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Inpatient and outpatient parenteral antimicrobial therapy: a cost analysis of care transition

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Abstract

Objective: To analyse the cost reduction of antimicrobial therapy in the short and long term, during the transition from hospital treatment to home care in the perspective of a healthcare provider. **Methods:** A selection of antibiotics was carried out comparing the recommendation of the Brazilian Guideline for Parenteral Antimicrobial Therapy (OPAT) and the standardization list of a specialized home care service. Then, were quantifield the direct costs of pharmacological therapy and supportive care for inpatient hospital treatment and home care program based on paid events by the health insurance company in the year 2022. **Results:** The lowest cost treatment has been associated with the use of Gentamicin, 5 days therapy amounted to R$ 178,98 and 42 days to R$ 532,85 in the home care modality, while in the hospital it ranged from R$ 1.782,08 the treatment for 5 days and R$ 2.337,08 for 42 days. The highest one were the drug Linezolid, which amounted R$ 487,29 for 5 days and R$ 2.620,71 for 42 days with administration at home, and in the hospital it had a cost of R$ 4.118,58 for 5 days and R$ 21.963,68 for 42 days. Aminoglycosides have a profile of little variability in the cost with the increase in days, while other drugs show a significant increase in the cost difference in extended treatment, highlighting Linezolid and Cephalosporins. **Conclusion:** Antimicrobial therapy proved to be economically favorable for home care in all scenarios, being a strong argument for early dehospitalization.

Keywords: Anti-Bacterial Agents, Home Care Services, Costs and Cost Analysis, OPAT.

Terapia antimicrobiana parenteral para pacientes internados e ambulatoriais: uma análise de custo na transição do cuidado

Resumo

Objetivo: Descrever e comparar os custos a curto e longo prazo na transição hospital-atenção domiciliar de pacientes em uso de terapia antimicrobiana, na perspectiva de uma operadora de saúde. **Métodos:** Realizou-se uma seleção de antibióticos confrontando a recomendação da Diretriz Brasileira de Terapia Antimicrobiana Parenteral (OPAT) e a lista de padronização de um serviço de home care especializado. Os custos diretos médico-hospitalares para o tratamento em regime de internamento hospitalar e programa de atenção domiciliar foram quantificados com base nos eventos faturados pela operadora de saúde no ano de 2022. **Resultados:** O tratamento com o menor custo foi com uso de Gentamicina, no qual cinco dias de tratamento somaram o valor de R$ 178,98 e 42 dias de tratamento R$ 532,85 na modalidade home care, enquanto na rede hospitalar variou de R$ 1.782,08 o tratamento para cinco dias e R$ 2.337,08 o tratamento para 42 dias. O tratamento de maior custo neste estudo foi com o medicamento Linezolida, o qual totalizou R$ 487,29 o tratamento para cinco dias e R$ 2.620,71 em 42 dias com a administração no domicílio, e na rede hospitalar teve um custo de R$ 4.118,58 no tratamento para 5 dias e R$ 21.963,68 para 42 dias. Os aminoglicosídeos tiveram pouca variabilidade no custo evitado com o aumento dos dias de tratamento. Os demais medicamentos apresentam um aumento expressivo na diferença dos custos com o aumento do tempo de tratamento, com destaque especial para Linezolida e as Cefalosporinas.**Conclusão:** A terapia antimicrobiana se mostrou economicamente favorável para o atendimento domiciliar em todos os cenários, sendo um forte argumento para desospitalização precoce, sem prejuízo no cuidado.

Palavras-chave: Antibacterianos, Assistência Domiciliar, custos e análise de custos, OPAT.

Introduction

Outpatient Parenteral Antimicrobial Therapy (OPAT) is a safe and effective treatment strategy aimed dehospitalizing patients with various infections, especially those that require long-term treatments[1-4].

