ORIGINAL ARTICLE

Cost management: the implementation of the activity-based costing method in central sterilizing services*

GERENCIAMENTO DE CUSTOS: APLICAÇÃO DO MÉTODO DE CUSTEIO BASEADO EM ATIVIDADES EM CENTRO DE MATERIAL ESTERILIZADO

GERENCIAMIENTO DE COSTOS: APLICACIÓN DEL MÉTODO DE COSTEO BASADO EN ACTIVIDADES EN CENTRO DE MATERIAL ESTERILIZADO

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ABSTRACT

This exploratory case study was performed aiming at implementing the Activity-based Costing (ABC) method in a Sterile Processing Department (SPD) of a major teaching hospital. Data collection was performed throughout 2006. Documentary research techniques and non participant closed observation were used. The ABC implementation allowed for learning the activity-based costing of both the chemical and physical disinfection cycle/load: ($9.95) and ($12.63), respectively; as well as the cost for sterilization by steam under pressure (autoclave) ($31.37) and low temperature steam and gaseous formaldehyde sterilization (LTSF) ($255.28). The information provided by the ABC method has optimized the overall understanding of the cost driver process and provided the foundation for assessing performance and improvement in the SPD processes.

KEY WORDS

Costs and cost analysis.
Cost control.
Materials management, hospital.
Hospital costs.

RESUMO

Esta pesquisa exploratória descritiva, na modalidade de estudo de caso, teve por objetivo a aplicação do Custeio Baseado em Atividades (ABC) em Centro de Material e Esterilização (CME) de um hospital de ensino de capacidade extra. A coleta de dados ocorreu durante o ano de 2006, utilizando-se as técnicas de análise documental e observação direta não participante. A análise de processos possibilitou o conhecimento dos custos do ciclo/carga de desinfecção química ($9.95) e física ($12.63), e esterilização por vapor saturado sob pressão ($31.37) e por vapor de Baixa Temperatura e Formaldeído Gasoso ($255.28). As informações geradas pelo ABC resultaram na compreensão do processo gerador de custos e forneceram base para a mensuração de desempenho e melhorias de processos do CME.

DESCRITORES

Custos e análise de custo.
Controle de custos.
Administração de materiais no hospital.
Custos hospitalares.

RESUMEN

Esta investigación exploratoria descriptiva efectuada en la modalidad de estudio de caso, tuvo por objetivo la aplicación del Costeo Basado en Actividades (ABC) en un Centro de Material y Esterilización (CME) de un hospital de enseñanza de capacidad extra. La recolección de datos se efectuó durante el año 2006 utilizándose las técnicas de análisis documental y observación directa no participativa. El análisis de procesos posibilitó el conocimiento de los costos de ciclo/carga de desinfección química ($9,95) y física ($12,63), y de esterilización por vapor saturado bajo presión ($31,37) y por vapor de baja temperatura y formaldehido gaseoso ($255,28). Las informaciones generadas por el ABC favorecieron la comprensión del proceso generador de costos y brindaron una base para la medición de desempeño y mejorías de procesos del CME.

DESCRIPTORES

Costos y análisis de costo.
Control de costos.
Administración de materiales de hospital.
Costos de hospital

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INTRODUCTION

Hospital organizations have been facing difficulties and challenges in balancing limited resources and costs to provide their demand for services. Historically, hospitals have worked for decades under unconcerned managers regarding services costs management. Moreover, up to current days, attempts for measurements and control have not been well accepted. Various factors are related to this issue: 1 - the social and religious scope that has always, historically and culturally, been connected to those organizations; 2 - legal and political aspects as the right to access health, which obligates hospitals to provide the service to those who cannot pay for the service, a fact that normally does not occur in other types of companies; 3 - most hospital organizations have an administrative-financial management performed by doctors who are not technically prepared for such a complex task; 4 - a lack of competition in the sector does not motivate measuring services costs under a management point of view. These factors have demonstrated that cost systems are underused in those organizations.

