Capacity Utilization of Dialysis Department of a Tertiary Care Hospital Using TDABC Model

By

Akshata Paropkari

Dissertation submitted in partial fulfillment of the requirements of the degree

MBA Hospital and Health Management

Academic year, 2018-2020

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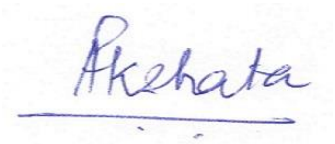
CERTIFICATE BY SCHOLAR

This is to certify that the dissertation titled **Capacity Utilization of Dialysis Department of a Tertiary Care Hospital using TDABC Model** and submitted by **Dr. Akshata Paropkari** Enrolment No **0709** under the supervision of **Dr. Sandesh Kumar Sharma** for award of MBA in Hospital and Health Management in of the University carried out during the period from **February 3, 2020 to May 3, 2020** embodies my original work and has not formed the basis for the award of any degree, diploma associate ship, fellowship, titles in this or any other institute or other similar institution of higher learning.



Dr. Akshata Paropkari

Abstract

Introduction: Healthcare industry in India is witnessing more change in today's time than ever before. Hospitals, especially, are at the heart of these changes. Increasing strict regulations are putting immense pressure on them, almost questioning their financial stability. Hospitals now are looking for innovative ways to curb their costs and maintain operational balance. Time-driven activity-based costing is one such new method, ahead of traditional activity-based costing. It not only helps better cost accounting but also gives a clearer picture of capacity utilization.

Rationale: Every year about 2.2 Lakh new patients of End Stage Renal Disease (ESRD) get added in India resulting in additional demand for 3.4 Crore dialysis every year[1]. Hence dialysis department plays a major role as one of the most reliable & continuous sources of income for a hospital. In current situation, especially after Covid-19, it is essential to review capacity utilization and ensure optimal efficiency.

Objectives:

- To estimate the capacity utilization of manpower and dialysis machines of the dialysis department using time-driven activity-based costing model.
- To provide recommendations to the hospital in terms of increasing the capacity utilization of manpower and dialysis machines of the dialysis department.

Methodology:

- Study design – Cross-sectional analytical study.
- Setting – Dialysis department of a tertiary care hospital in Navi Mumbai
- Study duration – 2 months
- Population
    - Inclusion criteria: Staff working in the dialysis department of and in-use dialysis machines therein.
    - Exclusion criteria: Standby dialysis machines and those installed in ICUs of the hospital.

[1] Pradhan Mantri National Dialysis Programme | National Health Portal Of India [Internet]. Nhp.gov.in. 2020. Available from: https://www.nhp.gov.in/pradhan-mantri-national-dialysis-programme_pg

- Population size –
    - Staff: 39.
    - Dialysis machines: 20.
- Data source – Primary data.
- Tools used for data collection – Observation and personal interviews.
- Tools used for analysis – Time-driven activity-based costing model and Microsoft Excel.

Results: The capacity utilization rate of manpower and dialysis machines is 91.43% and 73.53% respectively. The unused capacity is estimated to cause a loss of ₹4240 and ₹64,800 daily by manpower and dialysis machines respectively.

Conclusion: Hospitals in India had been walking a tightrope already, which got aggravated by the pandemic of Covid-19 in 2020. It's a public health crisis which has caused an economic crisis in the healthcare sector. Any cost-effective, innovative method to review the resource capacity and their utilization will prove to be boon to the hospital. Time-driven activity-based costing has proven itself promising to achieve the same with this study. By implementing the TDABC system on a broader level, further unrealized areas for efficiency enhancement can be identified. With a clearer financial and operational picture the hospital can move towards a more sustainable organization than before.

