ECUATORIAN JOURNAL OF PEDIATRICS
rev-sepp.ec

ORIGINAL RESEARCH

Prevalence and associated factors for healthcare-associated infections in a pediatric setting and pediatric intensive care unit of the Vicente Corral Moscoso Hospital

Tania Pamela Barzallo Ochoa*[1], Christian Javier Campoverde Espinoza[2]
https://orcid.org/0000-0003-0363-7114

1. Pediatric Service, "Vicente Corral Moscoso" Hospital, Ministry of Public Health, Cuenca, Ecuador.
2. Postgraduate department of pediatrics, Faculty of Medical Sciences, Universidad de Cuenca.

Received: July 2, 2020
Accepted: September 19, 2020
Published: April 30, 2021
Editor: Dr. Pául Astudiilo Neira

Bibliographic letterhead:
Barzallo T, Campoverde C. Prevalence and associated factors of HAI in the pediatric service and pediatric intensive care unit of the Vicente Corral Moscoso Hospital. Rev. Ecuat. Pediatrics 2021: 22 (1): Article 3: 1-7. Doi: 10.52011 / 0091

STROBE Statement
DOI: https://doi.org/10.52011/0091

Abstract

Introduction: Healthcare-associated infections (HAI) are communicable infections that occur after 48 hours of hospitalization without being present at the time of admission. The aim of the present study was to determine the prevalence and risk factors for HAI in pediatric settings.

Methods: The present cross-sectional and analytical study was conducted in the pediatric area and pediatric intensive care unit (PICU) of the Vicente Corral Moscoso Hospital in Cuenca, Ecuador from May 2018-October 2019. Children aged 29 days to 16 years were included in a probabilistic sample. The observed variables were the presence of HAI, age, nutritional status, admission diagnosis, days of hospitalization, use of mechanical ventilation, use of catheters, hospitalization site, isolated germs, and antibiotic resistance. Descriptive statistics and the prevalence ratio (PR) are reported.

Results: There were 385 cases with 212 males (55.1%). The most prevalent age group was infants (31.4%). The prevalence of HAI was 13.5% (95% CI 13.33-13.68%). The main HAI was sepsis (40.4%) followed by pneumonia (36.5%). For the other variables, the PR was as follows: age <24 months PR 2.55 (95% CI 1.5-4.2, P <0.001), malnutrition PR 4.07 (95% CI 2.5-6.6, P <0.001), hospitalization >14 days PR 32.0 (95% CI 16.6-61.6, P <0.001), and central venous catheter PR 16.6 (95% CI 8.7-32.2, P <0.001).

Conclusions: There is a prevalence of HAI was higher than 10% and was associated with factors such as longer hospital stays, malnutrition, and the use of invasive devices.

Key words: Cross Infection; Pediatrics; Pediatric Intensive Care Unit; Risk Factors; malnutrition.

* Corresponding author:

Email: pamelillab@hotmail.com (Tania Pamela Barzallo Ochoa) Pediatric Service, Hospital Vicente Corral Moscoso Av. Los arupos and Av. 12 de abril, Cuenca, Ecuador.

Introduction

Healthcare-associated infections (HAI) are defined as: "Those infections acquired by a patient during treatment in a hospital or other health center that he did not have or was incubating at the time of admission, after 48 hours of hospital stay" (Centers for Disease Control and Prevention) [1].

