

# Knowledge as a basis for decision making: An integrative review of the health product processing cost analysis

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Accepted 20 Feb 2018. Published 17 March 2018

## 1 ABSTRACT

The Central Sterilization Service Department has changed over the last thirty years and the professionals who work in this department face the challenge of the pursuit of knowledge and technical ability to carry out their activities. Among these, there is the management, which also involves controlling costs. This is an integrative review performed from September to November 2016, using the MEDLINE, LILACS, and IBECs databases to search for papers. The structure of the research question was based on the PIO anagram (patient/population, intervention, and outcome). It aimed the analysis of the scientific evidence that address the health product processing costs. Five out of 122 papers were selected and they addressed specific processing steps or all the processing in a broader way. Four points are highlighted from the studies: the preparation stage, the processing time designed, the need for training the CSSD professional for generating competence, and the attention to compliance with current legislation. The knowledge of each process cost is a need for managerial decision making. The search for knowledge and enhancement of skills helps the balance between the costs and the patient safety.

## 2 INTRODUCTION

The increase in healthcare costs is a challenge to the hospital administration, both in the public area and in the private area. Therefore, the search for knowledge of concepts and techniques of cost accounting as a management tool is essential for nurses, including those operating in the Central Sterilization Service Department (CSSD). It is through knowledge that the nurse gets technical basis to control costs, to argue with the health team, and to request resources required for safe patient care. The knowledge also identifies opportunities to evaluate measures that increase the efficiency of work processes, rationalizing resources and monitoring the productivity of the department. Many studies address the relationship between service knowledge or education with strategies to improve processes and quality (1) (2).

The current Brazilian economic crisis, health public and private establishments struggle to maintain quality services without having financial losses. So, with the rising costs,

there is a greater need to seek more knowledge to the economic analyses, its application in practice, and the development of studies. In this triad, the goal is to achieve a balance among cost, financial resources, and optimization of results (3).

In Brazil, the CSSD was for approximately six decades a physical and managerial dependent unit of the surgical center and this reality is still found in many health services. There have been many changes in the CSSD and historically they are related to the advancement of surgical techniques and to the need for facilities dedicated exclusively to the PHP processing (4). Currently have obtained a prominent position with the constant need for research and the ongoing professional development. With the current independence and autonomy (5), the CSSD has turned into vital to other hospital units.

The CSSD should also use evidence-based protocols assuming key role in patient recovery and prevention of surgical site infection. Optical security applied to this unit includes the arrival of new technologies and modern equipment, with greater controls and process monitoring. Nowadays it receives investments in technology and personnel (6), being a sector where the "light and hard technologies" are present, therefore, should be considered a complex sector like surgical center, emergency, and intensive care units.

The surgical center regarded as one of the most complex environments of the health institution, is recognized as a prime department because among other issues, its operation brings impact to the entire hospital (6) institution. But the CSSD can also be considered as a complex department, because provided assistance by the hospital depend on the work of this. The paralyzation of some equipment and the delay in a procedure performed may impact the dynamics of hospital care or failure in the process.

Nurses have a constant concern about the technical issue and improving the quality processes. A close look at the need to implement technologies and the reasons involving costs in processing health products (PHP) are part of the routine of the nurses. They have a fundamental role in processing due to their academic and technical responsibility. With advances in technology and scientific evidence, the nurse had to take the development of skills with regard to reducing costs without compromising the assistance.

The concern to know how much it costs each step of the processing is closely linked to maintaining a balance between used and necessary. Thus, standards are set, in addition to enabling the losses analysis. The technologies involved in the PHP processing are many and they are key elements for care standardization, time optimization, and effectiveness at work. The next section highlights aspects related to the development of the study, its objective, and aspects related to the search for papers.

### 3 MATERIALS AND METHODS

An integrative review was held which brought together and synthesized knowledge existing in relation to the theme in question and allowed to incorporate the results of these studies in practice. This review has the guiding question: What is the cost involved in processing health products? The main objective is to analyze publications in the literature that address the PHP processing costs. Strengthening the knowledge is a concern that is highlighted throughout this review.

A search of studies on the PHP processing cost analysis in databases: Medical Literature Analysis and Retrieval System Online (MEDLINE), Latin Literature - American and Caribbean Health Sciences (LILACS), and Excerpta Medical Database (IBECs) was performed between September and November 2016. The PIO anagram, which guides to formulate a research question and conduct a search of appropriate keywords, was used and it is shown in Table 1.

