 and 18 years, in keeping with movements in education. In the USA it is not unusual to find transition being delayed until the age of 21 years.

While the National Service Framework goal is laudable, it presupposes that all young people of a certain age have the same requirements. This is as unlikely as the very busy adult clinic being able to provide a similar service and structure to the relatively quiet paediatric clinic. Transition is inevitable for all young people in many different areas of life. Movement from school to college to university or into the workplace are all major transitions. The majority cope with such movements: the challenge is to identify the minority who will not and design a service to successfully guide them through transition.

To design a transition service certain data are required. It is necessary to look at the characteristics of the population undergoing transition and to identify their special requirements. These data then need to be compared with the characteristics of the population already in adult services and the design of the services structured for their needs. The establishment of the UK Renal Registry which started data collection almost 15 years ago, and since then has had a paediatric arm collecting data on children throughout the UK, allows such an analysis to be performed.

Registry data analysed

The paediatric arm of the UK Renal Registry collects demographic data on all paediatric patients treated in one of the 11 regional centres. An annual data set is also collected for each patient detailing treatment, growth parameters, laboratory analyses and comorbidity. To define the characteristics of the paediatric established renal failure population undergoing transition the authors looked at the most recent record of 806 patients who were over the age of 16 years at the time of data collection. Of this cohort 257 were current patients in line for transition and 549 had already transferred. *Figure 1* shows the age distribution of the patients at the time of their last data collection. It is clear that 18 years of age is the most popular age for transfer, although a small number are kept in paediatric services rather longer. As with all paediatric established renal failure series there was a high male to female ratio (1.5:1). Ethnic minority patients were over-represented compared to the general population with 16.6% coming from ethnic minority backgrounds, 12.7% of the total being of south Asian origin. Lewis et al (2009) have discussed the over-representation of ethnic minority patients in the paediatric established renal failure population.

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Aetiology of established renal failure in paediatric patients

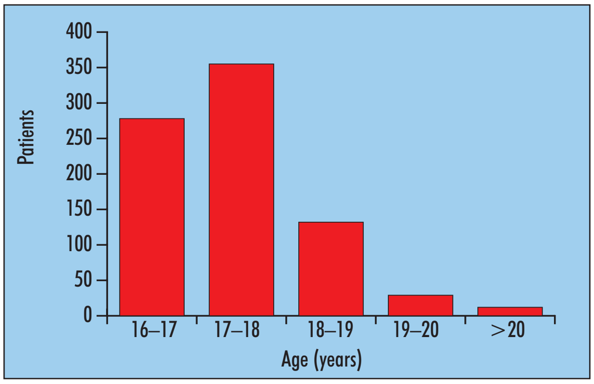
The aetiology of renal failure in the paediatric population has been described by Lewis et al (2009) and is significantly different to the causes of established renal failure in the UK adult population as described by Farrington et al (2009). *Table 1* shows the distribution of primary renal diagnoses for this transitional population. Unlike adult cohorts for most paediatric patients the aetiology of renal failure is known.

Of particular note with regard to transition is the high proportion of patients with established renal failure from obstructive uropathy. These patients mainly have established renal failure secondary to posterior urethral valves. Many have secondary bladder neuropathy and also require careful urological follow up. In the current cohort with a functioning allograft, 11% of patients did not void normally. Half of these intermittently catheterized while a further quarter catheterized an augmented bladder. The remainder had a urinary diversion. Of the 5% who had established renal failure from metabolic disease all but two had cystinosis. This is a multisystem disorder that requires input from a number of subspecialists. All those with established renal failure from drug nephrotoxicity had calcineurin inhibitor nephrotoxicity after a different organ transplant. Thus underlying diagnosis is an important factor in determining whether transition is ‘routine’ or whether special provision is needed.

Established renal failure treatment

The vast majority of patients undergoing the move to adult services have a functioning renal allograft. Of the cohort studied 84% had an allograft with the 16% on dialysis split fairly evenly between haemodialysis and peritoneal dialysis. Thus most work on transition has concentrated on those with allografts and ensuring adherence to therapy. Movement between renal replacement modalities is common. *Figure 2* shows the duration of established renal failure treatment at the time of sampling for the transitional patient cohort. While a number of patients have only had established renal failure for a short time 57% have had established renal failure for 5 or more years and 27% for 10 or more years. These patients are at high risk of secondary comorbidity. Those with a long dialysis history may have lost peritoneal function and/or vascular access sites. Those with one or more failed transplants are likely to be sensitized and difficult to regraft.

