medical sciences forum

MDPI

Proceeding Paper

Antibiotic Prescriptions in Pediatric Patients Hospitalized with Pneumonia at a University Hospital †

Rafael Rodrigues Leite, Felipe Lemos Esteves do Amaral, Sara Maria Gomes Bié, Maria Fernanda Bandeira da Silva, Sandriny Maria de Almeida Oliveira, José Dilbery Oliveira da Silva and Sávio Benvindo Ferreira *

Academic Unit of Life (UACV), Teacher Training Center (CFP), Federal University of Campina Grande (UFCG); rafarodriguesl2212@gmail.com (R.R.L.); felipelemos.1@hotmail.com (F.L.E.d.A.); saralelisa.sb@gmail.com (S.M.G.B); fernanda2000bandeira@gmail.com (M.F.B.d.S); sandrinymaria23@gmail.com (S.M.d.A.O.); jose.dilbery@ufcg.edu.br (J.D.O.d.S)

* Correspondence: savio.benvindo@professor.ufcg.edu.br

† Presented at the The 2nd International Electronic Conference on Antibiotics—Drugs for Superbugs: Antibiotic Discovery, Modes of Action And Mechanisms of Resistance, 15–30 June 2022.

Abstract: Community-acquired pneumonia (CAP) is the leading cause of hospitalization in the Brazilian Unified Health System, with a mortality rate of 18% in children under 5 years of age. Therefore, there is a need for an effective treatment, including antibiotic therapy, based on the main causative agents of the infection. However, there is a risk of the development of bacterial resistance, making it necessary to monitor this use in order to reduce the speed of emergence of multidrug-resistant strains. Thus, this study aims to verify the profile of antibiotic use in children and adolescents treated at a brazilian university hospital. The research consists of a cross-sectional retrospective and descriptive study based on data obtained from medical records provided by the institution, after approval by the ethics committee, and organized in Excel spreadsheets, covering the period from September 2017 to December 2020. It was observed that the profile of this group of patients consists of: a female prevalence in 2017 and 2020 (59% and 57% respectively); while in the years 2018 and 2019, males were higher, 52% and 59%. Regarding age, the age group from 3 months to 4 years was predominant (59.64%). Regarding the use of antibiotics by age group, the following data were found: up to 3 months, the most used were ampicillin (44%) and azithromycin (24.25%); from 4 months to 4 years, ampicillin (32.9%), ceftriaxone (31.7%) and azithromycin (25.9%); and over 5 years, ceftriaxone (33.8%), ampicillin (29.95%) and azithromycin (22.22%). Thus, when comparing the profile found with that recommended by the protocol adopted by the hospital, we can conclude, with the data analyzed, that there is a negligence in the prescription of antimicrobials in the treatment of pediatric CAP, which may corroborate the growth of bacterial resistance, longer hospital stay and, as a result, greater expenditure on care and reduced favorable clinical outcome.

Keywords: Bacterial pneumonia; drug therapy; antibiotics; doctor's prescription; antimicrobial stewardship

Citation: Leite, R.R.; Amaral, F.L.E.d.; Bié, S.M.G.; da Silva, M.F.B.; de Almeida Oliveira, S.M.; da Silva, J.D.O.; Ferreira, S.B. Antibiotic Prescriptions in Pediatric Patients Hospitalized with Pneumonia at a University Hospital. *Med. Sci. Forum* **2022**, *2*, x. https://doi.org/10.3390/xxxxx

Academic Editor(s):

Published: date

1. Introduction

Community Acquired Pneumonia (CAP) is an infection of the lower airways that affects people in health care units or those individuals with less than 48 h of hospitalization. In Brazil, CAP is the main cause of hospitalization in the SUS and responsible for more than 50,000 deaths in 2017, thus representing a major impact on public health resources [1].

In relation to CAP in the pediatric context, the implication of this becomes even more evident, since pneumonia is responsible for 18% of deaths in children under five years of age worldwide [2]. For this reason, it is necessary to carry out the appropriate treatment,

which is done, in most cases, with the use of antimicrobials. However, this treatment is initially prescribed empirically, based on the most frequent pathogens, such as Streptococcus pneumoniae [3]. knowledge about the epidemiology and clinical context of the disease and the resistance profile of microorganisms in the region where it is found.

