ACTAS MÉDICAS (ECUADOR)
actasmedicas.ec

ORIGINAL RESEARCH

Blood cultures in pediatric oncology, epidemiology 2023 of the National Oncology Institute - Solca Guayaquil.

Aníbal Bonilla Núñez [1] ID *, Nelly Mariel Andrade Mejía [2] ID *, Sara Daniela Pérez Londo [3] ID, Fabiola Aveiga Reinoso [2] ID *, Luis Espín Custodio [1] ID.

1. Pediatric Oncology Service, Solca Guayaquil, Ecuador.
2. Microbiology Service, Solca Guayaquil, Ecuador.
3. Internal Medicine Service, Alcívar Hospital, Guayaquil, Ecuador.

Abstract

Introduction: Infections are among the primary complications in pediatric oncology. Continuous monitoring of the microorganisms involved and their susceptibility to antibiotics has become as crucial as their rational use in preventing the emergence of resistance. The objective of this study was to utilize these data to establish an efficient and effective initial empirical management protocol.

Methodology: The results of blood cultures taken from febrile neutropenic children hospitalized in the Pediatric Department of the National Oncology Institute, Solca, Guayaquil, during 2023 were analyzed. Cultures were taken directly from peripheral blood samples, and retrospective cultures were taken from samples from a central catheter or an implantable venous chamber. Microorganisms and their susceptibility were identified in the institution's microbiology department.

Results: A total of 831 cultures were collected during the study period, 146 positive (17.5%). Bacteria were identified in 84 cases (57%), and fungi were identified in 62 (43%). Among the bacteria, 44% were gram-positive, and 56% were gram-negative. The results were compared with those from previous years. The main microorganisms isolated were gram-negative bacteria, with *Klebsiella pneumoniae* being the most common. Among the gram-positive bacteria, the majority were coagulase-negative staphylococci. The main fungus isolated was *Candida parapsilosis*. No Aspergillus spp. were isolated.

Conclusions: Blood culture sensitivity was 17.5%, with Klebsiella being the most common. KPC and ESBL levels decreased, but Candida levels persisted. Vancomycin was used in specific cases and at the beginning of managing severe sepsis caused by an unknown pathogen.

Keywords:

Blood culture, children, neutropenia, sensitivity.

Abbreviations

BLEE: Extended spectrum beta lactamase.
ION-Solca: National Oncology Institute-Society for the Fight Against Cancer.
KPC: *Klebsiella pneumoniae* carbapenemase.

Additional information

No supplementary materials are declared.

Acknowledgments

We thank the ION Solca Hospital staff and patients in Guayaquil, where the study was conducted.

Authors' contributions

Aníbal Bonilla Núñez: Conceptualization, research, writing—original draft, resources, software, supervision.

Nelly Mariel Andrade Mejía: Conceptualization, research, writing—original draft, resources, software, supervision.

Sara Daniela Pérez Londo: Research, Writing – original draft, Resources.

Fabiola Aveiga Reinoso: Research, Writing – original draft, Resources.

Luis Espín Custodio: Methodology, Data curation, Formal analysis, Funding acquisition, Project management, Validation, Visualization, Writing – review and editing.

All the authors read and approved the final version of the manuscript.

Financing

The authors funded the costs of this research.

Availability of data and materials

The datasets used and analyzed during the present study are available from the corresponding author upon reasonable request.

Introduction

Infections are among the main complications in pediatric oncology. They are associated mainly with immunosuppression states [1, 2] and the need to use invasive devices, such as central venous access or implantable venous camera systems [3].

The current use of increasingly myeloablative chemotherapies has led to deep and prolonged neutropenic states and the emergence of aggressive microorganisms [4, 5] that are resistant to antibiotics. This situation has become a public health problem, highlighting the need for continuous monitoring of primary germs, their sensitivity, and the rational use of drugs [6, 7].

The optimal and timely decision regarding empirical treatment with antibiotics and antifungals [7, 8] is not always simple or straightforward and depends on many variables, especially those related to each institution's epidemiology.