The eligible patients for this type of care are those who need to use parenteral antimicrobial therapy and who, preferably, have their selection guided by culture and antibiogram results[1,2]. It is important to avoid transitions of patients that present unstable clinical conditions or are at risk of instability. To this end, the institution that will provide this service should carry out an assessment of family support, household structure and associated risks, so that the transition is effective and safe, as recommended[1-4].

This treatment modality considers the family and the patient as essential care components, sharing responsibilities and conferring more autonomy to the patient[1]. Family support is extremely important since, through it, a barrier is established to ensure treatment effectiveness and safety. To this end, the caregiver should be able to maintain care with the venous access as well as recognize and report signs of adverse reactions or therapeutic failure[2].

There are several benefits associated with this practice, when carried out by experienced and qualified professionals. The transition of stable patients to home care promotes a reduction in the hospital-acquired infection rates, encourages recovery in a comfortable environment for the patient and increases the availability of hospital beds, in addition to being a more profitable option for health care providers[1,3,4,5].

This study aimed at evaluating short- and long-term cost reductions in the transition from hospital to home care for patients on antimicrobial therapy, from the perspective of a health care provider.

Methods

A descriptive study was conducted, characterized as a partial economic analysis where only direct medical-hospital costs for antimicrobial therapy in hospital and home care programs were quantified in the city of Curitiba-PR, from the perspective of a health care operator[12].

In the home care service in question, the request for patient inclusion must be made by the attending physician and can begin in the hospital or at home. The home care service establishes the criteria for admitting this patient in accordance with current guidelines, which are identified, case by case, after an assessment is carried out by a Nursing professional from the service. The requesting physician is then notified of the opinion and, when favorable, the procedures for implementation are initiated. The patient's inclusion in the service takes place within 72 hours, as this depends on administrative procedures, removal of the patient, pharmacy service and signing of the liability agreement by the person responsible for the patient. There is a third-party company that provides a qualified Nursing team to care for patients. Availability of these professionals is in accordance with the schedules pre-established in the service contract, and everything will depend on the antimicrobial dosage to be administered. All medications that the patient will use during their stay at the home care service are provided by the service's own pharmacy. The service has the support of a professional specialized in infectious diseases, who carries out analysis of all inclusions, thus becoming a personalized service and contributing to more efficient results for the patient, in addition to providing safety to patients and their families.

Choice of the antimicrobials for analysis was based on the reference of the Brazilian Guideline on Ambulatory Antimicrobial Therapy[1], in which the treatment schemes of the main antimicrobials used in the home care service in question, the doses and dosages were surveyed (as described in Table 1). A cost simulation model was built based on the data surveyed on antimicrobial therapies recommended for administration on an outpatient basis, accounting for the costs of events generated for billing and the mean cost paid for each item from January to December 2022. The events are generated according to the code in the Unified Terminology in Supplementary Health (*Terminologia Unificada em Saúde Suplementar*, TUSS) table, characterized as procedures performed, care expenses and medication expenses, among others, and its amount presented is equivalent to the total consumption of this procedure in the period during which the treatment extends. The calculation was carried out using the formula below, differentiating between internal providers and hospitals qualified for network care.

$$\frac{\text{Sum of Total Amount Paid per Year}}{\text{Sum of the Amount Paid for Events per Year}}$$

The maximum payment limit for hospital network events is defined by a contract based on the *brasindice* table, which may vary for each hospital. In turn, the maximum payment limit for the internal provider events is defined by the operator's national management and calculated based on the MPL (Market Price List) tabulated value, with a 20% increase. The mean cost values were extracted from the Benner operating system (Uniben) and made available by the controlling sector between January and December 2022.