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List of abbreviations

- EBITDA: Earnings Before Interest, Taxes, Depreciation and Amortization
- TDABC: Time-Driven Activity-Based Costing
- ESRD: End Stage Renal Disease
- IPD: In-Patient Department
- OPD: Out-Patient Department

1.0 Introduction

Indian hospital industry is undergoing a massive disruption currently. All of its stakeholders are putting pressure on it: the government is demanding rationalization and transparency in prices, the patients want accessibility, affordability and high quality care, and the shareholders & investors want a profitable growth. Due to the current price control regulations hospitals have seen their EBIDTA margin decreasing from about a range of 10 percent to 15 percent to a low of 6 percent (1). Controlling costs and figuring out innovative ways to increase the efficiency will guard them from walking on this tightrope. Learning from the other industries, one of the basic yet key performance indicators and operational metrics followed is capacity utilization rate.

1.0.1 What is capacity utilization?

It is the relationship between output that *is* produced with the installed equipment, and the potential output which *could* be produced with it, if capacity was fully used (Wikipedia). In other words, it is an indicator which shows how much a resource is utilized against its maximum capacity. This gives a good picture of how efficiently the resource is being used.

Capacity utilization = (Capacity utilized/ Optimum capacity) * 100

1.0.2 How to calculate the capacities?

Calculating capacity utilization is a complex procedure when it comes to a service industry, more so in healthcare. There are several variations within each activity that is performed. Hence one formula cannot be applied to both man and machine in question.

In a cover published by the Harvard Business Review in 2011, authors Kaplan and Porter said that '*the biggest problem in healthcare is that we're measuring the wrong things the wrong way'*. They have talked about a new approach, time-driven activity-based costing, which gives not only a better way of cost accounting costs but also identifies how much of each resource's capacity is actually used. Managers can clearly see the unused capacity and cost of a resource (2).

1.0.3 Time-driven activity-based costing

Time-driven activity-based costing was presented by R. S. Kaplan and S. R. Anderson as a modified version of traditional activity-based costing (3). The traditional ABC was complicated, cumbersome and failed to capture the complexity of actual operations. On

the other hand, TDABC provides meaningful cost and profitability information in a simplified yet dynamic manner. For each group of resources, estimates of only two parameters are required: the cost per time unit of supplying resource capacity and the unit times of consumption of resource capacity by products, services and customers.

TDABC's basic purpose is to provide a more advanced and sophisticated method of accounting costs. However it also highlights the difference between capacity supplied (both quantity and cost) and the capacity used. Based on this aspect of TDABC, this study seeks to achieve the undermentioned aim.

1.0.4 TDABC in dialysis department

Every year about 2.2 Lakh new patients of End Stage Renal Disease (ESRD) get added in India resulting in additional demand for 3.4 Crore dialysis every year. Dialysis practically remains the first, and in majority of cases, the only choice for ESRD patients over renal transplant (4). Hence dialysis department plays a major role as one of the most reliable & continuous sources of income for a hospital.

As this is the first time TDABC is being introduced to the hospital in question, it is applied to find capacity utilization of two biggest resource inputs in the dialysis department: manpower and dialysis machine. Both the resources are the top contributors of operational and capital costs respectively.

1.1 Aim

This study aims to provide a clear, fact-based capacity utilization level of the two major resources of dialysis department and give recommendations to improve the same.

1.2 Objectives

This study has two basic objectives:

1. To estimate the capacity utilization of manpower and dialysis machines of the dialysis department using time-driven activity-based costing model.
2. To provide recommendations to the hospital in terms of increasing the capacity utilization of manpower and dialysis machines of the dialysis department.

2.0 Methodology

- Study design: Cross-sectional, analytical study.
- Study setting: Dialysis department, tertiary care hospital, Navi Mumbai.
- Study duration: 2 months
- Data source: Primary data
- Tools used for data collection: Observation and personal interviews.

As mentioned earlier, TDABC requires estimates of only two parameters: cost per time unit of supplying resource capacity and the unit times of consumption of resource capacity. Multiplication of both the parameters gives the total cost of the resource consumed. In order to simplify the procedure followed, it has been explained in four phases.

