

# Nosocomial infections in a Pediatric Intensive Care Unit in Albania

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**Abstract:** *This study aimed to determine the incidence of nosocomial infections (NI) in general and device associated infections (DAI) in the paediatric intensive care unit (PICU) of University Hospital Center (UHC), Tirana, Albania. We performed a prospective study on the incidence of NIs and DAIs in the PICU according to CDC criteria, between May 2011 and December 2012. In the PICU 615 patients were hospitalised for 4597 days and acquired 140 episodes of NI with an incidence and NI rate of 22.8%, 30 per 1000 patient-days, respectively. The lower respiratory tract infection rate was 10.5%, with a ventilator associated (VAP) rate 6.8%, followed by urinary tract infection (UTI) rate with catheter associated UTI rate 7.1% and blood stream infection (BSI) rate 4.2%, with central line associated BSI (CLABSI) rate 2.4%. NI rates per 1000 device-days were 34.4 for VAP, 30.5 per 1000 CVC- days for CLABSI, 32.6 per 1000 UC-days for UTI. The device utilization of CVC, ETT, UC, surgical status, younger age, parenteral nutrition, H2 rec. blockers and blood transfusions were risk factors for NI. The incidence of NI, CLABSI, VAP, CAUTI were higher than international standards and strongly associated with extrinsic factors.*

**Keywords:** study, incidence, associated, rate, extrinsic

## 1. Introduction

Nosocomial infections (NI) are a frequent problem, particularly in Intensive care units (ICU). In Europe, incidences range from 1% in general paediatric wards up to 23.6% in Paediatric ICU (PICU) [1]. PICUs studies report incidences between 6.1 to 15.1% [2, 3]. Whilst across-sectional study found prevalence of 11.9% [4].

Bloodstream infections (BSI) are the most common NI in PICUs (28-52%) [2-6], followed by pneumonia (including VAP) and urinary tract infection (UTI), enteric, surgical site and skin [1-4]. BSI and pneumonia are responsible for approximately 50% of NIs, and UTI causes an additional 12-22% [3, 7]. Although VAP is the most frequent NI in adults [8], paediatric studies report incidences of 2 - 17% [9-10]. Studying 20 ICUs in eight European countries during 6 months, the incidence of NI was 23.6 % in PICU and the proportion of lower respiratory tract infection was 53% [11]. A study from Lithuania brings results which ranks VAP as the most common site of NI (58.8%) of all, with a high infection rate being 28.8 per 1000 patients days [12]. Only two paediatric studies have found VAP to be the most frequent NI in PICU [1, 12]. All aforementioned studies come from developed countries except one. Studies from developing countries bring other results. In one study performed in Teheran pneumonia was the most common NI followed by UTI and sepsis [13]. A study from Brazil found Pneumonia to be the most common type of NI with a high incidence of ventilator-associated pneumonia and central line-associated bloodstream infections [14].

In Albania, a few studies are performed on adult and children patients, including NI risk factors and measures to prevent a patient from acquiring NI. In one-day prevalence survey carried in the largest hospital in Albania between October and November 2003 in medical, surgical and ICU wards, urinary tract infections (33.0%), surgical site

infection (24.3%), pneumonia (13.0%) and venous infections (9.2%) were the most frequent NIs. The prevalence of NIs was higher in ICUs (31.6%) than the surgical (22.0%) and medical wards (10.3%) [15]. A previous study developed in an Albanian PICU between February 2007-February 2008 having an incidence of NI of 10.5 per cent with the most encountered in the urinary then respiratory tract and the bloodstream, respectively [16]. In this study we report the data on incidence rates, risk factors, incidence density, DAR, DUR, pathogens of nosocomial infections. In addition, we compare the length of stay and mortality rate in the group of patients with NIs vs. without NIs.

## 2. Materials and Methods

This prospective study was conducted over a period of eighteen months in the only paediatric intensive care unit (PICU) in University Hospital Center (UHC) in Albania. All patients admitted to PICU, aged between 1 month and 14 years, being medical or surgical and staying at least for 48 hours were enrolled into the study. In the study were included the neonates with surgical pathologies, as the PICU is the only ward they get recovered after surgery. Here we report the data on incidence rates of NIs, comparing the length of stay and mortality rate in the pathogens group of patients with NIs vs. without NIs. Standard data collection form was filled with general patient data (gender, age, referral place), clinical profile (medical, surgical, trauma), and patient status on admission, risk factors during stay in a PICU, the time of NI diagnosed during hospital stay, its treatment and outcome (discharge or death) were recorded in daily basis by the physicians in duty. The main risk factors for nosocomial infections were recorded, e.g. mechanical ventilation, venous central line, urinary catheter, peripheral venous catheter, and Standard Centre for Disease Control and Prevention definitions of infections were used [17]. We

calculated the PRISM III score during the first 24 hours of admission for 200 patients (32.5%).