The objective of this study was to identify, over 12 months (2023), the main microorganisms associated with infections in febrile neutropenic pediatric oncology patients at the "Dr. Juan Tanca Marengo" National Oncology Institute and their sensitivity to establish efficient and effective initial empirical management.

Materials and methods

Study design

This study is observational and retrospective.

Scenery

The study was conducted from January 2018 to December 2023 in the Pediatric Department of the Dr. Juan Tanca Marengo National Oncology Institute, located in Guayaquil, in the province of the Guayas.

Participants

Records of patients aged 0--12 years who were diagnosed with cancer and admitted for infectious complications associated with their immunosuppressive treatment were included.

Variables

The variables included the type of bacteria, antibiotic sensitivity, and type of fungus. The sensitivity was compared from 2008 to 2022.

Data sources/measurements

The source was indirect; an electronic form was completed using data from the institutional medical records. With informed consent from their families, the results of blood cultures taken from neutropenic children who developed fever were analyzed. Blood cultures were obtained from peripheral blood samples, and retrospective cultures were collected from central or implantable venous catheters. The BACT/ALERT 3D system was utilized for culture analysis and identification, employing the VITEK 2 COMPACT system, GN cards, AST 403 ANTIBIOGRAM for yeast, and an AST-YS08 fungigram. The institution's microbiology department carried out the identification.

Biases

The application of participant selection criteria helped avoid observation and selection bias. The principal investigator consistently maintained the data via a guide and records approved in the research protocol to prevent potential interviewer, information, and recall bias. Two researchers independently analyzed each record in duplicate, and the variables were entered into the database after verifying their concordance.

Study size

The sample was probabilistic. In a pediatric population of 758,290 children aged 1--12 years in the city of Guayaquil, the global incidence of cancer was 17.14 per 100,000 children [9], translating to 129 potential cases. EPI Info TM (Stat Calc, Epi Info, CDC, Atlanta. Version 7.2.6 [October 2023]), with an expected frequency of positive cultures of up to 17.0% in children and with a confidence limit of 5% and a confidence level of 99.99%, the sample size was determined to be 112 cases for the analysis.

Quantitative variables

Descriptive statistics were utilized. The results are presented as frequencies and percentages. Scale variables were not transformed into categorical variables.

Statistical analysis

Qualitative variables are expressed as frequencies and percentages. Proportions were compared using the chi-square test. Odds ratios were calculated to evaluate the associations among variables, considering previously published statistical studies [10- 13]. The statistical package utilized was IBM Corp., released in 2018: IBM SPSS Statistics for Windows, Version 26.0. Armonk, NY: IBM Corp.

Results

Participants

Among the 831 cultures, 146 positive cultures were analyzed (17.6% [95% CI 15.0–20.2%]). Bacteria were identified in 84 (57%), and fungi were identified in 62 (43%).

Characteristics of bacterial infections

Among the bacteria, 47 gram-negative bacteria (56%) were identified: 13 *Klebsiella pneumoniae*, 4 *Acinetobacter baumannii*, 8 *Burkholderia cepacia*, 4 *Escherichia coli*, 4 *Pseudomonas aeruginosa*, 2 *Ps. putida*, 2 *C. freundii*, 1 *Salmonella*, *1 P. vulgaris*, 1 *C. koseri*, 1 *C. indologentis*, 1 *Enterobacter aerogenus*, 1 *Serratia marcescens*, 1 *Stenotrophomona maltophilia* and 3 *A. iwofi*i. Among these strains, 4 were carbapenemase-producing strains with a marked predominance of *Klebsiella pneumoniae*, and 6 had extended-spectrum beta-lactamases (ESBLs) in *Klebsiella pneumoniae* and *Escherichia coli* (Table 1). In the remaining 37 cultures, gram-positive bacteria (44%) were isolated, 4 were *E. aureus*, and the remaining 33 coagulase-negative *staphylococci were included*: 19 *S. hominis*, 5 *S. epidermidis*, 4 *S. hemolyticus*, 4 *S. saprophyticus*, and 1 *S. viridans* (Table 2).

