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Cost Analysis of Services Delivered to Patients with End-Stage Renal Disease referring to Bou-Ali-Sina Hospital Affiliated to Qazvin University of Medical Sciences

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Abstract: Treating of patients with end stage renal disease has more noticeably costs and have grown in countries recently. This study was conducted to calculate the cost of Hemodialysis services in Patients with End stage renal disease referring to Bou-Ali-Sina hospital affiliated to Qazvin University of Medical Sciences. This cross-sectional study was conducted in 2011. Hemodialysis service costs were categorized in three groups: direct operational costs, indirect organizational and social costs and capital costs of hemodialysis unit. In this research, all of the emergency and chronic patients, were referred to this hospital in 2010 for receiving hemodialysis services, were studied. Needed data were collected by using of standard costing information sheets and also per session hemodialysis services cost for emergency and chronic patients was calculated using step-down costing model. Considering all of the costs issues for delivered services in this study, Average cost per session hemodialysis services was calculated 84.01\$ and 129.53\$ for emergency and chronic patients, respectively. Also, annul hemodialysis services Average cost per chronic patient was calculated 13508\$. In this study, financial Burden imposed on hospital per each session hemodialysis services received by emergency and chronic patients was estimated 12966RLs and 15916RLs, respectively. also, This finding showed that variance between costs and revenues of delivered services was not noticeable. Financial analysis is necessary in allocation of capital and human resources for providing of services and health cares, designing and developing the programs and projects. Hemodialysis cost in iran is cheaper than developed countries.

Key words: Hemodialysis % End-stage renal disease % Cost analysis % Iran

INTRODUCTION

Chronic renal diseases are of those diseases that not also threat physical health, but they also endanger other health dimensions. Thus, it makes appropriate and comprehensive planning and rehabilitation of patients inevitable. Nowadays, although, patients can survive from early renal-related death through using modern ways of treatment such as hemodialysis, but if they don't receive successful renal transplant, they fall into some physical, mental and socio-economic problems besides. Waste disposals, exact regulation of fluids and chemical component, secretion of certain hormones and activating vitamin D are those activities done by kidneys. In time of diseases, which 95% of renal tissues get

destroyed, accumulation of toxins reaches to a level that the rest of the life is impossible without using hemodialysis [1]. End-stage renal disease (ESRD) is an important disease that affects both health and health care expenditures [2]. Moreover, it is widespread in developing countries [3]. Its prevalence has been increased from 234 cases in 2000 [4] to 357 cases per million in 2006 [5]. It is predicted that in 2030 year, the number of patients inflicted to end-stage renal disease will be increase to 70% in developing countries, which their total economy forms 15% of global economy [6]. Nowadays, more than 50% of these patients are treated by hemodialysis method [7]. The growing number of patients inflicted to ESRD will consume 2-4% of healthcare budget [8]. Considering high cost remedial interventions in this area [9-11] and its

heavy fiscal burden on health care systems due to the high demand [12], therefore, it's necessary to change health policies with consideration to these facts [13]. As demand for hemodialysis is increasing, thus implementing policies to provide cost-effectiveness hemodialysis gets essential [9, 14] and it can also provide estimating health care policies economically and properly [15].

In state health centers of Iran, health costs are paid by insurance companies which are monitored by insurance council. Moreover, hemodialysis costs of patients are also monitored and announced by this council yearly. It seems that there is a mismatch between the costs calculated and announced by insurance companies with what hospitals, as health service providers are undergoing. In Iran, dialysis patients are categorized as special patients and their costs, even if are not covered by any insurance company, are paid by dialysis assembly. Formerly, ministry of health and insurance council were rated the price of services delivered by hospitals and remedial centers, recently, most of those services are rated as global, which it prevents paying detailed costs by patients. This study is aimed to calculate hemodialysis cost in Teaching-medical center of Bou-Ali-sina affiliated to Qazvin University of medical sciences in 2010.

MATERIALS AND METHODS

This cross-sectional study was conducted on emergency and chronic patients referring to hemodialysis unit of Bou-Ali-sina teaching hospital for receiving related services in 2010. Needed data were collected using standard costing information sheets of ministry of health. In general, three kinds of costs were considered for hemodialysis services cost including direct operational cost, indirect social and organizational cost and capital cost.

