Dialysis in Barbados: the cost of hemodialysis provision at the Queen Elizabeth Hospital

Sara A. Adomakoh,[1] *Chudi N. Adi,*[2] *Henry S. Fraser,*[1] *and George D. Nicholson*[3]

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ABSTRACT

Objective. *The purpose of this study was to assess the health service cost of hemodialysis delivered at the Queen Elizabeth Hospital in St. Michael, Barbados.*

Methods. *A cost analysis was performed from the viewpoint of the tertiary hospital studied here, using treatment protocols based on current practice for establishing vascular access sites (surgical set-up) and dialysis maintenance. Cost and patient data were collected for the period from 1 April 1998 to 31 March 1999. Sixty-four patients were studied and a total of 7 488 hemodialysis sessions were performed in the study period. The costs analyzed were personnel, drug expenditure, supplies (dialysis and nondialysis), inpatient costs, laboratory and other ancillary services, and indirect or overhead costs such as engineering, housekeeping, laundry and administration.*

Results. *The cost per hemodialysis treatment was calculated as US$ 156.64 in the first year and US$ 145.55 in subsequent years. The total cost per patient per year was US$ 18 327.22 in the first year of dialysis including surgical set-up, and US$ 17 029.54 thereafter. Direct costs (determined by patients' utilization of resources and labor costs for physicians and nurses) contributed to 80.7% of the total cost. The main expenditures were dialysis-related supplies, labor and overheads.*

Conclusion. *These findings are important in the light of limited economic resources available to health services in Caribbean countries coupled with the spiraling prevalence of kidney failure in these countries. Further analyses are recommended to review the provision of renal replacement therapy services in Barbados and to develop plans to expand and optimize services.*

Key words Renal dialysis; costs; cost analysis; hospital costs.

[1] Chronic Disease Research Centre, School of Clinical Medicine and Research, University of the West Indies, St. Michael, Barbados. Send correspondence and reprint requests to: Chronic Disease Research Centre, School of Clinical Medicine and Research, University of the West Indies, St. Michael, Barbados; telephone: +1 246 426 6416; fax: +1 246 426 8406; e-mail: sadomakoh@uwichill.edu.bb

[2] Department of Medicine, Queen Elizabeth Hospital, St. Michael, Barbados.

[3] School of Clinical Medicine and Research, University of the West Indies, St. Michael, Barbados.

Because of advances in medical technology, extension of the human lifespan has become a very real phenomenon, and hence the number of years spent living with chronic illnesses such as end-stage renal disease (ESRD) is also increasing (1). As a result the worldwide demand for and economic cost of renal replacement therapy is rapidly becoming a burden for health care systems (2). This situation is more pronounced in low- and middle-income countries throughout the Caribbean, where the financial resources allocated do not reflect the rates of increase in demand for the service. In addition, efficient health care and third-party reimbursement strate-

gies are sorely lacking, and the entire cost is borne mainly by the secondary care sectors.

In Barbados, demand for dialysis greatly exceeds the service capacity. In view of the steady increase in the rate of entry of new patients into the hemodialysis program, it is necessary to adopt measures aimed at making the delivery of hemodialysis more cost effective (3, 4). Although economic factors are not generally a primary consideration at the time of prescribing dialysis, it has become clear that the economic resources targeted towards this area need to be reviewed and allocated in the most effective way possible.

The Hemodialysis unit we studied is located within a tertiary care setting at the Queen Elizabeth Hospital (hereafter QEH), a teaching hospital of the University of the West Indies School of Clinical Medicine and Research. The service, like all other health services, is provided under the Barbadian public healthcare system. The unit is funded through a global budget system whereby a lump sum is allocated towards renal replacement therapy through the hospital budget. However, there is considerable flexibility in this regard, as the budgets for specific services are not fixed or easily identifiable. For instance, dialysis equipment may be assigned under the budget item labeled plant equipment and furniture, and dialysis-related supplies may be included under supplies and materials, etc.

This paper offers a detailed analysis of the current cost of the service delivered by the dialysis unit at the QEH in Barbados. We highlight the methods used in the costing exercise, the gaps in existing data collection, and our approach to data processing.

METHODS

Patient samples and dialysis utilization patterns

During the period from 1 April 1998 to 31 March 1999, 64 patients underwent regular hemodialysis therapy for ESRD. This number includes 5 new patients who were recruited into the program during the study period. All patients were treated with in-center hemodialysis. Cost analysis was restricted to patients who survived more than 3 months. Patients accepted for dialysis during the study year who died during that year were excluded from the analysis. All regular hemodialysis patients for this period had survived for longer than 3 months.