Table 01. Treatment schemes for the antimicrobials used in OPAT[1]

Antimicrobial	Therapeutic class	Dose and dosage for normal renal and hepatic function[2]
Amikacin	Aminoglycoside	15 mg/kg once a day
Cefepime	Cephalosporin 4th generation	2 g twice a day
Ceftazidime	3rd generation cephalosporin	2 g twice a day
Ceftriaxone	3rd generation cephalosporin	2 g once a day
Daptomycin	Cyclic lipopeptide	From 4 to 6 mg/kg once daily
Gentamicin	Aminoglycoside	5 mg/kg once a day
Linezolid	Oxazolidinone	600 mg twice a day
Meropenem	Carbapenem	2 g twice a day

[1]OPAT: Outpatient Parenteral Antimicrobial Therapy. [2]Brazilian guidelines for Outpatient Parenteral Antimicrobial Therapy (2020).

In this analysis, the costs of pharmacological treatment, application service by a qualified professional (Nursing technician) and the value of the hospital daily rate versus the daily rate of home care were considered, including administrative costs and professional evaluators for implementation in the service.

According to the standard dose, dosage and dilution, the infusion time for all drugs was defined as 30 minutes. To calculate the doses/kg, a patient weighing 70 kg was considered. The costs were projected over time horizons of 5, 7, 14, 28 and 42 days. The standard kit for preparing each dose was considered: 01 unit of 10 ml Luer Lock syringe + 01 unit of 25x12 mm aspiration needle, with the exception of Linezolid 600 mg, as it is dispensed in a ready-to-use bag, not requiring materials to prepare the dose.

The data were transferred to a Microsoft Excel spreadsheet, where the total values for each treatment were simulated and defined.

This study was conducted with administrative data, without any patient information.

Results

In 2022, for the eight antibiotics selected in the study, a total of 14,685 events paid to external providers were generated. The medication with the most paid events was Ceftriaxone, with a total of 1,879 doses for four different providers, totaling a paid amount of R$ 108,919.80 (referring to the medication only).

The aminoglycoside class was the one with the lowest unit cost in both scenarios (Table 2). Daptomycin, a representative of the lipopeptide class, was the most expensive medication. Only Amikacin had a higher unit cost in the home care service, but the total result for the full treatment was still significantly lower when compared to the hospital network. This is a reflection of the difference in the daily hospitalization rates and Nursing assistant/technician fees since, while in the hospital the patient has Nursing personnel available for the entire period (24 hours), in the home administration regime the professionals only commute to the patients' home during the medication infusion period.

The total costs of the home care treatments presented significant divergences, as shown in Table 03 and Figure 01, with Gentamicin use as the lowest-cost treatment, in which five days of treatment totaled R$ 178.98 and 42 days of treatment totaled R$ 532.85.

Table 02. Unit costs of the medications and materials, daily hospitalization costs and cost of Nursing professional service/hour

Medication (by presentation)	Mean Home Care Cost R$	Mean Cost in the Accredited Network Hospitals R$ (±SD)
Amikacin 500mg/2ml AMP[1]	6.64	4.90 (±3.44)
Cefepime 1g FA[2]	12.12	82.95 (±9.42)
Ceftazidime 1g FA[2]	21.21	43.27
Ceftriaxone 1g FA[2]	4.94	57.97 (±2.11)
Daptomycin 500mg FA[2]	145.57	230.17 (±92.62)
Gentamicin 80mg/2ml AMP[1]	0.84	2.04 (±0.17)
Linezolid 600mg/300ml BOLSA	28.83	241.15 (±71.55)
Meropenem 1g FA[2]	21.58	28.90 (±0.93)
Materials / Reconstituents / Diluents		
Vacuum needle 25x12 mm	0.19	0.47 (±1.39)
10 ml Luer Lock syringe	0.49	1.64 (±1.36)
Sodium chloride 0.9% 10 ml	0.35	0.46 (±0.50)
Sodium chloride 0.9% 100 ml	4.68	2.69 (±0.31)
Hospitalization daily cost	63.33	769.77
Nursing Assistant/Technician fee	67.83 (01 hora)	937.31 (24 horas)

[1]AMP: Ampoule. [2]AB: Ampoule Bottle. Note: The Home Care data refer to the amount billed and have already been extracted as an annual mean value; therefore, there is no availability of dispersion measures such as SD in the database. The purchase values were not considered because they already change the mean cost of the product with each new entry.