Currently, the system adopted by paying sources both in the public and private network have been exercising pressure over services providers to search for ensuring the survival of the organization, since they are not willing to pay for the care process inefficiency. Market conditions are signaling the need for better efficiency standards in the use of resources, mainly due to the degree of care variance and complexity and the technological improvement. Therefore, costs management is of great relevance for health services providing organizations.

Most hospitals with costs management systems, use the absorption method. Traditional costs methods have caused distortions in indirect costs and accounting reports normally do not provide the managers' interpretations and actions for the control of deviations related to specific problems; also, their actions are rarely reflected in accounting reports, leading to frustration[1].

The Activities-based Costs Method (ABC) has been suggested as suitable for hospital organizations. ABC aims at *tracing* expenses in a company to analyze and monitor many *directly identifiable* resources consumption ways by more relevant activities and from those products and services[2]. There is no consensus among researchers on the origin of this method. There are reports on its usage since 1800's and the beginning of 1900's[3]. Discussions about its origin in the USA were reported, developed, formalized and disclosed around the 80's by the Harvard academy by professors Robert Kaplan and Robin Cooper from Harvard Business School[4]. In Brazil, the ABC has gained knowledge as from studies in the Accounting and Actuarial Studies Department of the Economics, Administration and Accounting College of the University of São Paulo[2], in 1989.

Information generated by ABC significantly contribute to hospital management in planning and managerial control, as they enable organizational behavioral changes by enhancing the attention focus on activities rather than volume[2]. Moreover, they help understanding the productive process through processes analysis, since they allow for the identification of important details not previously visible before[5]. They enable the manager to understand the consumption generating factors, as well as productions costs within each resource. Costs are divided by the activity since most costs that would be indirect to the service, are now direct regarding the activities, avoiding distortions in the division criterion. Reports with more accurate and reliable information and costs measurements are possible, comprising an important instrument for costs management and decision-making[6].

Other benefits originated from the method are: the possibility of serving as instrument to obtain competitive advantages generating more precise and easily understood information by health professionals; provide better evaluation of services costs and possibilities to implement improvements in the productive process and managerial decisions favoring negotiations with health insurances[7].

Information generated by ABC significantly contribute to hospital management in planning and managerial control, as they enable organizational behavioral changes by enhancing the attention focus for activities due to volumes.

However, the method presents a few limitations while implemented. Among them, the complex and detailed construction of the information system can be related; high implementation costs; great number of activities demanding much time for data collection; difficulties in establishing patterns; need for a constant follow-up on activities by costs controllers[8]. Moreover, the higher the ABC detail level, the higher will be the cost on maintaining the system, in addition to eventually damage the operational performance[9].

It is important to state that the implementation cost cannot be higher than the benefits originated from the adoption of this method. Detailed investigations must be performed to see if advantages overcome costs, since benefits are only visible on a long term basis[10].

The method has been applied in hospital units, however, its application in Central Sterilizing Services (CSS)[11] has not been found in the literature researched. The nurse, while managing hospital units, holds a relevant role in using supply, human and technological resources. Its daily decisions demand for the use of information involving the cost variable in higher or lower scale, reflecting over the performance of the service. One of the units that is directly connected to supplies administration is the Central Sterilizing Services. This unit, classified as technical support, is fully responsible for dental-medical-hospital equipments and supplies reception, preparation, sterilization, storage and distribution processes in the consumption units pro-

viding direct service[12]. The activities developed in those units are essential for the success of surgical procedures and therapeutic care, mainly regarding the risk of infections and customers' safety.

Consequently, the aim of this research is to identify disinfection and sterilization processing costs for medical-hospital equipments and supplies.

METHOD

This is a descriptive exploratory study case carried out in the CSS of a large scale teaching hospital located in Northeast São Paulo State. The unit was chosen due to the current trend of outsourcing those services, lack of knowledge about costs and efforts in the search for continuous improvement.