Treatment pattern and utilization

Patients received dialysis two or three times weekly as determined by the physician on the basis of available resources and medical necessity. Overall quality of life and complication rates on this regimen are not addressed in this study. Per week, 144 dialysis treatments were performed in 16 sessions for a total of 7 488 dialysis sessions during the study period. Dialysis times varied from a minimum of 3.25 hours to a maximum of 5 hours per treatment. The average number of dialysis sessions per patient per week was 2.25. Dialyzers were reused, with an average utilization of 5 times per dialyzer. Thirteen staff nurses operated two 8-hour shifts in the dialysis unit.

Cost analysis was performed from the viewpoint of the health institution (QEH) to measure the overall cost of treating all patients, the unit cost per hemodialysis session, and the annual cost per patient. Inpatient creation of vascular access, dialysis unit, physician and other service intervention costs incurred by the hospital were included. We excluded costs of inpatient admissions not related to initial surgical creation of vascular access, and costs arising from treatment of complications.

Costing methods

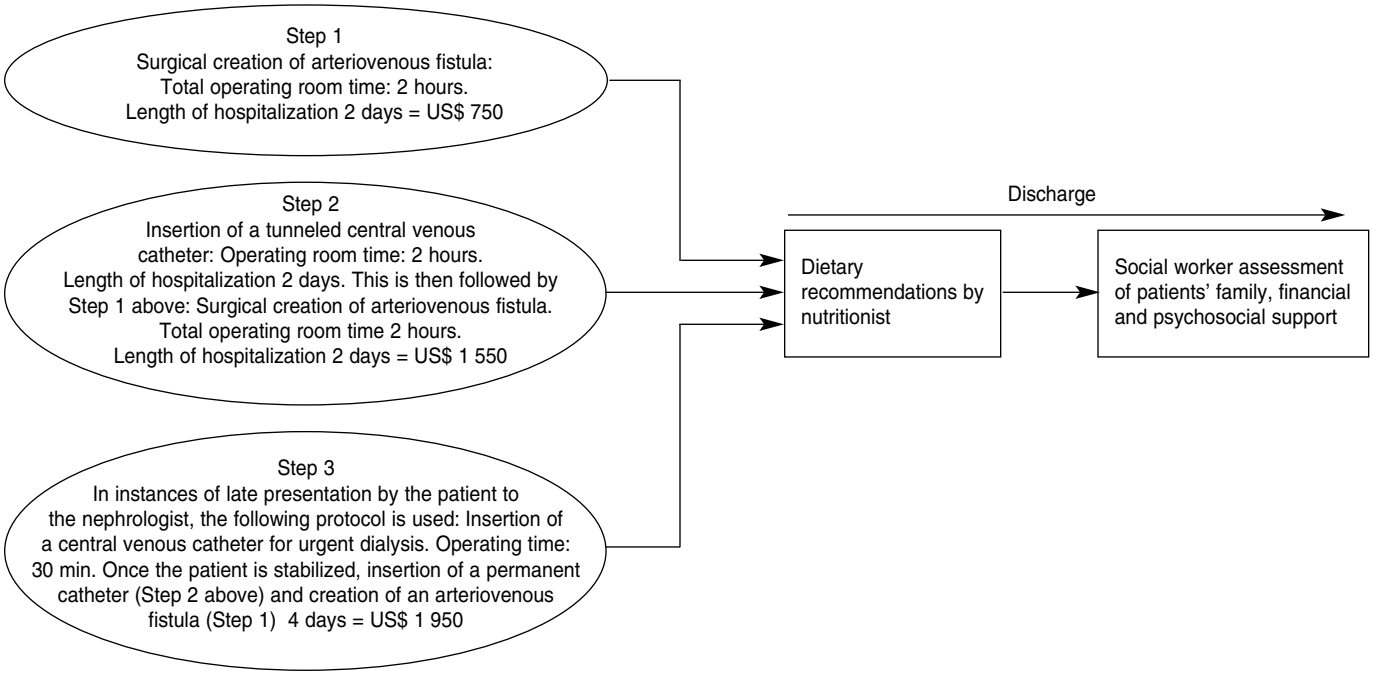
We collected cost data associated with surgical set-up to create vascular access at the start of dialysis (Figure 1), and with maintenance dialysis sessions. Although only 5 new patients were recruited into treatment during the study period, the set-up costs for these were considered as a separate cost and also as part of the total annual cost of dialysis for 1998 to 1999. (This distinction is required for further studies that compare the cost aspects of various treatment modalities.) The methods were used to determine both direct costs (those directly attributable to dialysis treatment) and indirect costs (the portion of the overhead costs incurred by the hospital in the provision of dialysis services).