2.1 Phase A – Identification of resources

The dialysis department of the hospital in question has 20 beds. Tables 2.1 and 2.2 below shows the information of manpower and dialysis machines in the hospital respectively.

Table 2.1: Manpower count

Dialysis department – Manpower	
Type	**Number**
Technicians	11
Nurses	23
Housekeeping	5
Total manpower = 39	

- Inclusion criteria: Only permanent staff of the dialysis department.
- Exclusion criteria: On-call staff or consultant doctors.

Table 2.2: Dialysis machine count

Dialysis department – Dialysis Machines	
Status	**Number**
In-use	20
Standby	5

- Inclusion criteria: Only the in-use machines as stated above.
- Exclusion criteria: All standby machines and machines in other departments such as ICU.

Annexure 1 contains the details of the shift timings and number of manpower per shift.

2.2 Phase B – Estimation of unit times of resource capacity

According to the number of resources and their shift timings, the available capacity of the resources can be determined. However, any resource, be it man or machine, isn't available for 100% of its ideal capacity. In case of human resource there is a significant amount of time spent in breaks, arrival & departure, communication and training. In case of machines, there is downtime due to breakdown, repair, maintenance and scheduling fluctuations. Hence *practical* capacity of resources is considered here instead of *theoretical* capacity.

The practical capacity of resource is described as a percentage of theoretical capacity. There are various ways to do this. As a rule of thumb, this study has allocated *80%* to people and *85%* to machines as the practical capacity (3). Refer to *Annexure 2* for the capacities of manpower and dialysis machines.

The hospital in this study conducts an average of 60 dialysis cycles per day. Each dialysis cycle lasts for 4 hours. However, shifts are calculated for an interval of 5 hours each. (Refer to *Annexure 3* for the shift timings of the cycles). This is because after each cycle, the machine goes through a process of disinfection and some tests, followed by patient preparation. All these activities consume an hour. Since the machine cannot be used anywhere or for anyone else during this time, it is considered as a part of cycle time.

The dialysis department of the hospital is functional 24*7. There are no planned cases post 9 PM. Emergency and/ or IPD patients requiring dialysis are accepted between 9 PM - 7 AM. *Annexure 4* mentions the number of cycles conducted during night shift from February 2020 to April 2020.

2.3 Phase C - Estimation of unit costs of resource capacity

Cost estimates in capacity utilization help managers be conscious of the amount of loss incurred due to unused capacity of resources. This information will drive cost-effectiveness in the organization.

The cost estimates for manpower and machines are calculated on per minute basis. They are explained separately below.

2.3.1 Manpower

The cost of each person is calculated with the help of their salary down to per minute of their shift time. Average salary of each category of staff is considered here.

2.3.2 Dialysis machine

The life cycle of one machine is 10 years. The cost of machine is calculated comprising of following expenses:

i. Purchase cost:

   Average cost is considered here.

ii. Annual maintenance cost:

   AMC begins from 4th year of the machine after purchase. A warranty of 3 years is given by the manufacturer at the time of purchase itself. Hence AMC has been calculated for a period of 7 years per machine.

iii. Depreciation:

   Depreciation of 10% has been considered for the 1st year since the purchase, followed by 15% for the next 9 years.

Refer to *Annexure 5* for the cost of resources per minute.

2.4 Phase D: Estimation of resource cost driver rates

Cost driver rates give the cost of each resource according to its utilization. This also gives the capacity utilization rate. The unused capacity and its cost can be obtained.

3.0 Literature review

When talking about capacity utilization, it is unconventional to adopt an approach primarily meant for cost accounting. However, application of TDABC has proven to bring some remarkable operational insights. These insights have been observed even in health care settings where TDABC has been applied.

A study conducted in Belgium's outpatient clinic reported that implementation of TDABC helped identify which activities demanded more time, consequently costing more. For instance, secretaries of two departments in the clinic took longer than the others to classify patients according to requirement of test. This prompted the management to rework the former's working structure, reducing the activity time and consequently reducing the costs as well. Aside from the small changes like mentioned before, the TDABC system played a significant role in future investment decisions as well (5).

