Original Article

Using activities-based costing in a sterile processing department as a management tool*

Utilização do custeio baseado em atividades em centro de material e esterilização como ferramenta gerencial

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ABSTRACT

The Center of Materials and Sterilization (CMS) is based on the cost related to the processes developed for its management and the activities-based costing (ABC) can be an adequate tool to help the manager in management decisions and practice. The aim of the study was to evaluate the application of ABC for an evidence-based management practice and its support for process of decision making. This is a case study, performed in a CMS of a teaching hospital, using documental analysis to apply the ABC. The individual cost to sterilize goods was R$ 6,05 (US$ 3,23) and to disinfect was R$ 3,03 (US$ 1,61). The ABC is applicable and highlights evidence supporting decision making in management practice, guaranteeing the analysis of the productivity process and the decisive and impacting interventions in the management of costs.

Descriptors: Costs and Cost Analysis; Cost Control; Health Services Administration; Materials Management, Hospital.

RESUMO

O Centro de Materiais e Esterilização (CME) baseia-se nos custos que incidem nos processos desenvolvidos para seu gerenciamento e o custeio baseado em atividades (ABC) pode ser uma ferramenta adequada para auxiliar o gestor nas decisões e prática gerencial. O objetivo do estudo foi avaliar a aplicação do custeio ABC para uma prática gerencial baseada em evidências e seu apoio ao processo de tomada de decisão. Estudo de caso, realizado em CME de hospital de ensino, usando análise documental para aplicação do custeio ABC. O custo individual da esterilização dos artigos foi de R$ 6,05 (US$ 3,23) e desinfecção foi de R$ 3,03 (US$ 1,61). O custeio ABC é aplicável e destaca evidências que balizam a tomada de decisão na prática gerencial, garantindo a análise do processo produtivo e intervenções decisivas e impactantes na gestão de custos.

Descritores: Custos e Análise de Custo; Controle de Custos; Administração de Serviços de Saúde; Administração de Materiais no Hospital.

INTRODUCTION

Management of costs propitiates adequate conditions for hospital institutions to analyze administrative and healthcare processes when looking for balance between services offering, availability of financial resources, meeting quality criteria and technological incorporation.

The growing demand for health services, promoted by the universalization principle of access proposed by the Brazilian Unified Healthcare System (SUS), associated with the adoption of new technological options led to an imbalance between the available and needed financial resources to meet this demand[1-2].

This equation, complex at first, indicates the importance of using adequate management tools for the administration of resources used in the attainment of their activities to hospital managers, leading to a growing demand by the manager professional[2].

For that reason, knowledge, development of skills and evidence-based decision making, from the practice and from the management process, are assertive competencies for this upgrading and are capable of promoting cycles of continuous improvements. Thus, management of costs lead to management efficacy and efficiency, being a fundamental tool to control costs and, as consequence, to obtain positive economic results in public and private institutions[3-4].

In this context, cost management at the Center of Materials and Sterilization (CMS) is highlighted. This unit is part of the hospital complex, inherent, indispensable and live in the assistencial process, defined as a technical support unit. Its goal is to provide medical-hospital goods adequately processed, propitiating safe conditions for health assistance of sick and healthy individuals[5-6].

Considering the importance of CMS for the quality of assistance, the reflection about the costs related to the developed processes becomes indispensable, as well as economic analysis, in order to guide the planning and decision making of the nurse manager.

Identification of costs related to the product and the activities of the productive process are the goals of a cost system, aimed to generate reliable reports, to subsidize decision in different units of a hospital[7]. Those conditions are contemplated in the activity-based costing (ABC), as it brings the manager this possibility, propitiating information and allowing restructuring activities identified to improve the process quality and efficiency, as well as optimization of financial resources.

The ABC have the English acronym standing for *"activity-based costing",* being widespread in Brazil at the 90's decade[8], constituting in the allocation of resources in many activities composing the productive process of a good or service, by the objects of cost. It identifies the resources used in the production activities of a certain product[7,9]. The interdisciplinary approach in the management of hospital costs reflects the need of health managers instrumentation when searching for capacity and effectiveness of health services[1-2,4,10-12].