The research used the "AND" and "OR" Boolean operators to the association of keywords. The inclusion criteria were applied: 1 - papers published during a decade (2007-2016); 2 - English, Portuguese, or Spanish; 3 - papers available in full; and 4 - papers that address the issue costs and the PHP processing. The exclusion criteria filtered the duplication of those papers that appeared more than once in the databases.

The work selection process consisted of two stages: the choice of title and the choice by reading the summaries. The studies were done by the full reading of the papers. To organize and to provide clarity in the publications found was used a framework with title, database, year of publication, authors, journals, keywords used, and methodology used in the study. In the next section, the results will be organized in table format and then discussed.

### 4 THEORY

The CSSD is a functional unit for the processing of health products (7). Indirect care is present in this broader form of unity in the care of all patients in the hospital. The PHP processing must comply with several steps, which must meet the scientific evidence, controls, and records, so that the expected outcome is reached, in other words, patient safety.

These processing steps are referred to as receiving, cleaning, preparation, sterilization, storage, and distribution. Some of these steps may vary depending on the type of PHP and method of disinfection and / or sterilization specified by the protocol established by the institution. This protocol must be based on scientific evidence and the PHP manufacturer's operating instructions. The arrival of new

technologies has enabled nurses to take the development of skills in relation to costs driven by evidence (8). Knowing how much each process and each stage costs is directly connected to the balance struck between what has been in use and what is required. This balance makes it possible to establish standards and to analyze the losses, because for some hospital administrators the CSSD is recognized as a unit that generates costs. So, management tools to know how much the process are needed.

The nursing business is the care with which professionals perform many daily tasks that they have under their responsibility. Should also be thinking about how much that their work worth for the company and as this value in price, issues that have often lived and that with the concepts of economy it is possible to answer (9).

Thus, the cost accounting brought to the stage of the industrial revolution the look of the production, in which the composition of the cost of this action involved several elements, which made the process more complex (10). With this, two important actions were presented: the aid in the control and the decision making.

The establishment of standards as related to the CSSD directs the development of standard operating procedures and the need for training to generate uniformity. The budget and other forms of forecasting enable control and help to understand the sectoral financial activities, the process of knowledge, and how much every action, every step taken. After all this momentum should be monitored and compared. This makes it possible to have a decision making based on knowledge of the cost of each process.

The costs are classified as direct, indirect, and intangible. Direct costs are divided into medical and non-medical and the first is specific and is directly related to the intervention or to a program. The non-physicians are related to the areas of support for certain action to take place. Indirect costs can be exemplified as the production losses or indirectly relate. The intangible costs are those that cannot be measured and which are exemplified as anxiety and suffering (11).

In addition to these, other classifications are also presented (12) like fixed and variable costs. Fixed costs will have their values being the same regardless if there is a variation in production. In contrast, variable costs have their values changed and this can happen due to the produced quantity or volume of the company's sales. This section presents the information obtained during the data collection and it presented in table format to create greater objectivity in identifying the papers.

### 5 RESULTS

In results are presented the number of reports identified, selected, eligibility, and included. In the Table 2 are showed the selected publications.

The research found in total 122 papers, that after applying the inclusion and exclusion criteria, resulted into five studies, one in English and four in Portuguese. Selected papers were found in LILACS database (04) and MEDLINE (01), one of which was found in the two databases, which was recorded once.

Some items observed during the stage of selection and

**Table 1. Anagram PIO with the application of the guiding question**

	Patient or Population	Health product
I	Intervention	Sterilization
O	Outcome	Cost analysis

application of the inclusion criteria, involved costs and sterilization subjects, but referring to the food area and the gynecology area, to the female sterility. In this way, they have not been accounted for in accordance with the inclusion criteria. At the end of this survey, it was observed that the year 2015 had the publication of two studies, followed by 2010 with two studies and 2006 with one study.

The Table 2 was structured to present a better organization, allowing greater clarity of the five selected publications. The publications were organized as follows: paper name, database, year of publication, authors, journal, and methodology of the study. The type of economic assessment that was used in studies can be partial economic assessment (which covers just simple cost) or total economic assessment (cost-minimization, cost-effective, cost-utility, or cost-benefit) (11).

**6 SELECTED PUBLICATIONS**

**7 DISCUSSION**

After reading the selected studies, it is realized the concern of the authors in presenting data involving the cost in various scenarios PHP processing. Some addressed specific steps and other processing more broadly, bringing conceptual contributions of hospital cost management, like the application of the ABC costing in the CSSD and the use of drivers. In this section, the obtained results will be discussed.