C Direct operational costs of hemodialysis

In this study, following costs were considered as direct operational costs of hemodialysis services:

- C Specific cost including; medication (Erythropoietin, heparin and Venofer...), routine Para clinical tests (including HCV, HIV, on average, once per year under doctor supervision, HBV, on average, once per every six months under doctor supervision and PTH, Albumin and Iron Para clinical tests, on average, once per three months under doctor supervision), imaging costs (including kidney ultrasound, Doppler and X-ray, on average, once per year), patients

nutrition and consumable material costs needed for hemodialysis (including dialysis set, fistula needle, dialysis filter, syringe, glue in cm, serum, hemodialysis solution, hypertonic glucose solution, hypertonic sodium and normal saline solution, mask, gloves, catheters, sodium bicarbonate powder, Shalloon, blood set ...) costs. The average specific cost was determined for each time hemodialysis in this study. By the way, Shalloon cost and Erythropoietin and Venofer medications costs were calculated and considered in study only for acute and chronic patients, respectively.

- C Human resource costs were including; continuous and non-continuous payment for personnel working in dialysis unit (including nephrologist, nurses, guard and servants). By the way, the difference in doctor's per-case percentage was considered for emergency and chronic patients in this study.
- C Indirect costs related to hemodialysis services

In this study, indirect costs include two parts: indirect organizational costs and indirect social costs.

Following costs were considered as indirect organizational costs of hemodialysis services:

- C Costs of General and overhead centers (including Human, non-human and capital costs) amortized from administrative, fiscal, medical equipment, laundry, services unit, pharmacological and food storages, medical record and archiving, infection control, sterilization and nursing management units. Moreover, step-down Costing Method was used for determining the share of the hemodialysis from amortized costs from general and overhead units. Then we focused on activities. Additionally, in this method we considered activity costs as a basis for cost sharing to other costs subjects including services, productions and users of these services [16].
- C Hemodialysis general and energy costs (water, electricity, fuel and telephone...), general consumable material cost, repairing and maintenance costs of equipment and facilities in the unit.

Also, in this study, transportation costs of patients plus their attendant to the hospital, cost of patients' wasted time and absence from work were calculated as social indirect costs. In this study, Iran's average income per capita in 2010 was used as a tool for calculating the lost gross national domestic income product [17].

Capital costs in hemodialysis center

In this study, following costs were considered as capital costs of hemodialysis services:

Capital costs were included facilities depreciation related to reduction of fixed assets value and this reduction is reflected in balance-sheet. In the present study, depreciation cost of facilities, building and equipment (e.g., dialysis machines...) of studied unit was calculated using article No151 for direct tax law in Iran. According to this law, depreciation rate for furniture and equipment, building and facilities and vehicle was considered 10, 7 and 30%, respectively [18].

In this study, three approaches were considered for analyzing findings:

- First approach including organizational approach, which covers only part of direct costs undertaken by hospital for providing hemodialysis services plus indirect organizational costs and capital costs in hemodialysis unit.
- Second approach was including organizational and non-organizational without considering social costs. This approach includes all of the direct costs (costs undertaken by hospital and patient) plus organizational indirect costs and capital costs in hemodialysis center.
- Third approach was including general approach (sum of two previous approaches plus indirect social costs).

In this study, for calculating financial variance only first approach was used. indirect organizational costs, capital costs and Human Costs in hemodialysis unit were considered as fixed operational costs of unit and direct costs undertaken by hospital (not by patients) were considered as variable operational costs of hemodialysis services [19].

RESULTS

According to our study results, direct operational costs formed a large part of total operational hemodialysis services costs in studied hospital (with 89.21%), moreover, capital costs of hemodialysis unit and indirect organizational costs were in second and third grade among hemodialysis operational costs components in studied hospital, respectively. Also, study showed that; specific costs and human resource costs formed the highest and the lowest amount of direct operational costs, respectively. Among the specific costs of hemodialysis, medication and imaging costs formed the most and the least part of it, respectively. Furthermore, the study results indicated that; among indirect organizational costs, those costs amortized from general and overhead units formed most part of these costs. Moreover, the lowest indirect organizational cost belonged to the energy costs. Also, among capital costs, equipment depreciation had the highest amount of capital costs and facility and building depreciation formed the lowest part of them. Generally, about 5.37% of total

Table 1: Hemodialysis operational costs occurred in the studied hospital for all chronic and emergency patients in 2010