### 3. NI Definitions

An infection was defined as NI if it occurred 48 hours after admission to the unit or within 48 hours after discharge. All patients with an ICU stay of >48 h were enrolled consecutively into the study. *Bacteremia*: was defined as the biological documentation of infection, i.e. the result of a positive blood culture. *Laboratory-confirmed bloodstream infection* must meet at least one of the following criteria: patient has a recognized pathogen cultured from one or more blood cultures not related to another site; patient has at least one of the following signs or symptoms: fever (>38° C), chills, or hypotension and at least one of the following: common skin contaminant (e.g., diphtheroids, *Bacillus* sp., *Propionibacterium* sp., coagulase-negative staphylococci, or micrococci) is cultured from two or more blood cultures drawn on separate occasions or common skin contaminant (e.g., diphtheroids, *Bacillus* sp., *Propionibacterium* sp., coagulase-negative staphylococci, or micrococci) is cultured from at least one blood culture from a patient with an *intravascular line*, and the physician institutes appropriate antimicrobial therapy. *Clinical sepsis* must meet at least one of the following criteria: Patient has at least one of the following clinical signs or symptoms with no other recognized cause, fever (>38° C), hypotension (systolic pressure <90 mm), or oliguria (<20 cm<sup>3</sup> /hr) and blood culture not done or no organisms or antigen detected in blood and no apparent infection at another site and physician institutes treatment for sepsis. Clinical and laboratory criteria for definition of primary BSI were based on the CDC criteria for infections [18].

For the diagnosis of VAP, a patient was required to have received mechanical ventilation for 48 hours or more and to have a new or progressive infiltrate, consolidation, cavitation, or pleural effusion on chest radiograph. In addition, a patient had to have one or more of the following: new purulent sputum or a change in the character of the sputum; an organism isolated from a blood culture that was not related to another source of infection; isolation of pathogens from a specimen obtained by transtracheal aspirate [18].

NI of UT was considered as positive all urine samples with the number of colony forming units (CFU/ml) greater than 10<sup>5</sup> CFU/ml, contamination with low counts (<10<sup>4</sup> CFU/ml) of microorganisms normally present in the skin or external or internal genitalia. Colonisation was defined as the presence of the microorganism in urine culture without clinical repercussions and which disappear after catheter removal. Other NIs such as upper respiratory, surgical, enteric, skin or infections at other sites, were not surveyed [18].

### 4. Sampling Method

Blood from a peripheral vein was drawn for culture, on clinical suspicion of sepsis, starting after first 48 h of ICU stay. The site of sampling was swabbed with povidone iodine, allowed to dry for 2 min and then swabbed with

alcohol. Two millilitres of blood was drawn and added 1 ml in each bottle containing 20 ml of media. Samples were delivered to the laboratory within an hour of collection and those collected overnight were stored at room temperature and delivered the next morning.

Endotracheal secretions were collected using a standard procedure after tracheal instillation of 5 ml saline. Sputum induced collection was used for non VAP respiratory tract suspected infections. The aspirates and sputum samples were sent into a sterile container for qualitative culture. All samples were collected on the day of clinical and radiologic evaluation. No bronchoscopy, protected specimen brush or lung biopsy were performed, not being a routine in this institution.

The urine samples were collected through the urinary catheter in catheterised patients, in non-catheterised children with sphincter control the middle portion of micturition after the local toilette with soap and water and drying with sterile gauze. In non-catheterised children without sphincter control the urine samples are collected with perineal adhesive bags after cleaning the zone.

### 5. Data Calculation

Types of NIs, incidence rates (NI incidence, NI incidence density, device-associated rate) and device utilization ratios were compared among the age groups. The patients for analysis were divided into four age groups: infants (aged 1 month to <1 year), preschool children (1-5 years), children (6-12 years), and adolescents (>12 years). NI incidence (number of NI divided by number of patients admitted), NI incidence density (number of NI divided by number of patient-days), device associated rate (number of NI divided by number of device-days), and device utilization ratio (number of device-days divided by patient-days) were calculated and compared among the age groups. Data are presented as mean ± SD, median and percentages wherever applicable. Parametric data were analysed using the Student's t-test and nonparametric data with Mann-Whitney U-test. Categorical data were analysed with Chi-square. Data of patients with NI was compared with those without NI with respect to demographic details, primary diagnosis surgical, nonsurgical, device utilization and invasive procedures to identify risk factors for NI. The statistical package used in the study was IBM SPSS version 20.