Figure 1. Age distribution of the cohort of patients analysed.



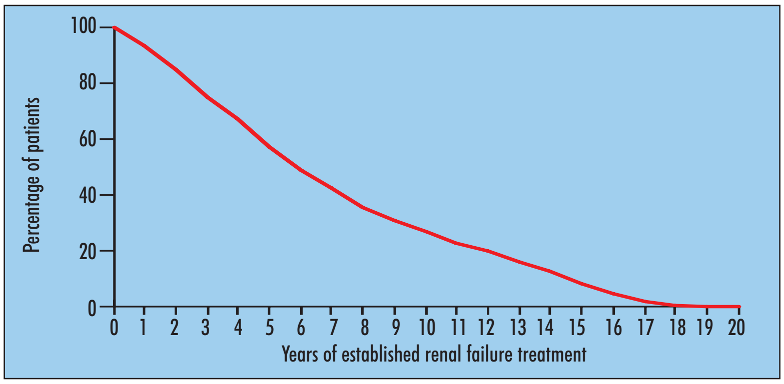
Blood pressure control

Control of hypertension is vital to long-term health and avoidance of comorbidity in patients with established renal failure. The Renal Association (2002) guidelines for blood pressure in adults on dialysis are based upon levels above which secondary complications are likely. They suggest the blood pressure ought to be below 140/90 mmHg for haemodialysis patients pre-dialysis and below 130/80 mmHg for haemodialysis patients after dialysis and for peritoneal dialysis patients. In paediatrics comorbidity is rarely seen unless hypertension is severe. The guidelines recommend that blood pressure should be within two standard deviations of the mean for age, height and gender (97th centile), and should be kept below the 90th centile for age, height and gender after haemodialysis and in patients on peritoneal dialysis. In patients with a transplant the recommendation is that blood pressure should be below 130/80 mmHg. There is no paediatric recommendation, but most paediatric

Table 1. Primary cause of established renal failure in patients undergoing transition from paediatric to adult renal units

Diagnostic group	Patients	Proportion of total	M:F ratio
Renal dysplasia ± reflux	259	33.8%	1.44
Glomerular diseases	164	21.4%	0.86
Obstructive uropathy	134	17.5%	7.38
Tubulo-interstitial disease	66	8.6%	1.44
Metabolic diseases	39	5.1%	1.29
Congenital nephrosis	26	3.4%	0.73
Unknown aetiology	25	3.3%	0.79
Renovascular disease	20	2.6%	1.22
Drug nephrotoxicity	15	2.0%	2.00
Polycystic kidney disease	12	1.6%	1.00
Malignancy	7	0.9%	1.33

Figure 2. Cumulative frequency chart showing duration of established renal failure in patients undergoing transition to adult units.



nephrologists aim to control blood pressure to below the 90th centile for age, height and gender. In practice, for young people of average height, the 90th centile is just above 130/80 mmHg for males and just below this for females. The 97th centile (two standard deviations from the mean) is above 130/80 mmHg for both genders.

Figure 3 shows cumulative frequency curves for systolic and diastolic blood pressure in the cohort studied. The patients are divided according to treatment modality. For transplanted patients 20% had a systolic blood pressure above 130 mmHg and 17% a diastolic above 80 mmHg. Patients on peritoneal dialysis seemed to have worse blood pressure control with 26% having a systolic above 130 mmHg and 30% having a diastolic above 80 mmHg. Haemodialysis patients fared slightly better with just 17% having a systolic blood pressure above 130 mmHg while 22% had a diastolic pressure above 80 mmHg. Longstanding hypertension in the presence of established renal failure is likely to predispose these patients to cardiovascular comorbid complications early in adult life.

Figure 3. Cumulative frequency curves for systolic and diastolic blood pressure in the established renal failure transitional cohort, divided according to treatment modality.

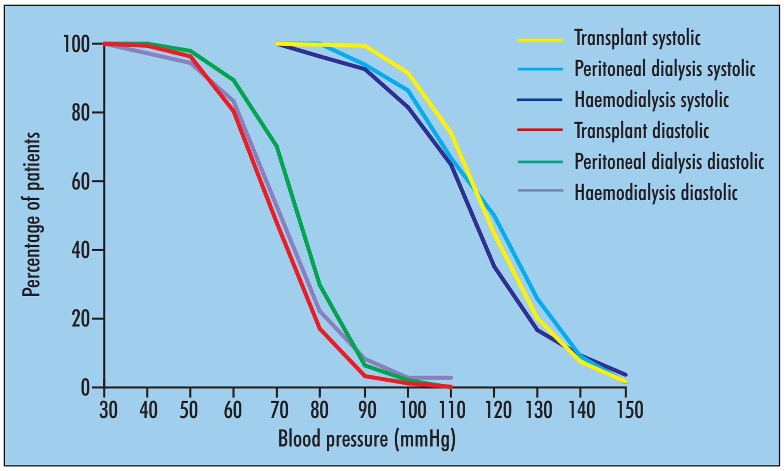


Table 2. World Health Organization classification of weight status according to body mass index (BMI) and the percentage of the transitional cohort in each category

