Indian Journal of Public Health Research and Development
Volume 14 No. 1, January-March 2023

A Study to Develop a Costing Model for Satellite Haemodialysis Unit for a Tertiary Care Hospital

Priscilla Rejison[1], Aileen J[2], Rakesh C[3]

[1]Post Graduate Student, [2]Assistant Professor, Faculty of Management and Commerce, Department of Hospital Administration, Ramaiah University of Applied Sciences, Bangalore 560054, [3]Assistant Professor, Department of Commerce, Government First Grade Collage, Ripponpet, 577426

How to cite this article: Priscilla Rejison, Aileen J, Rakesh C. A Study to Develop a Costing Model for Satellite Haemodialysis Unit for a Tertiary Care Hospital. Indian Journal of Public Health Research and Development 2023;14(1).

Abstract

End stage renal disease (ESRD) is a significant health problem worldwide. Nearly 220000 patients are diagnosed with end stage renal disease every year, which calls for an additional demand of 34 million dialysis sessions in India. There is a rapid increase in the ESRD population worldwide. Furthermore approximate 70% of those who starts dialysis in India given up dialysis due financial constraints or death.

Considering the need of the Satellite haemodialysis unit (SHD) for ESRD patients, 'A studyto develop a costing model for SHD unit" was undertaken. A prospective study was conducted in a tertiary care hospital.The aim of the research was to analyse the need of SHD unit among dialysis patients and to suggest costing model for the tertiary care hospital. The methodology involved survey to address the patients need and perception towards SHD unit, direct observation, informal interview, bottom –up approach of costing method to identify the various cost involved in SHD unit and expert opinions. A total sample size of 120 ESRD patients in in - centre dialysis unit was selected for the study. As per the survey 30 patients need satellite haemodialysis unit. The study provides a cost analysis of 5 bedded SHD unit in the chosen tertiary care hospital. The author provides costing model recommendation for the development of SHD unit based on interpretation of data and expert opinions.

Keywords: Haemodialysis, End stage renal disease, Cost analysis, Satellite haemodialysis unit, Patient's views, Dialysis Modality.

Introduction

In India the burden of end stage renal disease (ESRD) is increasing dramatically and the proportion of death due to kidney failure is rising from 2.1% in 2001-3 to 2.9% in 2010 -13[10].Renal replacement therapy available for ESRD patients is haemodialysis. [11]. All over the country India has close to 950 nephrologist. 10% of Indian patients who develop ESRD currently receive RRT, often for reason of cost[9]. There are 700 dialysis centers with total 4000 dialysis machine mainly in private sector.Satellite haemodialysis units are thosehaemodialysis (HD) units which do not have an onsite nephrologist and

Corresponding Author: Priscilla Rejison, Post Graduate Student, Faculty of Management and Commerce, Department of Hospital Administration, Ramaiah University of Applied Sciences, Bangalore 560054.

E-mail: priscilla.rejison12@gmail.com

treat patients who are not hospitalized. Constructing SHD units increased access to renal care for ESRD patients and reduced travel time for HD patients[6, 14].. These units are affiliated with regional renal centre and nephrologists from regional centre are responsible for the care of patients treated in SHD unit[16].Satellite HD units are offering dialysis facility with no admission facility and offer the dialysis at reasonable price by cutting down the overheads.

Economic Evaluation of Haemodialysis Treatment and Dialysis Provision

Dialysis is an expensive therapy i.e. it is high cost, and to support the life of indudual with end-stage renal disease, SHD is necessary. Haemodialysis service offered by the private sector can be afforded only the higher income patients, (according to socio economic status of patient)[20].The low economic status patients have higher death rate and loss of follow-up[8],[13].The cost to establish SHD units are varied due to the differences in size, potential for expansion and property cost[2]. Based on studies in India, direct medical cost of haemodialysis is 80.7%[20].

Direct operational cost formed a large part of total operational haemodialysis service (89.21%), capital cost is 5.37% and indirect operational cost is 5.16%[19].Direct cost in dialysis service included the capital equipments, staffs, medications, and the building costs. Costing elements were classified in to fixed and variable cost. In India the average cost need for the health system per haemodialysis session is INR 4148[10].

Objectives

1. To assess the patients need and perception towards satellite haemodialysis unit
2. To identify the various costs involved for the development of satellite haemodialysis unit
3. To analyze the cost effectiveness of satellite haemodialysis unit
4. To suggest a costing model for tertiary care hospital

Methods and Methodology

A prospective and cross sectional study was carried out in a tertiary care hospital HD unit for a period of six months to analyse the cost involved for the development SHD unit for tertiary care hospital based on the patients need and perception of SHD unit. Primary data has been collected by using survey questionnaire, informal interviews, and checklist (Indian society of nephrology guidelines for HD unit), expert opinion and direct observation. Secondary data has been collected from literature reviews.