The drivers array of resources and values identified in the CSSD draws attention to the highlights of labor with 59.61% followed by third-party services with 16.66%. When the approach is applied to the processing steps, the PHP preparation had the highest percentage (43%) which can be attributed to demand of time at this stage, because the consumed time by the professional represented 59.61% of the final cost of the performed processes (13).

Data on the under pressure saturated steam process cycle/load total cost had a value 56% higher compared to formaldehyde. According to the unit cost, the authors (13) showed that the second method had higher cost than the first. But the number of sterilized items was 14 times higher for saturated steam, which helped to reduce the cost of a cycle/load. The authors reported that the thermal qualification stage, by representing high cost, could bring impact to sterilization step, if performed at the time of the study.

The involvement of nurses is increasing in the financial decisions and budget planning of health institutions, managing not only human resources, but the material and financial resources (14). A critical look at the evaluation of the PHP processing steps brings to analyze which of these should absorb a greater amount of professional and the amount of time that should be available for each. This analysis can reduce bottlenecks or impact on processing, properly sizing the required manpower.

The driver time in hours revealed that the professional

manpower represented the highest percentage for the identified resources, in other words, 44.54% from the total (15). When the approach of one of the specific processing steps, for example the evaluation focused on surgical tweezers or instrumentals, an important aid was perceived to understand and to compose the details of the general appearance of the processing costs.

The study involving the evaluation of instrumental cost in surgical boxes (16) reports that during the observation, it was identified that the average time spent by the nursing staff to wash, to dry, to inspect the functioning of the forceps, to identify, and to pack the box was 55 minutes to a box 55 with tweezers. Thus, the study shows that there was a need 1.02 minutes per instrument, equivalent to US\$ 0.04 / forceps. The cost was US\$ 0.09 after adding the cost of the nursing technician time at a cost of US\$ 0.13 of the saturated steam sterilization cycle (16).

At the end of the study, the authors have drawn attention to the management of material resources, as identified waste and unused instrumentals. The projection of the monthly waste held by the authors showed that a year could save the institution US\$ 5,903.74. With management, costs can be reduced, also considering the impact on the professional time that operates in the processing, as the best design of the boxes.

The current cost approach with training is a topic that deserves more space in the CSSD (17). A comparative table of the cost of training new professionals in 1998 and 2008, where there was an increase of 102.8% on costs (US\$ 20.426 and US\$ 41.414, respectively). The knowledge and skills to perform all the processing steps are highlighted as influencers in process safety and surgeon satisfaction (17).

The need for evaluation of costs is highlighted and it should always be followed by an analysis of the context. The concerns to effective quality control and stresses that a low cost should be analyzed with caution, so that it is not interpreted as a justification rampant reuse. They point out that the low cost can be cause for concern when observing the quality control. The authors showed that the cost of reprocessing the three hospitals/ case studies was US\$ 2.91, US\$ 2.05, and US\$ 1.03 in cases 1, 2, and 3, respectively. Bringing the issue mentioned above, the costs in the three cases examined by the authors should be highlighted when the quality control measures are adopted, in other words, US\$ 57.51, US\$ 185.04, and US\$ 112.76 (18).

The regulation of the use or reuse of technology has important role in the implementation of safe practices and prevention of adverse events (19), as there is great pressure by the practice of reuse of high cost and recommendation products, the manufacturer for they are used only once (20). In this way, it should be strengthened as a point of the attention to compliance with the resolutions of the Brazilian National Health Surveillance Agency (ANVISA).

The review presents studies that reinforced the need for discussions and deployments of cost management in the CSSD environment. The various steps of the components of

**Table 2.** Paper 1

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Use of activity based costing in the sterilization center as a management tool

**Database:** BVS (Lilacs)

**Year:** 2015

**Authors:** Wellington Rodrigo de Souza, Wilza Carla Spiri, Silvana Andréa Molina Lima, Andréa Bernardes, and Claudia Helena Bronzatto Luppi

**Journal:** Botucatu; sn; 2013. 92 p. tab, illus.

**Keywords used:** Costs and Cost analysis, Cost control, Health services administration, Materials management, and Hospital

**Type of economic assessment:** Partial analysis of the costs

**Goal:** To evaluate the application of the ABC costing for a management practice based on evidence and its support for the decision making process.

**Methodology:** case study in the CSSD of a teaching hospital, using document analysis for the application of the ABC costing.

