E coli strains isolated in the United Kingdom are drug resistant and that resistance is transferable in more than 60% of these. The majority of autotransferring resistance plasmids identified were of the B and F compatibility groups. Group B plasmids are particularly common in shigellae and have been observed in strains of *Shigella dysenteriae* 1 that have caused epidemics in Central America⁸ and Asia.⁹ F-like resistance plasmids are common in salmonellae, and *E coli* and plasmids of the *F_{1me}* group have been observed in salmonella strains that have caused outbreaks of gastroenteritis in the Middle East,¹⁰ India,¹¹ and southern Europe.¹²

These findings are a cause for concern not simply because they indicate that the choice of treatment for severe illnesses is limited but also because they suggest the existence of a large pool of drug-resistant organisms in the community. Multiple drug resistance may be transferred in vivo to other pathogenic organisms including those *E coli* responsible for systemic infections such as neonatal meningitis. Further studies are in progress to determine the prevalence of drug resistance in *E coli* strains isolated from cerebrospinal fluid.

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(Accepted 29 June 1982)

Reuse of haemodialysis equipment: convenience and cost effectiveness

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Abstract

The shortage of resources for providing renal replacement makes it essential to reduce revenue costs wherever possible. Assuming that haemodialysis is likely to remain a mainstay of renal replacement, a policy of reusing the expensive disposable dialysers and blood lines could offer substantial cost savings. Such reuse has been shown to be safe and to maintain efficiency, but it must also take account of convenience to the patient, especially those dialysing at home. A survey of patients treated with home dialysis shows that the rate of reuse of the complete extracorporeal circuit was highest for those patients who had automated reuse systems.

Introduction

The treatment of patients with end-stage renal failure by haemodialysis has been highly successful. Nevertheless,

haemodialysis is expensive and several hundred patients die each year in the United Kingdom because the financial resources to provide treatment are lacking.^{1,2} In the United States, where there has been a quite lavish allocation of federal resources for dialysis programmes, there is increasing pressure to contain or reduce costs.^{3,4} At the same time most units in the United Kingdom and elsewhere are moving away from the use of the bulky Kiil-type artificial kidneys towards the use of small disposable dialysers, which require less work from staff and patients and take up less space in the home. This means, however, that the dialyser and other disposable equipment become a major revenue cost.

Though considerable savings could be made by reusing these disposable items, this policy has, however, met with resistance from both clinicians and patients on the grounds of safety, efficiency, and convenience. The safety and efficiency of the procedure is now widely accepted both in Europe and in the USA,^{5,6} but convenience to, and acceptance by, patients has received little attention. Since most patients in the United Kingdom dialyse at home, the success of any policy aimed at more economic use of materials depends on their co-operation. A recent survey of home dialysis practice in our unit has given us the opportunity to examine the extent to which our own policy of reuse is implemented in the home.

Cost benefits of reuse

Single use of a disposable dialyser is expensive, about £1900 a year. Reuse (in our case to a total of six times) dramatically reduces this cost by more than half (figure). It is less commonly recognised that the arterial and venous blood lines, which—with the dialyser—form the extracorporeal circuit, are also expensive. If the dialyser can be reused

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Costs per patient per year for use of dialysers and blood lines. (Allowance has been made for higher unit costs due to loss of bulk-purchase discounts.)

six times the cost of blood lines used only once constitutes 67% of the total cost of the extracorporeal circuit. Reusing blood lines to a maximum of six times can reduce costs still further. For a fair comparison of costs these must include not only the cost of major items but also that of materials used in reuse procedures: in our unit these amount to £1.75 per dialysis (£273 a year). When added to the total amount this still shows a dramatic difference between single use (£1872) and six-fold use of dialyser and lines (£637).

Dialysis policy and practice

On the basis of these financial considerations and evidence that reuse was safe and did not prejudice efficiency,^{7 8} we decided to switch patients progressively to disposable dialysers, reusing both dialysers and lines a maximum of six times.

From a survey of patients dialysed at home giving details of the actual usage of dialysers and lines we were able to compare policy with practice. From a population of 72 patients on home haemodialysis, reliable data were obtained from 61 (85%). Many of these (46) still used Kiil dialysers but 15 were using disposable dialysers; of these, six were operating a manual system for reuse while nine had automated systems using the Dylade DS equipment. Though the reuse of dialysers and lines varied considerably, certain important observations could be made.

Reuse of dialysers—On average Kiil dialysers were used 4.01 times without rebuilding (table). Such reuse has little economic value and must stem from convenience to the patient, as it is simpler to reuse than to rebuild a Kiil dialyser. Reuse of disposable dialysers occurred more frequently and reflects the patient's responsible attitude towards costs, since using a new dialyser each time would be more convenient. Reuse was marginally more frequent with the automated system.

Reuse of lines—For patients with Kiil dialysers the reuse rate was low (table); this may partly be because the patients were older and had

Cost of reusing dialysis equipment in practice. (Figures indicate mean No of times equipment reused)

Equipment	Dialyser	Lines		Annual cost per patient
		Arterial	Venous	
Kiil	4.01	1.37	1.57	£405*
Disposable:				
Manual reuse	4.64	2.74	2.70	£560
Automated reuse	4.90	5.00	5.00	£448

*Capital cost of a Kiil dialyser has not been included.

been trained initially to use dialyser and lines once only. The rate of reuse among patients on disposable dialysers was higher, reflecting both their training and an awareness of costs. The rate of reuse of the whole extracorporeal circuit where reuse procedures were automated was very high (table). The automated procedure is easier and less time consuming for patients to operate than the manual system, and these patients are clearly the most cost efficient.

Discussion

The unquestionable success of renal replacement programmes, whether by dialysis or transplantation for patients with end-stage renal failure, has created the extremely distressing situation in which many hundreds of patients now die in the United Kingdom each year because of lack of resources for treatment. Many factors are involved, but paramount among these is the lack of financial resources; in the present economic climate additional revenue is unlikely to be forthcoming. Indeed, far from expanding replacement programmes many centres find it difficult to sustain their present level of provision with presently available resources.

Given these hard facts, those concerned in this work need to examine the possible methods of achieving better provision from existing resources. Without question a considerable increase in successful cadaveric renal transplantation would be both more cost effective and more satisfactory to the patient. Sadly this has still yet to be achieved. Hopes that continuous ambulatory peritoneal dialysis might prove an equally successful but cheaper alternative to haemodialysis are at present threatened by the high incidence of recurrent peritoneal infections. For the foreseeable future regular haemodialysis must be an important mainstay of renal replacement. Assuming that self-supervised home dialysis must remain the principal method in the United Kingdom, we, like others throughout Europe and the United States,^{5 9} believe that costs can be reduced by a policy of reusing disposable equipment. That dialysers can be reused without appreciable loss of efficiency has now been widely proved.^{5 6} The safety of reusing dialysers has also been widely accepted. The cost benefit of reuse could be eliminated by cheaper manufacture of dialysers. The total cost of disposables must, however, take account of the cost of blood lines. Our own experience over several years has been that repeated use of blood lines is also safe; it not only reduces costs but is also more convenient for the patient if there is no need to connect and disconnect the lines for each dialysis. Cost-cutting exercises can only be effective if there is staff and patient compliance; this is especially important in home dialysis. This report suggests that this is most likely to be achieved by automated reuse procedures. The capital cost of equipment for automated reuse, especially if incorporated into automatic supply units, will be recouped in savings within the first year.

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(Accepted 22 June 1982)