**DOI: 10.17058/reci.v14i3.19171**

**ORIGINAL ARTICLE**

# Demographic and clinical factors associated with hospital infections in burned children and adolescents

*Fatores demográficos e clínicos associados às infecções hospitalares em crianças e adolescentes vítimas de queimaduras*

*Factores demográficos y clínicos asociados a las infecciones hospitalarias en niños y adolescentes víctimas de quemaduras*

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Submitted: 03/29/2024
Accepted: 09/12/2024



## ABSTRACT

**Background and Objectives:** burns are a leading cause of domestic accidents and the third leading cause of mortality in children and adolescents under 14 years old. This study aimed to identify demographic and clinical factors associated with healthcare-associated infections (HAIs) in burn victims under 18 years old treated at a Burn Treatment Center (BTC). **Methods:** this cross-sectional analytical study was conducted at the BTC of a public hospital using HAI notification records and medical records of patients under 18 years hospitalized from 2009 to 2019. The demographic variables considered were sex and age, while the clinical variables included causal agent, total body surface area (TBSA), burn depth, duration and location of hospitalization, dates of admission and infection detection, diagnosis of HAIs, invasive and surgical procedures, site of infection, etiological agent, antimicrobial susceptibility profile, antimicrobial agents used in the treatment of infections, diagnosis of sepsis and septic shock as well as the clinical outcome. Absolute and relative frequencies were used, and the chi-square test was applied for categorical variables. Multivariate analysis was conducted using Poisson regression with robust variance adjustment. **Results:** among the 591 victims, 187 (31.6%) developed HAIs. HAIs were associated with larger TBSA, third-degree burns, longer hospitalization, and mortality. Factors associated with HAIs included burn area ≥21%, hospitalization ≥15 days, and mortality. The prevalent microorganisms were multidrug-resistant (MDR) *Acinetobacter baumannii* and MDR *Pseudomonas aeruginosa*.

**Conclusion:** children with severe burns and prolonged hospitalization were more vulnerable to HAIs and associated mortality.

**Keywords:** *Child. Adolescent. Burns. Nosocomial Infection.*

## RESUMO

**Justificativa e Objetivos:** as queimaduras são uma das principais causas de acidentes domésticos e a terceira principal causa de mortalidade em crianças e adolescentes menores de 14 anos. O objetivo deste estudo é identificar os fatores demográficos e clínicos associados às infecções relacionadas à assistência à saúde (IRAS) em vítimas de queimaduras menores de 18 anos atendidas no Centro de Tratamento de Queimados (CTQ). **Métodos:** estudo transversal analítico, realizado no CTQ de um hospital público, utilizando fichas de notificação de IRAS e prontuários de pacientes menores de 18 anos hospitalizados de 2009 a 2019. As variáveis demográficas consideradas foram sexo e idade, enquanto as variáveis clínicas incluíram agente causal, superfície corporal queimada (SCQ), profundidade da queimadura, tempo e local de hospitalização, datas de admissão e de detecção da infecção, diagnóstico de IRAS, procedimentos invasivos e cirúrgicos, sítio da infecção, agente etiológico, perfil de sensibilidade aos antimicrobianos, antimicrobianos utilizados no tratamento das infecções, diagnóstico de sepse e choque séptico, além do desfecho clínico. Foram utilizadas frequências absolutas e relativas, e o teste qui-quadrado foi usado para variáveis categóricas. A análise multivariada foi conduzida por regressão de Poisson com ajuste de variância robusta. **Resultados:** entre as 591 vítimas, 187 (31,6%) desenvolveram IRAS. As IRAS foram associadas a maior SCQ, queimaduras de 3° grau, maior tempo de hospitalização e óbito. Fatores associados às IRAS incluíram área queimada ≥21%, tempo de hospitalização ≥15 dias e óbito. Microrganismos prevalentes foram *Acinetobacter baumannii* multirresistente (MR) e *Pseudomonas aeruginosa* MR. **Conclusão:** crianças com queimaduras graves e prolongada hospitalização apresentaram maior vulnerabilidade às IRAS e óbitos associados.