Fungal infections

Sixty-two fungi were isolated, 61 of which corresponded to the genus *Candida*: 42 *C. parapsilosis*, 7 *C. guilliermondii*, 9 *C. rugosas*, 2 *C. albicans*, 1 *C. ciferii* and 1 *Cryptococcus laurentis* (Table 3).

Discussion

Among the 831 blood cultures obtained in 2023, 146 were positive (17.5%). The bacteria included 84 (57%), 47 (32%), 37 (25%), and 62 (43%) gram-negative bacteria.

This incidence is related to chemotherapy treatments with more myeloablative agents, which lead to more intense and lasting neutropenia, increased length of stay, and, consequently, an increase in infections.

Most gram-positive bacteria are coagulase-negative staphylococci, which are poorly sensitive to oxacillin and clindamycin and 100% sensitive to vancomycin, linezolid, and tigecycline.

Based on previous studies conducted at ION SOLCA, the sensitivity of gram-positive bacteria to vancomycin, linezolid, and tigecycline has remained at 100% for more than 15 years. The sensitivity to clindamycin (55%) and oxacillin (40%) has gradually decreased, whereas the sensitivity to TMS has improved (73%) (Table 4).

gram-negative bacteria represented 56% of the total bacterial isolates, similar to the 1980s [14, 1 5].

Compared with the 2022 results, gram-negative bacteria are more sensitive to amikacin (70%, previously 78%), tigecycline (89%, previously 94%), and ceftazidime (100%, previously avibactam), both of which are considered last-line drugs. The sensitivity to third- and fourth-generation cephalosporins remains the same: cefepime (57%, previously 51%). Carbapenems (imipenem and meropenem) (89%, previously 74%). Piperacillin–tazobactam was used by 72% (previously 55%), and ciprofloxacin was used by 72% (previously 65%) of the participants; these sensitivities are related to the frequency of their use. Ceftazidime maintains a sensitivity of 70% (Table 5). In 2023, 4 KPC strains were isolated (2022/11), and 6 ESBL strains were isolated (2022/16).

Table 1. Frequency of gram-negative bacteria types.

Bacteria	Frequency n=47	%	% Accumulated
K. pneumo	13	27.66%	27.66%
B. Cepacia	8	17.02%	44.68%
P. Aeruginosa	4	8.51%	53.19%
A. Baumannii	4	8.51%	61.70%
E. coli	4	8.51%	70.21%
A. Iwofii	3	6.38%	76.60%
C. Freundii	2	4.26%	80.85%
Ps. Putida	2	4.26%	85.11%
E. Aerogenes	1	2.13%	87.23%
S. Maltophilia	1	2.13%	89.36%
Salmonella	1	2.13%	91.49%
St. Marcenses	1	2.13%	93.62%
P. Vulgaris	1	2.13%	95.74%
C. Koseri	1	2.13%	97.87%
C. Indologentis	1	2.13%	100.00%
Sensitivity: Amikacin 70%, CFP 57%, CFZ 70%, CIPRO 72%, IMI 89%, MERO 89%, PIP.TAZO 72%, TIGA 89%.			

Table 2. Frequency of gram-positive bacteria types.

Bacteria	Frequency n=37	%	% Accumulated
E. Hominis	19	51.35%	51.35%
E. Epidermidis	5	13.51%	64.86%
E. Aureus	4	10.81%	75.68%
E. Hemolyticus	4	10.81%	86.49%
E. Saprophyticus	4	10.81%	97.30%
E. Viridans	1	2.70%	100.00%
Sensitivity: VANCO 100%, LINEZOLID 100%, TIGACYCLINE 100%, CLINDAMYCIN 55%, TMS 73%, OXACILLIN 40%.			

Table 3. Frequency of types of fungi.