This first successful treatment is important because, in the case of bacteria, there is always the risk of developing resistance to the drugs used. In turn, this leads to resistant pathogens and, with it, CAPs that are difficult to manage clinically, with longer hospital stays and worse outcomes [4]. In this way, rational use is important not only for the present treatment, but for the future, as the WHO projections are that in 2050 deaths from superbugs will exceed cancer deaths [5].

Therefore, in view of this scenario, it is essential to develop studies that aim to help combat the indiscriminate use of antimicrobials, focusing on inappropriate prescription, in order to reduce the impact of such an act and, consequently, achieve one of the pillars that sustain the advance. of bacterial resistance, which, as explained above, makes the management of bacterial pneumonias difficult. Thus, this study aims to evaluate the prescription of antibiotics used in the management of bacterial pneumonia, comparing with what is recommended by the hospital protocol and in the literature, in order to determine whether there is a rational use of this class of drugs.

2. Methodology

The present study is part of a larger project entitled Profile of antimicrobial use in a university hospital in the upper sertão of Paraíba. This project consists of a research involving human beings carried out through a cross-sectional study of a retrospective and descriptive character in order to evaluate the use of antibiotics in patients hospitalized in the pediatric sector of the Júlio Bandeira University Hospital (HUJB) in the period from 1 September 2019. 2017 to 31 December 2020.

2.1. Location of the Research

Data were collected at the Hospital Universitário Júlio Bandeira (HUJB), Cajazeiras-PB, a public hospital, a reference for the municipalities of the Health Region of Paraíba. Due to its geographic location, it receives patients from surrounding municipalities, including from other states, mainly Ceará, who seek the hospital's urgent and emergency services.

2.2. Target/Sample Population

The study included patients treated in the pediatrics sector (children and adolescents up to 17 years and 11 months of age diagnosed with pneumonia and who received antibiotic therapy, hospitalized, at the university hospital from September 2017 to December 2020. During the period from September 2017 to December 2020. period in question, the hospital received a new physical and professional structure, which is the reason for choosing the period in question, as it facilitates the acquisition of the necessary information.

2.3. Procedures and Data Collection

Data collection was carried out at the HUJB through the availability of medical prescriptions and electronic medical records through the Management Application for University Hospitals (AGHU) which will be carefully analyzed and placed in a spreadsheet containing the following information: gender; age group; antibiotics used; and protocol follow-up

2.4. Statistical Analysis

After data collection, descriptive and qualitative statistical analysis was performed, using the Microsoft Excel 2019 program to compute the data, create frequency tables and graphs, with the aim of optimizing the observation of the results.

2.5. Ethical Aspects

The research has already been approved by the Research Ethics Committee, Opinion: 3,686,831, in order to ensure that the information collected has a guarantee of confidentiality in order to ensure the privacy and anonymity of the subjects regarding the confidential data involved in the research, taking into account thus Resolution No. 510/2016, of the National Health Council.

3. Results

After evaluating the medical records of 626 patients, the results found show a sociodemographic profile with a prevalence of females in 2017 and 2020 (59% and 57% respectively); while in the years 2018 and 2019, males were higher, 52% and 59%, not showing a direct relationship with sex (Figure 1).

