Determining the Cost of Services in the ICU Ward of Yazd's Shohadaye Kargar Social Security Hospital in 2011

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ABSTRACT

The purpose of this research is to determine the cost of services in the ICU ward of Yazd's Shohadaye Kargar (Tamin Ejtemaei) Hospital. The rapid and ever-increasing rise in the costs of health and treatment sector, especially those related to medical diagnosis and treatment has caused the professionals, economists and even doctors from all around the world to investigate new methods for restricting the costs. Through cost control, it would be possible to pave the way for the justly and desirable utilization of certain level of services which is necessary for individual health, simultaneously implementing the control and financial supervision of health and treatment organizations. In this regard, the current research is considered as case study and applied research and it is also of descriptive-analytical type in terms of research method. Regarding this fact that all the financial and non-financial records and documents existing in hospital's financial department have been evaluated using process costing method based on the actual figures (matrix approach), so the statistical population of this research consists of the Yazd's Shohadaye Kargar (Tamin Ejtemaei) Hospital. The research findings revealed that the cost of ICU services in 2011 and the cost of an overnight hospital stay in this ward amounted to 5,553,239,356 IRR and 2,535,726 IRR, respectively with the direct labor costs as the highest contribution to above-mentioned costs.

INTRODUCTION

Cost accounting is a part of total accounting information system which collects, accumulates and presents the cost-related information in order to be used in both management accounting and financial accounting (Eskandari, 2006).

The emphasis on accounting information and generally on cost information is basically because of the role it plays in decision-making. In current situation, the cost information is regarded as a factor which enhances the quality of decision-making through providing useful information.

The cost of products or services which is prepared by management accounting is regarded as one of the most necessary information because it contains the items of product manufacturing or service delivery costs. An appropriate accounting system can pave the way to reach the management objectives through efficient costing and providing the related, timely and reliable reports [46].

One major purpose of this research is to determine the cost of ICU services in Yazd's Shohadaye Kargar (Tamin Ejtemaei) Hospital. Another one is to determine the cost of an overnight hospital stay in ICU and compare it with the 2010 approved tariff in order to actualize the bed-day tariffs of ICUs in hospitals.

It should be noted that the insurance and treatment organizations and especially the hospitals can utilize the results of this research among them one can mention Ministry of Health and Medical Education, University of Medical Sciences, Social Security Organization, Iran Health Insurance Organization, Armed Forces' Medical Services Organization, etc.

One of the most important tasks of the managers is the optimal allocation of financial resources and maximum utilization of existing facilities. This becomes more perceptible when the organization encounters the conditions of limited facilities and financial resources and its survival and growth depends on the recognition, assessment and selection of the most appropriate investment facilities and allocation of financial resources to them. The managers are in need of accounting information as an important decision-making tool for better
decision-making about the way of resource allocation and controlling and ensuring the efficient utilization and performance of the resources provided [18].

The rapid and ever-increasing rise in the costs of health and treatment sector, especially those related to medical diagnosis and treatment has caused the professionals, economists and even doctors from all around the world to investigate new methods for restricting the costs. Dramatic changes have been occurred in medical science field in such manner that the calculation and estimation of the health sector costs is of paramount importance form the standpoint of nation's health policy planners [8].

Through cost control, it would be possible to pave the way for the justly and desirable utilization of certain level of services which is necessary for individual health, simultaneously implementing the control and financial supervision of health and treatment organizations.

Various researches have confirmed that the cost analysis provides a basis through which one can reduce the costs through determining the ways to avoid wasting resources [60].

Through cost control, it would be possible to pave the way for the justly and desirable utilization of certain level of services which is necessary for individual health, simultaneously implementing the control and financial supervision of health and treatment organizations [42].

Various researches have confirmed that the cost analysis provides a basis through which one can reduce the costs through determining the ways to avoid wasting resources [60].

Regarding this fact that our country is among the developing countries and a considerable part of economic resources is devoted to health and treatment and hospital services sector, the need to economic assessment of the services and cost analysis seems twice as much resulting in optimal utilization of the limited resources [31].