At the time of our study the QEH did not have prerequisites that might have made cost-analysis processes more efficient and accurate, namely:

1. A chart of accounts (categorized and labeled expense and revenue items) relating to the functional organization layout,
2. departments identified as cost centers,
3. an accurate accounting system that collected financial data by cost centers (departments), with the data displayed by expense and revenue items identified from a chart of accounts,
4. up-to-date management information systems that collected nonfinancial data for each cost center and department, e.g., the number of drugs prescribed by each service department, outpatient visits for each specialty, etc.

In the absence of these prerequisites, primary financial and statistical data were collected manually from several sources within the QEH and from the government in order to generate a profile of expenses across all departments. This manual approach is similar to that adopted by Lewis et al. in their cost analysis of hospitals in the Dominican Republic (5). Patient-, treatment- and activity-based surveys were undertaken through reviews of medical records, unit log books for diagnostic procedures, pharmacy records, and through staff interviews to assess working times and duties (time and motion survey). All costs associated with the hospital budget, including the emergency ambulance services, were allocated to calculate the propor-

FIGURE 1. Protocol for creating surgical access and starting hemodialysis at a tertiary-level hospital in Barbados, 1998–1999



tional part of the general hospital expenditure corresponding to each department, including the hemodialysis unit. Overhead expenses were allocated to their appropriate overhead departments for later allocation to specific departments. Ancillary costs were also allocated directly to their appropriate service departments (for example, drug costs were allocated directly to the hospital pharmacy).

Direct costs

Direct treatment cost (costs driven by activity and utilization) that could be allocated to surgical set-up for and maintenance of dialysis treatment were identified separately from overhead costs. They were classified as expenditures for physician services, operating room (time, labor), ward (per diem inpatient rate based on nursing input, routine drugs, medical supplies, disposables and food), and dialysis unit costs (based on nursing input, drugs, medical supplies, disposables, X-rays, other diagnostics, laboratory, and capital outlay) (Table 1).

Capital replacement costs incorporating opportunity cost

Capital replacement costs for dialysis machines costs were annualized over 5 years at a discount rate of 10%, and the hemodialysis unit building replacement costs were annualized over 30 years at a discount rate of 6%.

Overheads (fixed indirect costs)

Indirect costs were identified at two levels, namely unit level (specifically, capital equipment and building), and hospital (institutional) level (Table 1). Institutional-level overheads were allocated to the hemodialysis unit using the step-down allocation method (6, 7). Institutional-level capital equipment and building costs were annualized. The step-down allocation method was used to determine the portion of overhead costs from indirect (or shared) departments incurred by the dialysis units, wards and the operating room in treating dialysis patients. Allocation statistics that had resource use implications (cost drivers) were used to distribute overhead costs across departments in a logical fashion.

Assumptions were made to guide the cost analyses. Firstly, the operating room was assumed to be available for surgical set-up of dialysis patients at times appropriate for the creation of an arteriovenous fistula for vascular access. However, this was not always the case, and such scheduling conflicts led to inflated costs, as patients presenting late in their illness required urgent short-term vascular catheterization, followed by long-term catheterization prior to eventual surgical creation of a fistula (Step 3 in Figure 1). (On occasion this was not done until up to 6 months after dialysis started.) Secondly, the case-mix and volume were deemed to be representative of the annual case load normally seen at the QEH.

RESULTS

Surgical set-up

Costs included operating room direct and indirect costs, recovery room direct and indirect costs, and the cost

TABLE 1. Cost categories associated with dialysis provision at a tertiary-level hospital in Barbados, 1998–1999

Category	Cost item	Cost type
Case level	Drugs, lab investigations, X-rays and other investigations	Variable direct
Unit level	Dialysis unit: Dialysis-related supplies, physician, nurse, social services and dietitian salaries	Variable direct
	Operating and recovery room: Anesthetist, surgeon and theater nurse salaries, surgical supplies	
	Wards: Inpatient postoperative nurse and physician salaries	
	Dialysis unit: Equipment and building replacement costs	Fixed direct
Institutional level	All support services: engineering, housekeeping, medical records, dietary, laundry, transportation, medical aid scheme	Variable indirect
	Central administration: hospital administration, nursing administration, accounting, information services, capital equipment and depreciation, construction and redevelopment, benefits	Fixed indirect

of inpatient stay plus any drugs or tests required. This gave a total estimate per patient of US$ 1 297.68 (Table 2).