All patients, regardless of their age, are exposed to the risk of acquiring an HAI at the time of their hospitalization; however, children are the most susceptible due to their degree of immunological immaturity having little or no previous experience with microorganisms or pathologies. Within the pediatric population, the newborn is the most vulnerable, due to immune deficiency inversely proportional to gestational age, followed by infants (2-24 months), with an average incidence of 25/100 hospital discharges. The normal production of antibodies and the maintenance of the immune response are influenced by the nutritional status of the patients. It is a main factor within the protective mechanisms; however, even when immune status is preserved, it is likely that the risk of in-hospital exposure is significant. The reason for hospitalization corresponds to another determining factor, especially when patients present underlying diseases, congenital malformations, or pathologies that require interventions or the use of invasive devices, which in turn determines the prolongation of the length of the hospital stay and greater contact with health personnel and medical teams [2]. The areas with the greatest risk for developing HAI are pediatric intensive care units (PICU) and neonatal intensive care units (NICU). These are units that treat patients with severe neutropenia or hemato-oncological diseases, and those patients requiring post-surgical care or invasive diagnostic methods or treatments. Given this information, various basic HAI control programs have been developed, such as hand washing, use of disinfectants, control of sterile equipment and physical areas, prevention of infections of health personnel, and the surveillance of specific aspects including the use of antibiotics, vascular access control, post-surgical infection control, infectious-contagious waste management, food control, among others [3]. The success of any program will depend on the commitment of the members of the health team to conduct their daily activities with the aim of improving the quality of care for patients and reducing the risk of contamination to which they are exposed [4]. The following question arises from the previous approach: Is the prevalence of HAI in the Pediatric Service and Pediatric Intensive Care Unit of the Vicente Corral Moscoso Hospital greater than 10% and is it positively associated with factors such as age (i.e., infants 2-24 months), nutritional status, admission diagnosis, days of hospitalization, surgeries performed, use of mechanical ventilation, invasive devices (central venous catheter, arterial line, urinary catheter) and the place of hospitalization? Therefore, the following observational study was proposed to answer these questions.

Population and methods

Study design

Cross-sectional and analytical study.

Stage

It was conducted from May 2018-October 2019 in the Pediatrics area and Pediatric Intensive Care Unit of the Vicente Corral Moscoso Hospital in Cuenca, Ecuador.

Participants

The selected sample consisted of all patients admitted to the Pediatric Service and Pediatric Intensive Care Unit of the institution, with ages ranging from 29 days of life to 15 years 11 months 29 days.

Sample calculation

The sample calculation was performed with the EpiInfo program version 7.0 (CDC, Atlanta, Georgia, USA), and the following information was considered: sample population (total patient admissions expected during the period May 2018 to October 2019): 3,935 patients, with an expected frequency of 50%, an error of 5%, and a confidence index of 95% The calculated sample was 350 patients. 10% was added due to losses, and a total sample (n) of 385 patients was obtained. The sample was chosen in a simple random method with the "Random Number Generator" program. https://www.augeweb.com/azar/

Variables

Dependent: nosocomial infection. Independent: age, nutritional status, admission diagnosis, days of

hospitalization, surgeries performed, use of mechanical ventilation, catheters, and the place of hospitalization (general ward, Intermediate Care, Isolation or Pediatric Intensive Care). Descriptive: isolated bacteria, type of culture, sensitivity, and antibiotic resistance.

Data/Measurement sources

The data were collected by the researcher who observed the patient's clinical history in the pediatric services and PICU and recorded it in the data collection form prepared by the author. Nutritional status was classified according to the WHO guidelines. The weight/age curve was used. The definition of nosocomial infection and its classification was based on the criteria of the Centers for Disease Control (CDC) and National Nosocomial Infection Surveillance (NNIS), which is used as a protocol for in-service diagnosis.

Control of sources of bias

Patients with incomplete medical history or data were excluded.

Statistical analysis

The quantitative variables in scale are presented with means and standard deviation. Nominal quantitative variables are presented with frequency and percentage. The data were coded and entered into a database in the SPSS program, version 15.0 (IBM, Chicago, USA).

Results

Participants

The target population was a total of 3,935 patients, of which 385 cases were selected in a simple random manner.

Characteristics of the studied population

There were 385 cases with 212 males (55.1%). The most prevalent age was infants with 31.4%. Most of the patients had a normal nutritional status (See Table 1), approximately 20% of the cases presented malnutrition. 264 cases (68.6%) had a hospital stay of less than 7 days in the general ward (see Table 1).

