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RESEARCH ARTICLE
НАУЧНАЯ СТАТЬЯ

Costs of treating community-acquired bacterial bronchopneumonia in pediatric patients

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Abstract. Relevance. Health management has not escaped the pressure of the current epidemiological situation. In a complex scenario, characterized by the COVID-19 pandemic, the daily dynamics become more complex and greater agility is required for decision-making. Much of the success of those decisions is determined by access to timely information, especially in crisis conditions and limited resources. For this reason, health organizations are interested in knowing the costs of pathologies that frequently constitute causes of hospitalization. In this sense, community – acquired bacterial bronchopneumonia stands out, which is a disease that frequently causes hospitalization of pediatric patients. **Objective.** This article aims to carry out a partial retrospective financial evaluation in order to determine the costs associated with the treatment of community-acquired bacterial bronchopneumonia in pediatric patients. **Materials and methods.** The study was developed from the perspective of the health institution General Hospital Guillermo Luis Fernández Hernández – Baquero in the city of Moa. For this, the analysis – synthesis and comparative methods were used, as well as the methodology to calculate and analyze disease costs. **Results.** The research focused on the January-March quarters of the years 2017 and 2018 and provided valuable accounting information regarding the direct and indirect costs of the treatment of the pathology in question, which serves as a tool for the correct management of the hospital institution. **Conclusion.** The direct costs exceeded the indirect costs and the items that most affected the total cost were the salaries of the workers, food, and medicines used to treat the disease. The need to develop digital health was evidenced, with special emphasis on digital medical records to facilitate access to them and thus avoid the loss of information due to its deterioration. The study provides useful information to the management of the health institution, which serves as support for budget analysis and future projections.

Key words: Cuba, respiratory infection, community-acquired bacterial bronchopneumonia, partial financial evaluation, cost of treatment of diseases

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Затраты на лечение внебольничной бактериальной бронхопневмонии пациентов педиатрического возраста

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Аннотация. *Актуальность.* Управление здравоохранением находится под влиянием текущей эпидемиологической ситуации. В обстановке, характеризующейся пандемией COVID-19, ежедневная динамика роста заболеваемости требует принятия сложных решений. Значительная часть успеха этих решений определяется доступом к своевременной информации, особенно в условиях кризиса и ограниченных ресурсов. Поэтому, организации здравоохранения заинтересованы в том, чтобы узнать стоимость лечения патологий, которые часто являются причинами госпитализации. В этом смысле выделяется внебольничная бактериальная бронхопневмония, которая представляет собой заболевание, вызывающее госпитализацию пациента педиатрического возраста. *Цель.* Настоящая статья направлена на проведение ретроспективной частичной финансовой оценки с целью определения затрат, связанных с лечением внебольничной бактериальной бронхопневмонии у пациентов педиатрического возраста. *Материалы и методы.* Исследование было разработано на базе медицинского учреждения общей педагогической больницы Гильермо Луиса Фернандеса Эрнандеса – Бакеро города Моа. Для этого использовались методы анализа-синтеза и сравнения, а также методология расчета и анализа затрат на лечение заболеваний. *Результаты.* Исследование было проведено при анализе заболеваний в январе-марте 2017 и 2018 годов и предоставило ценную информацию о прямых и косвенных расходах на лечение рассматриваемой патологии, необходимую для правильного управления больничным учреждением. *Выводы.* Прямые затраты превышали косвенные, и наибольшее влияние на общую стоимость оказали заработная плата рабочих, продукты питания и лекарственные средства. Была подтверждена необходимость развития цифрового здравоохранения с особым упором на оцифрованные медицинские записи, чтобы облегчить доступ к ним и, таким образом, избежать потери информации. Исследование предоставляет полезную информацию для руководства медицинского учреждения для анализа бюджета и прогноза финансирования.

Ключевые слова: Куба, респираторная инфекция, внебольничная бактериальная бронхопневмония, частичная финансовая оценка, стоимость лечения заболеваний

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Introduction

Currently, the health sectors operate in a complex epidemiological scenario. The coronavirus disease COVID – 19, recently declared a pandemic by the WHO, affects in different ways depending on each organism. Among its most frequent symptoms are fever,

cough and fatigue [1], which are common to other diseases of the group of Acute Respiratory Infections (ARI). For this reason, all pneumonia must be treated as a potential case of COVID-19 and consequently managed as such. Precisely community-acquired bacterial pneumonia (CABP) is a frequent cause of

hospitalization in children. Bronchopneumonia is the most common clinical manifestation of pneumonia in pediatric population. It is a leading infective cause of mortality in children under 5 years of age [2]. In developing countries, such disease constitutes a major health problem. Despite the fact that Cuba has achieved health indicators comparable to those of developed countries, pneumonia continues to be among the 5 main causes of death in children between 1 and 15 years of age [3–5].