Magusa Yasam Hospital, the first well-equipped private hospital in Cyprus, experienced help with numerous, concrete managerial solutions post implementation of TDABC system on their open and closed gallbladder operations. It provided the hospital ways of cost-effectiveness by indicating the number of employees to be dismissed or directed to other productive areas. It also highlighted ways for the hospital to improve their price competitiveness by excluding the costs of unused capacities (6).

In a study conducted in a tertiary care paediatric emergency centre, TDABC was used to make cost comparison between ultrasound and MRI for diagnosis in acute abdominal/ pelvic pain. They were not only able to achieve the objective but also identify certain inefficiencies in their system. Acting on one such inefficiency they were able to achieve an overall mean decrease in total time taken to complete pelvic ultrasound examination by using point of care bladder ultrasound (7).

There are numerous other studies which have shown similar improvements in their operations post implementation of TDABC (8-12). Furthermore, TDABC not only shows operational improvements but also brings about positive change in the organizational culture. The participation of all members, especially at the lowest levels, fosters dialogue about the input parameters of the costing model. This promotes collective worker participation. In addition, when these discussions about costing data are held in groups guided by a considerate, people-oriented superior, it creates an atmosphere conducive to operational improvements (13).

All of the aforementioned studies have benefitted from the most integral part of TDABC: managers can clearly see the quantity and cost of unused resource capacity at the level of individual physicians, nurses, technicians, pieces of equipment, administrators, or organizational units (2).

4.0 Results

The capacity utilization and its rates along with cost driver rates are mentioned in the table below. Total practical capacities of all 35 staff members and 20 dialysis machines has been considered.

Table 4.1: Capacity utilization of resources and cost driver rates (per day)

Capacity utilization and cost driver rates (per day)				
Resource	**Available practical capacity (minutes)**	**Capacity utilized (minutes)**	**Capacity utilization (%)**	**Cost driver rates (₹)**
Manpower	13440	12288	91.43	45,235.20
Dialysis machine	24480	18000	73.53	1,42,200

Unused capacity and its associated costs are mentioned in the table below.

Table 4.2: Unused capacity of resources and its associated costs (per day)

Unused capacity and its associated costs (per day)				
Resource	**Available practical capacity (minutes)**	**Capacity unutilized (minutes)**	**Unused capacity rate (%)**	**Costs (₹)**
Manpower	13440	1152	8.57	4240
Dialysis machine	24480	6480	26.47	64,800

5.0 Discussion

The capacity utilization rate of manpower is exceptional at 91.43%. However, if we compare *Table 2.1* and *Annexure 1*, it is seen that the number of technicians and housekeeping employed at the department is the same as the number required for any particular shift. There is no resource on standby in case of emergency or leave of absence.

Ironically, Annexure 4 tells us that in the 3 months from February 2020 – April 2020, there have been only 53-night dialysis cycles in the hospital, out of which a negligible 2 cycles were on OPD basis. That equals to not even one case per night. This shows that the staff present at night shift are idle, with rare occurrence of cases.

This observation is reflected in *Table 4.2* showing unused capacity of staff of this shift. Losses up to ₹4240 daily, ₹1,27,200 monthly and ₹15,26,400 annually may occur if the staff is not engaged more efficiently.