**Descritores:** *Criança. Adolescente. Queimaduras. Infecção Hospitalar.*

## RESUMEN

**Justificación y Objetivos:** las quemaduras son una de las principales causas de accidentes domésticos y la tercera causa principal de mortalidad en niños y adolescentes menores de 14 años. Este estudio tiene como objetivo identificar los factores demográficos y clínicos asociados a las infecciones relacionadas con la asistencia sanitaria (IRAS) en víctimas de quemaduras menores de 18 años atendidas en el Centro de Tratamiento de Quemaduras (CTQ). **Métodos:** estudio transversal analítico, realizado en el CTQ de un hospital público utilizando registros de notificación de IRAS y prontuarios de pacientes menores de 18 años hospitalizados de 2009 a 2019. Las variables demográficas consideradas fueron sexo y edad, mientras que las variables clínicas incluyeron agente causal, superficie corporal quemada (SCQ), profundidad de la quemadura, tiempo y lugar de hospitalización, fechas de admisión y detección de la infección, diagnóstico de IRAS, procedimientos invasivos y quirúrgicos, sitio de la infección, agente etiológico, perfil de sensibilidad a los antimicrobianos, antimicrobianos utilizados en el tratamiento de las infecciones, diagnóstico de sepsis y shock séptico, además del desenlace clínico. Se utilizaron frecuencias absolutas y relativas, y se aplicó la prueba chi-cuadrado para variables categóricas. El análisis multivariado se realizó

mediante regresión de Poisson con ajuste de varianza robusto. **Resultados:** de las 591 víctimas, 187 (31,6%) desarrollaron IRAS. Las IRAS se asociaron con una mayor SCQ, quemaduras de tercer grado, mayor tiempo de hospitalización y mortalidad. Los factores asociados a las IRAS incluyeron área quemada ≥21%, tiempo de hospitalización ≥15 días y mortalidad. Los microorganismos prevalentes fueron *Acinetobacter baumannii* multirresistente (MR) y *Pseudomonas aeruginosa* MR. **Conclusión:** los niños con quemaduras graves y hospitalización prolongada presentaron una mayor vulnerabilidad a las IRAS y a la mortalidad asociada.

**Palabras Clave:** *Ninõ. Adolescente. Quemaduras. Infección Hospitalaria.*

## INTRODUCTION

Burns are one of the main causes of domestic accidents, and represent the third leading cause of mortality in children and adolescents under 14 years of age.[1,2,3] With a global estimate of 180,000 deaths annually, the impact of burns on public health is significant.[4] In Brazil, the Brazilian Burn Society reports around 1 million cases annually, with 2,500 deaths, resulting directly from burns or from complications such as infections, sepsis or organ failure.[5]

Children and adolescents are particularly vulnerable to burns, due to their age-related characteristics of being observant and curious, which exposes them to high risks.[1,2] Furthermore, the fragility of the developing immune system and long hospitalization contribute to the proliferation of resistant microorganisms, complicating clinical picture and prolonging recovery.[5,6,7]

Some factors favor the development of secondary infections, including the skin and mucosa integrity breakdown, which leads to a loss of the barrier against microorganisms; increased capillary permeability, which facilitates the migration of microorganisms and toxins into the bloodstream; and immunosuppression associated with trauma.[6,7] Burn patients are exposed to invasive and surgical procedures and prolonged hospitalization, increasing the risk of healthcare-associated infections (HAIs), which can occur during hospitalization or after discharge.[8,9,10,11] Although there are studies on the vulnerability of children and adolescents to burns and their complications, the publication adds value to the existing literature by offering a detailed and specific analysis on HAIs in this age group.[5,7,12] Understanding these aspects better is essential to develop more effective prevention and treatment strategies, aiming to reduce mortality associated with burns and infections in these vulnerable groups.[12] Therefore, the present study aims to identify the demographic and clinical factors associated with HAIs in burn victims under 18 years of age treated at the Burn Treatment Center (BTC).

## METHODS

This is an analytical cross-sectional study conducted at the BTC of a public university hospital that is a reference for the northern region of Paraná and other neighboring states. The BTC was opened in 2007 and currently has ten ward beds, eight beds in the Burn Treatment Unit (BTU), an Emergency Room, two surgical rooms, a balneotherapy room, an outpatient clinic and a hyperbaric oxygen therapy room.

The study population consisted of children and adolescents under the age of 18, of both sexes, hospitalized for burns, from January 2009 to December 2019. Patients under the age of 18 hospitalized for burns in a period longer than 24 hours were included. Admissions for elective surgeries were excluded.