Since 2011 Cuba has outlined the guidelines of economic and social policy, which guide the work of various sectors in order to update the economic model of the island [6]. The health sector, as part of social policy, has also been oriented towards its improvement. In this sense, various transformations have been carried out [7], with the aim of raising the quality of care, the satisfaction of the population and the efficiency of the Cuban National Health System. In a scenario characterized by the provision of exclusively state and free health services, the efficiency of institutions is an

essential issue to achieve their sustainability. Studies on the cost of the disease provide information on the economic burden of a specific disease from a social, public, family or individual perspective [8]. Hence, Cuban health organizations have shown a marked interest in perfecting their management and in having information regarding the costs of practices and diseases that usually condition the hospitalization of patients. In this context, this research has been developed at the Guillermo Luis Fernández Hernández – Baquero General Teaching Hospital in the city of Moa. Its main objective is to provide information to management on the cost of treatment of pediatric inpatients diagnosed with out-of-hospital bacterial bronchopneumonia. The study was framed in the January-March quarters of the years 2017 and 2018 and for this purpose made the work team, data were collected from the review of medical records, interviews were conducted, in addition to the observation of processes and review of documents of the institution.

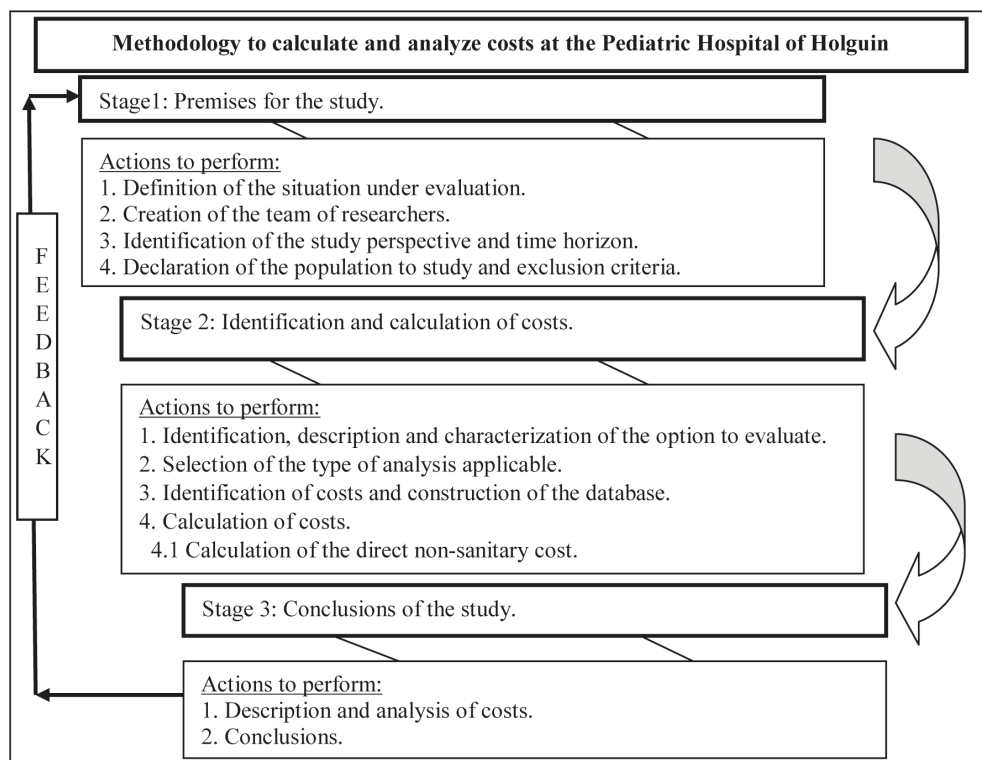


Fig.1. Methodology for calculating and analyzing disease costs



Рис. 1. Методика расчета и анализа стоимости заболевания

Materials and methods

According to the classification offered by M. Drummond [9], the study carried out corresponds to a partial financial evaluation. It is retrospective longitudinal and covers the first quarter of 2017 and the first quarter of 2018. The research was carried out from the perspective of the health institution: Guillermo Luis Fernández Hernández – Baquero General Teaching Hospital, and the treatment costs of hospitalized patients in the Respiratory Pediatric ward with a diagnosis of community – acquired bacterial bronchopneumonia were assessed.