Nurses have been using the ABC in their management practice in an incipient way, not adequately managing costs and making difficult the search for assistance efficiency. However, there are experiences proving its applicability for the hospital environment, configuring itself as a directive tool for decision making in costs management and also shows evidence of the accuracy of the ABC, thus, it is still not translated in a methodology for effective use in a work routine from health organizations and in the nursing work process[1,9,11,13].

Being the ABC adequate for the hospital environment, as a defined methodology in the literature and as an effective management tool, it has theoretical basis for its application as a support management tool to decision making in the management of costings in a CMS, contributing for an evidence-based management process.

Thus, this study intended to understand and undertake an evidence-based management, through activity-based costing to propitiate accurate information and guidance, adequate and precise for nursing

management. We aimed to evaluate the application of the activity-based costing system, in the center of material and sterilization of a public hospital, aiming an evidence-based practice and its consequent support for the decision making process.

METHODS

Applied research, descriptive and exploratory, having case study as technical procedure. The method's finality is to observe and describe aspects of a situation or reality as well as to provide valuable and rich detailed information, based in multiple and varied data sources, allowing a deep analysis of organizational and administrative processes, being a broad research strategy that converged to the aim of this investigation[14-15].

The research setting was the CMS of a teaching state public hospital, localized in the interior of São Paulo state – Brazil. It is exclusively designated for the assistance of SUS users, being a healthcare assistance reference for 68 cities in diverse clinical and surgical specialties. It has a medical residency program, internship training for medical students and internship site for undergraduate health professionals.

A protocol was for the case study, containing four steps: planning, data collection and analysis and conclusion. The data collection occurred between February and March of 2012. Documental analysis, non-participating observation and validated CMS Nursing activities[7] were used.

For costs calculations, values were expressed in Reals (R$) and the reference value was considered US$ 1,87/R$ 1,00 (Exchange rate in 12/31/2011). Sources for data collection were the CMS documents, as: reports of costs, reports from human resources, consumption of goods, and others. The observation technique was performed in an informal manner by the researcher, aimed to complete and/or confirm information obtained from other sources. Activities inherent to the CMS were listed from a validation study of those activities[7], comparing with those contained on the documental analysis.

For the case presentation, we considered data ordination, which was performed following an adapted model for the ABC application[7], as:

- Step 1: Institutional/unit of analysis diagnose;
- Step 2: Mapping of processes;
- Step 3: Identification of activities;
- Step 4: Measurement of resources and costing of activities;
- Step 5: Costing of goods.

During the conduction of this study, recommendations of the Brazilian legislation were followed and the project was approved by the Ethics in Research Committee of the Universidade Estadual Paulista – UNESP/Botucatu under the protocol registration CEP 3954-2011.

RESULTS

Application of the ABC

Step 1 – Institutional/unit of analysis diagnose

The study hospital assists tertiary complexity cases and the admittance capacity is 318 operational beds (clinical and surgical hospitalization for adults, pediatrics, burns, and intensive care), 14 surgical rooms, 30 rooms/clinics for ambulatory assistance.

The CMS of this institution was the case study unit of analysis. It is located at the inferior building floor, constituted by the areas of purge, prepare, disinfection, sterilization, storage and distribution, totalizing 326 m^2. It is part of the CMS technological park: ultrasonic washer, two disinfectant thermo-washers, four sterilizers, one bench sterilizer and one dryer for respiratory medical-hospital goods. Thus, it uses pressured saturated vapor as the unique sterilized method and the heat as disinfection

method for medical-hospital goods/items (thermic disinfection).

The unit is hierarchically subordinated to the Nursing Management of care units and has 43 employees divided as: five nurses, being one the unit supervisor; 36 Nursing technicians and two administrative officers.

In 2011, more than 496 thousand medical-hospital goods were processed. The data and information generated by the process were registered by the nursing team and administrative officers digitalized in electronic spreadsheets for posterior forwarding to the financial assistance of the institution, which aims to compile the information and apportionment of costs from the CMS to all intra-hospital clients.