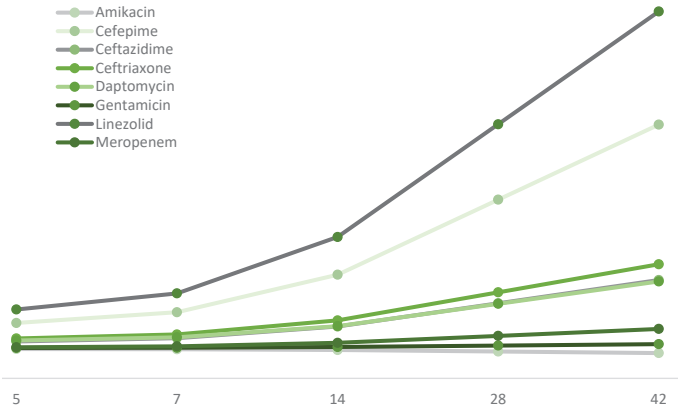
Table 03. Total cost by treatment time

Medication	Treatment time (days)	Mean Cost in the Accredited Network Hospitals R$	Mean Home Care Cost R$
Amikacin	5	1,804.58	257.58
	7	1,843.58	308.15
	14	1,980.08	485.14
	28	2,253.08	839.11
	42	2,526.08	1,193.09
Cefepime	5	3,423.28	502.08
	7	4,109.76	623.32
	14	6,512.44	1,047.65
	28	11,317.80	1,896.31
	42	16,123.16	2,744.96
Ceftazidime	5	2,629.68	683.88
	7	2,998.72	877.84
	14	4,290.36	1,556.69
	28	6,873.64	2,914.39
	42	9,456.92	4,272.08
Ceftriaxone	5	2,315.38	210.91
	7	2,558.70	242.80
	14	3,410.32	354.45
	28	5,113.56	577.74
	42	6,816.80	801.03
Daptomycin	5	2,884.23	887.59
	7	3,355.09	1,190.17
	14	5,003.10	2,249.17
	28	8,299.12	4,367.18
	42	11,595.14	6,485.20
Gentamicin	5	1,782.08	178.98
	7	1,812.08	198.11
	14	1,917.08	265.06
	28	2,127.08	398.95
	42	2,337.08	532.85
Linezolid	5	4,118.58	487.29
	7	5,083.18	602.61
	14	8,459.28	1,006.23
	28	15,211.48	1,813.47
	42	21,963.68	2,620.71
Meropenem	5	2,330.08	691.28
	7	2,579.28	888.20
	14	3,451.48	1,577.41
	28	5,195.88	2,955.83
	42	6,940.28	4,334.24

Figure 01. Comparison of the total amount paid for antimicrobial treatment in hospital and home care settings.

When comparing the cost of this medication in the hospital network, a variation was obtained from R$ 1,782.08 (treatment for 5 days) to R$ 2,337.08 (treatment for 42 days). In home care, the results indicate that it would be possible to reduce the treatment cost by R$ 1,603.10 (five days) and R$ 1,804.23 (42 days). In the general analysis, the treatment with the highest comparative value between both treatment modalities was with Linezolid, which totaled R$ 487.29 for a 5-day treatment and R$ 2,620.71 for a 42-day treatment with administration in the home, whereas this medication costs R$ 4,118.58 for 5-day treatments and R$21,963.68 for 42 days in the hospital network. By checking the difference between home and inpatient treatment regimes, it would be possible to reduce the cost by R$ 3,631.29 when administering the drug at home for 5 days, totaling R$ 19,342.97 in the difference in 42 days. These differences can be seen more clearly in Figure 02.

Figure 02. Cost avoided by treatment duration.



Only Amikacin showed a decreasing curve with the increase in treatment days, with an avoided cost in 5 days of R$ 1,547.00, whereas the cost dropped to R$ 1,332.99 in 42 days. This is because its mean unit cost was lower in the hospitals compared to the internal providers. However, it should be remembered that there is still a reduction in health care costs when compared to the amount paid to the hospital network.