The methodology used includes 3 stages as shown in Figure 1 and aims to quantify describe and analyze the costs of treating pathology [10]. For this, an Excel database was built with the information provided by the Hospital's Statistics Department and from the unstructured surveys applied to specialists at the center.

The population consisted of 150 pediatric patients, who were treated at the institution during the study period. The sample was determined as part of the Non-Probabilistic convenience sampling, obtaining as a result 42 patients between January and March 2017 and 44 patients in the same period of 2018 [11]. The exclusion criteria adopted were patients whose medical records were transferred to other health institutions.

Results and discussion

As a result of the application of the methodology, the costs associated with the treatment of pediatric patients with a diagnosis of out-of-hospital bacterial bronchopneumonia were obtained, those who were hospitalized in the Respiratory Pediatrics ward of the Guillermo Luis Fernández Hernández – Baquero General Teaching Hospital in the city of Moa in the first quarter of 2017 and 2018 (Table 1).

Table 1
Total cost of care for patients diagnosed with community-acquired bacterial bronchopneumonia hospitalized in the pediatric ward of Moa City Hospital

Таблица 1
Общая стоимость медицинской помощи пациентам с диагнозом внебольничная бактериальная бронхопневмония, госпитализированных в педиатрическое отделение городской больницы Моа

Costs (Затраты)	January-March 2017 (Январь-Март 2017 г.)		January-March 2018 (Январь-Март 2018 г.)	
	Costs (\$) (Затраты)	%	Costs (\$) (Затраты)	%
Salary of the room staff (Зарплата сотрудников комнат)	2574,14	52,76	4282,16	62,66
Materials (Материалы)	529,14	10,85	664,82	9,73
Medicines (Лекарства)	1164,57	23,87	1156,28	16,92
Diagnostic Tests (Диагностические тесты)	611,14	12,53	730,82	10,69
TOTAL DIRECT COSTS (ОБЩИЕ ПРЯМЫЕ ЗАТРАТЫ)	4878,99	100,00	6834,08	100,00
Indirect Costs (Непрямые затраты)				
Feeding (Питание)	1725,11	89,81	1735,44	89,51
Phone (Телефон)	22,34	1,16	23,55	1,22
Energy consumption (Энергопотребление)	1,23	0,06	1,27	0,07
Depreciation (Амортизация)	29,59	1,54	30,85	1,59
Water (Вода)	142,64	7,43	147,79	7,62
TOTAL INDIRECT COSTS (ОБЩИЕ НЕПРЯМЫЕ ЗАТРАТЫ)	1920,91	100,00	1938,92	100,00
TOTAL COSTS (ОБЩИЕ ЗАТРАТЫ)	6799,90		8773,00	

Note: \$ – Cuban Peso (\$) = 1 US dollar.
Примечание: \$ – это Кубинское песо (\$) = 1 доллар США.

When performing the average cost analyzes in the two periods studied, it was found that the treatment of a hospitalized patient in the Respiratory Pediatric ward with a diagnosis of community-acquired bacterial bronchopneumonia cost the institution approximately

180.16 pesos in 2017 and 199.39 pesos in 2018. Such behavior was motivated by total direct costs, which exceeded indirect costs in both years, where the salary item was the one that most determined this result (Table 2).

Table 2
Average cost of care for patients with a diagnosis of community-acquired bacterial bronchopneumonia admitted to the pediatric ward of the Moa City Hospital

Таблица 2
Средние затраты медицинской помощи пациентам с диагнозом внебольничная бактериальная бронхопневмония, поступившим в педиатрическое отделение городской больницы Моа

