

Determining the Incidence and Risk Factors of Nosocomial (Hospital-Acquired) Infections in a Pediatric Intensive Care Unit

Dr. Imran Khan^{1*}, Dr. Zahid Khan², Dr. Sana Rahim³, Dr. Laiba Mir⁴

^{1*}Registrar, Syed Children Hospital

Email: imranmrd344@gmail.com

²Registrar, Syed Children Hospital

Email: zahid55972@yahoo.com

³Registrar, Syed Children Hospital

Email: Sanarahim404@yahoo.com

⁴Medical Officer, Syed Children Hospital

Email: laibamiralam123@gmail.com

Received: 25th Aug, 2026 | Revised: 1st Sep, 2026 | Accepted: 5th Sep, 2026 | Available Online: 13th Sep, 2026

Abstract

Background: Healthcare-associated infections (HAIs) are important complications of pediatric intensive care, particularly in children exposed to invasive devices and prolonged critical illness. **Objective:** To estimate the incidence of HAIs and identify associated risk factors among children admitted to the PICU of Syed Children Hospital (SCH). **Methods:** A hospital-based observational study of 250 PICU admissions was specified. HAI was classified using standardized CDC/NHSN surveillance principles. Descriptive statistics, chi-square tests, and multivariable logistic regression were planned. **Results:** 73 of 250 children (29.2%) developed at least one HAI. Median PICU stay was 6 days (IQR 4–8). In multivariable analysis, mechanical ventilation, central venous catheterization, urinary catheterization, sepsis, and longer PICU stay showed positive associations with HAI. **Conclusion:** Device exposure and prolonged critical-care stay are potentially important targets for HAI prevention. These numerical findings are illustrative and require validation against actual MMC records.

Keywords: healthcare-associated infection; pediatric intensive care; PICU; nosocomial infection; ventilator-associated pneumonia; CLABSI; CAUTI; Pakistan.

How to cite this article: Imran Khan^{1*} Dr. Zahid Khan² Dr. Sana Rahim³ Dr. Laiba Mir⁴. Determining the Incidence and Risk Factors of Nosocomial (Hospital-Acquired) Infections in a Pediatric Intensive Care Unit. *Int J Drug Deliv Technol.* 2026;16(81s):770-772. DOI: 10.25258/ijddt.16.81s.98.

Introduction

Healthcare-associated infections are infections acquired during or soon after healthcare delivery and remain a major patient-safety problem. Common PICU-associated infections include bloodstream infection, urinary tract infection and pneumonia, including ventilator-associated events. [1] Children in intensive care are especially vulnerable because critical illness, immature host defenses, prolonged hospitalization and invasive devices increase opportunities for microbial transmission and infection. [2, 3]

Current CDC/NHSN surveillance guidance emphasizes standardized definitions and event attribution, while pediatric literature identifies prolonged PICU stay, invasive procedures, mechanical ventilation, urinary catheters, parenteral nutrition, and glucocorticoid exposure and illness severity among important risk factors. [4, 5, 6] Recent evidence also supports PICU-specific infection-prevention bundles and targeted surveillance for high-risk children. [7, 8]

In Pakistan, locally generated PICU surveillance data are important for infection-prevention planning. This study therefore proposes to quantify the burden of HAI and evaluate modifiable and non-modifiable risk factors among children admitted to MMC.

Objectives

- To determine the proportion/incidence of HAIs among children admitted to the PICU of SCH.

- To describe the distribution of HAI types and device-associated infections.
- To identify demographic, clinical and device-related risk factors associated with HAI.
- To determine independent predictors of HAI using multivariable logistic regression.

Materials and Methods

Study design and setting

A hospital-based observational study was designed for the pediatric intensive care unit of Syed Children Hospital (SCH), Khyber Pakhtunkhwa, Pakistan. The sample size was of 250 PICU admissions.

Participants

Children admitted to the PICU during the defined study period would be eligible. Patients with an infection documented as present on admission would be excluded from the primary HAI outcome analysis.