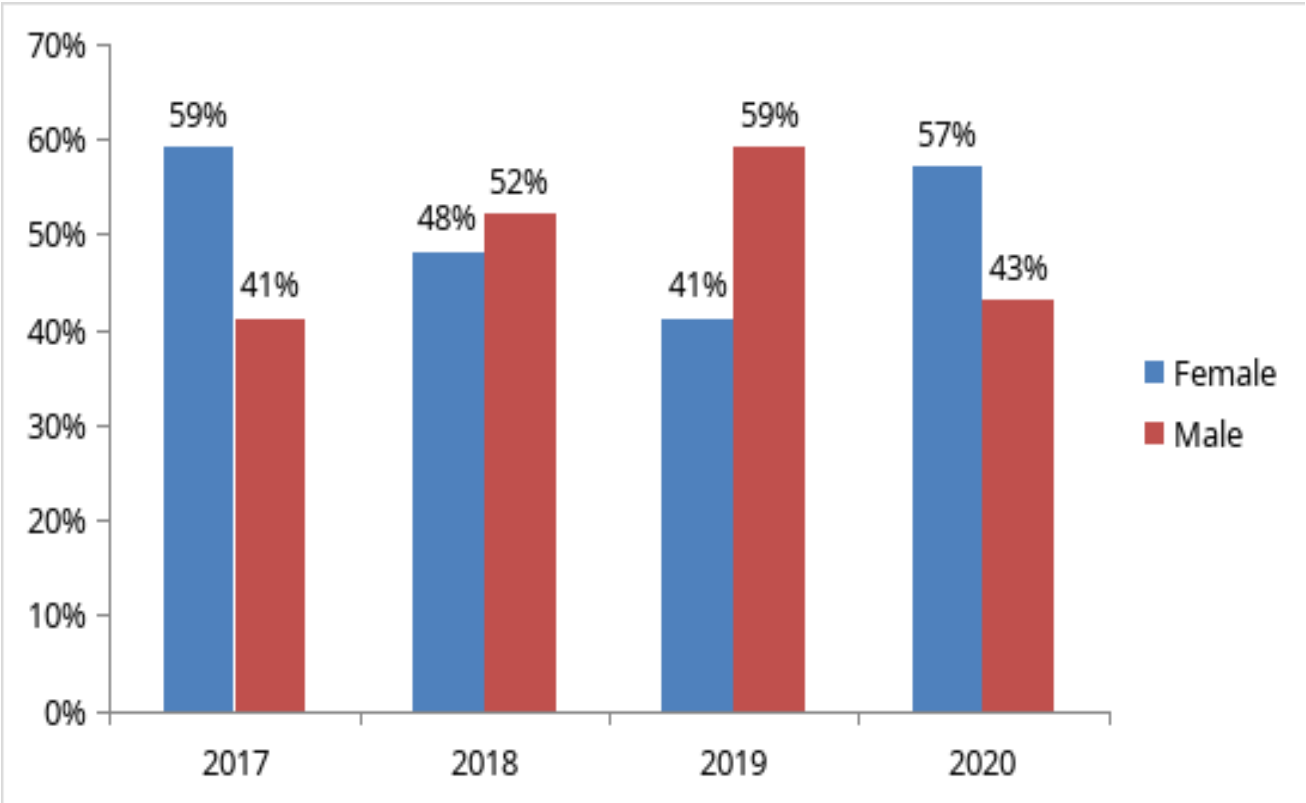

Figure 1. Percentage of Pneumonia Cases in the Pediatric Sector of the HUJB by Sex between the years 2017 and 2020. Source: Own authorship.

In relation to age, the division performed follows the age groups that appear in the hospital protocols, with the range from 3 months to 4 years being predominant (59.64%) (Figure 2). Percentage of Pneumonia Cases in the Pediatric Sector of the HUJB by Sex between the years 2017 and 2020.

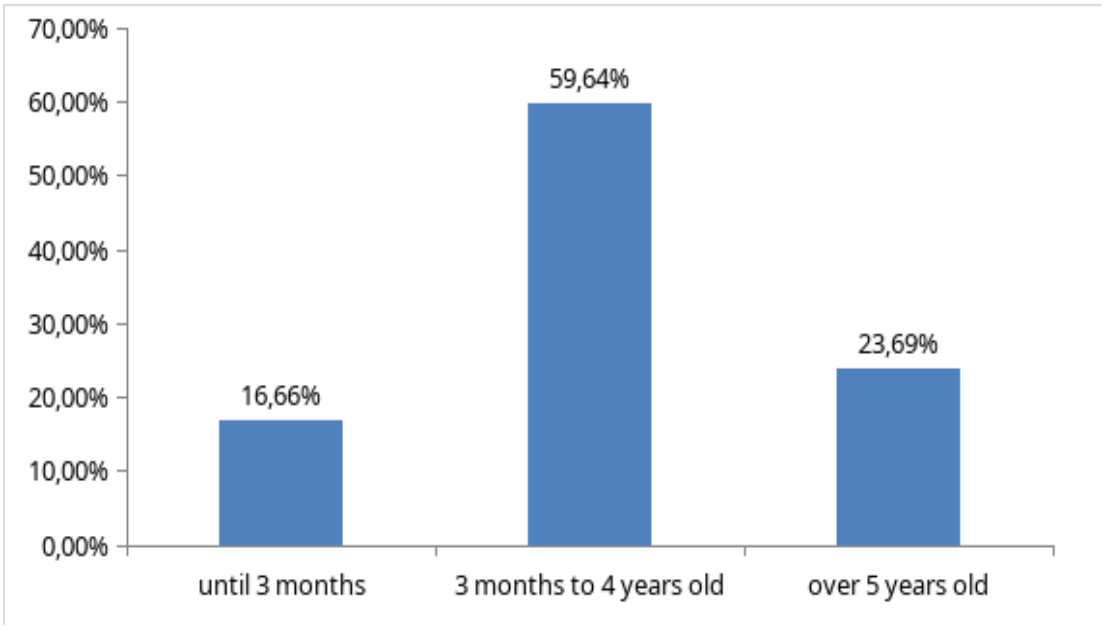

Figure 2. Relationship between the Number of Cases and the Age Group of Patients Hospitalized for Pneumonia at the HUJB from 2017 to 2020. Source: Own authorship.