### 6. Results

#### General Data

A total number of 615 children admitted to PICUs were analysed: 321 (52.2%) boys and 294 (47.8%) girls. Mean age was 19.43 (±33.7). The greatest proportion of the patients was in 1 month to 1 year age group (n=377, 61.3%). The mean length of stay in PICU was 7.47 days (± 6.1). Mean number of days from admission to PICU to onset of NI was 7 days (±3.6).

Twenty eight (24%) patients have acquired NIs before the fourth day, 44 (37.6%) during the fourth-seventh day, 45 (38.4%) after the seventh day of their stay at PICUs.

Most of patients 450 (73.2%) were admitted from home, 165 (26.8%) from other wards or hospitals. The greatest proportion of patients had medical pathology (n=437, 71.1%) and surgical pathology were (n=178, 28.9%). During the PICU stay 610 (99%) patients used at least one antibiotic. The overall mortality rate was 17.6% (n=108). Almost all patients had at least one risk factor during their stay in PICU: 43.9% of the patients were mechanically ventilated mean duration, 4.5 days ( $\pm 4.4$ ), 17.2% had a central line catheter with mean duration 5.5

days ( $\pm 4.9$ ), and 45% of the patients had a urinary catheter with mean duration 2.2 ( $\pm 3.9$ ) (Table.1). The trend of acquiring NI during the PICU stay is demonstrated in the Figure 1.

### 7. Incidence and types of nosocomial infections

One hundred seventeen (19%) children had a total of 140 nosocomial infections (NIs), 94 (80.3%) had only one episode of NI and 23 (19.7%) children had two episodes. The incidence of nosocomial infections was 30 per 1000

**Table1** Demographic characteristics of the children admitted to PICU during the study period

Characteristics	Total (N =615)	With IS (N=117)	Without IS=498 P value
Age (mo) Mean (min max)	19.4 (0.01;168)	19.9 (0.01;144)	19.3 (0.01;168) 0.92
Gender n (%)			
Male	321 (52.2)	56 (47.9)	265 (53.2) >0.05
Female	294 (47.8)	61 (52.1)	233 (46.8) >0.05
Age-group			
1mo- <1 year	377 (61.3)	87 (74.4)	290 (58.2) <0.001
2-5 years	185 (30.1)	16 (13.7)	169 (33.9)
5-12 years	35 (5.7)	8 (6.8)	27 (5.4)
>12 years	18 (2.9)	6 (5.1)	12 (2.4)
Admission Diagnosis, n (%)			
Medical			
Surgical	437 (71)	65 (55.6)	372 (74.7) >0.05
-abdominal	178 (29)	52 (44.4)	126 (25.3) 0.001
-thoracal	97 (15.8)	32 (27.4)	65 (13.1)
-post heart surgery	21 (3.4)	12 (10.3)	9 (1.8)
Emergency	450 (73.1)	66 (56.4)	384 (77.1) >0.1
Other wards	165 (26.9)	51 (43.6)	114 (22.9) <0.01
Device utilization,			
CVC n (%)	108 (17.5)	54 (46.2)	54 (10.8) 0.004
Parenteral nutrition, n (%)	111 (18)	70 (59.8)	41 (8.2) 0.003
Blood transfusion, n (%)	208 (33.8)	91 (77.8)	117 (23.5) 0.001
ETT, n (%)	270 (43.9)	87 (74.4)	183 (36.7) 0.06
CU, n (%)	276 (44.9)	96 (82.1)	180 (36.1) 0.12
H2-rec blocker	193 (31.4)	70 (40.2)	123 (24.7) 0.01
Nasogastric tube	372 (60.5)	106 (90.6)	266 (53.4) 0.003
Total PICU stay (days)	4597	1838	3259
CVC- days, total, mes (DS)	608 (0.78 $\pm$ 2.09)	492 (5.5; $\pm$ 4.8)	116 (0.59; $\pm$ 1.96)
ETT -days, total, mes (SD)	1569 (1.3; $\pm$ 2.42)	1221 (7.44; $\pm$ 5.9)	348 (1.39; $\pm$ 2.6)
UC-days, total, mes (SD)	1718 (1.3; $\pm$ 2)	1351 (8.21; $\pm$ 5.5)	367 (1.69; $\pm$ 3.35)
Mortality n (%)	108 (17.6)	43 (36.8)	65 (13.05) 0.001
PICU stay (days) mean (SD)	7.47 ( $\pm$ 6.1)	15.7 ( $\pm$ 15)	5.54 ( $\pm$ 19) 0.001
PRISM score >10	120 (60)	27 (22.5)	93 (77.5) 0.001
PRISM score <10	80 (40)	6 (7.5)	74 (92.5)