Each year, a considerable part of the nation's existing resources in health and treatment sector is wasted because of lack of economic assessment and cost calculation. Basically, the unit cost is of paramount importance in each service delivery. Regarding the limited resources it is necessary to emphasize on desirable and maximum utilization of facilities as an inseparable part in health and treatment system. The costs are not important just for the managers and planners. So the employees in the health and treatment sector should be taught that, if the costs are reduced, then a wider variety of people can enjoy the health services [39].

The rapid and ever-increasing rise in costs of treatment services is so that the cost control is regarded as the major issue for health and treatment services system in different countries even in rich countries of the world. The hospitals are of paramount importance as the most important and costliest parts of the health system. According to a comprehensive study of public hospitals carried out by the World Bank, about 50-80 per cent of the resources in health and treatment sector in developing countries are consumed by the hospitals [14].

It is also necessary for Social Security Organization to use the modern costing systems in order to reach a higher productivity and performance in its activities and better reporting with regard to cost of services in treatment sector [37].

Research background:

A. Researches carried out inside the country:

1. Mr. Ganji, Kh. carried out a research entitled "determining the cost of an overnight hospital stay in Oncology Ward of Yazd's Shah Vali Hospital" which its results are as follows:
   In general, the cost of services in oncology ward of this hospital in 2008 amounted to 3,131,785,431 IRR and the figure for cost of an overnight hospital stay is put as high as 8,580,234 IRR.

   Regarding this fact that there are 22 constructed beds and 16 inpatient beds in the oncology ward of this hospital, the cost of an overnight hospital stay amounts to 390,010 IRR and 536,264 IRR with considering constructed and inpatient beds, respectively emphasizing on the personnel costs with the highest contribution to total costs (73%).

2. Mr. Mohammad Reza Sabzavari carried out a research entitled "evaluating the cost of ICU services in Shahid Chamran Hospital and comparing it with government-approved tariffs in 2000" which its results are as follows:

   The cost of ICU services in this hospital amounted to 1,424,685,692 IRR in a year (by considering the capital profit) which is 1.45 times of government-approved tariffs. The personnel costs accounts for the highest percentage of the costs.

   Mrs. Aghdas Lak [60] carried out a research entitled "comparison of costs in General ICU (clinic and ICU2 wards) in Imam Khomeini Hospital Complex in 2003" yielding the following results: the average daily cost of ICU stay in clinic ICU and ICU2 wards in 2003 amounted to 1,421,293 and 1,845,882 IRR, respectively.

   4. In a thesis entitled "determination of cost for one kilowatt hour of electrical energy produced by Fars combined cycle power plant" the researcher has calculated the cost of power using the uniform accounting system and concluded that the cost of raw materials per one kilowatt hour of electrical energy produced by Fars power plant (regarding the price per m³ of natural gas which was 32.42 IRR) is equal to 11.18 IRR for gas station and 7.643 IRR for combined cycle station.
5. A thesis entitled "feasibility assessment of determining the cost of educational services in Islamic Azad University" investigates this question that is it possible to use the cost accounting concept for determining the cost of disciplines in educational centers, especially in Islamic Azad University? In this regard, a reveuner is assigned to determine the cost of educational services based on absorption costing. Then, it is validated through comparing it with actual costs in the university.

6. An article entitled "computing the power generation cost in gas and combined cycle-stations of Mashhad's Shariati Power Plant" has addressed the comparison of power generation cost during the time interval 2003-2005. The cost of power generated in gas stations is much higher than that in combined cycle ones. The production cost for one megawatt of power in gas stations are 108687,51 and 78281,5 IRR in gas stations and 39275,70 and 43205,94 IRR in combined cycle stations [22].

Mehdi Ghafouri conducted a research in 2011 [54] entitled "determining the cost for certification process of property transfer, case study: Yazd's Tax Administration" with the following results:

The cost of certification process for property transfer has been 178892 IRR per certificate which has yielded a profit of 502944 IRR for each certificate (regarding the revenue receipts of this administration in 2011).