Regarding the use of antibiotics (745) by age group, the following data were found: ampicillin leads (34.25%), followed by ceftriaxone (28.21%) and azithromycin (24.80%). Regarding the use of antimicrobials by age group, we found the following distribution: up to 3 months, the most used were ampicillin (44%) and azithromycin (24.25%); from 4 months to 4 years, ampicillin (32.9%), ceftriaxone (31.7%) and azithromycin (25.9%); and over 5 years, ceftriaxone (33.8%), ampicillin (29.95%) and azithromycin (22.22%) (Figure 3).

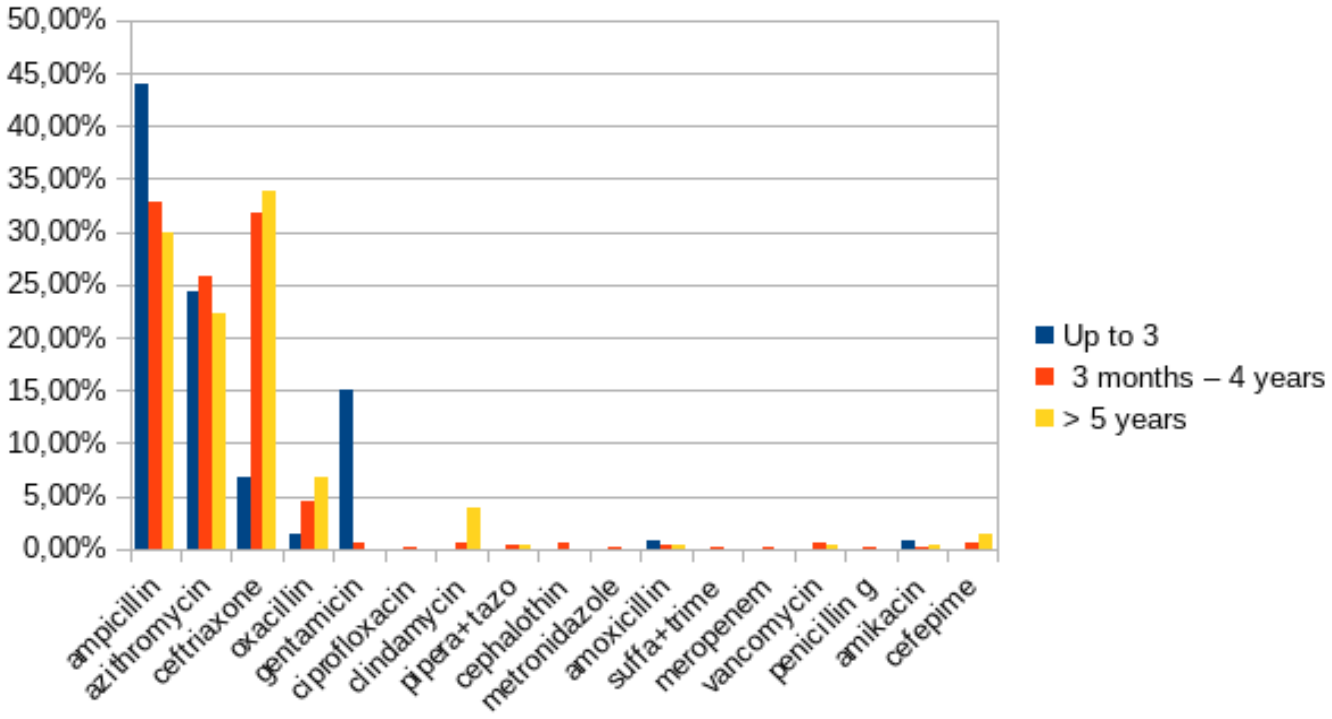

Figure 3. Use of Antibiotics in the Management of Pneumonia in the Pediatric Sector of the HUJB from 2017 to 2020. Source: Own authorship.

