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Original Article

The cost of waste of consumable materials in a surgical center¹

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Objectives: to identify the types, quantities and cost of the consumable materials sent, used, returned unopened and wasted in surgical operations; to classify the incidences of waste as avoidable or unavoidable losses, and to calculate the rate of waste of the consumable materials in the peri-operative period in the Surgical Center of a São Paulo university hospital. **Method:** a descriptive-exploratory case study with a quantitative approach. The convenience sample corresponded to 105 types of consumable materials sent for the 275 operations observed between February and May 2011. **Results:** the items wasted most were surgical sutures, surgical cotton sutures, and gauze compresses. The total cost of the waste was R\$ 709.84. The mean percentage of waste in the sample was 9.34%, of which 1.23% was avoidable and 8.14% unavoidable. **Conclusion:** the study evidenced that the effective management of material resources reduces the costs of the processes, and reduces waste.

Descriptors: Materials Resources in Health; Surgery Department, Hospital; Cost and Analysis of Cost; Nursing.

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Introduction

Due to the increase in demand, the high care costs and limited resources, health organizations need to be efficient, increasing their productivity and minimizing expenditure. In order to achieve these goals they need to study their assistential and managerial processes in depth, so as to align resources and actions and, also, eliminate waste.

Waste is directly linked to carrying out actions which do not benefit or add value to either products or services, but which create un-necessary costs and expenditures, without effectively meeting the client's needs⁽¹⁾. Nevertheless, identifying waste is an activity which requires thorough and exhaustive analysis by all those involved in the processes, as what is valuable to one may be waste to another.

In the health sector, the complicated web of actions necessary for attending the clientele, the enormous quantity of information created and the complex logistical support make it difficult to survey the different processes – and, consequently, to identify and measure waste⁽²⁾. However, in these organizations, the following are sources of waste considered routine: patients waiting to be attended, innumerable revisions or repetitions of work resulting from lack of training of personnel or badly-designed processes, un-necessary movement and transport, superfluous exams and procedures, and excessive materials and medications; at the same time as there are shortages and incidences of inappropriate use, badly-calibrated equipment, and stressed and/or idle staff⁽²⁻³⁾. Nevertheless, irrespective of the type of waste, the client should not pay for the organizations' inefficiency, their badly-elaborated processes, or their inefficient managers⁽⁴⁾.

In this regard, merely identifying waste and encouraging its reduction cannot change behavior in the organizations; both of these require constant investment in education and training, as well as knowledge of managerial tools so as to restructure the administrative, operational and clinical processes in the health sector⁽³⁾.

Studies on waste carried out in two teaching hospitals indicate that, in the opinions of medical and nursing professionals in the institutions studied, the biggest source of waste is related to the category of material resources, with 32.1% and 36%, respectively, generating an annual waste cost estimated at approximately R\$ 479,262.86, in the most recent study⁽⁵⁻⁶⁾. It is emphasized that these studies did not measure the waste; their value is in the professionals'

indication regarding the sources which they considered important in their workplaces.

The studies and the concerns regarding the material resources have given rise to constant reflections and discussions, as these represent the health organizations' second-highest cost, consuming between 15% and 45% of the hospital budget⁽⁷⁻⁸⁾.

It is considered that this cost is associated with the complexity of the activities, as well as with the different procedures and diverse types of attendance, which increasingly incorporate technology into the assistance, with greater variety and consumption of material resources⁽⁹⁻¹⁰⁾.

In this setting, principally in the public institutions, one can observe shortages, absence and/or poor quality of the consumable materials leading to stress in the multi-professional team, discontinuity in the assistance given, and possible harm to the patients. This reality evidences the absence of efficient and coherent planning in the processes of purchasing and controlling, and use of information on the management of materials.

In this context, even so, the health professionals and administrators are little informed, aware, or sensitized regarding the capacity that materials management has, and the contributions it can make, concerning reducing the costs of the assistance provided to the patients⁽¹⁰⁾.

However, so as to reduce waste and improve efficiency in the consumption of material resources, it is essential for these to be appropriately planned, controlled and used⁽¹¹⁾, with the objective of ensuring that inadequate quantities or quality in the same should not cause the assistance to be interrupted⁽¹²⁾.