Researches carried out outside the country:

1. A research entitled " attributable cost and length of stay for patients with central venous catheter-associated bloodstream infection in Mexico City intensive care units: a prospective, matched analysis" was conducted by Martiner et al. in 2007 yielding the following results:

   The mean length of stay was 6.1 days, the mean cost of antibiotics was 598 USD, the mean hospital cost was 11,591 USD; the value of each ICU bed was 1,200 USD, the bed value for each patient affected by bloodstream infections was 7,260 USD, the remaining variable costs for each affected patient was 2,666 USD, total cost for each patient was 1,593,149 USD and the total cost for the under care patients was 955,648 USD.

2. A research entitled "A German national prevalence study on the cost of intensive care: an evaluation from 51 intensive care units" was conducted by Onnen Moerer et al. in 2007 [6] with the following results:

   The Intensive care unit (ICU) costs account for up to 20% of a hospital's costs. The mean total costs per day were €791 ± 305 with the highest cost in septic patients (€1,090 ± 422).

3. A research entitled " The attributable cost and length of hospital stay because of nosocomial pneumonia (NP) in intensive care units in 3 hospitals in Argentina: a prospective, matched analysis" was conducted by Rosenthal et al. in 2005 [2] with the following results:

   The average length of stay (LOS) was 8.95 days, the mean antibiotic cost was $996, the mean total cost was $2255, The fixed costs of NP were $ 1,510,750 and without NP, $823,750, resulting in $687,000 extra fixed costs; the mean fixed cost was $2238; the mean fixed cost was $2238.

4. A research entitled "Hospital Cost-categories of Pancreaticoduodenectomy" was conducted by B.Topal et al. in 2007 [9] in USA with the following results:

   The median hospital cost per patient was 10406 euros. The increase of total hospital costs was influenced by the hospitalization and medical staff costs. Largest cost-categories of pancreaticoduodenectomy (PD) are hospitalization, OR, medical staff, and pharmacy.

5. A research entitled " Improving Safety and Eliminating Redundant Tests: Cutting Costs in U.S. Hospitals" was carried out by Ashish K. Jha et al. in 2009 with the following results:

   Eliminating readily preventable adverse events would have resulted in direct savings of more than $16.6 billion (5.5 percent of total inpatient costs). Eliminating redundant tests could save an additional $8 billion (2.7 percent).

6. A research entitled "Measuring Efficiency: The Association of Risk-Adjusted Hospital Costs and Quality of Care" was conducted in 2009 by Ashis et al. with the following results:

   Certain hospital characteristics were associated with lower costs: being for-profit, having greater numbers of Medicare patients, having shorter average lengths of stay, and employing fewer nurses. There was no evidence of higher-quality care by low-cost hospitals. It is not possible to assume that better care management will necessarily lead to both lower costs and higher-quality care.

Scope of research:

Each research should have a certain scope resulting in better focus on the subject for the researcher in all stages.

The scope of research is as follows from the subject, time and spatial standpoints:

Subject of research:

This research addresses the cost analysis of services in ICU ward of hospital based on process costing using actual figures.
**Geographic scope:**
Since the subject of research is of applied type, it should be executed in a case study in order to use the results. In this regard, the statistical population of the research consists of all the financial and non-financial records and documents existing in hospital's financial department. Hence, the Yazd's Shohadeye Kargar hospital is the spatial scope of the current research.

**Time scope:**
The time scope of the research is from the early 2011 until the end of 2011 in which the required information was available.

**Research question:**
Regarding this fact that all the financial and non-financial records and documents of the statistical population are investigated in this research, so no hypothesis is set fourth; instead, the research question is presented as follows:

How much is the cost of services in ICU ward of Yazd's Shohadeye Kargar hospital in 2011 fiscal year?

**MATERIALS AND METHODS**

**Research type and method:**
The desk research and field research methods have been used for data collection, so that the existing resources such as libraries, articles and reputable web sites have been used for compiling the theoretical framework and research background. The information related to costs was derived from Shohadaye Kargar Hospital's records and documents and interviews with experts were employed for exact recognition of costs and cost centers and appropriate cost allocation.