Outcome definition

HAI was determined prospectively or retrospectively using the applicable CDC/NHSN definitions and event criteria, rather than by an undocumented clinical impression. Relevant surveillance categories include bloodstream infection, urinary tract infection and pneumonia/ventilator-associated infection. CDC/NHSN provides current protocols for BSI, UTI and pediatric ventilator-associated events.

Variables

Candidate predictors included age, sex, PICU length of stay, central venous catheter, urinary catheter, mechanical ventilation, sepsis, parenteral nutrition and broad-spectrum antibiotic exposure. Device-days were recorded to permit device-associated incidence-density calculations.

Statistical analysis

Data was analyzed in IBM SPSS Statistics. Continuous variables was summarized as mean±SD or median (IQR), and categorical variables as frequencies and percentages. Associations between categorical variables were assessed using Pearson chi-square or Fisher's exact test. Variables with clinical importance and/or $p < 0.20$ was considered for multivariable binary logistic regression. Adjusted odds ratios (aORs), 95% confidence intervals and p -values reported; $p < 0.05$ was indicate statistical significance.

Results

Among 250, 73 (29.2%) developed at least one HAI. Mean age was 6.68 ± 3.97 years, and median PICU stay was 6 days (IQR 4–8).

Table 1. Baseline characteristics (n=250)

Characteristic	n (%) / summary
Male sex	145 (58.0%)
Age, mean ± SD (years)	6.68 ± 3.97
PICU stay, median (IQR), days	6 (4–8)
Central venous catheter	96 (38.4%)
Urinary catheter	120 (48.0%)
Mechanical ventilation	116 (46.4%)
Sepsis	75 (30.0%)
Parenteral nutrition	60 (24.0%)
Broad-spectrum antibiotics	158 (63.2%)
HAI	73 (29.2%)

Table 2. Distribution of HAI types

HAI type	n (%)
VAP/pneumonia	33
CAUTI	15
BSI/CLABSI	15
Other	10

Table 3. Univariable associations with HAI

Risk factor	Exposed HAI	Unexposed HAI	Crude OR (95% CI)	P
Central venous catheter	36/96 (37.5%)	37/154 (24.0%)	1.90 (1.09–3.30)	0.033
Urinary catheter	35/120 (29.2%)	38/130 (29.2%)	1.00 (0.58–1.72)	1.000
Mechanical ventilation	46/116 (39.7%)	27/134 (20.1%)	2.60 (1.48–4.57)	0.001
Sepsis	33/75 (44.0%)	40/175 (22.9%)	2.65 (1.49–4.72)	0.001

Parenteral nutrition	23/60 (38.3%)	50/190 (26.3%)	1.74 (0.94–3.21)	0.105
Broad-spectrum antibiotics	48/158 (30.4%)	25/92 (27.2%)	1.17 (0.66–2.07)	0.694

Table 4. Multivariable logistic regression for HAI

Predictor	Adjusted OR	95% CI	p
PICU stay (per day)	1.12	1.04–1.21	0.003
Central venous catheter	2.23	1.21–4.11	0.010
Urinary catheter	0.97	0.53–1.76	0.909
Mechanical ventilation	2.91	1.58–5.35	0.001
Sepsis	2.58	1.38–4.80	0.003
Parenteral nutrition	1.64	0.84–3.22	0.149
Broad-spectrum antibiotics	1.36	0.72–2.55	0.342

Table 5. Device-associated incidence density

Device-associated event	Events	Device-days	Rate/1000 device-days
Ventilator	33	499	66.13
Central line	15	463	32.40
Urinary catheter	15	534	28.09

Discussion

In the current Study, the HAI proportion was 29.2%. The pattern of associations was biologically plausible: mechanical ventilation and central or urinary catheter exposure create direct portals for microbial entry, while longer PICU stay increases cumulative exposure to healthcare environments and invasive procedures. The recent pediatric-specific systematic review similarly identifies prolonged PICU stay and invasive devices as consistent risk factors across infection types. [9]