Step 2 – Mapping of processes

Medical-hospital goods and supplies were processed as demonstrated in Figure 1 and the sequence of activities in each sub process can be verified.

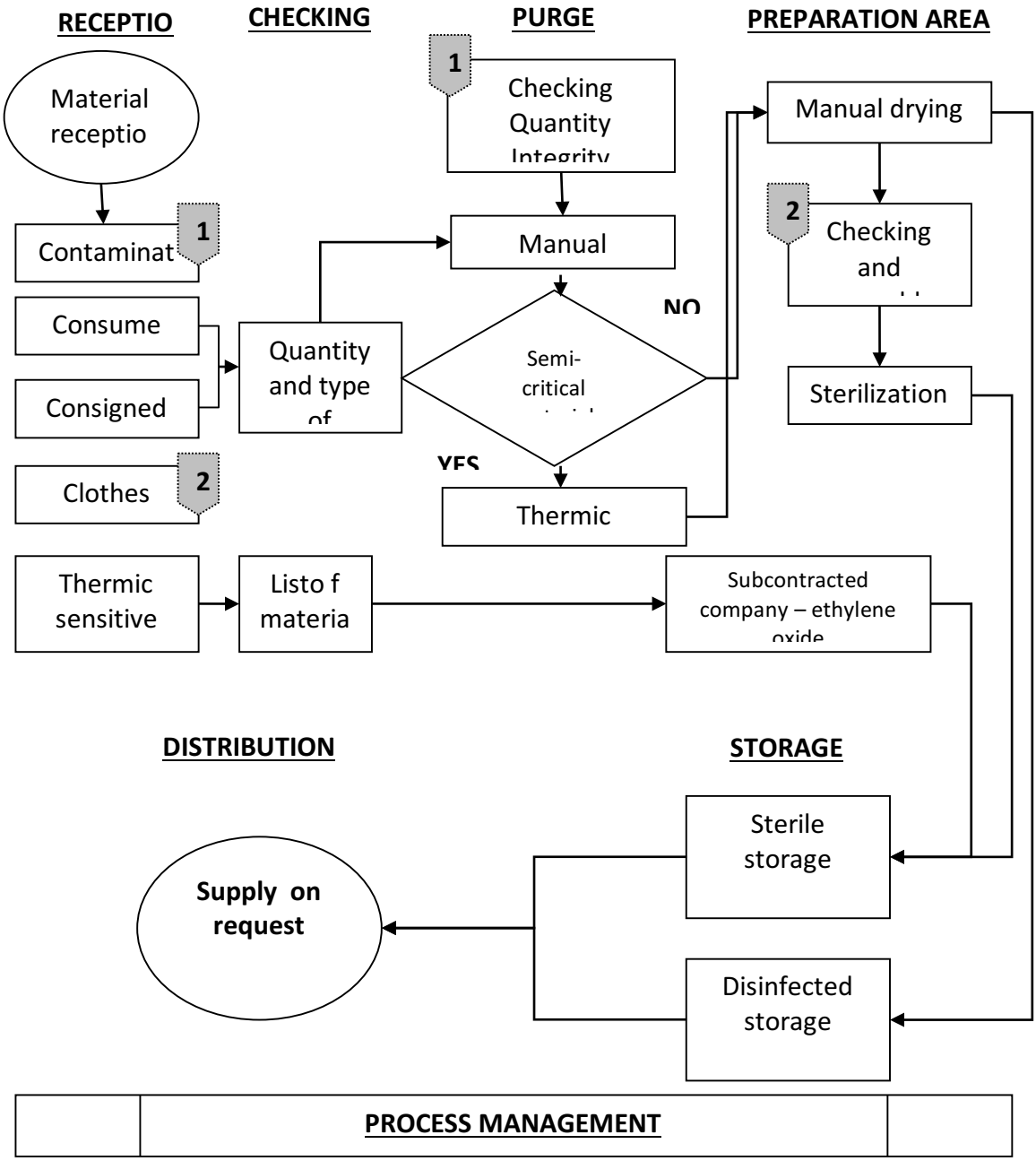

Figure 1: Fluxogram of the CSM process. Bauru, SP, Brazil, 2012.