20.8% of the admissions to the pediatric service were for traumatic causes. Also, a significant percentage of patients presented with pneumological, gastroenterological, endocrine, metabolic, and cardiological conditions. 9.9% of patients used a central venous catheter and almost 40% underwent some type of surgical intervention (see Table 2).

Main results

We found that the total prevalence of HAI was 13.5% (95% CI 13.33-13.68%). The main HAI diagnosed in the pediatric setting was sepsis (40.4%), followed by pneumonia (36.5%), surgical wound infection (17.3%), and urinary tract infection (5.8%).

51 blood cultures were carried out, the most frequent group of bacteria were gram negative. In the 13 cultures of purulent secretion, gram-negative bacteria were isolated in 71.4%. In the 33 urine cultures, 69.7%. were negative. Yeasts and hyphae were observed in 23.5% (See Table 3).

7 cultures of other secretions were performed, such as catheter tips, probe tips, and tracheal aspirate. Again, the main isolated group was gram-negative bacilli, 57.1% (Table 3).

Table 1 Sex, age, nutritional status, days of hospitalization.

Variable	Frequency n=385	Percentage (%)
Sexo		
Female	173	44.9%
Male	212	55.1%
Age		
Infant	121	31.4%
Preschool	79	20.5%
School	98	25.5%
Teenagers	87	22.6%
Nutritional condition		
Malnourished	76	19.7%
Eutrophic	287	74.5%
Overweight	22	5.7%
Days of hospitalization		
Up to 7 days	264	68.6%
8 to 14 days	71	18.4%
15 to 21 days	28	7.3%
22 to 28 days	3	0.8%
> 28 days	19	4.9%
Place of hospitalization		
General room	318	82.6%
Isolation room	28	7.3%
Intermediate care	17	4.4%
PICU	22	5.7%

PICU: pediatric intensive care unit

Gram-positive cocci exhibited high resistance to penicillins (69.2%), when combined with beta-lactamase inhibitors (BLI) this decreased (15.4%). With gram-negative cocci, there was complete resistance to penicillin (100.0%), when combined with IBL it was lower (66.7%). The gram-negative bacilli were the most frequently reported group of bacteria in the different cultures (23 in total). High resistance to cephalosporins (56.5%), aminoglycosides (30.4%), and quinolones (26.1%) was observed (See Table 3).

Associated factors

We found a positive association between nosocomial infection and the variables of age (infants), malnutrition, intensive care, and hospitalization longer than 14 days. We also observed an association between nosocomial sepsis and the use of central venous catheter and arterial line with a prevalence ratio and confidence interval (CI 95%) greater than 1 and P value less than 0.05 (See Table 4).

Discussion

Currently, HAIs are an major cause of morbidity and mortality in hospitalized pediatric patients. The present study was conducted in a randomly selected sample of 385 patients. We report a prevalence of HAI of 13.5% (N = 52) in our setting. There are no studies on these data in the pediatric population. While national reports present a prevalence of 26.2%, in other countries in the region, such as Chile, the Ministry of Public Health published a global incidence of 10% and in Paraguay, prevalences between 7% and 11% are reported [5]. In Mexico, in a cross-sectional study in 2014, a prevalence of 9.2% was published [6].

Thus, there is a wide range in the prevalence, which is why reference studies constitute global statistics. For example, the WHO, in a study of 55 hospitals from 14 countries representing 4 regions (Europe, the Eastern Mediterranean, Southeast Asia and the Western Pacific), showed an average 8.7% prevalence of HAI [7]. In this regard, we must consider that due to preventive protocols and the surveillance of health systems, the worldwide figure has tended to decrease in recent years. For example, a study conducted in our institution in 2010, reported that the prevalence of HAI in all settings was 19.8% [8]. Currently, it is 13.5%, although this prevalence is 4.8% higher than the world prevalence.