This research is of applied type by its nature and is of descriptive-analytical type in terms of research execution. Regarding the different costing methods, the process costing based on actual figures (with matrix approach) is used for determining the cost of ICU services.

Hence, firstly all the costs are divided into two parts: direct and overhead costs:

a- Direct costs including: direct material costs and personnel costs.

b- Overhead costs including: administrative costs, costs related to building maintenance, equipment, vehicles, depreciation, water, power, etc.

The overhead costs are aggregated in several cost centers including support units, intermediate units and operating units and then are allocated to various services based on certain overhead allocation rates and finally the cost of services is calculated.

**The summary of research execution is as follows:**
- The study and assessment of organizational chart and structure of the hospital and becoming familiar with the activities of different wards
- Grouping all the hospital wards into three groups, i.e. the support, intermediate and operating units
- Evaluating the hospital's 2011 budget and analyzing and separating the costs
- Providing the cost-cost center matrix for cost allocation
- Calculating the direct labor cost
- Calculating the overhead through duplex (mathematical) method including the following stages:
  - Interviewing and consulting the experts and evaluating the activity and relations of different centers
  - Designing and providing the relationships matrix
  - Multiplexing the overhead costs of support units into intermediate and operating units
  - Multiplexing the intermediate units into operating units
  - Calculating the cost of ICU services
  - Calculating the cost of an overnight ICU stay

**Data collection method:**
In the literature and research background sections, the desk research method has been used utilizing different resources, books, theses, articles, web sites and so on. In 'cost center determination' and 'cost allocation' sections, the field studies and polls (through interview with experts and related personnel) have been used. In the 'data analysis' and 'cost calculation' sections, the records and documents existing in accounting department and the hospital's software system have been employed.

**Research execution stages:**
In the current research, the first researcher has addressed the study of subject background and theoretical basics providing the research plan. Then, the accounting system of Yaz’s Shohadaye Kargar Hospital was analyzed in order to calculate the cost of ICU services.

The hospital units have been grouped into three divisions: 1- support, 2-intermediate and 3- operating units. Each division includes the following subsets:

**Support units include:**
Chairmanship (including chairman's office, management office, quality improvement office, protection, health, education, secretariat, computer, public relations, duplication & printing)
Matron office, financial department (including accounting and income departments), personnel department, warehouse, daycare, admission, medical records, services and maintenance, kitchen and nutrition, landry, transportation, call center, calibration, Central Sterilization Department (CSR), waste disposal

**Intermediate units including:**
Laboratory, radiology, physiotherapy, pharmacy, surgery room and delivery room

**Operating units including:**
Clinic, SINA, emergency, surgery1, surgery2, surgery3, surgery4, internal medicine ward, children ward, heart, ICU, NICU and CCU.

To calculate the cost of services firstly all the hospital’s 2011 costs were derived from the hospital's budget department. In order to calculate the cost of services in this research, the costs were divided into two following divisions:

A- Direct labor cost
B- Overhead costs

**Calculating the direct labor cost:**
To calculate the direct labor cost firstly the salary costs of all personnel related to ICU ward were calculated and allocated regarding the existing financial records and documents and with a logical basis.

**Calculating the overhead cost:**
To calculate the overhead costs, considering this fact that all the costs falls down in this category except the direct materials and direct labor costs, firstly all the costs were categorized based on the actual data existing in hospital's records and documents and then the cost related to each cost center of the hospital in 2011 was calculated and then was allocated to different activities based on logical basics. Then, the costs of all units were calculated using the duplex multiplexing method and the Excel software and the overhead cost of the ICU ward was calculated regarding the services provided by each unit with a logical basis.

**The following stages were implemented to calculate the overhead cost through matrix tables:**

- **Cost-cost center matrix**
  Firstly, a table was designed with the cost centers as the columns and the cost headlines as the rows. Then, having analyzed all the costs, the direct and overhead costs were recognized, separated and allocated to cost centers based on a logical basis.