However, when we evaluated the rate of follow-up to the hospital protocol, we found that only 34.1% of the 626 evaluated medical records followed the recommended (Figure 4). The antibiotic therapy occurred empirically.

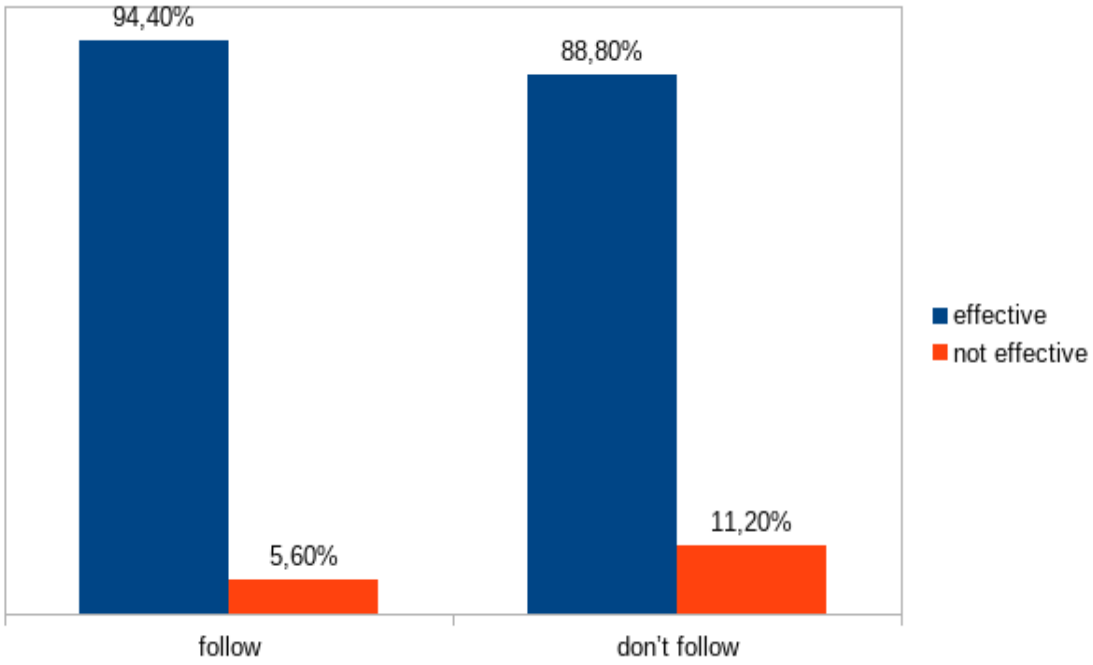

Figure 4. Effectiveness Rate According to the Follow-up of the Protocol in the Management of Pneumonia in the Pediatric Sector of the HUJB between 2017 and 2020. Source: Own authorship.

4. Discussion

Regarding the sociodemographic profile of the analyzed patients, the alternation of the prevalence of male or female sex, depending on the year analyzed, differs from that found in other literature, in which there is a predominance of males, despite the difference between both sex being less than 10% [6,7].

As for the age group, the findings of this study are similar to those found in other literature, that is, there is a predominance between the ages of 1 to 4 years old [8]. This age group is important for the current context, as it fits into one of the goals of the World Health Organization for 2030, which aims to reduce avoidable deaths in children under 5 years of age, with pneumonia being an important preventable cause of death in this population [8,9].

For this reason, it is important that the treatment is done properly, according to the indications given by the guidelines. However, what we noticed when processing the data on the main antibiotics was a considerable discrepancy (65.9%) in the number of prescriptions that did not follow the recommendations of the Hospital Universitário Júlio Bandeira (HUJB). However, when observing the three main antibiotics used in the management of bacterial pneumonia in children (Ampicillin, Ceftriaxone and Azithromycin), it is parallel with the prescription profile found in other parts of the world [10–12].

It is important to point out that in order to evaluate the rational use of these antibiotics, it is first necessary to have knowledge about the main pathogens that cause pneumonia according to age group, in order to choose the most appropriate antimicrobial. This is because performing a culture to identify the pathogen is indicated only in severe cases, in others the treatment is done empirically, taking into account the epidemiological data of the region [1,13].