Dialysis maintenance

The total cost of dialysis maintenance excluding surgical set-up was US$ 1 089 890.55. The cost of each maintenance dialysis session was estimated to be US$ 145.55. Total annual cost per patient for dialysis maintenance only was US$ 17 029.54. Most (80.7%) of the total maintenance expenditure for the year was made up of direct costs; overheads accounted for another 15.3%, and fixed direct capital costs accounted for 4.0% (Table 3). The major contributors to the total costs were dialysis-related supplies, labor and overheads.

First-year costs

Total cost per patient year during the first year of dialysis treatment was calculated as the cost of both surgical set-up and maintenance hemodialysis—a total of US$ 18 327.22, yielding a unit cost (cost per dialysis session) in the first year of US$ 156.64.

TABLE 2. Cost of surgical set up in the first year of dialysis at a tertiary-level hospital in Barbados, 1998–1999 (n = 5).

Surgical set-up procedures	Amount US$ Unit cost	Amount US$ Total cost (n = 5)
Surgical creation of arteriovenous fistula: operating room staff, supplies, overheads	750.33	3 751.65
Recovery: labor, supplies, overheads	151.52	757.575
Anesthesia and anesthetist	192.35	961.75
Inpatient admission: 2-day hospital stay, nursing, supplies, social work overheads, at US$ 98.84/day	197.68	988.4
Lab tests	4.60	23
Drugs	1.20	6
Set-up cost per patient in the first year of dialysis	1 298	6 488

DISCUSSION

The use of dialysis to treat patients with ESRD remains one of the most resource-intensive and hence expensive therapeutic interventions (4, 8, 9). With the criteria for the provision of dialysis services being expanded to include older patients, dialysis is no longer considered a privilege in Barbados. Comparative unit costs for in-center dialysis in other countries over the same period indicate that the costs of dialysis per patient per year in the United States, Italy, Canada and France are all more than twice those observed in Barbados (10–15). True differences in cost obviously ensue as a result of various factors, namely, different management protocols, inpatient care, an older population of patients with more comorbid illness (especially in the United States), different local labor costs, import duties and shipping charges, tariffs, etc. Further in-depth comparisons between countries of the cost of dialysis must take into consideration perceived quality of life, as well as morbidity and mortality outcomes in these patients (16, 17).

Prevalence rates of renal replacement therapy in the study period were estimated at only 250 per million population (pmp) in Barbados, compared to almost 1 600 pmp in Japan, 1 200 pmp in the US, 755 pmp in France, 320 pmp in Chile, 600 pmp in Uruguay, and 85 pmp in the Dominican Republic (18–24). The 1998–1999 prevalence rate for regular hemodialysis therapy in Barbados reflects the considerable limitations in the availability of dialysis services, and not a lower prevalence of ESRD. A marked increase in overall expenditure for renal replacement therapy will be observed as hemodialysis services are expanded to meet the needs of approximately 36 new patients a year. Indeed, with the acceptance of older patients and the increas-

TABLE 3. Breakdown of costs of hemodialysis maintenance at a tertiary-level hospital in Barbados, 1998–1999 (*n* = 64)

Costs	Amount US$	Proportion of total cost (%)
Direct costs		
Nursing and ancillary (including overtime, allowances, etc.)	257 668.53	23.6
Dialysis supplies: dialyzers, acid concentrate, machine parts, filters, fistula sets, catheters, etc.	325 500.00	29.9
Other medical supplies: saline, formalin, alcohol acetic acid, gel foam, needles, gauzes, gloves, etc.	155 777.98	14.3
Dialysis-related drugs (epoetinum, heparin, etc.)	49 639.27	4.6
Drugs	40 523.12	3.7
Medical staff	13 775.48	1.3
Nondialysis supplies: office supplies, printing material, cleaning	373.75	0.4
X-rays	390.00	0.04
Total variable direct costs	878 883	80.7
Overhead costs		
Engineering, laundry, housekeeping, stores, medical records, administration, infection control, sterilization dept., nursing administration, natural gas	154 614.43	14.2
Electricity	11 212.36	1
Water	841.17	0.1
Total variable and fixed indirect overheads	166 667	15.3
Capital replacement costs		
Nine dialysis machines	38 798.75	3.6
Building	4 540.55	0.4
Total fixed direct capital	43 339	4
Total	1 089 890.55	100

ing admission of patients with diabetic nephropathy to the hemodialysis program, the number of patients receiving renal replacement therapy has risen to approximately 540 pmp in 2004.