patient-days and the rate of NIs per 100 admissions was 22.8%. Comparing groups in respect of incidence, incidence density, DAR and DUR, there were not differences among age groups for incidence density for all types of NI, for VAP ( $c^2=1.0$ ,  $df=3$ ,  $P=0.801$ ), CALBSI ( $c^2=0.33$ ,  $df=1$ ,  $P=0.56$ ), for CAUTI ( $c^2=3.1$ ,  $df=3$ ,  $P=0.36$ ).

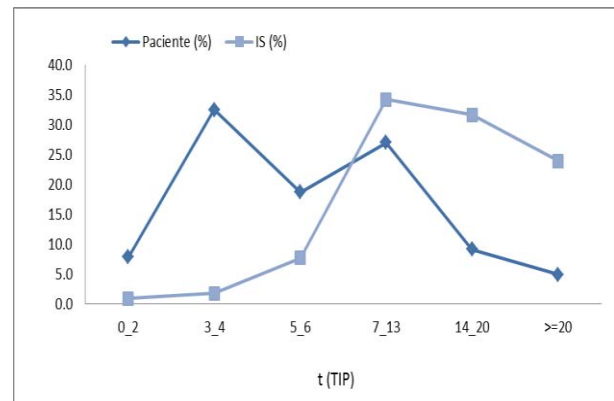
There were differences in the incidence of NI, DAR and DUR for each affected tract among the different age groups.

The age group 6-12 years was more affected than other age groups for VAP, with an incidence rate 28.6 per 100 admission versus 16.5; 9.7; 22.2 per 100 admission ( $c^2=9.89$ ,  $df=3$ ,  $P=0.019$ ).

The DAR was higher in age group >12 years 62.5 per 1000 VM days comparing to other age group ( $c^2=16.7$ ,  $df=3$ ,  $P=0.01$ ). There was no difference among age groups in respect to DUR of VAP patients ( $c^2=5.4$ ,  $df=3$ ,  $P=0.19$ ). The



age group 1mo-1 year was most affected for CLABSI with an incidence rate, DAR, DUR higher than the other age groups ( $\chi^2=10.7$ ,  $df=1$ ,  $P=0.01$ ), ( $\chi^2=8.96$ ,  $df=1$ ,  $P=0.03$ ), ( $\chi^2=29.6$ ,  $df=3$ ,  $P=0.0001$ ). The age group >12 years was most affected for CAUTI with an incidence rate and DAR higher than the other age groups ( $\chi^2=25.68$ ,  $df=3$ ,  $P=0.001$ ), ( $\chi^2=58.79$ ,  $df=3$ ,  $P=0.001$ ) but without differences in DUR among age groups ( $\chi^2=0.34$ ,  $df=3$ ,  $P=0.9$ ) (Table.2) The most common site of NIs was respiratory tract (46.4%). There was a statistically significant domination of other lower respiratory tract infections (LRTIs) in the age group 1 month to < 1 year. The second most affected site was urinary tract (34.4%) with the most cases encountered in the age group 1 month to < 1 year. The third site was BSI (18.6%) with the age group 1 month to < 1 year being the most affected (Table3).



**Figure 1:** The relation of PICU stays with NI

**Table 2:** Incidence rates of nosocomial infections (NIs) by types in the age groups and device utilization ratio by types in the age groups

Age groups	Nosocomial infections				Device utilization ratio
	Number of NIs (n)	Incidence	Incidence density	Device associated rate	
Pneumonia					Mechanical ventilation
1mo - <1 year	29	16.6	18	32.7	0.54
1-5 years	7	9.7	14	30.7	0.47
6-12 years	4	28.6	32	53.3	0.6
>12 years	2	22.2	24	62.5	0.38
Total	42	22.8	18	34.4	0.52
BSI					CVC
1 mo- <1 year	13	22	15	40.6	0.37
1-5 years	2	5.3	6	17.5	0.37
6-12 years	0	0	0	0	0.38
>12 years	0	0	0	0	0.81
Total	15	14.2	12	30.5	0.39
UTI					CU
1 mo - <1 year	31	10.2	18	33.1	0.55
1-5 years	5	6.4	9	17.4	0.5
6-12 years	5	23.8	30	54.3	0.55
>12 years	3	33.3	48	88.2	0.55
Total	44	10.7	17	32.6	0.54