Costs (Затраты)	Average costs (\$) (Средние затраты)	
	January-March 2017	January-March 2018
Direct average costs (Средние прямые затраты)		
Salary of the room staff (Зарплата сотрудников)	61,29	97,32
Materials (Материалы)	12,60	15,11
Medicines (Лекарства)	27,73	26,28
Diagnostic Tests (Диагностические тесты)	14,55	16,61
TOTAL DIRECT AVERAGE COSTS (Общие прямые средние затраты)	116,17	155,32
Indirect Costs (Средние непрямые затраты)		
Feeding (Питание)	41,07	39,44
Phone (Телефон)	0,53	0,54
Energy consumption (Энергопотребление)	0,03	0,03
Depreciation (Амортизация)	0,70	0,70
Water (Вода)	3,40	3,36
TOTAL INDIRECT AVERAGE COSTS (Общие косвенные средние затраты)	45,74	44,07
TOTAL AVERAGE COSTS (Общие средние затраты)	180,16	199,39

Note: \$ – Cuban Peso = 1 US dollar.
Примечание: \$ – это Кубинское песо (\$) = 1 доллар США.

From the social point of view, the community-acquired bacterial bronchopneumonia caused a decrease in the well-being of households and the contribution to the region's economy, since family members who work as companions of the hospitalized child are unable to carry out their productive tasks (Table 3).

Table 3
Loss of production and income associated with community-acquired bacterial bronchopneumonia in pediatric patients hospitalized at the Moa City Hospital/

Таблица 3
Потеря производства и дохода, связанная с внебольничной бактериальной бронхопневмонией у педиатрических пациентов, госпитализированных в городскую больницу Моа

Period (Период)	Number of patients (Число больных)	Hospital stay (days) (Пребывание в больнице)	Intangible Cost (\$) (Нематериальные затраты)
January – March 2017 (Январь-Март 2017 г.)	42	167	5,086.82
January – March 2018 (Январь-Март 2018 г.)	44	172	5467.88
Total / Всего	86	339	10,554.70

Note: \$- Cuban Peso (\$) = 1 US dollar.

Примечание: \$ – это Кубинское песо (\$) = 1 доллар США.

The option evaluated in the research was drug treatment, as it was the alternative to follow during the development of the pathology under study. Patients treated at the Moa city health institution were referred by their respective health areas for presenting different symptoms. Sometimes they arrive by their own means to the Hospital guard body, always in the company of their relatives. Patients have previously presented symptoms such as: general malaise, chills, stiffness, fever, cough, dyspnea and chest pain, pain in the upper abdomen, also tachycardia, crackles, bronchial breath sounds, shortness of breath and digestive symptoms (nausea, vomiting, diarrhea) are also common. According to the patient's condition, it is decided whether or not to enter the Hospital Pediatric Respiratory room, where they are received by the nurse on duty. Subsequently, the different complementary studies of complete blood count with erythro, complete blood count, coagulogram, white blood cells, partial urine, creatinine, abdominal ultrasound, glycemia, TGP, uric acid are indicated. Based on the results of the complementary tests, treatment is started, where different types of drugs are used, such as: Diphenhydramine, Cefazolin, Multivitamins, Meclizine, Cefotaxime, Dipyrone, Ondansetron. Antibiotics such as Penicillin, Crystalline or Rapid are also indicated and in case of allergy to any of these medications, they are

changed to Rocephin, Azithromycin or others. They will also make use of oxygen with salbutamol and saline solution if they have shortness of breath, and inhalations with water vapor are indicated. It is valid to note that patients have a free diet according to age.

To identify the costs related to the treatment of the pathology in question, the Pediatric Intensivist doctors and the Head of Nurses of the Pediatric Respiratory ward were consulted. In addition, the criteria of the Cost, Energy, Human Resources Specialist, staff from the Department of Statistics, Economics and Archives, Dietitian and staff from the service area were taken into account. Based on the above, the medical records were reviewed in order to extract the pertinent data for the prior organization of the information. The number of medical records, age of the patient, place of origin, employment relationship of the parents, complementary analyzes performed, medications consumed, stay, date of admission and discharge were the most relevant questions that the review of medical records contributed. The database was then prepared in Excel, which facilitated the calculation of the direct and indirect costs of treating community-acquired bacterial bronchopneumonia.

According to J. Puig [12], direct costs include the time of health personnel, medicines, diagnostic tests, etc., hence which were declared as direct costs of treatment: the salary of the ward staff, the consumption of materials and medicines intended for treatment, as well as diagnostic tests.