Data collection was carried out throughout the year of 2006, after the authorization of the Research and Ethics Committee (statement No. 001-003558/2006) and the institution under study.

In order to investigate hospital medical supplies processing, the conceptual model was adjusted[14] into five steps: 1 - Institutional and analysis unit diagnosis; 2 - processes mapping and activities identification; 3 - activities costs and resources drivers; 4 - cost objects and activities drivers costs; and 5 - processes analysis and improvement (activities-based costing management - ABC Management). This study presented steps 1 to 4.

RESULTS AND DISCUSSION

Practical Application of ABC Management in the Central Sterilizing Services

Step 1 - Institutional and analysis unit diagnosis

The study field was a teaching hospital located in the Northeastern region of the State of São Paulo with 773 beds. The service covers SUS (Unique Health System) patients, twenty-six health insurance plan operators and six insurance companies, achieving an average of 3,500 monthly hospital admittances and 2,300 surgeries per month. The staff team is composed of 4,100 workers. Within these workers, 1,114 nursing assistants, 182 nurses, 52 technicians and 2 nursing attendants.

The analysis unit - CSS, has an average monthly production of supplies admitted to sterilization by pressurized steam autoclave in approximately 56,182 supply units. Within these supplies, instruments contribute for 13,241, *clothing* for 4,463 and manufactured material for 38,478. The supplies subjected to the chemical or physical disinfection process sum a total of 5,505. Thermo-sensitive supplies subjected to Low temperature Steam Formaldehyde (LTSF), comprise around 18,700 supplies articles per month. They are all forwarded to an outsourced company.

The nursing staff has 52 employees; 3 nurses (1 supervisor and 2 nurses), 48 nursing assistants and 1 nursing attendant. In addition to an intern who performs secretarial tasks.

Step 2 - Processes mapping and activities identification

Process is a compound of activities related and interdependent by the production of hospital services[15] and an activity is represented by a compound of tasks and operations[5], which describes what the company does, in other words , resources conversion (supplies, labor and technology) into products / services[16]. To draw the processing of hospital-medical processing, it is important to create a flowchart to facilitate the view and determine which factor generates the inputs and outputs of each activity.

Flowchart in Figure 1 enables the view of a work performed in the CSS and the consequent understanding of those activities, acknowledgement of their sequence and inter-relation among them generating a view of the process flow.

Relevant activities that compose the productive process were identified as from the main processes. Hence, those with a higher impact on the quality of the service of processing supplies were chosen, totalizing 7 sub- processes, 22 activities and 93 tasks. This study identified and validated the activities performed by the CSS nursing team, generating 6 working areas, 25 sub- processes, 110 activities and 25 specific nursing activities[17].

Chart 1 describes CSS sub-processes, main activities and also inputs and outputs.