Candida	Frequency n=61	%	% Accumulated
Parapsilos	42	68.85%	68.85%
Rugosa	9	14.75%	83.61%
William	7	11.48%	95.08%
Albicans	2	3.28%	98.36%
Ciferii	1	1.64%	100.00%
Sensitivity: AMPHOTERICIN 98%, CASPOFUNGIN 98%, FLUCONAZOLE 100%, VORICONAZOLE 100%.			

Table 4. Antibiotic sensitivity to gram-positive bacteria 2008-2023.

↓Antibiotic/Sensitivity→	2008	2009	2010	2011	2013	2014	2018	2019	2021	2022	2023
Vancomycin	100	100	100	100	100	100	100	100	100	100	100
Linezolid	100	100	100	100	100	100	100	100	100	100	100
Ampicillin Sulbactam	58	65	18	64	50	28	-	-	-	-	-
Clindamycin	69	83	59	82	61	41	45	28	67	35	55
Erythromycin	59	78	39	82	61	48	45	-	-	22	-
Oxacillin	54	65	18	73	50	31	9	17	25	24	40
Trimethoprim-Sulfa	42	83	63	82	89	62	100	61	83	80	73
Tigacycline	100	100	100	100	100	100	100	100	100	100	100

Table 5. Antibiotic sensitivity to gram-negative bacteria 2007-2023.

↓Antibiotic/Sensitivity→	2007	2008	2009	2010	2011	2013	2014	2018	2019	2021	2022	2023
Amikacin	65	85	87	42	90	87	94	97	80	93	78	70
Cefezoline	70	75	75	90	84	70	71	67	78	60	60	70
Cephalexin	50	59	68	58	63	45	55	64	-	-	-	-
Ciprofloxacin	59	67	70	95	61	65	58	67	78	58	51	57
Imipenem	91	97	92	95	82	89	99	77	93	85	74	89
Meropenem	96	98	95	95	86	93	99	87	93	85	74	89
Tazobactam	74	95	87	100	81	85	80	164	88	73	55	72

Sixty-one Candida species were isolated, including 2 *albicans*, 42 *parapsilosis*, 7 *guilliermondii*, 9 *rugosa*, 1 *ciferii*, and *1 Cryptococcus Laurentiis*, representing a significant increase in fungal infections in the group of children with NF [16] (only 5 in 2021) or improvement in detection methods, so we consider it necessary to improve the antifungal prophylaxis policy with fluconazole. No Aspergillus spp. were isolated [17, 18].

The sensitivity of Candida infections was 98% to amphotericin, 98% to caspofungin, 100% to fluconazole, and 100% to voriconazole.

Despite frequent antimicrobials, isolated organisms maintain acceptable sensitivity to the drugs utilized. The systematic management of antibiotics adheres to a predetermined empirical regimen, adjusted based on the isolates, the source of infection, the severity of the condition, and the characteristics of the host.

Some germs in successive cultures lose their sensitivity, and multiresistance exists in patients with frequent previous hospitalizations or those referred from other hospitals.

The early use of fluconazole for prophylaxis or treatment, provided there is no interference with chemotherapy- even without detection of the germ- during fever lasting longer than 5 days, prolonged neutropenia, and relevant findings in imaging studies, could help reduce yeast isolation. Fluconazole could be temporarily substituted with low-dose amphotericin (0.3 mg), while monitoring for nephrotoxicity or caspofungin given on alternate days. There have been reports of Candida strains developing resistance to amphotericin and caspofungin.

In patients with profound neutropenia, pharyngeal and nasal cultures are unproductive and often yield normal flora. No methicillin-resistant staphylococci, penicillin-resistant pneumococci, or Aspergillus were isolated. However, perianal cultures identified multiresistant gram-negative bacteria, *Klebsiella* BLEE and KPC, and *Stenotrophomonas* maltophilia, which colonize germs that could have been responsible for fever in difficult-to-manage prolonged febrile neutropenia. No resistant enterococci were observed, and only one *Serratia* was isolated.