In this perspective, the University Hospital of the University of São Paulo (HU-USP), from 2008 onwards, in the Surgical Center, started managing material resources using the Computerised Materials Management System (CMMS), constructed according to the principles of the *Just in Time* management tool, which proposes minimum stocks, with continuous replacement of the materials based on their use, more frequent distribution in smaller quantities, on time and at lower cost. CMMS's post-implementation evaluation showed there to be greater control of the stocks of materials and, consequently, of their costs, indicating that the computerized system is efficient in the reduction of the medical materials used in the Surgical Center, and that it provides greater control over the materials provided to the operating rooms, which are returned unopened after the surgical procedures⁽¹⁰⁾. However, in

relation to the material used in the operating room, in the peri-operative period, it was not possible to learn whether waste was occurring or not. There was empirical evidence that important waste of materials was taking place in this period, principally through the offering/availability of many materials in the form of surgical kits.

Thus, the present study aimed to survey the quantity of consumable materials used, returned unopened and wasted; to classify the waste as either avoidable or unavoidable; to measure the costs of the materials wasted and to calculate the rate of waste generation of the consumable materials used in the peri-operative period in the HU-USP's Surgical Center.

Methods

This is an exploratory-descriptive case study with quantitative analysis. The study was undertaken in the HU-USP's Surgical Center, following its approval by the HU-USP's Chamber of Teaching and Research, under decision nº 1052/10.

The HU-USP is a general hospital organization, a teaching hospital, and carries out a mean of 390 operations per month in the general, urological, child, thorax, plastic, vascular, orthopedic, otolaryngology (Ear, Nose and Throat - ENT), ophthalmology, endoscopy, maxillofacial and gynecology specialties.

The sample was by convenience, with the four-month period between February and May 2011 being established for data collection. The operations were chosen at random, in accordance with scheduling and occurrence in the Surgical Center. As a result, the sample was made up of 105 types of consumable materials sent in standardized sets for the 275 operations observed.

Endoscopic procedures - as these do not have surgical sets - were excluded from the study, as were emergency operations on persons who died. The operating rooms' consumable materials, such as procedure gloves, were not analyzed in the study; neither were the materials and drugs used by the anaesthetic team.

Data was collected by means of participant observation through monitoring the surgical procedures - the opening of the consumable materials, the monitoring of the peri-operative period, counts, discarding and classification (avoidable and unavoidable) of the materials opened and not used, and the sending of the unopened materials to the stockrooms, as well as the filling out of the form.

The first part of the form was prepared to survey the actual consumption of the materials according to: the operation observed: data; codes, names and quantity of material sent, used and returned unopened; and the cost of each material, both per unit and total. The second part aimed to ascertain the wasted consumable materials: the identification of the material and its respective code, the quantity wasted (in units) and classification as avoidable or unavoidable; and the total and per unit cost of these materials.

Avoidable waste was considered to have taken place when material that should not have been opened was opened, that is, those presenting a total loss of the amount contained in the packaging, due to being requested ahead of time and/or inadvertently by the health professionals in the operating room. Unavoidable waste included those materials in the case of which it was not necessary to use all the items, because of how many items were included within the packaging (in accordance with the production of the industry); they wasted only a few items from their packaging.

Following the filling-out of the forms and with the identification of the patient/service user by the CMMS, the following were printed out: the materials used in the operations, the surgical sets and the single-packed materials, along with their respective codes and the quantities used and returned unopened.

For the treatment and analysis of the results, a database was prepared to record the data using an Excel 2010 spreadsheet. The SPSS (Statistical Package for the Social Sciences) software was used for presenting and treating the data.

For the qualitative variables, the absolute frequencies (n) and the relative frequencies (%) were presented. The Pearson coefficient was used to ascertain the linear correlations between the items. It is known that the closer the correlation is to 1 or -1, the stronger it is. The existence of a linear correlation between the variables can indicate that the greater one value, the greater shall be the other, or alternatively, the greater one value, the lower the other (negative correlation)⁽¹³⁾.

The currency used for calculating costs was that of Brazil, the Real.

Results

In the period of data collection, 1,555 operations were undertaken, of which 275 (17.7%) were observed, which presented 105 items of material sent, used, returned unopened and wasted.

The total of the operations observed was: February 45 (16.4%), March 47 (17.1%), April 14 (41.5%) and May 69 (25.1%).