Problem solving and Analysis

Random sampling technique was adopted to collect the sample and sample were haemodialysis patients in in –centre hospital. The pretested structured questionnaire after face validation by subject matter experts was administered to 10 HD patients as a pilot survey. A sample size of 120 HD patients were chosen based on the confidence interval 95%, margin of error 10% and ESRD prevalence rate in India (0.8%) as per literature review, using the formula N= (1-p)/.Cronbach's Alpha has been done for the study and the value obtained is 0.702 which show alpha coefficient of reliability is acceptable for the research.The Pearson correlation coefficient (r) obtained is 0.448 at a level 0.01 (p value) which states that there is a weaker correlation between the two variables (perception and willingness). The costing model was developed for 5 bedded SHD unit working in six days in a week with 3 shifts per day based on number of patients (30) willingness to prefer SHD unit. Most of the patients are from similar locality, travel distance has been taken (6-15 KM).

Results and Interpretation

Based on the study, large part of total operational haemodialysis cost were the direct operational costs followed by indirect costs.

Analysis on SHD unit Costing Elements

Calculation of Cost of Project

Table 1. Cost of project

Expenditure	Cost (INR)		
	Rent	Lease	Own
Total Capital Expenditure	6439745	106,83,745	211,83,745
Total Working Expenditure (INR)	9845684	9089684	9089684
Total cost of project (INR)	16285429	197,73,429	302,73,429

The above table shows the cost of project for rent, lease and own SHD units.

Cost of Project = Total Capital Expenditure + Total Working Expenditure

Calculation of Means of Financing

Means of financing has been included own capital with borrowed capital (from bank)Assumption:The percentage of contributions has been taken as 100%, 75%, 50% and 25%.

Calculation of Estimation of Loan Amount

Estimation of loan amount has been calculated for 25%, 50% and 75% of repayment loan of borrowed capital with payment period of 5 years, 10 years and 15 years respectively.

Assumption: Interest remains constant in all years (11.2%).

Calculation of Income Estimation

The price of HD session has been taken as 2000 – 4000 INR.

Income Estimation = Price per HD session * Number of dialysis.

Assumption: The number of dialysis per year remains constant (4320).

Calculation of HD price

Table 2: Price per HD session

	Rent	Lease	Own
Working capital expenditure (INR)	9845684	9089684	9089684
Number of dialysis sessions per year	4320	4320	4320
Cost per HD session (INR)	2279	2104	2104
Profit per HD session (INR)	221 (8.8%)	396 (15.8%)	396 (15.8%)
Price (INR)	2500	2500	2500

The above table shows the price per HD session in SHD unit. It has been taken as 2500 RS.

Price per HD session = Cost per HD session + Profit.

Calculation of Payback Period

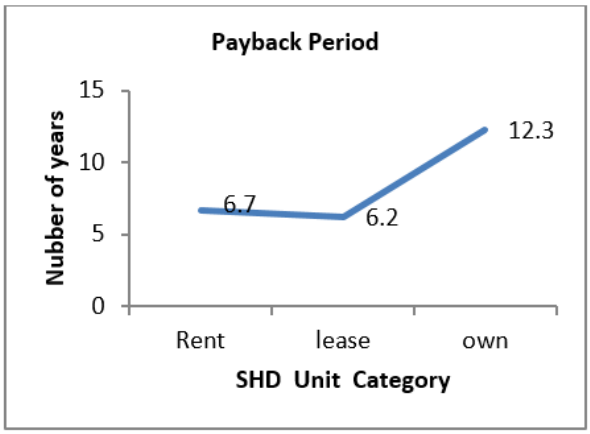

Figure 1. Payback Period

The above graph showing the payback period of rent, lease and own SHD units.

Payback Period = Capital Investment/ Net Cash inflow (Profit)

Breakeven Point

Table 3: Breakeven Analysis

Particulars	Rent	Lease	Own
Total cost (Fixed cost + Variable cost)	16285436	19773436	30273436
Sales	10800000	10800000	10800000
Number of dialysis	4320	4320	4320
Selling Price per Dialysis (INR)	2500	2500	2500
Variable cost per Unit (INR)	1801.427	1626.427	1626.427
BEP	12172.34	14592.11	26611.71
BEP Price (BEP* Sales Price per Unit)	30430858	36480265	66529277

The table showing the BEP of SHD units (rent, lease and own). The BEP is showing 12172 HD sessions- rent SHD unit, 14592 HD sessions- lease SHD unit and 26612 –own SHD unit.