The sensitivity of blood cultures was 17.5%, indicating predominantly gram-negative bacteria, with *Klebsiella* being the most common. The initial empirical treatment regimen in 2023 utilized cefepime with or without amikacin, transitioning to carbapenems as needed, in contrast with the 2022 regimen, which employed piperacillin and tazobactam. The results indicate a reduction in KPC and ESBL. Theoretically, antibiotics that often suppress the resident intestinal flora, particularly anaerobes, facilitate the overgrowth of *C. difficile*, fungi, and other pathogenic bacteria.

Candida infection persisted even when fluconazole and occasionally caspofungin or amphotericin were used as prophylaxis and/or treatment. Vancomycin was used in specific cases and at the beginning of managing severe sepsis caused by an unknown pathogen (Table 4).

Conclusions

Piperacillin-tazobactam susceptibility decreased significantly against *K. pneumoniae* and *E. coli*, coinciding with the 2022 cefepime shortage, whereas ceftazidime/avibactam maintained good activity against KPC and ESBL. An increase in multidrug-resistant *Candida auris* has been observed in hospitalized children since 2021, necessitating improved antifungal prophylaxis with fluconazole in the face of *Aspergillus* resistance. Although overall antifungal susceptibility is high, antibiotic resistance in isolated organisms has increased, requiring adjustment of empirical management according to local patterns and patient characteristics. Prolonged stays and prior antibiotic use are associated with lower sensitivity and greater resistance. Gram-negative bacteria, especially *Klebsiella*, cause febrile neutropenia, and the 2023 antibiotic protocol resulted in increased resistance to KPC and ESBL. Discontinuation of prophylactic fluconazole and initiation of amphotericin B increased *Candida* isolates, whereas empirical fluconazole in sepsis patients with severe neutropenia was successful in selected cases.

References

1. Maldonado E, Acuña M, Álvarez A, Avilés C, Maza V, Salgado C. Microorganismos aislados de hemocultivos en niños con cáncer y neutropenia febril de alto riesgo en cinco hospitales de Santiago, Chile, período 2012-2015. Rev. chil. infectol. 2018 Abr; 35(2):140-146. doi: 10.4067/s0716-10182018000200140.

2. Rose W, Veeraraghavan B, Pragasam AK, Verghese VP. Antimicrobial susceptibility profile of isolates from pediatric bloodstream infections. Indian Pediatr. 2014 Sep;51(9):752-3. PMID: 25228617.

3. Özdemir ZC, Koç A, Ayçiçek A. Microorganisms isolated from cultures and infection focus and antibiotic treatments in febrile neutropenic children from Şanlıurfa, Turkey. Turk J Pediatr. 2016;58(1):47-53. doi: 10.24953/turkjped.2016.01.007. PMID: 27922236.

4. Alali M, David MZ, Danziger-Isakov LA, Elmuti L, Bhagat PH, Bartlett AH. Pediatric Febrile Neutropenia: Change in Etiology of Bacteremia, Empiric Choice of Therapy and Clinical Outcomes. J Pediatr Hematol Oncol. 2020 Aug;42(6):e445-e451. doi: 10.1097/MPH.0000000000001814. PMID: 32404688.

5. Kebudi R, Kizilocak H. Febrile Neutropenia in Children with Cancer: Approach to Diagnosis and Treatment. Curr Pediatr Rev. 2018;14(3):204-209. doi: 10.2174/1573396314666180508121625. PMID: 29737253.

6. Fawad U. Bacteriological Spectrum and Antibiotic Susceptibility on Blood Culture in Newly Diagnosed Pediatric Patients With Acute Lymphoblastic Leukemia During the Induction Phase. Cureus. 2022 May 30;14(5):e25470. doi: 10.7759/cureus.25470. PMID: 35800825; PMCID: PMC9246452.