The percentages of the operations observed in this period were: Gynecology 28 (29.5%), ENT 27 (24.3%), Ophthalmology 8 (18.2%), Maxillofacial 19

(18.1%), General Surgery 152 (16.3%) and Orthopedics 41 (15.4%).

In accordance with the data in Table 1, it is ascertained that the quantity of items sent was 37,298 units, a mean of 135.63 units/operation. 21,301 items of materials were used, with a total waste of 2,479 items in 210 operations.

Table 1 - Distribution of the total of items of consumable materials in the operations - São Paulo, state of São Paulo (SP), Brazil, 2011

	N	Mean	Standard-deviation	Minimum	Maximum	Total
Total quantity of items	275	135.63	71.51	14	458	37,298
Total of items used	275	77.46	46.25	10	286	21,301
Total of items returned unopened	274	49.4	43.58	2	315	13,518
Total waste	210	11.8	7.64	1	38	2,479
Avoidable items	210	1.56	4.6	0	33	327
Unavoidable items	210	10.2	7.1	0	38	2,152

One can see, also, that in 65 operations there was no waste. In the majority of the operations, the use of white 7.5 x 7.5 cm, 45 x 45 cm and/or 30 x 30 cm swabs was observed for cleaning the skin and applying the dressing, as well as by the anesthetists in the extubation process.

Table 2 presents the mean percentage of the items which were sent, returned unopened or wasted

(avoidable and unavoidable) in the operations observed. In the operations, on average, 58.25% of the items sent were used, and 34.49% were returned unopened.

In relation to the waste, there is a mean percentage of 9.34%, with 1.23% of items wasted avoidably, and 8.14% non-avoidably.

Table 2 - Mean percentage distribution of the total of the items used, returned unopened and wasted, avoidably and non-avoidably, by surgical speciality, São Paulo, SP, Brazil, 2011

	Specialities					Total	
	Maxillofacial	General	Gynecology	Ophthalmology	Orthopedics		ENT
% of items used	59.44	56.45	51.75	76.51	67.56	53.93	58.25
% of items returned unopened	38.37	34.58	43.24	20.73	27.39	37.54	34.49
% of waste	6.25	10.21	6.81	12.42	7.77	10.41	9.34
% of items avoidable	1.47	4	2.54	.	5.16	5.42	1.23
% of items unavoidable	6.03	8.98	6.1	12.42	5.59	9.33	8.14

The highest percentage of items used corresponds to the speciality of Ophthalmology (76.51%), with fewer returned unopened (20.73%). However, it presents the total waste rate of 12.42%. All were classified as unavoidable, as they used only part of the contents of the packaging.

In all the surgical specialities except Orthopedics, unavoidable waste has the highest percentage, when compared to avoidable waste.

The Pearson Coefficient was used to ascertain the possible correlations between the scales. The results of the correlation coefficients are presented in the data in Table 3. Correlations with values above 0.8 (degree of correlation above 80%) were considered strong, and Pearson values between 0.5 and 0.7 were considered moderate⁽¹³⁾.

Table 3 - Correlation coefficient between the total of the items used, returned unopened and wasted, avoidably and unavoidably, in the operations. São Paulo, SP, Brazil, 2011

	Total of items used	Total of items returned unopened	Total waste	Avoidable items	Unavoidable items
Total of items used	1				
Total of items returned unopened	0.23	1			
Total waste	0.17	0.13	1		
Avoidable items	-0.07	-0.09	0.64	1	
Unavoidable items	0.19	0.16	0.81	-0.24	1

A strong correlation can be observed between total waste and the wasting of unavoidable items; a moderate correlation can be observed between total waste and avoidable waste. There was no correlation between materials returned unopened and wasted materials.

Table 4 presents the results of the costs of the items which were sent and used, the total waste and the

costs from avoidable and unavoidable waste during the period studied, in the operations observed.

In the study, 275 (17.7%) operations were monitored, but when the costs of all the operations carried out in the period of one year are extrapolated the cost of the waste would be R\$ 12,031.20, of which R\$ 5,550.51 would be avoidable and R\$ 6,480.68 unavoidable.