- The salary of the staff of the Respiratory Pediatrics ward was obtained from the information by cost center (278 Respiratory Pediatrics) provided by the economic department. The calculation of this item was determined from the total monthly salary expense divided by the number of days in the month and then by the number of beds, this yielded the daily salary per patient, which when multiplied by the stay, the total was obtained by this concept. This indicator was the highest direct cost in both years, which was influenced by the number of workers in the ward and the time they dedicate to direct patient care. Nurses work 12-hour shifts while specialist doctors visit for three hours twice a day. Salaries by occupational category, additional payments for different concepts and the number of stays

were also taken into account. In the latter case, for the first quarter of 2017 it was 167 days and for the same period of 2018 it was 172 days.

- To determine the cost of the materials used in the treatment of patients with community-acquired bacterial bronchopneumonia, the amounts of syringes, depressants, gauze and cotton swabs, pairs of gloves, cannulas and mochas used in the care of each patient were taken into account. The quantities of these materials used were multiplied by their respective unit cost, information that was provided by the Accounting department of the health institution. Syringes were the material with the highest unit cost and, at the same time, the most used in both years, reaching a value of 193.11 in 2017 and \$196.12 in 2018. Gloves followed, with a unit cost of \$0, 21 and were also used intensively for a total value of \$157.27 in 2017 and \$159.62 in 2018. Cannulas and mochas ranked third within the materials in 2017 with an amount of \$137.36, Next are gauze and cotton swabs, which were the most used of all materials, but with the lowest unit cost of all, so their value reached the figure of \$34.49, depressants ranked last among materials due to their low cost and mainly their low use in patient care. In 2018, the cotton swabs reached a value of \$162.95 and for the other materials the cost ranged between \$144.78 and \$0.108. It is worth mentioning the consumption of cannulas and mochas (\$144.78).

- In the section on medications, all those that were registered in the medical indications of the medical records of the patients in the periods studied were listed. The cost of these was determined by multiplying the consumed quantities of each one of them by their respective unit costs, for a total of 29 drugs. In both years, drugs ranked second in importance in direct costs. In the quarter of 2017, the most significant was methylprednisolone (500 mg) with a unit cost of \$5.95, which was used intensively although in few patients. It is followed by Cefazolin with a unit cost of \$1.49 and was also indicated in 80 % of the patients. However, the Saline Solution with a higher unit cost (\$3.09) was consumed to a lesser extent and by a smaller number of patients in both years. The fourth place was occupied by Ondansetron, which was only used in three patients, but 33 bulbs were consumed with a unit cost of \$1.80. Other of the most

widely used drugs in the treatment of this pathology were Dipyrone (600 mg) and Crystalline Penicillin, they were widely indicated to various patients, but their unit costs were \$0.04 and \$0.06 respectively. Salbutamol was also used to treat the disease at a cost of \$3.04. The rest of the drugs used did not have a significant weight within the total cost value. Drug consumption had a similar behavior in 2018, highlighting Methylprednisolone, Cefazolin, Salbutamol, Ondansetron, Cefotaxime, Diphenhydramine (bulb) and Saline Solution in that order.

- The third place among direct costs was occupied by diagnostic tests, which in 2017 represented 12.53 % of total direct costs and in 2018, 10.69 %. To determine its cost, the amounts of analysis indicated to each patient and the accounting information regarding the cost of the resources used in the execution of said complementary analyzes were taken into account, say; the salary of the personnel involved in the activity, the cost generated by the consumption of electricity, as well as the depreciation of equipment and work premises, as well as reagents and others.

The most significant diagnostic test in both years turned out to be the complete blood count with Erythro with a value of \$199.92 in 2017 and \$207.06 in 2018, as it was one of the tests most indicated by doctors. It is followed by abdominal ultrasound, it is the most expensive diagnostic test and intensive use of it was also carried out, for a value of \$139.80 in 2017 and \$198.05 in 2018. The complete blood count is also highlighted, which in both years ranked third among diagnostic tests, with a unit cost of \$6.71. In 2017 it reached a total value of \$108.36 and in 2018 it increased to \$127.49. In 2017 the costs corresponding to the other diagnostic tests did not reflect very high values, they ranged between \$46.98 and \$8.50. In 2018 they had a similar behavior, the Leukograms presented a cost of \$53.46, which was given by the number of times it was indicated. Creatinine, Partial Urine, Coagulograms and TGP were the other diagnostic tests with the highest values, ranging between \$33.48 and \$24.16. Finally, the Erythro was the test with the lowest significance (\$7.20) due to its low unit cost.