7. Oliveira AL, de Souza M, Carvalho-Dias VM, Ruiz MA, Silla L, Tanaka PY, Simões BP, Trabasso P, Seber A, Lotfi CJ, Zanichelli MA, Araujo VR, Godoy C, Maiolino A, Urakawa P, Cunha CA, de Souza CA, Pasquini R, Nucci M. Epidemiology of bacteremia and factors associated with multidrug-resistant gram-negative bacteremia in hematopoietic stem cell transplant recipients. Bone Marrow Transplant. 2007 Jun;39(12):775-81. doi: 10.1038/sj.bmt.1705677. Epub 2007 Apr 16. PMID: 17438585.

8. Freifeld AG, Bow EJ, Sepkowitz KA, Boeckh MJ, Ito JI, Mullen CA, Raad II, Rolston KV, Young JA, Wingard JR; Infectious Diseases Society of America. Clinical practice guideline for the use of antimicrobial agents in neutropenic patients with cancer: 2010 Update by the Infectious Diseases Society of America. Clin Infect Dis. 2011 Feb 15;52(4):427-31. doi: 10.1093/cid/ciq147. Epub 2011 Jan 4. PMID: 21205990.

9. Siegel RL, Giaquinto AN, Jemal A. Cancer statistics, 2024. CA Cancer J Clin. 2024 Jan-Feb;74(1):12-49. doi: 10.3322/caac.21820. Epub 2024 Jan 17. Erratum in: CA Cancer J Clin. 2024 Mar-Apr;74(2):203. doi: 10.3322/caac.21830. PMID: 38230766.

10. Mora-Bravo F, Muñoz J. Impaired Reconversion of Bone Marrow in Nuclear Magnetic Resonance in Patients with Chronic Renal Disease. Curr Med Imaging. 2021;17(10):1256-1261. doi: 10.2174/1573405616999201118140832. PMID: 33213332.

11. Torres PTM, Campoverde NR, Carcelen GLB, Mancheno JCS, Tipanta ÁCS, Perez-Grovas H, Abarca WPR. Blood pressure control with active ultrafiltration measures and without antihypertensives is essential for survival in hemodiafiltration and hemodialysis programs for patients with CKD: a prospective observational study. BMC Nephrol. 2025 Jan 17;26(1):30. doi: 10.1186/s12882-025-03948-0. PMID: 39825259; PMCID: PMC11742504.

12. Rivera-González SC, Pérez-Grovas H, Madero M, Saavedra N, López-Rodriguez J, Lerma C. Identification of impeding factors for dry weight achievement in end-stage renal disease after appropriate kidney graft function. Artif Organs. 2014 Feb;38(2):113-20. doi: 10.1111/aor.12133. Epub 2013 Jul 25. PMID: 23889479.

13. Abril J, Sánchez J. Características de la Enfermedad Renal Crónica en el Ecuador en el años 2009 hasta el 2012 [Tesis de grado]. Universidad de Cuenca. 2012. URL: dspace/0f483

14. Garcia RA, Spitzer ED, Beaudry J, Beck C, Diblasi R, Gilleeny-Blabac M, Haugaard C, Heuschneider S, Kranz BP, McLean K, Morales KL, Owens S, Paciella ME, Torregrosa E. Multidisciplinary team review of best practices for collection and handling of blood cultures to determine effective interventions for increasing the yield of true-positive bacteremias, reducing contamination, and eliminating false-positive central line-associated bloodstream infections. Am J Infect Control. 2015 Nov;43(11):1222-37. doi: 10.1016/j.ajic.2015.06.030. Epub 2015 Aug 19. PMID: 26298636.

15. Gorfinkel L, Hansen CE, Teng W, Shabanova V, Prozora S, Rodwin R, Qadri U, Manghi T, Emerson B, Riera A. Clinical decision rule for obtaining peripheral blood cultures in febrile oncology patients. Pediatr Blood Cancer. 2022 May;69(5):e29519. doi: 10.1002/pbc.29519. Epub 2021 Dec 22. PMID: 34939321.

16. Kobayashi S, Ito M, Sano H, Mochizuki K, Akaihata M, Waragai T, Hosoya M, Kikuta A. Clinical analysis of combination therapy for febrile neutropenic patients in childhood cancer. Pediatr Int. 2013 Feb;55(1):65-71. doi: 10.1111/ped.12025. PMID: 23240936.