Discussion

The data surveyed in this article indicated that antimicrobial therapy in the home/outpatient setting results in lower care costs. The literature supports an important point of this savings due to the reduction of the Nursing team's working hours and the simplification of the process[6]. Berrevoets *et al.* (2018) reinforce that the difference between service models does not justify the additional complexity layer in the process[8]. Patients' preferences and satisfaction were cited as reasons to encourage home care. These authors evaluated the perception and evaluation of these services, showing that most users are satisfied, especially for providing therapeutic elements that enhance the feeling of freedom and safety, in addition to offering patient-centered care[8].

As parenteral therapy is necessary, choice of the medications is a relevant point to define the transition possibility and ensure safe treatment continuity. The pharmacokinetic profile is a factor that assists in choosing antimicrobial therapy, but other guiding aspects should also be taken into account when defining the treatment, such as culture-guided therapy, always aiming for rational use[6]. Dosage can ease choice of the therapy, in which the lower administration frequency reduces care costs and favors patients' independence, thus increasing their satisfaction with the service offered[2].

OPAT has been used for more than 40 years and a growing body of research studies supports its clinical applicability and cost-effectiveness[9,16,17]. Home treatment programs are preferred by patients and families, safe and associated with clinical results equivalent to hospital care[13,17]. In the study by Suleyman *et al.*, it was shown that home therapy is safe and associated with clinical results, including improvements in quality of life, comparable to those of hospitalizations[13]. The studies found that home therapy was not associated with a clinically important increase in adverse reactions and that it was significantly less expensive than in-hospital therapy, an observation consistent with other cost analyses[7,10]. This resoluteness profile is also relevant for epidemiological indicators to be favorable, decreasing mortality due to these causes, reducing hospital readmissions and optimizing costs for the public and private health networks[10,13,14,15].

In contrast, a study of in-hospital therapy in adult patients with cystic fibrosis showed improvements in the quality of life scores in patients undergoing in-hospital therapy for acute exacerbations of their disease when compared with those receiving home therapy[13,14]. This is a fact which corroborates sustaining that management of acute and unstable conditions should be done in a hospital environment.

This study has some limitations. Only medical-hospital costs were contemplated, which shows the simplified value of a therapy, omitting some costs of the home care service, such as application materials, in addition to other home hospitalization costs that also include care from the multidisciplinary team. Therefore, this study did not reflect the total cost of any of the modalities. In addition to that, it did not evaluate clinical outcomes of treatment improvement or failure. When discussing the cost of the overall treatment, it is suggested that all interferences to the therapy be considered, which may increase the probability of an undesirable outcome during course of the treatment. Another limitation is the variability of costs in external providers, as it depends on some values fixed in contracts with network hospitals and may undergo seasonal changes.

Conclusion

There are many challenges in patients' transition to the outpatient regime, including adequate assistance in this care modality to ensure effective and safe treatments. The cost of intravenous treatments for patients with a stable clinical condition still remains high for supplementary health care, as it adds care layers that can be reduced in home care. Thus, the comparison of direct costs for the dehospitalization of this patient profile proved to favor to home therapy, where the pharmacological therapy values and the costs associated with hospitalization that were analyzed proved to be more economically advantageous.

Another important finding in this study was that some therapeutic regimes benefit from greater savings in longer treatments, in the simplified analysis of expenses. These results may be useful for evaluating and possibly encouraging the early dehospitalization practice for these patients.

This study carried out a partial economic evaluation of direct medical costs, and its results can support the conduction of complete economic evaluations for better decision-making.

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Collaborators

ICD: Conception and design, data analysis and interpretation; Writing of the article; TBA and MAC.: Data analysis and interpretation; Writing of the article; JFS: Data analysis and interpretation; Relevant critical review of the intellectual content.

Declaration of conflicts of interest

The authors declare that there are no conflicts of interest in relation to this article.

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