Table 4 - Total cost of the items which were sent, used, returned unopened, and wasted, avoidably and unavoidably, in the operations observed. São Paulo, SP, Brazil, 2011

Total of items	Items used	Items returned unopened	Total waste	Total -avoidable	Total -unavoidable
R\$ 153,457.88	R\$ 133,730.30	R\$ 19,017.71	R\$ 709.84	R\$ 327.48	R\$ 382.36

Discussion

In a study undertaken in HU-USP in 2009, after CMMS had been in place for 4 months, it was observed that the percentage of items returned unopened was 51.9% in the majority of the kits (66.6%) analyzed, and the goal proposed was a 'returned unopened' rate of approximately 20%⁽¹⁰⁾. In the present study, in 2011, in the same hospital, the mean 'returned unopened' percentage was 34.49% in 50% of the kits analyzed, showing a reduction in revisions and repetitions of work of 17.5% in two years.

The 'returned unopened' is an activity considered re-work, and, therefore, waste. All the materials which are returned unopened/returned must go back to the place where they are stored, which uses the time of the staff in the area of the Surgical Center Supplies.

Returning sets unopened is intrinsic to the process of working with surgical kits, as, even if all the processes of the operations are defined and delineated, this is to do with the health services, so there are variations from individual to individual – surgeons, patient, pathology – which make it impossible to define the process of the

preparation of the kits 100%. This waste is inherent to the process of management of the consumable materials in the operations, although it can be minimized as much as possible.

The waste ratio expected in the Surgical Center, at the time of writing, is 20%, according to what was proposed in a work undertaken in the Surgical Center of a university hospital in the state of São Paulo. However, this data was obtained by surveying the opinions of the nursing team on types, causes and suggestions regarding possibly-existing waste⁽⁵⁾.

The rate of waste of consumable materials measured in the HU-USP hospital was 9.34%, which may be considered low. This is, however, a case study, and only represents the reality in this particular context (this context being that of a teaching institution, defined by assistance at the secondary level, where the majority of the operations are elective and emergency, of small or medium size. Nevertheless, through this rate, it may be considered that the measurement is the first stage leading to the control of, and eventually the improvement of, the processes in the organizations⁽¹⁴⁾.

Based on the HU-USP's rate, we can develop an important indicator – the waste of consumable materials – emphasizing that indicators based on rates are markers of non-conformity, needing periodic reviews and whose use depends on the context in which they are inserted⁽¹⁵⁾.

For the implantation of the indicator, one must monitor the records of all the information defined by the content of the indicator, with the validation of the results and the comparative analysis with internal and external standards⁽¹⁵⁾. This information, obtained at the right moment, can benefit the administration of the services and benefit decision-making with lower levels of uncertainty⁽¹⁴⁾.

The strong correlation between total waste and unavoidable waste evidences the relationship between total waste and the dimension of quantity contained in the packaging of the consumable materials (unavoidable), above all of the gauze (7.5x7.5cm; 30x30cm, 45x45cm) and cotton surgical suture. We have also evidenced that waste is not related to the quantity of material offered/made available for surgical procedures.

The report of the costs of the waste presented showed them to be low, when compared with the total cost of materials used in the institution, R\$ 2,266.615.25. These values, however, represent the unit studied, which uses a materials-management tool based on the *Just in Time* system, and this management is considered essential to the administration.

CMMS is currently being restructured and implemented in the other units of the HU-USP, which will allow the knowledge and measurement of the waste so as to allow comparison and analysis of the relevance of the institution's rates.

Conclusion

In addition to the calculation of the waste and its rate, this study allowed the creation of a benchmark for future research in the area of management of material resources; it emphasizes the importance of the knowledge of the management of hospital consumable materials and, also, of evidencing the importance of the thorough analysis of its processes and costs, and of defining the aggregated value for minimizing and/or eliminating waste.

In the situations of waste analyzed, the avoidable waste refers to the relationship between the health teams' behavior and the culture and management of the organizations, which are therefore modifiable. However, the other situation analyzed – that of unavoidable waste,

under the industries' responsibility, creates economic waste (for the person buying) and of raw materials, and furthermore, impacts on the environment through the generation of waste materials.

This study intends to reflect on the issue of waste and present a methodology for future studies and, in this way, make it possible to compare the same, for the establishment of rates and indicators in the area of health.

In this way, we hope that health institutions and professionals, through scientific evidence, may be sensitized to, and made aware of, the importance of the necessary resources for safe, quality care for the patients.

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