**Results:** The study allowed the planning of resource costs showing the human resource with 44.5%, followed by consumer and packaging material with 17.8%, and equipment maintenance with 12.5%. Based on data provided by the authors in the study, a one-year projection for disinfection and sterilization processes was carried out. The average unit cost of the disinfection process was US\$ 0.94 with the average monthly cost of US\$ 17,044.69 for a total of 18,113 items processed in the month. The annual cost was US\$ 204,536.29. Since the sterilization process had 22,950 items submitted to an average unit cost of US\$ 1.88. The monthly projection indicated US\$ 231,198.48 and US\$ 517,453.49 annual, representing an estimated 63% of total costs.

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**Table 3.** Paper 2

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Instrumental in surgical cases: evaluation of cost

**Database:** BVS (Lilacs)

**Year:** 2015

**Authors:** Julierme Rodrigo de Almeida Paula, Rita de Cassia Rodrigues da Silva, Aparecida Cleuza Vedovato, and Ana Paula Boaventura

**Journal:** Rev. SOBECC

**Keywords used:** Surgical instruments, Costs and cost analysis, Surgical procedures, and operative

**Type of economic assessment:** Partial analysis of the costs

**Goal:** To assess the number of instruments of surgical cases that are not used during surgery in a hospital in the state of São Paulo.

**Methodology:** Data collection resulted from direct observation of the instruments used in surgery, recording the current number of instruments in the box, the number of instruments used in surgery, and the number of unused instruments.

**Results:** On average, about 52% of existing materials in surgical boxes are used, generating high costs for the institution. Calculating the waste was obtained an average of US\$ 2.48 per box used, reaching the amount of US\$ 491,978.26 per month.

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**Table 4.** Paper 3

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Cost management: application of costing method based on the sterilized material center activities

**Database:** BVS (Lilacs) and Medline

**Year:** 2010

**Authors:** Marli de Carvalho Jericó and Valeria de Castilho

**Periodical:** Journal of Nursing USP

**Keywords used:** Costs and cost analysis, Cost control, Materials Management in the hospital, and Hospital costs.

**Type of economic assessment:** Partial analysis of the costs

**Goal:** To identify the cost of processing disinfection and sterilization of medical papers.

**Methodology:** Descriptive exploratory study with a case study method. Held in an extra capacity teaching hospital, located in São Paulo No rthwest region. Data collection used the techniques of documentary analysis and direct non-participant observation.

**Results:** The costs found in a cycle/load of the chemical disinfection and the physical disinfection processes were US\$ 9.95 and US\$ 12.63, respectively. In the pressurized saturated steam sterilization processes, the cost was US\$ 31.37 and low temperature steam and formaldehyde of US\$ 255.28. The analysis of processing steps showed a higher percentage of the cost for preparation step with 43%, followed by cleaning and sterilization with 14% and 13%, respectively. Regarding the workforce, present at all times in the CSSD, the study showed representation of 59.61%. Another highlight is the annual revalidation of thermal qualification of autoclaves, because if this were done, the impact on the distribution of costs would be different from the one found due to its high cost.

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## *Knowledge as a basis for decision making: An integrative review of the health product processing*

**Table 5.** Paper 4

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The real costs of surgical instrument training in sterile processing revisited

**Database:** Medline

**Year:** 2010

**Author:** Nancy Chobin

**Periodical:** AORN Journal

**Keywords used:** Sterile processing and Surgical instrument training

**Type of economic assessment:** Partial analysis of the costs

**Goal:** To identify the real costs of training of professionals working in a material and sterilization center.

**Methodology:** In 1998, the author conducted a survey that addressed various aspects of the training of professionals working in the PHP processing, including training time for processing surgical instruments. A second survey was conducted ten years later.

**Results:** Most respondents of 2008 indicated that the training would take three to six months (60%) or six to 12 months (31%) and that most tutors (52%) spend two to three months working with new employees. A cost calculation processing to sterile technician appropriate level, including teacher's salary, was US\$ 41,414 in 2008. An increase of over 100% compared to the calculation performed in the study of 1998. These costs must be weighed due to the loss of revenue when to damage to instruments or have not been placed in surgical cases or have not been cleaned. Problems with patient safety could happen if an employee is not well trained

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**Table 6.** Paper 5

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Analysis of reprocessing cost of single use tongs used in video-assisted surgery.