The classification of patients as children and adolescents was carried out in accordance with the Brazilian Child and Adolescent Statute (In Portuguese, *Estatuto da Criança e do Adolescente* - ECA), which defines children as individuals up to 12 years of age and adolescents as those aged 12 years up to 18 years.[13]

For data collection, the institution's statistics department provided records of all patients admitted to the BTC during the period of interest. The unit's spreadsheets, physical medical records and the MedvVew computerized system, which allows access to electronic medical records and laboratory tests, were also used.

Regarding the diagnosis of HAIs, this was obtained through individual forms, with the notification of HAIs filled out by the Hospital Infection Control Commission (HICC) team, which evaluates children with infectious diseases, in accordance with the International Classification of Diseases (ICD-10) and the Brazilian National Health Regulatory Agency (In Portuguese, *Agência Nacional de Vigilância Sanitária* - ANVISA) definition, in accordance with the revisions of the diagnostic criteria established by ANVISA.

It is noteworthy that information with the diagnosis of HAIs was included in accordance with the notifications of all infections associated or not with invasive devices as well as that infections were acquired during individuals' stay in the hospital and after the first 48 hours of hospitalization, associated with laboratory tests and clinical signs specific to each type. In cases where patients presented a new episode of infection associated with invasive devices, it was only considered after a period of 14 days, with the presence of new episodes of signs and symptoms and with positive laboratory test results.

For the classification of antimicrobial resistance, microorganisms were divided into two groups: multidrug-resistant (MDR), which included Gram-negative bacilli, resistant to 3rd and 4th generation cephalosporins, extended-spectrum β-lactamase (ESBL) producers and oxacillin-resistant *Staphylococcus*, and carbapenem-resistant (CR) Gram-negative bacilli.[14]

The total body surface area (TBSA) was calculated by a plastic surgeon using the Lund and Browder diagram and recorded in the admission medical record. A previously developed and tested instrument was used to collect information, containing demographic and clinical variables. Data collection took place from August to September 2020.

Information was entered into a Microsoft Excel® spreadsheet, in which demographic variables were categorized according to sex (male and female) and age (≤1 year, 2 to 6 years, ≥7 to 11 years and ≥12 to <18 years). Clinical variables were: causal agent (scald, flame and others, such as electrical, contact with heated surface and chemical); TBSA (≤10%, 11% to 24%, and ≥25%); burn depth (2nd, 3rd, or 2nd and 3rd degrees combined); length of hospital stay (≤14 days and >15 days); place of hospitalization; date of admission and infection detection; diagnosis of HAI (yes and no); invasive and surgical procedures (yes and no); infection site; etiologic agent; antimicrobial sensitivity profile; antimicrobial agents used in the treatment of infections; diagnosis of sepsis and septic shock (yes and no); and outcome (discharge or death). Subsequently, the IBM Statistical Package for the Social Sciences (SPSS) version 20.0® was used for statistical analysis, taking into account the significance level of $p<0.05$.

In descriptive analysis, absolute and relative frequencies were used for the variables sex, age group, TBSA, burn depth, length of hospital stay, outcome, invasive procedures, surgical procedures, HAIs and complications. To verify the difference between categorical variables, the chi-square test was ($x^2$) was applied. In multivariate analysis, Prevalence Ratios (PR) and their respective 95% Confidence Intervals (95% CI) were calculated using Poisson regression, with robust variance adjustment. This regression model allows us to evaluate the relationship between qualitative factors and a binary response variable.

Collinearity diagnosis was performed to determine whether the variables were correlated. When constructing the multivariate model, the crossover of the predictor variables sex, age group, TBSA, burn depth, causal agent (scald, flame and others), length of hospitalization (≤14 days and >15 days) and outcome (discharge and death) with the

response variable presented HAI (yes or no) was considered. After multivariate analysis, the backward method was used, which removes, one by one, the factors with a p-value >0.20 from the model, with the aim of controlling confounding factors. Thus, the final adjusted model was composed of these predictor variables: TBSA; burn depth; length of hospital stay; and outcome discharge or death. In all stages, model adjustment tests were applied (Omnibus test, model effects test and Akaike Information Criteria (AIC)).

This study is an excerpt from the research project entitled "*Avaliação das Infecções Relacionadas à Assistência à Saúde em Crianças e Adolescentes*", and complied with the ethical precepts established by the Ministry of Health (Brazilian National Health Council Resolutions 466/2012, 510/2016 and 580/2018), authorized by the hospital management and approved by the institution's Research Ethics Committee on July 21, 2020, under Opinion 4,165,597, with Certificate of Approval for Ethical Consideration (In Portuguese, *Certificado de Aprovação para Apreciação Ética* - CAAE) 28-68119.6.0000.5231.