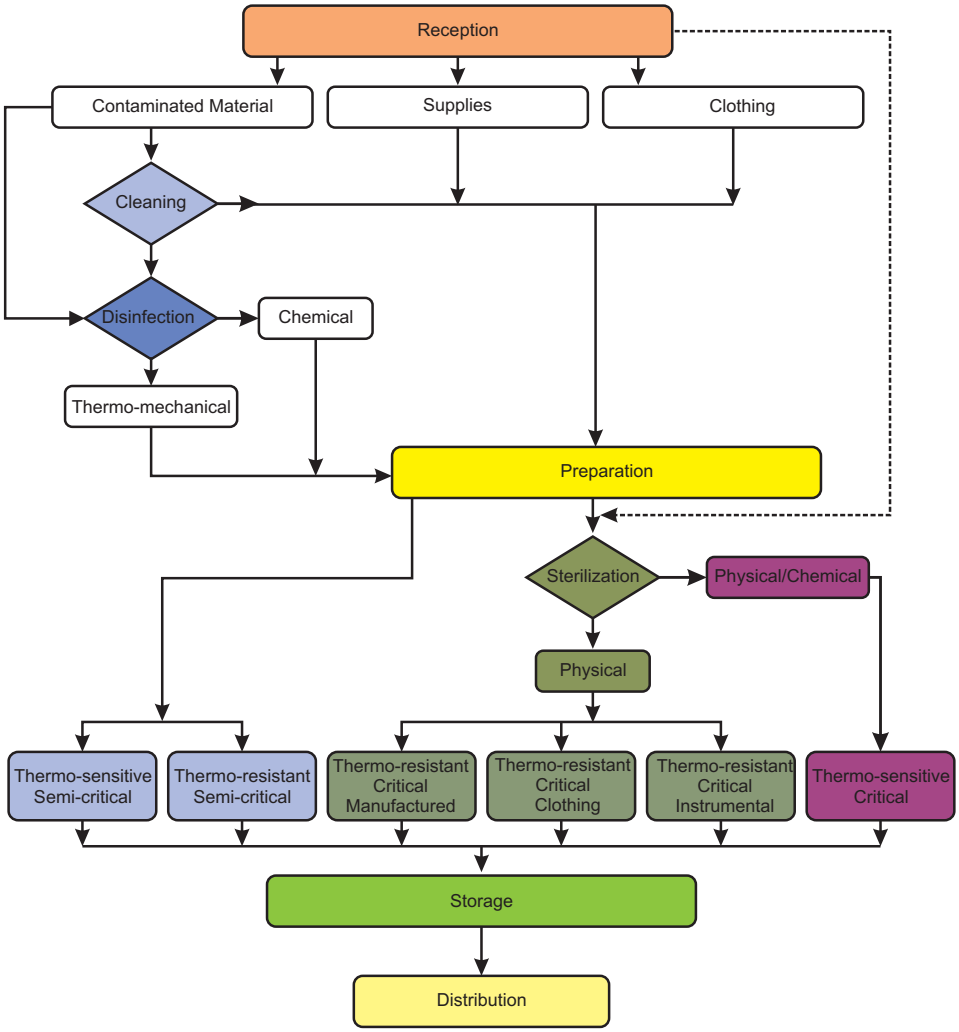

Figure 1 - CSS hospital-medical supplies processing flowchart - São José do Rio Preto - 2007

Chart 1 - Sub-processes mapping - São José do Rio Preto - 2007

Subprocess	Activities	Inputs	Outputs
Reception	A1 Receive supplies A2 Check and record	Supplies reception Manual parameter	Supplies exchange Recorded supply item
Cleaning	B1 Immerge into solution B2 Perform manual cleaning	Organic matter supply item Dirty item	Organic matter removal Clean item
Disinfection	C1 Perform thermo-mechanical disinfection C2 Perform chemical disinfection	Dirty item Clean item	Disinfected item Disinfected item
Preparation	D1 Dry D2 Control item quality D3 Check and assemble item D4 Control quality and sterilization D5 Pack D6 Label D7 Transportation	Web item Quality parameter Manual routine parameter Apply chemical indicator or integrator Select packaging Identify items Items in the laundry	Dry item Inspected item Checked item Chemical control applied Packed item Traceable item CSS items
Sterilization	E1 Control equipment quality E2 Assemble load E3 Control sterilization cycle E4 Unload E5 Control sterilized item quality	Apply biologic indicator test Adjust load parameters Activate and record cycle initiation End of sterilization Visual inspection	Applied biologic indicator Prepared items load End of recorded cycle Sterilization cart removal Released sterilized items
Storage	F1 Control and perform forecast F2 Separate and store items	Count and check surgical/HU schedule Items input	Control spreadsheet Stored items
Distribution	G1 Develop requisitions G2 Deliver and record items	Receive requisitions Assembled items	Requested assembled items Requested items output

HU- Hospitalization Unit

Step 3 - Activities and resource drivers cost

This step aims at collecting, along with the departments, financial data on the costs involved in the activities execution. All documentation surveyed in the personnel, accounting, civil, electrical engineering, storeroom and other departments are now used to identify and measure resources consumed by the CSS. Afterwards, they were designated to the tasks, establishing a relation between resources and activities, using resources and costs drivers, the actual generating cause of activities costs, where their variation/frequency is the one generating the impact on costs (effect).