Dialyzer reuse had considerable economic impact on the cost of dialysis at the QEH. Each dialyzer was reused up to five times per patient, yielding five manual reprocessing procedures per dialyzer and six uses. Final reprocessing cost (labor, supplies and overhead) was estimated at US$ 11.05 per treatment. In the absence of reuse, the cost of each dialyzer per treatment was US$ 20. At the rate of 7 488 treatments annually, dialyzer reuse led to an annual savings of US$ 66 605.76

Another modification in practice that resulted in additional cost reductions was quarterly, instead of monthly, hepatitis B testing. In addition, skeletal survey X-rays were not routinely done annually, but were obtained only as needed and during work-up for hyperparathyroidism.

The unrelenting increase in the number of patients requiring dialysis in Barbados and worldwide, along with the greater demand for and wider access to health care, mean that providing adequate dialysis services will remain a challenge to the public health system (3, 25). Since the start of this study, the QEH has collaborated with a private dialysis unit to provide hemodialysis services. To maximize the gains in efficiency for dialysis maintenance in terms of cost and quality outcome, the existing partnership between the QEH and the private dialysis unit should be evaluated as soon as possible. This will enable planners and policy makers to identify the most appropriate balance of care across the two services in the public provision of dialysis treatment.

Efforts to reduce the long-term costs of renal care require the early identification of patients (particularly those with diabetes) at risk for the development of kidney disease. When kidney disease is detected, treatment strategies aimed at retarding its progression should be aggressively implemented (26). Achieving this goal will require improved awareness and diagnosis of kidney disease by primary care physicians, and early referral to nephrologists (27).

This comprehensive approach raises the issue of short- and long-term costs and benefits. It is recommended that further studies explore the cost-effectiveness of current dialysis practice at the QEH. Clinical and quality outcomes must be assessed, and the costs associated with complications estimated and used to adjust the costs derived from this study. Only then can the strengths and weaknesses and the true "value" of current practices be established, and service restructuring and reprogramming undertaken.

CONCLUSION

From the findings of this cost analysis of dialysis in Barbados it can be concluded that hemodialysis provision at a tertiary care unit within the QEH currently functions at a cost level well below the average cost observed in industrialized countries. In terms of efficiency, however, have quality of care and the attainment of optimal outcomes been adequately maintained?

In a global climate of constrained health resources, this is the question health care providers are raising worldwide. Concern, which is particularly great in the industrialized world, now extends to middle-income countries such as Barbados where expectations are increasing as patients seek greater returns on their tax contributions to governments.

The best way forward for countries like Barbados is to concentrate on strategic health rationing with (for example) the application of priority-setting techniques that focus on the economic evaluation of available options for delivery of care. These evaluations should address the effectiveness of the various modalities of renal replacement therapy, the settings in which they are used, and the long-term economic and social benefits to the community.

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RESUMEN

La diálisis en Barbados: el costo de la hemodiálisis en el Queen Elizabeth Hospital

Objetivo. El objetivo de este estudio fue analizar el costo, para los servicios sanitarios, de la hemodiálisis realizada en el Queen Elizabeth Hospital de St. Michael, Barbados.
Métodos. Realizamos un análisis de costos desde el punto de vista del hospital terciario objeto de este estudio, con protocolos para el tratamiento que se basan en las prácticas actuales para establecer el punto de acceso vascular (preparación quirúrgica) y el mantenimiento de la diálisis. Los datos relativos a los costos y pacientes fueron recogidos desde el 1 de abril de 1998 hasta el 31 de marzo de 1999. Fueron estudiados 64 pacientes y se realizó un total de 7 488 sesiones de hemodiálisis durante el estudio. Los costos analizados han sido los de mano de obra, farmacéuticos, suministros (para diálisis y para otros fines), costos de hospitalización, laboratorio y otros servicios complementarios, y costos indirectos tales como la ingeniería, limpieza, lavandería y administración.
Resultados. Se calculó como costo de cada tratamiento de hemodiálisis una cifra de US$ 156,64 durante el primer año, y US$ 145,55 en años sucesivos. El costo total anual por paciente fue de US$ 18 327,22 en el primer año de diálisis, incluida la preparación quirúrgica, y de US$ 17 029,54 en lo sucesivo. Los costos directos (determinados por la utilización de recursos por el paciente y los costos de mano de obra para médicos y personal de enfermería) representaron el 80,7% del costo total. Los gastos principales fueron los suministros relacionados con la diálisis, la mano de obra, y los costos indirectos.
Conclusión. Estos resultados son importantes, habida cuenta de las limitaciones en los recursos económicos en los servicios sanitarios de los países del Caribe, junto con el aumento de la prevalencia de la insuficiencia renal en dichos países. Se recomienda la realización de nuevos análisis para estudiar el suministro de los servicios de terapia de sustitución renal en Barbados y trazar planes para extender y optimizar estos servicios.