Breakeven Point = Fixed Cost / (Selling Price per unit – Variable Cost per Unit.

Discussion

The number of people with ESRD disease grows, the market of HD service is expected to expand. Having this situation, it is necessary to have satellite HD unit. The service charges should be set at least equal to running costs of the organisation because it has to recover the expenses[5].

The primary objective of the study was to determine the need of SHD unit among dialysis patients. The results shows that 30 (25%) of patients from in- centre HD unitneeds the SHD unit.Dialysis treatment requires a greater focus on patient's preference[12].Based on this result cost analysis of SHD unit has done for 5 bedded SHD unit.Second objective was to determine the various costs involved for the development of SHD unit. These costs increase proportionally with the number of dialysis. The fixed cost is not increases with the number of dialysis[15]. The methodology used for the study has been followed by the costing methodology used by other researchers[9],[17],[7], [10]. The third and fourth objectives were to analyse the cost effectiveness of SHD unit and to suggest a costing model to develop SHD unit respectively. The study results shows that rent and lease based SHD is more cost effective than own SHD unit. The main cost driver for the HD were direct operational cost associated with running unit and it is formed large part of total operational cost[18]. Based on the studies equipments, building and facility cost are large part of total operational cost. Break even analysis helps to calculate the average profit or loss per dialysis depending on the number session per month or year[15].Strength of this study are, standard methods were used for data collection i.e. the methodology used for the study have been used other researchers, Actual costs have been taken to develop costing model and expert opinions were incorporated in the study to develop costing model. Limitation of our study is it was conducted in single centre because of the time constraint.

Recommendation

Table 4. Costing Model to Develop SHD unit

	Rent	Lease	Own
Cost of Project (INR)	162,85,436	197,73,436	302,73,436
Means of Finance (INR)			
Own capital 100%	16285429	19773429	30273429
Borrowed capital 0%	0	0	0
Own capital75%	12214072	14830072	22705072
Borrowed capital 25%	4071357	4943357	7568357
Own capital 50%	8142715	9886715	15136715
Borrowed capital 50%	8142715	9886715	15136715
Own capital 25%	4071357	4943357	7568357
Borrowed capital 75%	12214072	14830072	22705072
Estimation of Loan (INR)			
5 years for 25%	1270263.38	1542327.38	2361327.38
10 years for 50%	1726255.58	2095983.58	3208983.58
15 years for 75%	2182247.52	2649639.52	4056639.52
Income Estimation (INR)	10800000	10800000	10800000
Payback period (In year)	6.7	6.2	12.3
Break Even Point (Dialysis sessions)	12172	14592	26612
Break Even Period (In year)	2.8	3.3	6.1

The above costing model has been suggested for the hospital to develop a satellite haemodialysis unit. The model has developed for one year. It has been developed for 5 bedded dialysis unit working in 3 shifts per day with 6 days in a week, expert opinions were incorporated.

- Based on the analysis of the research the following recommendations are suggested:
- Hospital can focus on extending HD care by having SHD unit to HD patients
- It was felt that there is a need of SHD unit for HD patients
- The SHD unit must be provided HD care with better facilities, affordable cost and best treatment
- The SHD unit should be rent / lease based, it is more cost effective than own SHD unit and to reduce the cost of project the hospital can go by rent SHD unit
- The dialysis cost should be start from the range of 2500RS

Conclusion

The results showed that there is a need of SHD unitfrom in-centrehaemodialysis unit. The cost information is needed to the management to develop SHD unit, it helps to make decisions. (Table 1) shows

the various costs involved for the development SHD unit.From Result it is clear that rent or lease based SHD unit are more cost effective than own SHD unit. From the table given in (Table 1) we can see that the total capital expenditure for the rent SHD unit is lower compared to lease and own SHD units. Similarly in case of payback period (Figure1) we can see that the rent and lease SHD units are showing lower payback period than own SHD unit. From the breakeven analysis (Table3) we can understand that the number of dialysis sessions needed for rent and lease SHD units for breakeven is lower and BEP period is lower for these units compared to own SHD unit. Overall the rent and lease based SHD units is much better than compared to own SHD unit.

To conclude, cost information is a tool which is useful in setting priorities of various course of action to meet objectives and allocate the resources to facilities and service[4]. Majority of dialysis patients to undergo the irregular haemodialysis treatment due to the inaccessibility of HD units[1], [3]. It is very much essential to establish a SHD unit from in-centre to provide a holistic care to HD patients.

Future Directions:

Further research is needed to identify cost effectiveness of HD service between in-centre and satellite haemodialysis unit from patient's perspective. Also the clinical outcomes of the care provided in the SHD unit as compared to main unit.