Step 3 – Identification of activities

From the process design, the sub processes and main activities were identified (Chart 1).

Step 4 – Measurement of resources and costing of activities

The financial resources used to perform CMS activities were identified through monthly financial reports, available in the unit.

Data were organized and they compose Table 1.

The constant values in the report were allocated in the 10 categories from Table 1, described as necessary resources to the process' activities. For each identified resource, the total value was divided by one denominator (driver), for example, the spending with human resources was divided by the time (hours) spent by workers in each task performed.

Thus, all resources were distributed between all activities, following the drivers of each constant activity in the process, as it is shown on Table 2.

Step 5 – Costing of goods

The CMS have as costing objects: number of items submitted to the sterilization process and thermal disinfection and the number of items processed by type of material (light material/ box, avulse/ box, small size clothing/ large box, medium size clothing).

Criteria for material classification were the use specificity for each type of item and the time and temperature for sterilization and disinfection needed for its processing. Thus, the multipliers (weights) were adjusted for each costing object, as follows:

- Light material/avulse – weight 1;
- Box/small size clothing – weight 2;
- Box/ medium size clothing – weight 3;
- Large box – weight 4;

This type of costing objects classification was specific for the CMS being studied, allowing the unit manager to adopt different ways to classify costing objects, in accordance with its purpose and the profile of clients being assisted.

Drivers of activities

The production of costing objects is done by many consecutive activities developed in each sub process. Thus, there is a straight relationship between the different activities and the costing objects. The values of costing objects were calculated, adding the value of all activities applied in the processing of costing objects by the quantity of costing objects processed. For example, the costing object "Disinfection" is not contemplated as sub process *Sterilization*, thus in Table 3 we verify that these activities were not part of the "Disinfection" total value. On the other hand, we can note that all activities are inherent from the costing object "Sterilization".

When items submitted to sterilization process are separated by the different costing objects used by the unit, there are other unitary costing values, due to the difference in the processing time of those being justified by its dimensions and weight (Table 3). We highlight that the value of the costing object *box/ small size clothing* (R$ 6,34) and *box/ medium size clothing* ((R$ 6,18) are relatively similar. The costing object *large box* reached the cost of R$ 14,16, being the higher unitary value of all costing objects.

Table 4 highlights costing values of main activities in descending order and its percentages. The two first activities are highlighted (D3 and D1), and when added, reach more than half (53%) of all CMS costs, besides the activity H1 – process management. This last one reached 7,7% being the only one not directly inherent of the process, however it permeates all other activities in all sub processes.

Chart 1: List of sub processes and activities . Bauru, SP, Brazil, 2012.

Sub processes	Code	Activities
RECEPTION	A1	Reception of medical-hospital items
	A2	Collection of items
	A3	Checking and registration of items
	A4	Segregation of items
CLEANING	B1	Solution preparation and rack/basket assembly
	B2	Immersion of items in solution
	B3	Manual cleaning of items
	B4	Placing the rack/basket in the equipment
DISINFECTION	C1	Thermal disinfection
PREPARATION	D1	Drying items
	D2	Checking items
	D3	Assembly and labeling items
	D4	Receiving, checking and assembling clothes
	D5	Sending items to subcontractor
STERILIZATION	E1	Assembling the load
	E2	Monitoring sterilization cycles
	E3	Load removal
	E4	Checking sterilization effectiveness
STORAGE	F1	Packaging and storage of items and clothes
	F2	Validity control of items
	F3	Control of temperature and humidity
DISTRIBUTION	G1	Surgical kit assembly and distribution
	G2	Assembling boxes with medical-hospital goods
	G3	Distribution of items
MANAGEMENT	H1	Process management

Table 1: Matrix of identified resources, drivers and values in the CMS, in 2011. Bauru, SP, Brazil, 2012.