Classification	BMI (kg/m^2)	Dialysis patients	Transplant patients
Underweight	<18.50	35%	18%
Severe thinness	<16.00	10%	5%
Moderate thinness	16.00–16.99	9%	5%
Mild thinness	17.00–18.49	16%	8%
Normal range	18.50–24.99	51%	50%
Overweight	>24.99	14%	32%
Pre-obese	25.00–29.99	9%	20%
Obese	>29.99	5%	12%
Obese class 1	30.00–34.99	4%	8%
Obese class 2	35.00–39.99	1%	3%
Obese class 3	>39.99	0%	1%

From World Health Organization (2010)

Body mass index

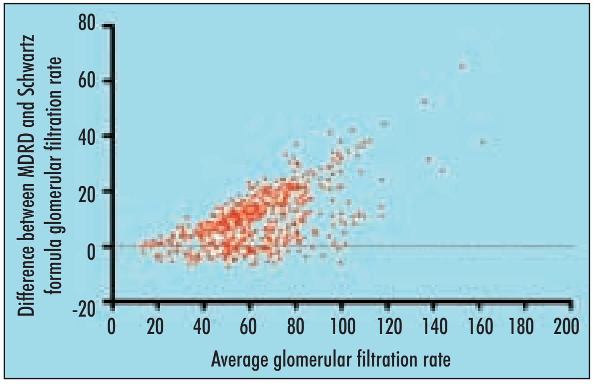
Obesity is a risk factor for cardiovascular disease. Body mass index rises steadily through childhood and by 16 years of age the average body mass index is just over 20 kg/m^2 for males and 21 kg/m^2 for females. Beyond this age, it is reasonable to use the World Health Organization (2010) standards for the interpretation of body mass index. These are shown in *Table 2* together with a breakdown of the percentage of the transitional cohort in each category. A small proportion of patients are very thin although it needs to be remembered that young people with renal failure are often pathologically short (vide infra) and these patients would be expected to have a lower body mass index. More alarmingly, while 50% of patients have a normal weight, 14% of dialysis patients and 32% of transplant patients are overweight. True obesity is limited to 5% of dialysis patients but 12% of transplant patients are obese.

Renal function in engrafted patients

With the vast majority of the patients undergoing transition to adult units having a functional transplant it is clearly important to know what the renal function of these patients is. A proportion of patients with allografts will have significantly reduced function and, in addition to having routine transplant follow up, they will need the input of a 'low clearance' clinic. These are patients where a decision will be needed relatively soon after transfer about whether the patient is regrafted or whether he/she will need dialysis. One problem lies with how estimated glomerular filtration rate is calculated. Within the adult clinics it is normal for the Modification of Diet in Renal Disease (MDRD) formula (Jones and Imam, 2009) to be used while within the paediatric clinic a modified Schwartz formula is used, based upon the patient's height (Schwartz et al, 1976).

The authors compared these two values for estimated glomerular filtration rate in 625 of the transitional cohort who had a functioning allograft and a measurement of height and creatinine. *Figure 4* shows a Bland–Altman plot of MDRD estimated glomerular filtration rate and

Figure 4. Bland–Altman plot of the average of Modification of Diet in Renal Disease (MDRD) and Schwartz formula estimated glomerular filtration rates against the difference between these two estimates.



Schwartz formula calculated estimated glomerular filtration rate. While there is fairly good agreement below a glomerular filtration rate of 40 ml/min/1.73m^2, above this there is a tendency for MDRD to give a rather higher estimated glomerular filtration rate than the Schwartz formula. Which is 'correct' can only be determined with a large study using both formulae and either isotope glomerular filtration rate or inulin glomerular filtration rate estimation. The agreement at the lower glomerular filtration rate range, however, is reassuring as it means transitional patients with poor clearance will not be put into a higher clearance group simply through a change in the method of estimated glomerular filtration rate calculation.