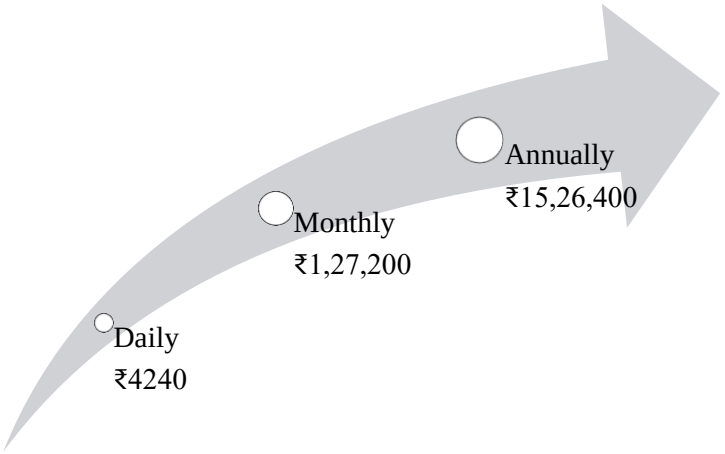

Figure 5.1: Financial loss due to unused capacity of manpower

Coming to the capacity utilization rate of machines, it stands at a modest 73.53%. The lower percentage is again due to the lack of productivity during the night shift. The losses caused due to unused machinery is a lot more than manpower. ₹64,800 daily, ₹19,44,000 monthly and ₹2,33,28,000 annually may go waste due to the machine lying unused.

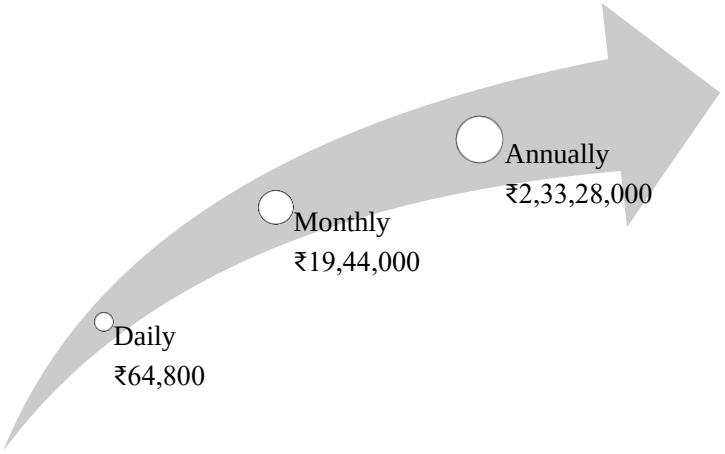

Figure 5.2: Financial loss due to unused capacity of dialysis machines

It should be noted that these capacity utilization rates are out of the practical capacity available, not theoretical. Hence achieving a 100% utilization in these rates should be the aim.

5.1 Study limitations

TDABC has been applied in studies in a more extensive manner. Especially in healthcare settings, this system has been used to derive costs for particular treatment, comprising of all costs required to deliver the treatment. It is the best suggested method to reap full benefits of the system. A more holistic implementation of this system may provide better results.

5.2 Study strengths

This study has opened new doors to studying the resources and their utilization at an individual and micro-level. It has helped to determine exactly how much losses are currently being incurred due to inefficiency in the system, in a simplified and easy manner.

This study has also managed to introduce a new cost accounting method to the hospital. It will enable them to maintain a real-time tracking of the finances easily. Additionally, it can help them take, implement and monitor strategic & tactical decisions more accurately and seamlessly.

6.0 Suggestions

The results and its analysis have highlighted that the resources are lying unused at the night shift, causing a considerable loss. The flipside to this is that dialysis cycles are usually planned. Patients therefore choose a comfortable time to undergo the treatment, and justifiably so.

However, the number of ESRD patients requiring dialysis is increasing in such volumes that the demand is not being met (4). Leveraging this opportunity, a volume-based strategy may help increase the productivity, efficiency of resources as well as enable the hospital to provide the service at lower costs.

Based on this idea, the hospital can start night dialysis slots for the patients at discounted/ lower prices. According to the shift details mentioned in *Annexure 1*, each technician oversees 4 patients while each nurse oversees approximately 2 patients currently. So 2 slots can be introduced for 3 patients each at the following timings:

1. 9 PM – 2 AM
2. 2 AM – 7 AM

This will have a manifold effect on the hospital as given below.