Hemodialysis costs	Cost issue	Cost amount (RLs)	Percentage from Total operational cost
Direct operational costs (89.21%)	• Specific costs (72.94%)	Medication	6518250000
		Para clinical tests	64400000
		Imaging	14098770
		Nutrition	223575000
		Consumable materials	3893076000
		Cost of blood transfusion	31200000
Indirect organizational costs (5.16%)	• Human resource costs (16.37%)		2105840618
	Amortized Costs from general and overhead units		607835394
	Energy costs	22951000	0.15
	Consumable material costs	95545477	0.65
	Repairing and maintenance of facilities in Hemodialysis unit	35338551	0.24
Capital costs in hemodialysis unit (5.37%)	Building depreciation cost	335160000	2.27
	Equipment depreciation cost	460395000	3.10
Total operational costs		14376465810	100.00

*because indirect social costs are not occurred in hospital service delivery, therefore, they were not shown in this table

Table 2: Per session hemodialysis Average cost of emergency and chronic patients in studied patients

	First approach		Second approach		Third approach		
	Cost of hemodialysis services	Financial variance	Cost of hemodialysis services	Cost of hemodialysis services	Cost of hemodialysis services	Cost of hemodialysis services	Cost of hemodialysis services
	Per session	for hospital	Per session	Per weak	Per session	Per weak	Per year
	(RLs)	(RLs)	(RLs)	(RLs)			
Emergency	462466	-12966	-	-	84.01\$	-	-
Chronic	418616	-15916	781986	1563972	129.53\$	259.06\$	13508\$

*financial variance is used for the difference between service tariff in hospital with its hospital operational cost, thus, it can be calculated only in first approach

operational costs related to the hemodialysis in studied hospital were accounted for two above-mentioned capital costs (Table 1).

In first approach, variable and fixed costs formed 72.94% and 17.06% of total hemodialysis operational costs in studied hospital, respectively (Table 1).

Additionally, according to third approach, among costs related to hemodialysis in society, 10.53% of hemodialysis cost was accounted for fixed costs and 89.47% was estimated for variable costs.

According to the study results, considering first approach, per session hemodialysis Average cost for emergency patients receiving related services was 462466 RLs. Also, according to first approach, it was 418616 RLs for chronic patients, but it was estimated 781986 RLs in second approach for those patients. Moreover, financial variance for each time referring to receive hemodialysis services was 12966 and 15916 RLs for emergency and chronic patients, respectively. According to third approach, per session hemodialysis services Average cost was calculated 84.01\$ and 129.53\$ for emergency and chronic patients, respectively (Table 2).

In general, with considering all costs, annual hemodialysis cost for one chronic patient was calculated 13508\$ in the year of study (Table 2).

DISCUSSION AND CONCLUSION

Hemodialysis is, undoubtedly, a critical treatment and also an expensive one for patients. Supporting dialysis patients is an important approach for the future in developing countries. Of course, it is not likely in compliance with increasing number of patients in the future [20-22]. Moreover, cost-effectiveness strategies, which are implemented in developed countries in order to reduce or maintain the occurrence of end-stage renal diseases, can rationally be used in low-income countries, too. Also, it provides adequate analytical information in order to properly allocation of financial resources to dialysis services for local health managers [23-25].

According to our study results, direct operational costs formed a large part of total operational hemodialysis services costs in studied hospital(with 89.21%), moreover, capital costs (5.37%) of hemodialysis unit and indirect organizational costs (5.16%) were in second and third grade among hemodialysis operational costs components in studied hospital, respectively.

Furthermore, among direct costs, the highest and the lowest rate of costs belonged to the special and human resource costs with 72.94 and 14.37%, respectively. Moreover, among specific costs, the highest and the lowest amount of costs were estimated for medication and imaging costs, respectively. Additionally, among indirect organizational costs, amortized costs from general and overhead units and energy costs had the highest and the lowest rate of costs with 4.12% and 0.15% out of operational costs, respectively. Furthermore, equipment depreciation cost of hemodialysis unit with 3.1% and building and facility depreciation costs with 2.27% of total operational costs formed total capital costs. In a study done by Mahdavi et al in 2008, direct, indirect and capital costs formed 85.7, 2.57 and 11.7% of total hemodialysis costs, respectively. In this study, specific and human resource costs formed 44.96 and 9.31% of total hemodialysis costs, respectively.