Table 2 Diagnostics, procedures and cultures.

Frequency n=385		Percentage
Admission diagnosis		
Infectious diseases	104	27.00%
Traumatic injuries	80	20.80%
Acute abdomen	49	12.70%
Diseases of the digestive system	37	9.60%
Planned surgery	31	8.10%
Nervous system diseases	28	7.30%
Diseases of the respiratory system	16	4.20%
Endocrine, nutritional, metabolic diseases	15	3.90%
Congenital malformations and chromosomal abnormalities	8	2.10%
Tumors and neoplasms	6	1.60%
Mental and behavioral disorders	6	1.60%
Diseases of the blood and hematopoietic organs	5	1.30%
Invasive medical procedures		
Surgeries	153	39.70%
Mechanic ventilation	24	6.20%
Urinary catheter	21	5.50%
Central venous	38	9.90%
Arterial line	16	4.20%
Blood cultures n=51		
Negative	20	39.20%
Gram positive cocci	11	21.60%
Gram negative cocci	4	7.80%
Gram positive bacilli	3	5.90%
Gram negative bacilli	13	25.50%
Secretion culture n=14		
Negative	1	7.10%
Gram positive cocci	2	14.30%
Gram negative cocci	2	14.30%
Gram positive bacilli	1	7.10%
Gram negative bacilli	8	57.10%

This fact could be explained by the higher number of patients who undergo invasive medical procedures, and more complex entities typical of a specialty hospital of reference in the region. Regarding the type of infection, the most frequent was sepsis (40.4%) followed by pneumonia (35%). These data are similar to the global reference in which these two infections are reported as the top two infections with 33% and 19%, respectively [7].

In the present investigation, infants were the group at the highest risk in relation to their degree of immunological immaturity and little or no previous experience with some microorganisms. This is

corroborated in other studies. For example, in a prospective study carried out in 2003 in Brazil, there was an association of HAIs with this age group with a PR of 9.7 (95% CI 5.75-16.43) [2, 4]. Likewise, the Study of Prevalence of HAIs in Spain (EPINE) in 2018, reported a PR of 3.67 (95% CI 3.09-4.25) [9]. Malnutrition increases the risk of presenting HAI by 4 times, suggesting that adequate nutritional status is responsible for optimal immune response and corresponds to a protective mechanism for the host against infections and other diseases. This relationship could not be statistically confirmed. For example, studies carried out in Mexico describe a PR of 1.6 (95% CI 0.90-2.85) [10].

It has been determined that being admitted to an intensive care unit increases the risk of HAI, a phenomenon that can be explained by the high complexity of the patients hospitalized here, as well as the amount and type of invasive procedures to which they are subjected.

A prospective study conducted in 20 pediatric hospitals in 8 European countries describes the prevalence of HAI in Intensive Care Units as 24%, while in patients hospitalized in the general ward it was 2.6% [11]. Similarly, when hospitalization is longer than 14 days, there is a strong association since the time of exposure to contact with health equipment and medical devices increases. In this same study, there was a difference in the number of days of hospitalization of patients who developed HAI and those who did not. In this case, in Intensive Care it was 17.3-26.1 days versus 6-10.6 days and in the general ward it was 3.5-9.2 days versus 2.8-4.2 days [11].

Among invasive devices, the association with nosocomial sepsis was observed with the use of a central venous catheter and an arterial line. Similarly, in the EPINE-2018 study, they report the use of a central venous catheter with a PR of 21.6 (95% CI 20.6-22.6) and arterial line with a PR of 3.9 (95% CI 3.7-4.1). Likewise, the EPINE-2018 study determined that the use of a urinary catheter is a risk factor for nosocomial urinary infection with a PR of 14.12 (95% CI 13.48-14.76) and mechanical ventilation for nosocomial pneumonia with a PR of 29.59 (95% CI 27.16-32.01). In the present study, no statistically significant association was found with the use of urinary catheter and mechanical ventilation.