The distribution of estimated glomerular filtration rates in the transitional transplant population is shown in *Figure 5*. At most 10% have an estimated glomerular filtration rate below 30 ml/min/1.73m^2, although between 30 and 50% are in chronic kidney disease stage 3 with an estimated glomerular filtration rate between 30 and 60 ml/min/1.73m^2, depending on which formula is used.

Height, achievement and disability

Measurement of height is something which is only usually undertaken once in an adult dialysis unit. Indeed, for the data collection for the UK Renal Registry there is just a single static field for height. This height is then used for all subsequent calculations of both surface area and body mass index. Puberty in patients with established renal failure is often delayed and it is not unusual to find patients growing beyond the age of transfer. Thus a proportion of patients undergoing transition will require ongoing height measurement until it is clear that growth has ceased.

Growth is a major problem in children with established renal failure. While accepting that a number of the transitional cohort have a few more centimetres to grow, the overall height distribution of the cohort, as shown in *Figure 6*, demonstrates that these patients are in general poorly grown: 70% of males are below 170 cm (5 feet 7 inches) and 30% are below 160 cm (5 feet 3 inches). For females 70% are below 160 cm (5 feet 3 inches) and at least 30% are below 150 cm (4 feet 11 inches).

Short stature has been regarded by some as a disability in itself, although this was not supported by psychological studies in 'normal short stature' by Kranzler et al (2000). In a systematic review Wheeler et al (2004) found children with short stature scored lower than their peers on functional tests. Magnusson et al (2006) showed that height at 18 years, controlling for other factors, was a strong predictor of attained education in later life. Duquette et al (2007) demonstrated that children with chronic kidney disease performed poorly in academic areas compared to matched controls while Groothoff et al (2002) showed that adults who had established renal failure from childhood had impaired cognitive and educational attainment in adulthood. Longer periods of dialysis were associated with worse outcome. Thus, in addition to having to cope with their renal impairment and the social problems of profound short stature a proportion of this group will have educational and intellectual limitations also.

Data on educational achievement are not collected by the Renal Registry but, within the paediatric data set, rough data on the severity of disability is. These data for the transitional cohort are shown in *Figure 7*. While the majority of the population were described as having no disability, 13% had some intellectual disability and this was described as moderate or severe in 8%. Moderate or severe physical disability was present in 5%.

Figure 5. Cumulative frequency plot of estimated glomerular filtration rate in the cohort of transitional patients with functioning allografts showing values for both the Modification of Diet in Renal Disease (MDRD) and Schwartz formulae.

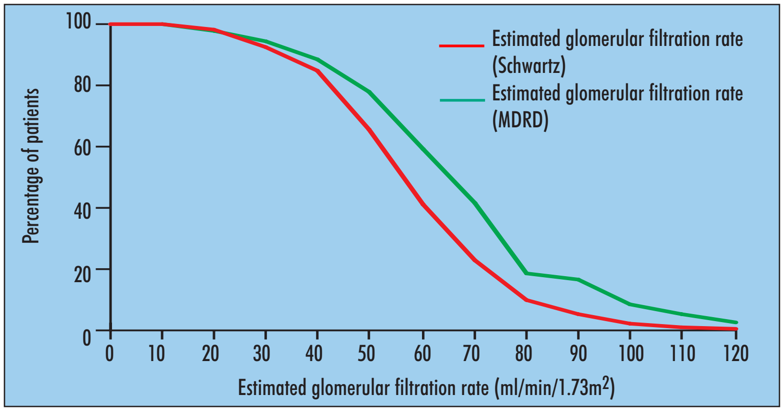


Figure 6. Cumulative frequency chart of height in the transitional cohort divided according to gender and treatment modality.