On the other hand, indirect costs were identified taking into account those that were indirectly related to the treatment of the pathology [12]. The cost of food,

telephone, energy consumption, depreciation and water were included in this classification.

- The food costs were determined taking into account: the cost of a tray that the child consumes, as well as that of his companion in addition to the hospital stay. A standard food menu with rice, proteins, salad, meats and dessert was assessed, considering two trays a day for each one, a breakfast for the child and one for the companion, in addition to three snacks for the child and three for the companion.

In both years, the cost of food was the most significant among the total indirect costs, representing 89.8 % in 2017 and 89.5 % in 2018. This was influenced by the daily cost of food received by the child and his companion, which were \$4.4 and \$2.9 respectively. The cost of the patient's breakfast was \$0.78 and for the companion it was \$0.45 and finally, the 3 daily snacks for each one had the same cost, thus amounting to \$0.9.

- The cost generated by using the telephone in the room was determined taking into account the Information on Cost Centers (# 278). The calculation of this item was made from the monthly telephone expense between the 30 days of the month, then it was divided by the number of beds in the ward and finally it was multiplied by the stay of the patients analyzed. This made it possible to assign the approximate cost of the telephone service per patient. For 2017 this cost represented 1.16 % of the total indirect costs and in 2018 1.21 %, considered insignificant in both years.

- For the calculation of energy consumption, we proceeded in the same way as the telephone item. The Information from the Cost Center (# 278) was taken into account and determined from the total energy consumption of the room and the existence of means and equipment located in it, such as: 24 lamps, 8 fans, 1 TV, 1 refrigerator and 1 X-ray viewer. As a result, each patient was assigned the cost corresponding to energy consumption, so that for 2017 it represented 0.06 % of the total indirect costs and 0.07 % for 2018.

- To determine the cost of depreciation, the equipment that has not yet lost its useful life in the room was considered. For this, information provided by the accounting department of the hospital was used and the stay of the patients under study was taken into account. This item represented 1.54 % of the total indirect costs

in 2017 and 1.59 % in 2018, influencing the fans located in the room since the rest of the tangible fixed assets had already exhausted their useful life.

- Finally, the second most significant element within indirect costs corresponds to the water service represented by 7.43 % in 2017 and 7.62 % in 2018. This service is consumed continuously and is of vital importance for the operation of the hospital. In the same way, each patient was assigned the consumption of water in the room, depending on their stay.

Taking into account the sample studied, as well as the total costs, the average costs were determined, which offer the institution valuable information. It refers to the approximate amount paid by the institution to treat a patient admitted to the Respiratory Pediatric ward with a diagnosis of community-acquired bacterial bronchopneumonia. In general, the behavior of costs in both quarters of the 2 years was quite similar. Direct average costs prevail over indirect ones. It is necessary to point out that the variation between the number of patients in both periods is not significant, as is the patient days, so the difference between the average costs of each year is not noticeable either.

Regarding the calculation of the direct non-healthcare cost, it must be added that the average monthly salary corresponding to the Holguín province, where the city of Moa is located, was used. According to the National Office of Statistics and Information of Cuba, the average monthly salary in 2017 was \$731.00 and in 2018 it was \$763.00 [13]. After this, the income that the companion of the hospitalized patient who has been absent from her workplace was calculated. Such a result provokes, on the one hand; the decrease in the economic welfare of that household and, on the other, loss of production from the social perspective. The calculation yielded a value of \$5,086.82 for the first quarter of 2017 and \$5,467.88 for the same period of 2018.

It is necessary to clarify that the following assumptions and limitations were declared in the study:

The value of the clothing and lingerie is null according to information on the sheet by cost center, so it was not considered in the study. In addition, the tools and supplies were not taken into account because the sheet provided by cost center counts it as zero for the entire period analyzed.

Conclusion

The study carried out allowed determining the cost of treating community-acquired bacterial bronchopneumonia in pediatric patients who were admitted to the Moa city hospital during the first quarter of 2017 and 2018. In both years the direct costs exceeded the indirect costs and the items that most affected the total cost were the salaries of the workers, food, and medicines used to treat the disease. In addition, the need to develop digital health was evidenced, with special emphasis on digital medical records to facilitate access to them and thus avoid the loss of information due to its deterioration. In general, the study provides useful information to the management of the health institution, which serves as support for budget analysis and future projections.

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