Thus, in the case of the pediatric population, the main causative agents by age group are [3,14]:

- up to 3 days- Group B Streptococcus, Gram negative *Bacillus, Listeria monocytogenes*;
- 3 to 28 days: *Staphylococcus aureus, Staphylococcus epidermidis*, Gram negative;
- 1 month to 3 months: *Chlamydia trachomatis, Ureaplasma urealyticum, Streptococcus pneumoniae, Staphylococcus aureus*;
- 4 months to 5 years: Virus, *Streptococcus pneumoniae, Staphylococcus aureus, Haemophilus influenzae, Moraxella catarrhalis, Mycoplasma pneumoniae, Chlamydia pneumoniae*;
- Over 5 years: *Streptococcus pneumoniae, Staphylococcus aureus, Mycoplasma pneumoniae, Chlamydia pneumoniae*.

Therefore, bearing in mind the most common etiological agents according to age group, it is possible to assess whether the HUJB prescriptions that did not conform to the protocol (65.9%) and that are repeated in other services are made in a rational.

Starting with the most used drug, ampicillin (34.25%). This beta-lactam has good action against the main agents for gram positives, being the first indication in children over 4 months. However, its action against gram negative bacteria is reduced, which requires the use of another drug for such coverage, with aminoglycosides being the most indicated for their synergistic action with beta-lactams. This combination (ampicillin + gentamicin) for patients up to 3 months is indicated as the first option in the HUJB protocol, but in practice we observe the predominance of the isolated use of beta-lactam, which can contribute to therapeutic failure, requiring longer hospital stays. and the use of more potent antibiotics [15].

However, going beyond ampicillin, a broadening of the spectrum of action of prescribed antibiotics is observed, especially in relation to azithromycin (24.8%). Regarding ceftriaxone (28.21%), there is an increase in its action against gram negatives, but a reduction in its activity against gram positives. Despite still having action against *S. penumonieae*, it is not the most suitable for covering this bacterium, in view of the existence of other antimicrobials with better action [16].

Finally, azithromycin is the third most used, even without being recommended in the HUJB protocol, and its use is a frequent finding in the literature [11]. This is mainly due to its broad spectrum of action, acting both on gram positive and gram negative, in addition to covering some atypical microorganisms. But this use is an inadequate practice, since for the rational use of antibiotics, it is important to prescribe them bearing in mind the one whose action spectrum is the most suitable for the likely pathogen and for the shortest time, reserving the broad spectrum for more serious cases, such as Health Care-Related Infection [17].

5. Conclusions

Therefore, Community-Acquired Pneumonia (CAP) is a disease with a great global impact, both because of the number of hospitalizations and, therefore, health costs, and because it is an important cause of mortality in children under 5 years of age. Thus, it is important that its treatment occurs properly, which aims not only at clinical improvement but also involves the rational use of antibiotics, in order to reduce the risk of developing bacterial resistance. Studies evaluating antimicrobial prescriptions in the management of CAP are important, in order to identify therapeutic failures and propose solutions.

Author Contributions:

Funding:

Institutional Review Board Statement:

Informed Consent Statement:

Data Availability Statement:

Conflicts of Interest:

References

1. Da Silva, C.H.; de Oliveira, R.X.; Gomes, A.P.; Moreira, T.R.; Braga, L.M. Resistência antimicrobiana na pneumonia adquirida na comunidade: revisão de literatura. *VITTALLE-Rev. Ciênc. Saúde* **2021**, *33*, 76–88. https://doi.org/10.14295/vittalle.v33i3.12659
2. Gaspar, M.A.R.; Barros, P.H.S.; Costa, A.S.V.; Soares, F.A.; De Oliveira, B.L.C.A. Desigualdade social e hospitalizações por pneumonia em crianças menores de cinco anos no Estado do Maranhão, Brasil. *Rev. Bras. Saúde Matern. Infant.* **2020**, *20*, 81–89. https://doi.org/10.1590/1806-93042020000100006
3. *PNEUMONIA ADQUIRIDA NA COMUNIDADE NA INFÂNCIA: Programa de Atualização em Terapêutica Pediátrica***;** São Paulo, 3 July 2018.
4. O'Connor, R.; O'Doherty, J.; O'Regan, A.; Dunne, C. Antibiotic use for acute respiratory tract infections (ARTI) in primary care; what factors affect prescribing and why is it important? A narrative review. *Ir. J. Med Sci.* **2018**, *187*, 969–986. https://doi.org/10.1007/s11845-018-1774-5
5. Lanks, C.W.; Musani, A.I.; Hsia, D.W. Pneumonia adquirida na comunidade e pneumonia adquirida no hospital. *Clín. Méd.* **2019**, *103*, 487–501.
6. Lima, D.E.P.; Serra, G.H.C.; Duarte, A.D.; Almeida, B.A.D. Prescrição de antibióticos em pneumonia. Pesquisa PIBIC. Orientador: MELLO, M. J. G. 2014. Available online: http://tcc.fps.edu.br:80/jspui/handle/fpsrepo/107 (accessed on 10 March 2022).
7. Pereira, N.H.; de Abreu Moraes, P.S.; Karollynne, K.E.; Lemos, C.; Soares, M.E.D.S.M.; da Costa Santos, A.C.B. Perfil das Internações Hospitalares e Mortalidade por pneumonia em crianças no Estado da Paraíba. In *Anais do 2º Congresso Brasileiro de Ciências da Saúde*; 2016. Available online: https://editorarealize.com.br/artigo/visualizar/29499 (accessed on 10 March 2022).
8. Wen, Z.; Wei, J.; Xue, H.; Chen, Y.; Melnick, D.; Gonzalez, J.; Hackett, J.; Li, X.; Cao, Z. Epidemiology, microbiology, and treatment patterns of pediatric patients hospitalized with pneumonia at two hospitals in China: A patient chart review study. *Ther. Clin. Risk Manag.* **2018**, *14*, 501–510. https://doi.org/10.2147/TCRM.S143266
9. De Oliveira, I.C.; Moreira, E.A.F.; De Andrade, F.B. Desigualdade social e hospitalizações por pneumonia em crianças menores de cinco anos no Estado do Maranhão, Brasil. *Rev. Bras. Saúde Matern. Infant.* **2020**, *20*, 81–89. https://doi.org/10.21680/2446-7286.2020v6n2ID19910
10. Medeiros, H.S.L. Perfil Sócio-Demográfico, Clínico e Farmacoterapêutico de Crianças com Pneumonia em um Hospital de Referência no Vale do Jequitinhonha. Master's Thesis, Universidade Federal dos Vales do Jequitinhonha e Mucuri, Diamantina, Brazil, 2020. Available online: http://acervo.ufvjm.edu.br/jspui/handle/1/2403 (accessed on 10 March 2022).
11. SOUZA, G. R. S.. Perfil de utilização de antimicrobianos por pacientes pediátricos em um hospital público do DF**.** Orientador: Alcidésio de Sales de Souza Júnior. Bachelor's Thesis, Centro de Universitário do Planalto Central Apparecido dos Santos, Brasília, Brazil, 2019. Available online: https://dspace.uniceplac.edu.br/handle/123456789/209 (accessed on 10 March 2022).
12. Thaulow, C.M.; Berild, D.; Eriksen, B.H.; Myklebust, T.; Blix, H.S. Potential for more rational use of antibiotics in hospitalized children in a country with low resistance: data from eight point prevalence surveys. *Pediatr. Infect. Dis. J.* **2019**, *38*, 384–389. https://doi.org/10.1097/INF.0000000000002106
13. Ebeledike, C.; Ahmad, T. Pediatric Pneumonia. In *StatPearls [Internet]*; StatPearls Publishing: 2022.
14. Katz, S.E.; Williams, D.J. Pediatric community-acquired pneumonia in the United States: changing epidemiology, diagnostic and therapeutic challenges, and areas for future research. *Infect. Dis. Clin. N. Am.* **2018**, *32*, 47–63. https://doi.org/10.1016/j.idc.2017.11.002.
15. Webb, B.J.; Sorensen, J.; Jephson, A.; Mecham, I.; Dean, N.C. Broad-spectrum antibiotic use and poor outcomes in community-onset pneumonia: a cohort study. *Eur. Respir. J.* **2019**, *54*, 1900057. https://doi.org/10.1183/13993003.00057-2019
16. Tavares, W. *Antibióticos e Quimioterápicos Para o Clínico/Walter Tavares*, 4th ed.; erv. e atual; Editora Atheneu: São Paulo, Brazil, 2020.
17. Alfayate Miguélez, S.; Garcia-Marcos, L. Uso racional de antimicrobianos no tratamento de infecções das vias aéreas superiores. *J. Pediatr.* **2020**, *96*, 111–119. https://doi.org/10.1016/j.jped.2019.11.001.