**Database:** BVS

**Year:** 2010

**Authors:** Eliane Molina Psaltikidis, Kazuko Uchikawa Graziano, and Fabio Frezatti.

**Periodical:** Latin American Journal of Nursing

**Keywords used:** reuse equipment, costs and cost analysis, video-assisted surgery, and sterilization

**Type of economic assessment:** Partial analysis of the costs

**Goal:** To analyze the reprocessing costs of disposable forceps used in video-assisted surgery.

**Methodology:** The study method of multiple cases in three hospitals in the state of São Paulo, using the techniques of observation and document analysis.

**Results:** The reprocessing cost was US\$ 2.91 in the case n°1, US\$ 2.05 in the case n°2, and US\$ 1.03 in the case n°3. Low cost must be carefully analyzed; it is found that the control quality plays a role in the final cost. When the quality control measures are adopted, the costs will be US\$ 57.51, US\$ 185.04, and US\$ 112.76, respectively for the cases n°1, n°2, and n°3.

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the PHP processing offer a wealth of research and continuous improvement opportunity. To know the costs of each process becomes a need for managerial decision making. Health cost and result systematic evidences become key parts, enabling better decisions (21) (22). The nurse needs to master the details of all activities involving work processes, aiming at monitoring, improvement, elimination of unnecessary activities and losses, and adding value (23). Failures may occur by the lack of professional update and lack of standardization of shares (24) and the challenges are both in training and in the improvement of this professional (25).

These four aspects are highlighted in the studies:

- The PHP preparation, as a processing step in most representative costs;
- The time for the professional who works in the CSSD to develop processing activities;
- (i) The need for professional training of the CSSD for competence, it is an agent in maintaining the quality
- The attention to compliance with current legislation in Brazil.

The importance of the presence of the theme in local and international congresses should be remembered, bringing the stimulus for the study and mapping of the processes. The supply of technologies is constant, as well as the improvement of the service quality, bringing the need for balance

among direct costs, indirect costs, and the expected outcomes with a focus on patient safety.

## 8 CONCLUSIONS

This integrative review, in which the PIO strategy was used, presented studies that reinforce the need for discussion and implementation of cost management in the CSSD environment. The PHP processing and its various stages enable learning opportunities, training, and generating skills. Among these opportunities is the knowledge of the costs, much discussed topic today and that directs a safer decision.

Scientific evidence helps professionals and it is one of the fundamental bases of the day to day of the manager. Five studies that permeated the subject cost at different times of the CSSD were selected. The economic evaluation is enhanced as a valuable tool to support decision making (26) (27) (28) (29) and it brings to the CSSD nurse an empowering condition as it takes part in controlling the activities developed by the sector in the hospital.

The few studies on cost management area in the CSSD in the last ten years draw attention, which bring more and more to reflect the need for research on the topic. The insertion of this discussion has been common in opportunities, where the community of professionals working in the CSSD is gathered, providing that this movement grows every day.

In the selection universe, the Brazilian publications represent four studies. This aspect is important to the national publications, which are based on the Brazilian reality and they paint a support model and a relevant contribution to other services that want to conduct studies. The concern for the authors to present the cost and possible management tools for managing this is highlighted. Allied to this concern is the relevance of the CSSD to the hospital environment and the need for the issue of increasing understanding through the pursuit of knowledge. Issues relating to waste and to disuse of certain surgical instruments were highlighted. The role of the nurses involved in the management of work processes in the CSSD and surgical center with respect to cost control allows planning and revision components of surgical instrument boxes (16).

Four aspects are evidenced in the studies:

(i) preparing PHP with the highest percentage with 43%,  
 (ii) the time to perform professional actions is highlighted with 59.61% of the final cost of processing,

- the in-service training and the monitoring of this professional to generate skills to perform the various sectoral actions should be subject discussed and evaluated as a management tool,

- the attention to compliance with current legislation in Brazil.

Thus, studies involving the education service and continuous quality improvement coupled with the knowledge of the costs reveal the construction of the base for the managerial role of the CSSD nurse.

Decision making is more assertive when based on knowledge, scientific evidence, and analysis of the costs. Continuous quality improvement is a concern element of many health institutions and the support on the ongoing development of professionals, so that assistance can be provided with the safety.

## 9 ACKNOWLEDGEMENTS

The present study integrates the Laboratory of Economic Analysis and Health Technologies from the Federal University of the State of Rio de Janeiro. The authors would like to acknowledge the help from the Rio de Janeiro State Foundation for Research Support, the Brazilian Network for Evaluation of Health Technologies, and the Brazilian National Scientific and Technological Development Council.

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*Knowledge as a basis for decision making: An integrative review of the health product processing*

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