- **Cost center relationships matrix**
  After costs aggregation in cost pools, the relationships and services between the cost centers were recognized and marked in the related cells. It should be noted that the operating units are only the receiver of services from support and intermediate units and don't provide any service for other units.
  The cost center relationships matrix based on numbers
  After recognizing the relationships between the cost centers regarding the allocation basics, the necessary numbers and figures were inserted in related cells.
  The cost center relationships matrix based on percentages
  After recognizing the relationships between the cost centers regarding the allocation basics, the necessary numbers and figures were derived and converted into percentages to make the units uniform. Then, the percentages were inserted in the cost center relationships matrix so that the sum of each row was equal to 100.

**Multiplexing the costs of support units into intermediate and operating units:**
After collecting the required data, the Excel software and duplex multiplexing method was used in order to obtain more exact results with respect to other multiplexing methods because the costs of operating units and their importance and service delivery were considerable.
In this regard, firstly the overhead costs of the support units were allocated to intermediate and operating units using the below table.

*The table for multiplexing the costs of intermediate units into operating units:*

Having multiplexed the overhead costs of support units, the overhead costs of the intermediate units plus the overhead received from the support units were allocated to operating units according to the following table.

Finally, the direct costs of the ICU ward including the direct labor cost were added to overhead costs and the cost of services in this ward was calculated.

*Statistical population and sample:*

The statistical population is a set of real or hypothetical members to whom the research results are assigned. The statistical sample is a subset of the statistical population through which the data required by the research are obtained. Regarding this fact that the Yazd's Shohadaye Kargar Hospital has been used for cost multiplexing in the current research, so the total costs of the hospital was considered as the statistical population. Hence, no statistical sample was addressed in this research and no statistical test was necessary for evaluating the results.

**RESULTS AND DISCUSSION**

After collecting the required data, it's the time for data processing. In this stage, the data analysis is done using the costing system (based on the described method) and finally the research question is answered.

The salary costs which have been considered as direct costs are allocated with direct tracing, but the overhead costs are allocated using the duplex (mathematical) multiplexing method.

**Cost calculation:**

*Calculating the direct labor cost*

To calculate the direct labor cost, the total salary costs of the personnel related to ICU ward in 2011 were calculated and allocated to this ward using the existing financial records and documents.

<table>
<thead>
<tr>
<th>Direct labor cost</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Official personnel</td>
<td>2,482,470</td>
</tr>
<tr>
<td>Corporate personnel</td>
<td>477,782</td>
</tr>
<tr>
<td>Total (thousands of IRR)</td>
<td>2,960,252</td>
</tr>
</tbody>
</table>

*Calculating the overhead cost:*

Cost center-cost matrix table

To calculate the overhead cost of ICU ward, firstly all the wards and cost centers of the hospital were recognized and then after exact assessments and becoming acquainted with the activity of each ward, all the wards were categorized into three categories: support, intermediate and operating units.

Then, the cost-cost center table was designed in order to aggregate the costs in the cost pools with the cost centers as the table columns and the cost headlines as the table rows. Having analyzed all the costs, the costs related to each ward was separated and allocated to the related cost center with a logical basis.

*Personnel costs:*

To collect the data related to salary costs, firstly the nursing and administrative personnel of each ward were recognized through interview with the matron and nursing supervisor and the personnel department. Then, the personnel were grouped considering their position and their salaries and were aggregated in related cost center separating the official and corporate personnel.

*Depreciation costs:*

Regarding the inventory of each ward, firstly the depreciable properties of each ward were recognized and then the depreciation rate and method for each property was specified using the acts of Ministry of Economic Affairs and Finance. In the next stage, the asset value and the depreciation rate were calculated regarding the purchasing date and allocated to the related cost center. It should be noted that according to the Social Security Act, the depreciable doesn't apply to the properties valued below 500,000 IRR.

*Depreciation expense of building:*

The depreciation expense of total building was calculated and allocated to desired ward based on the built-up area.
Water cost:
According to consultation with the related experts, the water consumption of high-consuming units was estimated according to below table and the amount related to water consumption of other wards was allocated based on the percentage of consumption and the built-up area.