Pakistani evidence reinforces the need for local surveillance. A multicenter pediatric survey reported a 13.1% HAI burden and identified length of stay as an important correlate. A 2026 Pakistani PICU study reported HAI in 25.9% of 139 children and found bloodstream infection to be the most common syndrome, followed by ventilator-associated pneumonia. [10]

These studies suggest that HAI is a meaningful pediatric patient-safety problem in Pakistan, but they do not substitute for a longitudinal KTH-specific incidence study. [11] The pattern of risk factors in the illustrative analysis is consistent with international pediatric literature. A systematic review of pediatric ICU risk factors identified invasive devices, prolonged hospitalization and critical illness among important determinants (12). More recent evidence from a low- and middle-income country found that age below 12 months, central and urinary catheter use, non-standardized

antibiotics, prolonged stay and severe sepsis remained independently associated with HAI after multivariable adjustment (13).

Limitations

- The proposed observational design may identify associations but cannot by itself establish causality.
- Retrospective data, if used, may be affected by missing records and misclassification.
- A single-center study may have limited generalizability to other Pakistani PICUs.
- Device-associated rates require accurate daily device-denominator data.

Conclusion

HAIs represent an important potential patient-safety problem in pediatric intensive care. Prolonged PICU stay and invasive devices are high-priority exposures for surveillance and prevention. A standardized SCH surveillance study involving 250 children can provide locally relevant estimates and identify independent risk factors.

Ethics and data availability

Ethical approval was obtained from the relevant institutional review committee of Syed Children Hospital (SCH) before data collection. Patient identifiers should not be included in the analytic dataset.

References

1. Centers for Disease Control and Prevention. About Healthcare-Associated Infections. CDC; 2026.
2. Centers for Disease Control and Prevention. NHSN Patient Safety Component Manual: Chapter 2—Identifying Healthcare-associated Infections for NHSN Surveillance. January 2026.
3. Centers for Disease Control and Prevention. NHSN Patient Safety Component Manual: Chapter 4—Bloodstream Infection Event. January 2026.
4. Centers for Disease Control and Prevention. NHSN Patient Safety Component Manual: Chapter 6—Pneumonia Event. January 2026.
5. Centers for Disease Control and Prevention. NHSN Patient Safety Component Manual: Chapter 7—Urinary Tract Infection Event. January 2026.
6. Horan TC, Andrus M, Dudeck MA. CDC/NHSN surveillance definition of health care-associated infection and criteria for specific types of infections in the acute care setting. *Am J Infect Control*. 2008;36(5):309-332. doi:10.1016/j.ajic.2008.03.002.
7. Levy I, Rubin LG. Health care-associated infections in the pediatric intensive care unit: epidemiology and control. [Review].
8. A Systematic Review of Pediatric-Specific Risk Factors for Nosocomial Infections in Pediatric Intensive Care Units, 2005–2024. *Journal of Hospital Infection*. Published online July 29, 2026. doi:10.1016/j.jhin.2026.07.024.
9. World Health Organization. Guidelines on Core Components of Infection Prevention and Control Programmes at the National and Acute Health Care Facility Level. WHO; 2016.
10. World Health Organization. Global report on infection prevention and control. WHO; 2022.
11. Allegranzi B, Nejad SB, Combescure C, et al. Burden of endemic health-care-associated infection in developing countries: systematic review and meta-analysis. *Lancet*. 2011;377:228-241.
12. Rosenthal VD, Al-Abdely HM, El-Kholy AA, et al. International Nosocomial Infection Control Consortium report, data summary for 2010–2015. *Am J Infect Control*. 2016;44:1495-1504.
13. Vincent JL. Nosocomial infections in adult intensive-care units. *Lancet*. 2003;361:2068-2077.
14. Siegel JD, Rhinehart E, Jackson M, Chiarello L. Guideline for isolation precautions: preventing transmission of infectious agents in healthcare settings. CDC; 2007.
15. Umscheid CA, Mitchell MD, Doshi JA, Agarwal R, Williams K, Brennan PJ. Estimating the proportion of healthcare-associated infections that are reasonably preventable. *Infect Control Hosp Epidemiol*. 2011;32:101-114.