## RESULTS

During the study period, 591 children and adolescents under 18 years of age were hospitalized due to burns, of which 187 (31.6%) developed HAIs. The analysis of victims who acquired HAIs showed similarity between sexes and age group, without statistical significance. However, the age group of 2 to 6 years was the most prevalent in burn accidents. Children and adolescents with higher TBSA (≥ 25%), 3rd degree burns, flame burns, length of hospitalization (≥ 15 days) and with death outcome had a higher percentage of HAIs, with statistical significance (Table 1).

**Table 1**. Distribution of demographic and clinical variables of children under 18 years of age hospitalized for burns and who developed healthcare-associated infection. Londrina, Paraná, Brazil, 2009-2019

| Variables | Total (n=591) | | HAIS | | p-value[a] |
|---|---|---|---|---|---|
| | | | Yes (n=187) | No (n=404) | |
| | n | % | n (%) | n (%) | |
| **Sex** | | | | | |
| Male | 390 | 66 | 120 (30.8) | 270 (68.2) | 0.293 |
| Female | 201 | 34 | 67 (33.3) | 134 (66.7) | |
| **Age group** | | | | | |
| ≤1 year | 28 | 4.7 | 8 (28.6) | 20 (71.4) | |
| 2 a 6 years | 322 | 54.5 | 100 (31.1) | 222 (68.9) | 0.802 |
| ≥7 to 11 years | 116 | 19.6 | 41 (35.3) | 75 (64.7) | |
| ≥12 to <18 years | 125 | 21.2 | 38 (30.4) | 87 (69.6) | |
| **TBSA*** | | | | | |
| ≤10% | 322 | 54.5 | 38 (11.8) | 284 (88.2) | |

| | | | | | |
|---|---|---|---|---|---|
| 11% to 24% | 195 | 33 | 91 (46.7) | 104 (53.3) | |
| ≥25% | 74 | 12.5 | 58 (78.4) | 16 (21.6) | **< 0.001** |
| **Burn depth** | | | | | |
| 2nd degree | 139 | 23.5 | 58 (41.7) | 81 (58.3) | |
| 2nd and 3rd degrees | 354 | 59.9 | 55 (15.5) | 299 (84.5) | |
| 3rd degree | 98 | 16.6 | 74 (75.5) | 24 (24.5) | **< 0.001** |
| **Causal agent** | | | | | |
| Scald | 327 | 55.3 | 88 (26.9) | 239 (73.1) | |
| Flame | 219 | 37.1 | 93 (42.5) | 126 (57.5) | **< 0.001** |
| Others** | 45 | 7.6 | 6 (13.3) | 39 (86.7) | |
| **Length of hospitalization** | | | | | |
| ≤ 14 days | 369 | 62.4 | 50 (13.6) | 319 (86.4) | |
| > 15 days | 222 | 37.6 | 137 (61.7) | 85 (38.3) | **< 0.001** |
| **Outcome** | | | | | |
| Discharge | 570 | 96.4 | 171 (30.0) | 399 (70.0) | |
| Death | 21 | 3.6 | 16 (76.2) | 5 (23.8) | **< 0.001** |

Source: the authors (2021).
Note: [a]chi-square test; *burned body surface; **others: electrical, contact with heated surface and chemical.

Among the children and adolescents who developed HAIs, 127 (67.9%) required intensive care for a period of stay that varied from one to 119 days and a median of ten days.

Those with a larger TBSA area, longer hospital stay and death were significantly associated with HAIs. Second- and third-degree burns proved to be a protective factor when compared to third-degree burns. Data analysis suggests a higher frequency of second-degree burns compared to third-degree burns (Table 2).