.

Table 3 Antibiogram results

	Gram Positive Cocci (n=13)		Gram Negative Cocci (n=6)		Gram Positive Bacilli (n=5)		Bacilos Gram Negativos (n=23)	
	Sensitive	Resistant	Sensitive	Resistant	Sensitive	Resistant	Sensitive	Resistant
Beta-lactams	30.8%	69.2%	0%	100%	0%	100%	0%	100%
Beta-lactams + BLI	84.6%	15.4%	33.3%	66.7%	20%	80%	8.7%	91.3%
Cephalosporins	100%	0%	83.3%	16.7%	60%	40%	43.5%	56.5%
Carbapenem	100%	0%	100%	0%	100%	0%	91.3%	8.7%
Macrolides	100hu%	0%	100%	0%	100%	0%	91.3%	8.7%
Aminoglycoside	100.00%	0.00%	100.00%	0.00%	80.00%	20.00%	69.60%	30.40%
Quinolones	100.00%	0.00%	85.70%	14.30%	100.00%	0%	73.90%	26.10%

BLI: beta-lactamase inhibitors

Table 4 Bivariate analysis of factors associated with HAIs

Variable(s)	Healthcare Associated Infections				PR	CI 95%	*P*
	Present		Absent				
	F=52	%	F=333	%			
Age (< 24 months)	28	53.85%	93	27.93%	2.55	1.54-4.20	<0.0001
Malnutrition	26	50.00%	50	15.01%	4.07	2.51-6.59	<0.0001
Hospitalization greater than 14 days	43	82.60%	7	2.10%	32.01	16.64-61.57	<0.0001
Need for intensive care	15	28.85%	7	2.10%	6.69	4.40-10.16	<0.0001
Surgery	17	32.69%	136	40.84%	0.74	0.43-1.27	0.70
Central venous catheter	15	28.85%	23	6.91%	22.17	9.83-50.05	<0.0001
Arterial line	8	15.38%	8	2.40%	16.47	8.70-31.20	<0.0001
Mechanic ventilation	3	5.77%	21	6.31%	2.82	0.88-9.01	0.077

PR: Pevalence ratio. CI: confidence interval

It is important to emphasize the high antibiotic resistance found in this study. The limitation of this study is that the origin of the data (medical history) was the main source.

Conclusions

The prevalence of HAI was 13.5%; the age group at the greatest risk was infants. The main associated factors were malnutrition, days of hospitalization (> 14 days), admission to the Intensive Care Unit, and the use of a central venous catheter and arterial line. The predominant type of infection was nosocomial sepsis and the group of bacteria that was isolated most frequently were gram-negative bacilli followed by gram-positive cocci.

Abbreviations

CDC: Disease Control. HAI: health care associated infections. NNIS: National Nosocomial Infection Surveillance. WHO: World Health Organization. PR: Prevalence ratio. PICU: Pediatric intensive care. NICU: Neonatal Intensive Care Unit.

Acknowledgments

The authors thank the authorities of the Faculty of Medicine of the University of Cuenca and the Vicente Corral Moscoso Hospital, the place where the study was carried out.

Authors' contributions

TPBO: conceptualization, data curation, formal analysis, fund acquisition, research, resources, software, writing - original draft.
CJCE: supervision, validation, visualization, methodology, project management, writing: review and edition.
All authors read and approved the final version of the manuscript.

Authors' information

1 Barzallo Ochoa Tania Pamela, Physician from the Universidad de Cuenca (2009), Specialist in Pediatrics from the Universidad de Cuenca, Ecuador (2020). Email: pamelillab@hotmail.com https://orcid.org/0000-0002-1407-1235.