Resource	Driver	Value R$	%
Human	Time (hours)	1.178.175,72	44,54%
Consumption materials and packages	% of consumption	471.872,80	17,84%
Equipment maintenance	Service order	331.601,01	12,53%
Water	% of consumption	245.452,97	9,28%
Medical-dentistry CMS material	Direct consumption (item)	139.595,05	5,28%
Laundry	Direct consumption (item)	130.722,92	4,94%
Building maintenance	Service order	80.613,48	3,05%
Electricity	Meter sq.	29.394,44	1,11%
Hygiene and cleaning supplies	Meter sq.	34.654,07	1,31%
Telephone	Extension numbers	3.330,38	0,13%
TOTAL		**2.645.412,84**	**100%**

Source: Individualized financial report by costing center. HEB, 2012.

Table 2: Matrix of resources by activity. Bauru, SP, Brazil, 2012.

Activity	Human	Pac.Cons.Mat.	Eq.Maint.	Water	Laundry	CSM Mat.	Electricity	Hy.Cl.Supplies	Telephone	Build.Maint.	TOTAL
A1	7.001,28	4.718,73	15.423,30	-	-		99,18	116,93	832,60	2b72,01	12.208,13
A2	3.590,40	4.718,73		-	-		99,18	116,93	-	272,01	9.629,85
A3	13.647,12	4.718,73	2.570,55	-	-		99,18	116,93	-	272,01	18.853,97
A4	4.936,80	4.718,73		-	--		99,18	116,93	-	272,01	10.143,65
B1	2.513,28	4.718,73	15.423,30	2.454,53	-		99,18	116,93	-	272,01	25.597,96
B2	7.749,28	4.718,73	5.141,10	-	-		99,18	116,93	-	272,01	12.956,13
B3	28.442,64	4.718,73	51.411,01	4.909,06			99,18	116,93	-	272,01	41.129,10
B4	2.872,32	-	11.995,90	-	-		99,18	116,93	-	272,01	3.360,44
C1	14.600,96	-		41.727,00	-		108,20	127,57	-	296,74	72.283,77
D1	364.515,36	23.593,64		-	6.536,15		2.407,46	2.838,23	-	6.602,39	411.634,33
D2	27.376,80	23.593,64		-	13.072,29		2.407,46	2.838,23	-	6.602,39	128.134,42
D3	475.428,80	377.498,24	44.984,63	-	45.753,02	67.165,73	2.407,46	2.838,23	832,58	6.602,39	989.689,78
D4	34.264,56	47.187,28		-	58.825,31	67.165,73	2.407,46	2.838,23	-	6.602,39	219.290,97
D5	5.697,56	2.359,36	8.568,50	-	-		2.407,46	2.838,23	-	6.602,39	19.905,01
E1	5.535,20	4.718,73	5.141,10	-	-	2631,79	2.407,46	2.838,23	-	6.602,39	24.733,80
E2	14.897,52	-	5.141,10	196.362,38	-		2.407,46	2.838,23	-	6.602,39	268.092,61
E3	3.171,52	4.718,73		-	-		2.407,46	2.838,23	-	6.602,39	19.738,33
E4	4.158,88	4.718,73		-	6.536,15	2631,79	2.407,46	2.838,23	-	6.602,39	38.462,13
F1	12.985,28	4.718,73		-	-		736,36	871,67	-	2.019,46	26.472,60
F2	10.142,88	4.718,73		-	-		736,36	871,67	-	2.019,46	23.630,20
F3	89,76	4.718,73	165.800,51	-	-		736,36	871,67	-	2.019,46	8.435,98
G1	18.694,94	4.718,73	15.423,30	-	-		736,36	871,67	832,60	2.019,46	27.041,16
G2	1.795,20	4.718,73		-	-		736,36	871,67	-	2.019,46	10.141,42
G3	10.069,84	4.718,73	2.570,55	-	-		736,36	871,67	-	2.019,46	19.248,65
H1	11.425,26	14.580,87		-	-		2.407,46	2.838,23	832,60	6.602,39	204.487,31
Total	**1.178.175,72**	**564.312,70**	**331.601,01**	**245.452,97**	**130.722,92**	**139.595,05**	**29.394,44**	**34.654,07**	**3.330,38**	**80.613,48**	**2.645.412,84**