**Table 2**. Adjusted multivariate analysis of variables regarding clinical aspects associated with healthcare-associated infection (n=187) according to a robust Poisson regression model. Londrina, Paraná, Brazil, 2009-2019

| Variables | $PR_a$ | 95% $CI_b$ | P-$value_c$ |
|---|---|---|---|
| **Total body surface area** | | | |
| ≥ 25% | 2.47 | 1.75 – 3.57 | <0.001 |
| 11% to 24% | 2.26 | 1.60 – 3.19 | <0.001 |
| ≤ 10% | 2.00 | – | – |
| **Burn degree** | | | |
| 3rd degree | 1.16 | 0.93 – 1.45 | 0.001 |
| 2nd and 3rd degrees | 0.48 | 0.36 – 0.64 | <0.001 |
| 2nd | 1.00 | – | – |
| **Length of hospitalization** | | | |
| >15 days | 2.58 | 1.90 – 3.48 | <0.001 |
| ≤14 days | 1.00 | – | – |
| **Outcome** | | | |
| Death | 1.36 | 1.02 – 1.80 | 0.003 |
| Discharge | 1.00 | – | – |

Source: the author (2021).

Note: [a]adjusted prevalence ratio; [b]Confidence Interval; [c]p-value for Poisson regression with robust variance.

Table 3 describes the distribution of procedures performed in individuals with HAI. Central catheter insertion was the most common procedure (28.8%), followed by surgeries with two or more debridement (48.1%).

Some children and adolescents had more than one infection (1.72%), totaling 321 infections, with a predominance of skin and soft tissue infection (SSTI) (31.2%) and ventilator-associated pneumonia (VAP) (30.8%). It is noteworthy that 64.7% of the population developed sepsis.

**Table 3**. Distribution of invasive and surgical procedures in children and adolescents who were victims of burns and had healthcare-associated infections (n=187). Londrina, Paraná, Brazil, 2009-2019

| Variables | Total n (%) |
|---|---|
| **Invasive procedures** | |
| Central catheter | 158 (28.8) |
| Indwelling bladder catheter | 133 (24.2) |
| Peripheral catheter | 129 (23.5) |
| Mechanical ventilator | 129 (23.5) |
| **Surgical procedures** | |
| Number of debridement | |
| 1 debridement | 89 (47.6) |
| 2 or more debridement | 90 (48.1) |
| No indication | 8 (4.3) |
| **Number of grafts** | |
| 1 graft | 78 (41.7) |
| 2 or more grafts | 49 (26.2) |
| No indication | 60 (32.1) |
| **Associated infections*** | |
| Skin and soft tissue infection | 100 (31.2) |
| Ventilator-associated pneumonia | 99 (30.8) |
| Catheter-associated urinary tract infections | 41 (12.8) |
| Catheter-associated bloodstream infection | 32 (9.9) |
| Pneumonia | 26 (8.1) |
| Bloodstream infection | 23 (7.2) |
| **Complications** | |
| **Sepsis** | |
| Yes | 121 (64.7) |
| No | 66 (35.3) |
| **Septic shock** | |
| Yes | 25 (20.7) |
| No | 96 (79.3) |

Source: the author (2021).
Note: *presented more than one infection.

Among the laboratory results, 196 positive cultures were found with 114 isolated microorganisms, of which 73 demonstrated resistance to antimicrobial agents. Gram-negative bacilli were predominant (70.9%), including MDR (30.7%) and CR (9.6%) *Acinetobacter baumannii*, in addition to MDR (16.6%) and (14.0%) CR *Pseudomonas aeruginosa*. Gram-positive bacilli accounted for 22.1% of the total, with coagulase-

negative *Staphylococcus* (7.0%) and methicillin-resistant *Staphylococcus aureus* (MRSA) (4.4%) standing out. Fungal infections were observed in 7.0% of cases. A total of 693 antimicrobial agents and/or antifungals were prescribed, varying according to age group. For children under 11 years of age, the most common were amikacin sulfate and sulbactam sodium + ampicillin sodium and piperacillin + tazobactam. Adolescents received vancomycin, meropem, and tigecycline.

## DISCUSSION

The difference in HAI rates between the sexes was small, suggesting that sex may not be a significant determinant of HAI risk or that other factors have a greater influence. Although the variation in HAI rates between different age groups was not significant, analysis of the demographic characteristics of the total sample indicates the relevance of additional risk factors and the need for personalized care.