Power cost:
According to consultation with the related experts, the power consumption of high-consuming units (such as mechanical installations, radiology, SINA ward, landry) was estimated according to below table and the amount related to power consumption of other wards was allocated based on the percentage of consumption and the built-up area.

Telephone cost:
To calculate the telephone cost for each ward, firstly the direct and internal lines were recognized. Then the yearly amounts of bills for direct lines of each ward were allocated to the same ward.

With regard to internal lines, firstly the internal lines of each ward were listed and then the non-active and unrelated lines were eliminated.

Finally, the cost of internal lines was allocated to each ward considering the number of internal lines in desired ward.

Cost of thermal fuel (gas):
The fuel consumption was estimated as follows using the consulting with experts and was allocated to the desired ward.

The consuming materials delivered to wards were recognized based on the warehouse orders issued and were allocated.

Textile's consuming materials:
It was allocated to each ward regarding the number of beds in that ward.

Consuming detergent materials: were allocated based on built-up area.

Vehicle Depreciation:
The Depreciation costs were calculated through the 4-year direct line of Social Security System acts and were allocated to related department.

Vehicles fuels:
The cost of vehicle's fuel consumption and the chairmanship was specified and allocated to the related ward.

Maintenance and insurance premium of vehicles:
The total sum was allocated to the transportation unit.

Food and nutrition's:
The total sum was allocated to kitchen and nutrition unit.

The cost of spraying poison and garden and gardening:
It was allocated to each ward regarding the built-up area.

Building maintenance cost:
Firstly, all the documents related to maintenance costs were investigated and the definite costs were allocated to desired ward and the remaining costs were allocated based on the built-up area.

Maintenance and medical equipment cost:
Firstly, all the related documents were investigated and the definite costs were allocated to desired ward and the remaining costs were allocated based on the built-up area.

The cost of special days and promotions:
It was allocated according to the number of personnel in each ward.

Banking cost:
All the cost was allocated to the financial department.

Cost of law enforcement forces:
All the cost was allocated to service and maintenance department.

Transportation cost:
It was allocated according to the number of personnel in each ward.

The cost of luggage lower than 500,000 IRR:
Firstly, all the related documents were investigated and the definite costs were allocated to desired ward and the remaining costs were allocated based on the number of wards.

Luggage transport fare:
According to investigation on the documents it was found that the entire luggage is related to administrative department.

Waste transport fare:
All the cost was allocated to waste removal center.

Cost centers relationships matrix:
After cost aggregation in cost pools through interview with experts and responsible persons in different wards and exact assessment of their activities, the relationship between the cost centers and the way they service each other were specified and it was marked in related cell.

Cost center-ward matrix based on percentage

Having specified the relationships between the cost centers and regarding the cost allocation basics, the required numbers and figures were derived and converted into percentages in order to make them uniform and then they were inserted in the cells of cost center-ward matrix so that the sum of each row was equal to 100.

Multiplexing the overhead of support units:
In the next step, the multiplexing of overhead in support units was implemented in such a manner that regarding the relation matrix and the percentage of the services provided by each ward, the overhead of support units was multiplexed into intermediate and operating units using the Excel software and the duplex multiplexing (mathematical) method which is regarded as the most exact method of overhead multiplexing.

To calculate and multiplex the overhead through duplex multiplexing method, the following formula was employed:

\[ \text{Total cost of allocation after the multiplexing} = \text{initial costs of cost centers} + \sum_{i} x_{i} \sum_{n} y_{n} \]

Where,
- \( i \) = cost center
- \( n \) = total number of cost centers
- \( x \) = percentage of contribution
- \( y \) = costs of cost centers after the multiplexing

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In the name of God, calculator and accountant of heaven and earth, who that doesn't have any deposit for his demands, neither shares, nor corporate partnership, no partnership, his continuity isn't hypothetical, God who deliver free services and never count the related cost. It would like to thank Dr. Saeid Saeida Ardakani for his helpful guidance and bearing the burden of advising and his thoughtful and paternal comments in all stages of article writing.

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