Ethical clearance It has been taken from the institution, publication committee. Written informed consent was obtained from all participants prior to data collection. Participation was voluntary, and confidentiality and anonymity of the respondents were maintained throughout the study.

Source of funding- Self

Conflict of Interest - Nil

References

1. Agarwal SK, Srivastava RK. Chronic kidney disease in India: challenges and solutions. Nephron clinical practice. 2009;111(3):c197-203.
2. Baboolal K, McEwan P, Sondhi S, Spiewanowski P, Wechowski J, Wilson K. The cost of renal dialysis in a UK setting—a multicentre study. Nephrology Dialysis Transplantation. 2008 Jan 3;23(6):1982-9.
3. Bhowmik D, Tiwari SC. Challenges of hemodialysis in India. J Int Med Sci Acad. 2012;25(2):99-100.
4. Chatterjee S, Levin C, Laxminarayan R. Unit cost of medical services at different hospitals in India. PLoS One. 2013 Jul 23;8(7):e69728.
5. Cleemput I, De Laet C. Analysis of the costs of dialysis and the effects of an incentive mechanism for low-cost dialysis modalities. Health Policy. 2013 May 1;110(2-3):172-9.
6. Diamant MJ, Harwood L, Movva S, Wilson B, Stitt L, Lindsay RM, Moist LM. A comparison of quality of life and travel-related factors between in-center and satellite-based hemodialysis patients. Clinical Journal of the American Society of Nephrology. 2009 Dec 17:CJN-05190709.
7. FergusonTW,ZachariasJ,WalkerSR,CollisterD,Rigatto C, Tangri N, Komenda P. An economic assessment model of rural and remote satellite hemodialysis units. PloS one. 2015 Aug 18;10(8):e0135587.
8. Georgi AB, Jayaseelan T, Milly MA, Padma P, Saravanan AK, Nancy LE, Yuvaram NR, Saravanan S, Yogesh NR. Resource settings have a major influence on the outcome of maintenance hemodialysis patients in South India. Hemodialysis International. 2010 Apr;14(2):211-7.
9. Jha V, John O, Joshi R, Kotwal S, Essue B, Jan S, Gallagher M, Knight J. Dialysis outcomes in I ndia: A pilot study. Nephrology. 2015 May;20(5):329-34.
10. Kaur G, Prinja S, Ramachandran R, Malhotra P, Gupta KL, Jha V. Cost of hemodialysis in a public sector tertiary hospital of India. Clinical Kidney Journal. 2017
11. Khanna U. The economics of dialysis in India. Indian journal of nephrology. 2009 Jan;19(1):1.
12. Lee A, Gudex C, Povlsen JV, Bonnevie B, Nielsen CP. Patients' views regarding choice of dialysis modality. Nephrology Dialysis Transplantation. 2008 Jun 27;23(12):3953-9.
13. Maripuri S, Arbogast P, Ikizler TA, Cavanaugh KL. Rural and micropolitan residence and mortality in patients on dialysis. Clinical Journal of the American Society of Nephrology. 2012 Apr 19:CJN-10831011.
14. Moist LM, Bragg-Gresham JL, Pisoni RL, Saran R, Akiba T, Jacobson SH, Fukuhara S, Mapes DL, Rayner HC, Saito A, Port FK. Travel time to dialysis as a predictor of health-related quality of life, adherence, and mortality: the Dialysis Outcomes and Practice Patterns Study (DOPPS). American Journal of Kidney Diseases. 2008 Apr 1;51(4):641-50.

15. Mushi L, Krohn M, Flessa S. Cost of dialysis in Tanzania: evidence from the provider's perspective. Health economics review. 2015 Dec 1;5(1):28.

16. Prakash S, Austin PC, Oliver MJ, Garg AX, Blake PG, Hux JE. Regional effects of satellite haemodialysis units on renal replacement therapy in non-urban Ontario, Canada. Nephrology Dialysis Transplantation. 2007 Apr 4;22(8):2297-303.

17. Ranasinghe P, Perera YS, Makarim MF, Wijesinghe A, Wanigasuriya K. The costs in provision of haemodialysis in a developing country: a multi-centeredstudy. BMC nephrology. 2011 Dec;12(1):42.

18. Rezapoor A, Azar FE, Safari H, Arabloo J. 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. World Applied Sciences Journal. 2012;18(6):796-802.

19. Soroka SD, Kiberd BA, Jacobs P. The marginal cost of satellite versus in-centerhemodialysis. Hemodialysis International. 2005 Apr;9(2):196-201.

20. Suja A, Anju R, Anju V, Neethu J, Peeyush P, Saraswathy R. Economic evaluation of end stage renal disease patients undergoing hemodialysis. Journal of pharmacy &bioallied sciences. 2012 Apr;4(2):107