17. Trecarichi EM, Tumbarello M. Antimicrobial-resistant gram-negative bacteria in febrile neutropenic patients with cancer: current epidemiology and clinical impact. Curr Opin Infect Dis. 2014 Apr;27(2):200-10. doi: 10.1097/QCO.0000000000000038. PMID: 24573013.

18. Nucci M. How I Treat Febrile Neutropenia. Mediterr J Hematol Infect Dis. 2021 Mar 1;13(1):e2021025. doi: 10.4084/MJHID.2021.025. PMID: 33747406; PMCID: PMC7938921.

Statements

Ethics committee approval and consent to participate

The Bioethics Committee of the National Oncology Institute-Solca, Guayaquil, Ecuador, approved the study.

Consent to publication

This information was not needed because the present study did not publish images, radiographs, or specific patient studies.

Conflicts of interest

The research has no financial interests or conflicts of interest.

Authors' information

Aníbal Bonilla Núñez, PhD in Medicine and Surgery from the University of Guayaquil (Guayaquil 2008). He holds a degree in Pediatrics from the University of Guayaquil (Guayaquil 2009). He is an attending physician at the Pediatric Oncology Service, Solca, Guayaquil.
Email: anibalbon@yahoo
ORCID https://orcid.org/0009-0008-2002-4188

Nelly Mariel Andrade Mejía, medical laboratory technician from the University of Guayaquil (Guayaquil 2009). She holds a degree in Clinical Laboratory Science from the University of Guayaquil (Guayaquil, 2012). She also has a Master's in Applied Microbiology from the Autonomous University of Barcelona (Spain, 2018). She is currently a member of the Microbiology Service staff at ION Solca Guayaquil.
linkedin.com/in/mariel-andrade-mejía-b654a5151
ORCID ORCID https://orcid.org/0009-0000-3239-7979

Sara Daniela Pérez Londo, MD from the University of Guayaquil (Guayaquil 2018). Resident physician at Alcívar Hospital.
Email: nany12-89@hotmail.com
ORCID https://orcid.org/0009-0009-5103-9451

Juanita Fabiola Aveiga Reinoso, PhD in Medicine and Surgery from the University of Guayaquil (Guayaquil, 2002). Specialist in Clinical Pathology from the University of Guayaquil (Guayaquil, 2010). Clinical Pathologist in the Microbiology Service of SOLCA Guayaquil.
Email: faveiga@solca.med.ec
ORCID https://orcid.org/0009-0004-3669-6676

Luis Enrique Espín Custodio, PhD in Medicine and Surgery from the University of Guayaquil (Ecuador, 2002). He holds a degree in Pediatrics from the University of Guayaquil (Ecuador, 2011). He is the Head of the Pediatric Oncology Service, Dr. Juan Tanca Marengo National Cancer Institute, Solca, Guayaquil.
ORCID https://orcid.org/0000-0003-0880-2377

Editor's Note

The Journal of Actas Medicas (Ecuador) remains neutral regarding jurisdictional claims in published maps and institutional affiliations.

Received: January 8, 2025.
Accepted: April 11, 2025.
Published: April 11, 2025.
Editor: Dr. Mayra Ordoñez Martínez.

How to cite:

Bonilla A, Andrade N, Pérez D, Aveiga F, Espín L. Blood cultures in pediatric oncology, epidemiology 2023 of the National Oncology Institute - Solca Guayaquil. Medical Acts (Ecuador) 2025;35(1):42-48.

Correspondence: Aníbal Bonilla Nuñez. Email: anibalbon@yahoo
Address: Av. Pedro J. Menéndez Gilbert and Atahualpa Chávez (next to the Atarazana citadel). Postal Code 090505
National Oncological Institute "Dr. Juan Tanca Marengo"-SOLCA. Guayaquil - Ecuador.
Telephone: [593] 04 371 8300 Ext 2218.