As from the resources surveyed, the activities were traced by resources drivers. Hence, each resource was analyzed along with each activity where those resources were consumed, in other words, most of the times, a non-financial indicator was used.

Table 1 - Resources and values drivers matrix identified in the CSS in the year of 2006 - São José do Rio Preto - 2007

Resources	Drivers	US$	%
Labor - force	Time consumed	494,188.47	59.61
Water	Volume em m³	10,503.12	1.27
Electrical Energy	Kw/h	34,197.04	4.13
QC Supplies	% consumption	17,542.95	2.12
IPE Supplies	Number of employees	1,208.81	0.15
Office supplies and consumption	Number of employees	25,917.38	3.13
Installations Maintenance	m²	3,510.41	0.42
Correctional Maintenance	% of consumption	12,934.23	1.56
Preventive Maintenance	Time consumed	2,737.58	0.33
Building Depreciation	m²	16,839.49	2.03
Equipments Depreciation	% of usage	8,497.31	1.02
Telephone	Number of extensions	78.63	0.01
Hygiene and Janitorial Services	m²	8,168.59	0.99
Insurance	m²	26,976.18	3.25
Packaging Supplies	Consumption - direct	22,161.62	2.67
Outsourced Services	Consumption - direct	138,086.83	16.66
Laundry	Consumption - direct	5,469.17	0.66
Total		**829,017.79**	**100.00**

Note: IPE - Individual Protection Equipment; QC - Quality Control

Table 1 demonstrates the resources identified and their respective values in dollars in December of 2006. In Brazil, 50 to 70% of hospital costs are represented by personnel costs[18], a study in Albert Einstein Hospital demonstrates approximately 70% of their total expenses[19]. The unit studied here supports those findings, demonstrating 59.61%.

A study in the Dialysis Unit demonstrated that 6% of financial resources are used in equipments maintenance[20], in a Intensive Care Unit, equipments maintenance represented 0.03%[21] and this investigation demonstrated 1.89%, where 0.33% is preventive and 1.56%, correctional. Maintenance has been losing its corrective feature throughout its evolution and assumed a more preventive posture, aiming at improving the useful life of equipments, generating costs reduction, higher safety and performance[22]. However, the lack of qualified human resources has led those who perform those tasks to prioritize correctional activities, generating the abandonment of preventive programs[23], which is recommended to be performed monthly[24].

Lack of data in literature makes comparing findings to consumed supplies costs impossible in quality control (physical, chemical and biological tests) that represented 2.12%. Thermal autoclave qualification revalidation, which is recommended to be performed annually and of high cost, is still not performed in the CSS studied here[24].

When resources were traced to their activities, the total cost of activities can be calculated by adding all allocated resources to them (Table 2).

The percentage distribution of costs in all seven sub-processes demonstrated that the highest resources consumption occurred in preparation sub-processes (43%), janitorial (14%) and sterilization (13%). If the annual certification of the mechanical and monitoring systems of the autoclave was performed in the CSS in this study, most certainly, costs distribution would impact sterilization differently, since it is a high cost procedure.

Step 4 - The cost of cost objects and activity drivers

After activitie costing, the objects that should be measured were determined. Hence, it is important to consider that the CSS manager information needs to be related to organizational objectives.

Costs objects or *costs objectives* in this institution are costing sterilization and disinfection by cycle/load and by the groups of products performed in this CSS. They were grouped considering the type of processing; physical-chemical disinfection and pressurized and LTSF steam sterilization. Hence, critical thermo-resistant Items (manufactured items, gowns and instrumental items) are subjected to the sterilization process; and critical thermo-sensitive to the disinfection process, semi-critical thermo-resistant and semi-critical thermo-sensitive items.