A study in southern Brazil revealed a similarity in the high number of hospitalizations due to burn accidents, with 8,256 hospitalizations, with Paraná being the state with the highest rates.[3] This analysis highlights the need for preventive measures and increased surveillance to reduce the prevalence of burns in children, requiring specific care for each age group.[3]

In this study, a HAI rate of 31.6% was identified. Among patients with HAI, TBSA was higher than 25%. Flame was the most frequently identified causal agent in cases of HAI, aggravating the extent and depth of lesions. However, in the total sample, scald was the most common causal agent. These results corroborate other studies, which indicate that lesions caused by flames result in greater extent and depth of the body area, increasing susceptibility to nosocomial infection.[8,15]

Analysis revealed a strong association between TBSA and the prevalence of HAIs, with a higher risk of infections in patients with extensive burns. Children and adolescents with third-degree burns had a 1.16-fold higher prevalence of HAIs compared to those with second-degree burns.

The most frequent infections were skin and soft tissue infections, followed by VAP and urinary tract infection (UTI) associated with indwelling urinary catheters. These results are in line with systematic research that has indicated a high number of SSTIs in burn victims, representing a global problem.[12] Thermal injuries compromise tissue integrity and alter the immune system, hindering healing and increasing vulnerability to secondary infections, prolonging hospital stays.[2,8,17]

It was observed that patients hospitalized for more than 15 days had a prevalence of HAIs 2.58 times higher than patients hospitalized for 14 days or less, highlighting the impact of prolonged exposure to hospital environments on the likelihood of infections. This finding reinforces the importance of effective infection control protocols and strategies to reduce hospital stay when appropriate.[2]

The main microorganisms found in skin infections were MDR *Pseudomonas aeruginosa, Acinetobacter baumannii* and *Staphylococcus aureus*. These data are in line with a study that highlights the vulnerability of burn victims to *Pseudomonas aeruginosa* infections.[7]

Critically ill patients, including burn patients, require continuous care and support to maintain vital functions, which may be associated with high rates of VAP. In this study, VAP was the second most prevalent infection, with the presence of pathogens such as *Acinetobacter baumannii* and *Pseudomonas aeruginosa* in tracheal secretion examinations, highlighting the vulnerability of burn patients to nosocomial infections.[16]

Children and adolescents have undergone a variety of invasive procedures, which are potential contributors to infections or complications, indicating the need for rigorous infection control practices and aseptic techniques during insertion and maintenance.[18]

In a systematic review, the authors identified that burn patients who previously used β-lactams and invasive devices had a higher risk of infections by MDR Gram-negative.[18] These findings corroborate the present study, which also observed a higher prevalence of MDR Gram-negative.[18]

Another systematic review highlighted that patients hospitalized in BTUs were at high risk of developing secondary MRSA infections, with outbreaks reported in several centers. The authors emphasized that MRSA was responsible for serious complications, such as pneumonia, sepsis, and bacteremia.[11] These results confirm the vulnerability of burn patients to nosocomial infections by MDR microorganisms, highlighting the importance of rigorous infection control measures and constant monitoring to prevent these complications.[12,18]

Regarding antimicrobial susceptibility tests, studies highlight the predominance of Gram-negative bacilli, mainly *Pseudomonas spp*. and *Acinetobacter spp*. MDR to antimicrobial agents.[9] High rates of antimicrobial resistance limit effective treatment in the population with burns, causing several complications and a major financial impact, constituting a global health problem.[7,17]

Drug resistance is occurring rapidly, especially in developing countries, due to the lack of resources for laboratory tests and medications, which hinders the choice of the appropriate drug. This situation is particularly serious in burn victims, due to exposure and immunosuppression, leading to infections and sepsis.[19] A high percentage of the population studied developed sepsis. In the literature, 75% of deaths in severe burn victims were caused by sepsis resulting from skin infections.[12,19]

The association between outcome and HAIs revealed that patients who died had a higher prevalence of HAIs compared to those who were discharged. This result reflects the severity of infectious complications and the need for intensive surveillance and early treatment to minimize infectious complications and avoid fatal outcomes.

Among the limitations of the study, the lack of specificity and underreported information in the medical records, with data obtained from secondary sources, stand out. In addition, it was not possible to access all the medical records, making it impossible to combine some clinical variables for comparison between groups.

The study revealed that children with larger TBSA area, prolonged hospitalization time and death outcome were associated with higher prevalence of HAIs. It was also found that children and adolescents underwent various invasive and surgical procedures, which represents risk factors for acquiring secondary infections, such as UTI, bloodstream infection and pneumonia. SSTI and VAP were the most prevalent HAIs, with a predominance of MDR *Acinetobacter baumannii* and *Pseudomonas aeruginosa*.



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All authors approved the final version to be published and are responsible for all aspects of the work, including ensuring its accuracy and integrity.