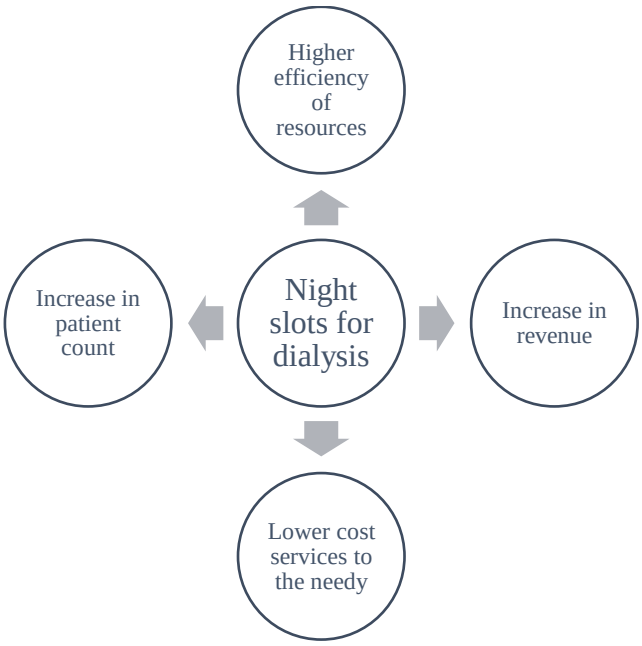

Figure 6.1: Manifold effects of introducing night dialysis slots

Opting for 3 patients per slot will enable the hospital to increase revenue and capacity utilization without increasing resource costs. Increased patient count will further empower the hospital to lower the price of treatment, making it available to those who are otherwise unable to afford it, and achieve price competitiveness at the same time.

Once this model achieves success, more resources can be deployed to cater to more number of patients.

7.0 Conclusion

Hospitals in India had been walking a tightrope already, which got aggravated by the pandemic of Covid-19 in 2020. It's a public health crisis which has caused an economic crisis in the healthcare sector. It has caused 70-80% drop in footfalls, test volumes and 50-70% drop in revenue in the last 10 days of March 2020 itself (14). Consequently, achieving high efficiency of performance is the urgent need of the hour.

Any cost-effective, innovative method to review the resource capacity and their utilization will prove to be boon to the hospital. Time-driven activity-based costing has proven itself promising to achieve the same with this study. It has not only introduced a new method of cost accounting but also highlighted the operational improvement areas that can potentially increase the revenue of the hospital, without increasing the costs.

By implementing the TDABC system on a broader level, further unrealized areas for efficiency enhancement can be identified. With a clearer financial and operational picture, the hospital can move towards a more sustainable organization than before.

8.0 Annexures

Annexure 1: Manpower shift details

Manpower – shift details		
Shift	**Time**	**Number of manpower (including general shift)**
Morning	7 AM – 3 PM	Technician – 5 Nurse – 9 Housekeeping - 2
Evening	2 PM – 10 PM	Technician – 5 Nurse – 9 Housekeeping – 2
Night	9 PM – 7 AM	Technician – 1 Nurse – 1 Housekeeping - 1
General	10 AM – 6 PM 11 AM – 7 PM	

Annexure 2: Capacities of resources (minutes per day)

Capacities of resources (minutes per day)		
Resource (1 unit)	**Theoretical capacity**	**Practical capacity**
Manpower	480	384
Machine	1440	1224

Annexure 3: Time slots of planned dialysis cycles

Time slots of planned dialysis cycles	
Slot 1	7 AM – 12 PM
Slot 2	12 PM – 4 PM
Slot 3	4 PM – 9 PM
Average planned dialysis cycles per day = 60	

Annexure 4: Dialysis cycles conducted at night shift between Feb 2020- April 2020

Dialysis cycles undertaken at night from February 2020 to April 2020	
IPD	**OPD**
51	2
Total = 53	

Annexure 5: Cost per minute of resource consumption (₹)

Cost per minute of resource (₹)	
Resource	**Cost/ minute**
Technician	1.25
Nurse	1.39
Housekeeping	1.04
Dialysis machine	7.9

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