Table 2 - Resources matrix per activity (US$) - São José do Rio Preto - 2007

Activ.	Labor - force	Water	Electrical Energy	QC Supplies	IPE	O&G Supp.	Inst. Main.	Corr. Main.	Prev. Main	Building Deprec.	Equip. Deprec.	Telephone	HJS	Insurance	Total
A1	12,846.06	0.00	99.54	0.00	151.10	1,246.03	89.71	0.00	0.00	430.35	0.00	0.00	208.74	689.36	15,760.88
A2	25,327.70	0.00	99.54	0.00	151.10	1,246.03	89.71	0.00	0.00	430.35	0.00	0.00	208.74	689.36	28,242.52
B1	20,769.19	702.18	520.51	0.00	302.20	1,869.04	226.36	0.00	0.00	723.29	0.00	0.00	350.98	1,159.09	26,622.83
B2	51,702.69	3,721.19	3,556.79	0.00	302.20	1,869.04	226.36	0.00	0.00	723.29	0.00	0.00	350.98	1,159.09	63,611.63
C1	9,345.49	3,245.98	4,424.30	0.00	151.10	1,869.04	106.22	238.85	881.90	1,021.11	4,991.30	0.00	495.50	1,636.35	27,784.14
C2	5,957.06	2,601.98	173.50	0.00	151.10	1,869.04	106.22	0.00	0.00	723.29	0.00	0.00	350.98	1,159.09	13,092.27
D1	41,538.39	0.00	782.72	0.00	0.00	1,210.43	158.66	0.00	0.00	761.05	145.63	0.00	369.15	1,219.10	46,185.13
D2	25,756.59	0.00	782.72	0.00	0.00	1,210.43	158.66	0.00	0.00	761.05	0.00	0.00	369.15	1,219.10	30,257.70
D3	80,091.98	0.00	782.72	0.00	0.00	1,210.43	158.66	6,995.15	0.00	761.05	0.00	0.00	369.15	1,219.10	91,588.24
D4	10,403.86	0.00	782.72	14,385.22	0.00	1,210.43	158.66	0.00	0.00	761.05	0.00	0.00	369.15	1,219.10	29,290.18
D5	63,806.03	0.00	782.72	0.00	0.00	1,210.43	158.66	0.00	91.87	761.05	582.54	0.00	369.15	1,219.10	68,981.55
D6	12,494.65	0.00	782.72	0.00	0.00	1,210.43	158.66	0.00	0.00	761.05	0.00	0.00	369.15	1,219.10	16,995.76
D7	682.25	0.00	782.72	0.00	0.00	1,210.43	158.66	0.00	0.00	761.05	0.00	0.00	369.15	1,219.10	5,183.36
E1	5,366.44	0.00	143.09	3,157.73	0.00	498.41	111.51	5,700.22	1,763.81	133.73	0.00	0.00	64.87	214.22	17,154.05
E2	8,987.00	0.00	143.09	0.00	0.00	498.41	111.51	0.00	0.00	133.73	0.00	0.00	64.87	214.22	10,152.84
E3	8,086.87	231.78	18,506.54	0.00	0.00	498.41	111.51	0.00	0.00	2,139.74	2,212.04	0.00	1,037.90	3,427.58	36,252.37
E4	5,616.88	0.00	143.09	0.00	0.00	498.41	111.51	0.00	0.00	133.73	0.00	0.00	64.87	214.22	6,782.72
E5	13,703.75	0.00	143.09	0.00	0.00	498.41	111.51	0.00	0.00	133.73	0.00	0.00	64.87	214.22	14,869.59
F1	11,443.52	0.00	276.98	0.00	0.00	1,246.03	294.55	0.00	0.00	1,412.95	240.95	39.31	685.36	2,263.35	17,903.01
F2	31,737.31	0.00	276.98	0.00	0.00	1,246.03	294.55	0.00	0.00	1,412.95	240.95	0.00	685.36	2,263.35	38,157.48
G1	8,272.27	0.00	105.49	0.00	0.00	1,246.03	204.28	0.00	0.00	979.94	41.95	0.00	475.25	1,569.48	12,894.68
G2	40,252.51	0.00	105.49	0.00	0.00	1,246.03	204.28	0.00	0.00	979.94	41.95	39.31	475.25	1,569.48	44,914.23
Total	494,188.47	10,503.12	34,197.04	17,542.95	1,208.81	25,917.38	3,510.41	12,934.23	2,737.58	16,839.49	8,497.31	78.63	8,168.59	26,976.18	663,300.18