Table 3: Costing of cost objects by type of material: Disinfection and Sterilization. Light material/avulse and box/small, medium and large size clothing. Bauru-SP, 2012

Activity	Disinfection	Sterilization	Light/avulse (P1)	Box/ small size clothing (P2)	Box/medium size clothing (P3)	Box/ large size clothing (P4)
A1	4.347,22	5.508,10	2.927,22	1.072,74	1.241,20	266,94
A2	4.347,22	5.508,10	2.927,22	1.072,74	1.241,20	266,94
A3	8.694,44	11.016,20	5.854,44	2.145,48	2.482,40	533,88
A4	4.347,22	5.508,10	2.927,22	1.072,74	1.241,20	266,94
B1	25.614,61	2.5614,61	2.561,46	5.122,92	7.684,38	10.245,84
B2	13.293,49	13.293,49	1.329,35	2.658,70	3.988,05	5.317,40
B3	40.162,78	40.162,78	4.016,28	8.032,56	12.048,83	16.065,11
B4	3.478,08	3.478,08	347,81	695,62	1.043,42	1.391,23
C1	32.604,15	41.310,75				
D1		228.586,15	121.479,63	44.518,71	51.509,80	11.078,01
D2	56.513,86	71.605,30	38.053,86	13.945,62	16.135,60	3.470,22
D3	432.548,39	548.055,95	291.258,39	106.737,63	123.499,40	26.560,53
D4		121.178,20		23.600,28	27.306,40	5.872,68
D5		19.905,01				
E1		24.698,25	6.174,56	6.174,56	6.174,56	6.174,56
E2		268.058,34	67.014,59	67.014,59	67.014,59	67.014,59
E3		19.758,60	4.939,65	4.939,65	4.939,65	4.939,65
E4		38.419,50	9.604,88	9.604,88	9.604,88	9.604,88
F1		13.770,25	7.318,05	2.681,85	3.103,00	667,35
F2	23.630,10	23.630,10	5.907,53	5.907,53	5.907,53	5.907,53
F3		5.508,10	2.927,22	1.072,74	1.241,20	266,94
G1		27.060,00	6.765,00	6.765,00	6.765,00	6.765,00
G2	4.347,22	5.508,10	2.927,22	1.072,74	1.241,20	266,94
G3	8.694,44	11.016,20	5.854,44	2.145,48	2.482,40	533,88
H1	89.118,01	112.916,05	60.080,01	21.991,17	25.444,60	5.472,27
TOTAL	**658.276,00**	**1.665.661,20**	**653.124,01**	**340.095,91**	**383.340,89**	**188.949,30**
Costing object quantity	**217.361**	**275.405**	**146.361**	**53.637**	**62.060**	**13.347**
Mean unitary cost	**3,03**	**6,05**	**4,46**	**6,34**	**6,18**	**14,16**

Table 4: Cost of the main activities in descending order. Bauru, SP, Brazil, 2012.

Activity	Description	Value (R$)	Total (%)
D3	Assembling and labeling items	989.689,78	37,40%
D1	Drying items	411.634,33	15,60%
E2	Monitoring sterilization cycles	268.092,61	10,10%
D4	Receiving, checking and assembling clothes	219.290,97	8,30%
H1	Process management	204.487,31	7,70%
D2	Checking items	128.134,42	4,80%
C1	Thermal disinfection	72.283,77	2,70%
B3	Manual cleaning of items	41.129,10	1,60%
E4	Checking sterilization effectiveness	38.462,13	1,50%
	All other activities	272208,42	10,30%
Total		**2.645.412,84**	**100%**

DISCUSSION

The chart of the hospital being studied presents well defined hierarchical positions, making the decision making in the supervision level difficult, thus demonstrating a strong influence of the Administration General Theory, where assumptions of classic and scientific administration are very present.

The management focused in prescriptive and normative approaches rationally conducts the work, however, it keeps workers commands in a relationship of subordination and obedience to the norms and existing prescriptions[16].

A Brazilian study found that management practices performed by nurses are concentrated on the technical management dimension, with emphasis in coordination, supervision and control activities, noting that the assumptions of classic administration theories still guide nursing management[17]. The overcoming of this model requires more collective and participative strategies, thus involving workers on the comprehension and importance of costs in their jobs.