Also, among specific costs, the highest and the lowest hemodialysis costs belonged to the consumable dialysis materials with 28.55% and imaging costs with 0.24%, respectively. Furthermore, among indirect costs, repairing and maintenance costs of equipment and constitution with 3.75% and amortized costs from other units with 0.09% formed the highest and the lowest rate of costs from total hemodialysis costs, respectively [26]. In other study done in Barbados in 2004, direct, indirect and capital costs were estimated 80.7, 15.3 and 4% of total hemodialysis costs, respectively. Moreover, specific and human resource costs formed 55.1% and 24.9% of total hemodialysis direct cost, respectively. In addition, among specific costs, the highest and the lowest rate of costs were for consumable material cost needed for

hemodialysis and imaging with radiology costs, respectively. Furthermore, among indirect costs, amortized costs from other units and energy costs had the highest and the lowest costs, respectively. Moreover, hemodialysis equipment depreciation costs had the highest rate of cost among the capital costs [19].

According to our study results, hemodialysis cost for emergency patients was 462466 RLS per each session in first approach and it was estimated 418616 RLS for chronic patients. Meanwhile, in this study, according to second approach, hemodialysis cost for chronic patients was estimated 781986 RLS and also based on third approach, the cost of each hemodialysis session for chronic and emergency patients was \$129.53 and \$84.01, respectively and the annual cost of dialysis for chronic patients was \$13508 based on this approach. Financial burden imposed on the studied medical-teaching center for each emergency and chronic hemodialysis visit was 12966 and 15916 RLS, respectively. The result of different studies showed that; per session hemodialysis cost without using Erythropoietin was 21.6 to \$130 in 2005 [27] in Malaysia, \$72.1 in Barbados in 2004 [19], \$240 in Greece in 2005 [28], \$209.79 in Chile in 2007 [22] and \$46 in Brazil in 2006 [29].

Furthermore, annual hemodialysis cost in Jordan in 2007 was estimated \$17358 [30], \$23966 in Spain in 2007 [31], \$103500 in France in 2007 [32], \$66951 in Canada in 2002 [33], \$9631 in Mexico in 1998 [34], \$10065 in Brazil in 1990 [35], \$22759 in Turkey in 2004 [36], \$78600 in Australia's Northern territories in 2002 [37] and \$46000 in Japan in 2001 [38]. The reason for disparity in the amounts estimated in present study compare to the other mentioned studies is due to the differences in the time, place, treatment technology type, differences in operational costs of various health care centers and in costing methods and the way of allocating costs. These differences in costs are more enough to be justified with difference in national per capita income.

There are a lot of ways to reduce annual costs of renal alternative treatments. Decreasing the number of patients inflicted to the end-stage renal diseases is an important factor for reducing total annual cost of alternative kidney treatments. The proceeding goal can be reached through implementing preventive programs for patients inflicted to the renal diseases [36]. In Iran, the most important reasons for renal diseases can be attributed to diabetes, blood pressure, obstructive neuropathy, congenital and systemic disorders, glomerulonephritis, urinary tract infection, vasculitis, tubulo interstitial nephritis and pregnancy [39]. Furthermore, early diagnosis of these diseases are as

important as their proper treatments, thus, planners and policy-makers should focus on the treatment policies to slow down the progression of disease in order to reduce renal alternative treatments [5].

Moreover, considering hemodialysis as the most common renal treatment in Iran, it seems that the peritoneal dialysis and kidney cadaveric or living transplantation is in an increasing trend [5]. Renal transplantation is the most affordable treatment for patients inflicted to the end-stage renal diseases [40-42]. Furthermore, this method can increase the patients' staying and their quality of life, prevent disability and reduce its period and also it is effective with consideration to economic evaluation compare to other countries [43].

Also, in Iran, alternative methods including home hemodialysis (autonomous), which its cost-effectiveness has been proven in the previous studies, is used for inside hospital hemodialysis [32]. Furthermore, according to the studies, it is expected that with implementing satellite hemodialysis units, not only can improve the quality of services, but also can reduce the costs and can help patients mentally [44-47].

In this study, the other costs that are imposed by ESRD on society such as mortality and lost production, disability and times spent for patient by family and relatives ... were not considered and this issue is one of the important limitations in a comprehensive study. Meanwhile, we studied patients in only one center in this study. Generally, the result of this study indicated that; hemodialysis cost is in compliance with costs in other developing countries. It is suggested that economic evaluation techniques will use for alternative technology and interventions in treating patients with ESRD.

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