O&G Supp- Office and General Supplies

The sum of the total indirect and direct costs is equal to the total cost per object. Therefore, the cycle/load objects unit cost in the sterilization process (LSTF and PSS) is obtained, as well as the physical-chemical disinfection.

Table 3 - Unit cost per cost object per cycle/load (US$) - São José do Rio Preto - 2007

Costs	Physical Disinfection	Chemical Disinfection	LST Sterilization	PS Sterilization	Total
Total Indirect Cost	79,247.95	38,379.68	112,077.09	433,595.46	663,300.18
Total Direct	2,944.31	939.30	142,946.53	18,887.48	165,717.62
Total Cost	82,192.25	39,318.97	255,023.62	452,482.95	829,017.79
Amount of Cost Objects	6510	3952	999	14424	
Total Unit Cost	12.63	9.95	255.28	31.37	

The findings enable, in addition to costing objects per category/cycle, to identify the unit cost per products group; a task only performed in the outsourced market of dental-medical-hospital supplies (Table 4).

Table 4 - Unit cost per cost object per products group (US$) - São José do Rio Preto - 2007

Costs	Critical thermo-resistant Manufactur ed items	Critical thermo-resistant Clothing	Critical thermo-resistant Instruments	Critical thermo-sensitive	Semi-critical thermo-sensitive	Semi-critical thermo-resistant	Total
Total Indirect Cost	68,178.01	68,903.58	389,992.71	72,500.32	9,342.08	54,383.48	663,300.18
Total Direct Cost	17,033.46	17,214.74	97,435.01	18,113.34	2,334.01	13,587.06	165,717.62
Total Cost	85,211.48	86,118.32	487,427.73	90,613.65	11,676.08	67,970.54	829,017.79
Amount of Cost Objects	227113	80882	279465	212760	41123	128903	
Unit Cost	0.38	1.07	1.75	0.43	0.28	0.53	

The unit cost, the LSTF, demonstrated in the sterilization cycle, is the highest cost (US$ 255.28) compared to other types of sterilization/disinfection costs. However, the unit cost per product (US$ 0.43) presents compatible values compared to other values.

These findings are crucial for managerial decision making, since they help on choosing the type of sterilization/disinfection process that a product should go through. Hence, in face of those identified costs, the managing nurse in the CSS can intensify, reduce, alter or exclude the use of a sterilization/disinfection process. For costs reduction, the manager is recommended to not only pay attention to the unit cost of the cycle/load or product, but also to consumption demand, since this is a impacting factor in financial management in those institutions[15]. Although variable cost is a relevant factor, other non-financial aspects must be considered, as much as the clients' safety.

CONCLUSION

The findings in this study demonstrate that the application of Activities-Based Costing in a Center of Supplies and Sterilization is feasible for managing costs and also enables finding out the advantages generated from those information regarding the cause and effect relation within the activities performance process and resources consumption, identification of how activities influence costs. In addition, the method allows for following up processes performance as from financial and non-financial data, with a view to improve managerial practices. The complexity of this method was also demonstrated, since it depends on the exhausting search, construction and detailed analysis of data and information within the analysis unit, people and various services.

Activity costs and cost objects are believed to support decision-making in a safe way by the manager allowing for a redesign of processes in the search for better performance.

Therefore, investigations in hospitals of different sizes (small, medium and large) are suggested as a way to continue this present study and confirm or not these findings. Moreover, the methodology proposed here can be effectively implemented in order to be validated.

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