Precise data regarding cost of CMS activities facilitate the identification of critical knots in its process and positively influence management decisions, based in consistent information, as the ones available in Table 4[12,18].

Intermediate financial information, regarding production, direct costs and supplies should be available for the application of ABC[9]. This way, the descending order of resources was possible, and we found the Human Resources as the highest impact (44,5%), following Consumption Material and Packages (17,8%) and Equipment Maintenance (12,5%). Regarding Human Resources, literature registers 60%[5] of costs in institutions, a percentage not found in the present study. However, the impact of human resources costing in organizations is noted.

The unitary cost for sterilization of items is almost double (199,7%) when compared to the unitary cost of disinfection of items (Table 3). Although it is economically more viable, not all items can go through the disinfection process.

The nurse manager can consider a higher use of the thermal disinfection process due to the economic feasibility shown in the study, however, without leaving behind technical and scientific restrictions inherent to the process of goods.

The cost of pressured saturated vapor sterilization was R$ 6,05 for each unit of sterilized medical-hospital item, a relatively lower value than the one found in another study[9], conducted in a hospital in the interior region of São Paulo State.

Table 4 presents evidence that the *Prepare* sub process accumulates more than half of the value (53%) of all CMS process, with only two activities. In this step there is a large consumption of packaging material, however, this sub process is determined by many hours of work of CMS employees.

Thus, this sum propitiate a large impact in the processing cost of medical-hospital items, and it can be reduced through a computerized system generating more agility when registering and identifying processed items, allowing tracking of materials by sterilization cycles and releasing identification labels in the boxes and other benefits[19].

The evaluation of the *Preparing* area regarding the ergonomic adjustment of securities associated to computerizing registries can reduce time spent in related activities and in their costs [17].

A safe and effective sterilization process is essential in the CMS[8]. A guarantee of process safety as well as its effectiveness was found in activity H1 – *Process management,* corresponding to 7,7% of activity costs and activity E2 – *Monitoring sterilization cycles* indicating the performance of this control and consuming a little bit more than 10% of activity costs (Table 4). The management of all material processing falls into the nurse' responsibility and aims to guarantee an efficient and high quality assistance[6,20].

This way, it should be highlighted that sterilization process is safer, as it has sterilizer validation and thermal, chemical and biological efficacy indicators[5]. This configuration propitiate safety to the process, however, it increase the unitary cost of items. Meanwhile, we have to consider that in function of the final cost, it is justified.

The percentages found for both activities cited above shows a conscious effort to guarantee quality in the processing of CMS materials. This finding ratifies the information demonstrated in the institutional diagnosis, indicating the unit alignment to the institution strategy in the management of processes.

CONCLUSIONS

The ABC is applicable for CMS and allows emergence of evidence to guide decision making in the management practice context, guaranteeing production process analysis through costing of activities, and determining decisive interventions and with impact in cost management.

The ABC in the CMS needs a minimal computerized cost system to make its application viable and to be a first approach of the nurse manager to costs reports. Furthermore, many data and information from different departments were aggregated to compose the ABC, which can be a hampering factor for its application in hospitals.

The CMS management practice should be based on the ABC as source of evidence in the decision making process for investments in physical structure, human and technological resources and reengineering processes.

The ABC could still contribute with financial reports of hospital units in the elaboration of control strategies and rational use of goods through identification of stock costs of items in these units; to serve as argument for investments in information technology, in the acquisition of more modern and ergonomic equipment that can significantly contribute to reduction of costs in activities at the preparation unit, optimizing identification registry, reducing drying time of items and optimizing the quantity of hours spent by works in processing those goods.

The evaluation of aggregated value of activities could allow other analyzes and evidence, however there were no conditions to implement them, indicating gaps for future studies.

In conclusion, the ABC propitiated to glimpse the possible investment proposed in a temporal manner (short, medium and long term), the identification of critical points in the work process with note to the reengineering proposed and presented here. We verify the ABC as an efficient tool for an evidence-based management practice in a CMS.

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