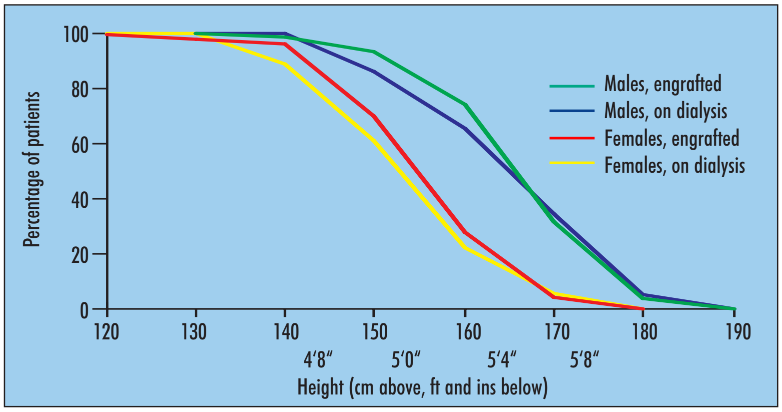
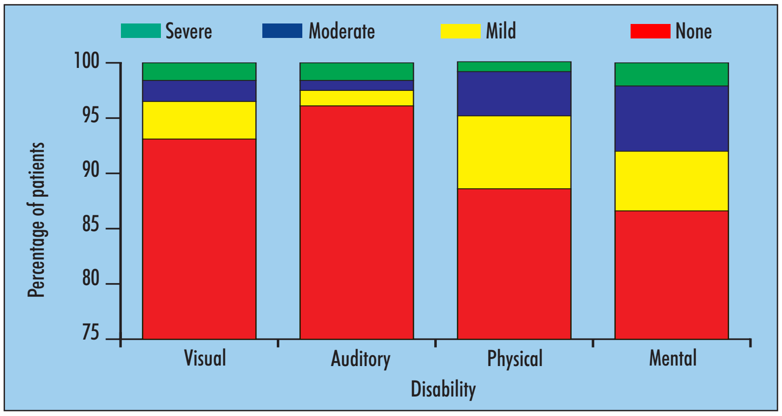


Figure 7. Distribution of disabilities in the transitional cohort.

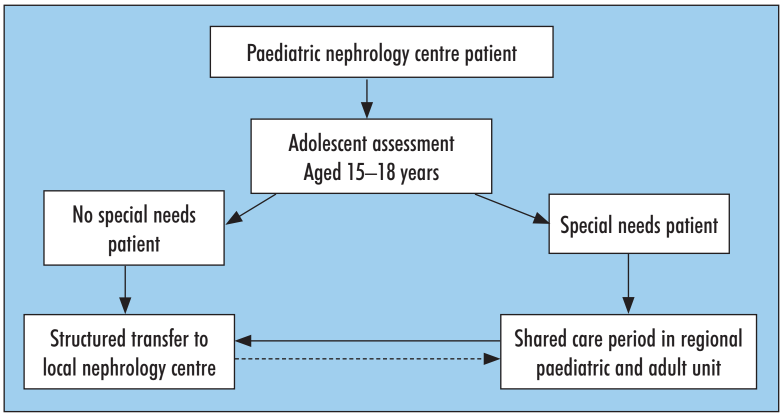


Conclusions

Designing a transitional service for young people with established renal failure has to take account of numerous factors. One very practical problem is that care for children with renal failure is based in just a few regional centres while care for adults is centred around their local dialysis unit. The above analysis shows that there are a number of paediatric patients who are going to need very special input. This may be a result of multisystem problems secondary to their underlying diagnosis, specific comorbid problems that will make management problematic, issues to do with growth and puberty, significant psychological or educational problems, major disabilities or, in a number of cases, a combination of these factors.

For those without problems transition to their local adult unit is most appropriate. They can be cared for with other adults with established renal failure and their local management will allow them to pursue education or careers without the time out required for major excursions to a regional centre. This will apply to the majority of patients and building up to this transition ought to start at the age of 15 years with the final move being made in accordance with the views and wishes of the patient, family and the groups of carers. As with other major life events problems will arise with a few but the majority will move through in the same way as young people make the transition from college to university or the workplace. For those who do have problems with this move it may be necessary to have input from a regional centre closely linked with the paediatric centre.

Figure 8. Algorithm for the transition of patients with established renal failure from paediatric to adult services.



KEY POINTS

- All young people with established renal failure need to undergo the transition from paediatric to adult medical services.
- Ability and circumstances rather than age should determine transition arrangements.
- Major disabilities, co-morbid, psychological or educational problems pose greater challenges in ensuring effective transition to local services.
- Closely linked paediatric and adult regional centres are the key to successful eventual transfer to local units.

A minority of patients will have clearly identified special needs in one or more area. For these patients continuing in a regional centre and maintaining links with those who have looked after them through childhood for a period of time can be advantageous. In this group it is the authors' view that it is ability not age that is important. Building specialist services in renal units closely linked with the paediatric regional centres will allow a gradual transfer over an indefinite period of time with shared care taking place for as long as necessary. A practical design for a transition service is demonstrated in *Figure 8*. Eventually all patients would transfer to their local adult unit but the timing of this for those with complicated problems should be individualized according to their specific needs and not forced into an age-defined protocol. **BJHM**

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