2 Campoverde Espinoza Christian Javier, Physician from the Universidad de Cuenca (2007), Specialist in Pediatrics from the Universidad de Buenos Aires, Argentina (2016), Specialist in Pediatric Infectology from the Universidad de Buenos Aires, Argentina (2018), Higher Diploma in Primary Health Care from the Universidad de Guayaquil, Ecuador (2013). Email: christian.espinoza@ucuenca.edu.ec https://orcid.org/0000-0003-0363-7114

Financing

The authors financed the expenses incurred in the production of this research.

Availability of data and materials

The data sets generated and / or analyzed during the current study are not publicly available due to the confidentiality of the participants, but are available through the corresponding author upon reasonable academic request.

Ethical statements

The protocol for this research was approved by the Bioethics Commission of the Faculty of Medical Sciences of the University of Cuenca and the Teaching and Research Commission of the Vicente Corral Moscoso hospital.

Protection of people

The authors declare that the procedures followed were in accordance with the ethical standards of the responsible human experimentation committee and in accordance with the World Medical Association and the Singapore Declaration.

Data confidentiality

The authors declare that they have followed the protocols of their work center on the publication of patient data without identification.

Publication consent

The present study did not involve direct interaction with the participants, so informed consent was not required. The data obtained are generated daily as a result of the registration of the activity of the Pediatrics service and were used only in the research work and recorded in a database with an identification code, maintaining confidentiality.

Conflicts of interest

The authors declare not to have any interest conflicts.

References

1. CDC/NHSN. Surveillance Definition of Healthcare-Associated Infection and Criteria for Specific Types of Infections in the Acute Care Setting [Internet] Library of Medicine (US); 2017. [Actualizado Noviembre 2017]. SU: cdc.

2. Vaque J. Sociedad española de Medicina Preventiva Salud Publica e Higiene, estudio EPINE 2012 y encuesta puntual de prevalencia en los hospitales de agudos de Europa (EPPS) protocolo [Internet]. Ministerio de Sanidad España;. SU: MSE

3. Organización Mundial de la Salud (sede web). Dinamarca: OMS; 2013 (actualizado en 2014, citado Noviembre 2019). SU: WHO

4. Organización Panamericana de la Salud [Internet]. Washington, D.C: Biblioteca OPS; 2003 [actualizado en 2013; citado en Octubre 2017]. SU: paho

5. Gobierno de Chile, Subsecretaría de Redes Asistenciales. Indicadores IAAS [Internet].Santiago: Gob; 2018 [actualizado 15 mayo 2019; citado 15 nov 2019]. SU: minsal

6. Castañeda F, Valdespino M. Prevalencia de IAAS en un Hospital de segundo nivel de atención en México. Rev Med Inst Mex Seg Soc 2015;53(6):86-90

7. Organización Mundial de la Salud (sede web). USA: OMS; 2002 (actualizado en 2009). SU: WHO/EPH/2002

8. Salcedo R. Características de las infecciones nosocomiales en el servicio de cuidados intensivos pediátricos del Hospital Vicente Corral Moscoso, Cuenca 2014-2015 (tesis de titulación). Cuenca-Ecuador: Universidad de Cuenca; 2015. 60 p

9. Socieda Española de Medicina Preventiva. Estudio de Prevalencia de las IAAS en España (EPINE) [Internet] Madrid: EPPS; 2018 [actualizado 11 Abril 2019; citado 10 Dic 2019). **SU**: epine

10. Avila-Figueroa C, Cashat-Cruz M, Aranda-Patrón E, et al. Prevalencia de infecciones nosocomiales en niños: encuesta de 21 hospitales en México. Salud Pública Mex. 2014; 41(1):S18-S25.

11. .Raymond J, Aujard Y. Nosocomial Infections in Pediatric Patients: A European Multicenter Prospective Study. 2000; 21(4): 260-263

DOI: Digital Object Identifier
PMID: PubMeD Identifier
SU: Short URL

Editor's Note

The Ecuatorian Journal of Pediatrics remains neutral with respect to jurisdictional claims on published maps and institutional affiliations.