**Table 3:** Distribution of nosocomial infections by site of infection in the age groups

NI	1 month - <1 year N (%)	1-5 years	6-12 years	>12 years	P value	Chi square (df)	All N (%)
VAP	29 (27.1)	7 (41.2)	4 (44.4)	2 (28.5)	0.019	9.89 (3)	42 (30)
Other lower respiratory tract	22 (20.6)	1 (5.9)	0	0	0.0001	38.7 (3)	23 (16.4)
BSI	20 (18.7)	4 (23.5)	0	2 (28.5)	0.001	10.7 (1)	26 (18.6)
UTI	4 (3.7)	0	0	0	0.0001	-	4 (2.9)
CAUTI	31 (29)	5 (29.4)	5 (55.6)	3 (43)	0.001	25.6 (3)	44 (31.4)
Others	1 (0.9)	0	0	0	-	-	1 (0.7)
Total	107 (100)	17 (100)	9 (100)	7 (100)	-	-	140 (100)

## 8. Pathogens of nosocomial infections

The total number of 140 (100%) NI cases were tested microbiologically. There was a growth of pathogens in 132 (85.4%) cases, no growth - in 8 (5.1%). The most frequent isolated microorganisms were gram negative (n=81, 61.8%) followed by gram positive (n=34, 26%) and yeast (n=16, 12.2%). The predominant isolates among gram negative was *Pseudomonas aeruginosae* 32 (24.4%), the predominant isolates among gram positive was *Staphylococcus aureus* 22 (17%). The most common agents in BSI was *Staphylococcus spp* (16, 73%). In lower respiratory tract the most common

agent was *Pseudomonas aeruginosae* (32, 49%), in UTI the most common was the most common cause was *Escherichia coli* (26, 54.2%).

## 9. Antimicrobial Susceptibility

### a) Gram positive bacteria

Almost all bacteria isolates showed multiple drug resistance (resistance to two or more drugs). Most isolates showed high level of resistance 100% to chloramphenicol, 87% to penicillin and ampicillin, less than 80% (middle level of resistance) to gentamicin and eritromicin but against

ceftriaxone, imipenem, vancomycin and ciprofloxacin showed low level (15%) of resistance.

#### b) Gram negative bacteria

All isolates showed high level of resistance (100%) to cefalotin, ampicillin, amoxicillin-Clavulanic, chloramphenicol, intermediate resistance to ceftriaxone, gentamicin (60-80%). But against nalidixic acid, nitrofurantoin, ciprofloxacin, imipenem, amikacin showed low level of resistance (<60%). Like Gram positive bacteria, almost all isolated Gram negative bacteria showed multi-drug resistance.

### 10. Length of Stay and the Mortality Rate

The length of stay for patients with NIs was more than twice longer as compared with the patients without NIs (15.7 days vs. 5.54 days,  $P < 0.001$ ). The presence of NI, was associated with a raise in mortality rate which was higher in patients with NI than without respectively 36.7% vs. 15% ( $p = 0.001$ ). For value of a PRISM III score greater than 10, the frequency of NI was higher compared to the group with PRISM III score less than 10 (22.5% vs. 7.5%; chi-square (1) = 7.2,  $p = 0.007$ ).

### 11. Discussion

Prevention of NIs is the key procedure in quality of healthcare. Accurate data on NI rates are essential for evaluation of current infection prevention activities and for planning further interventions in hospital as well as at national level [19]. This prospective study is the first from the single Albanian PICU to have evaluated the rate and risk factors of NI among paediatric patients using the NNIS System standards and definitions. Studies such as this provide a benchmark for future studies from developing countries and the region and allow for comparison of international and national data.

The incidence of NI in PICU during the study period proved to be 22.8%, similar to reports from other studies done in PICUs ranging from 22.2% - 29.7% [20-22]. The data are also similar to other studies done in adult ICUs as reported in the study EPIC of 20.6% [23], but higher than data reported by NNIS of 6.1% or 14.1 / 1000 patient-days or other studies in Europe, where the incidence varies from 6.1-10.2% [24, 25]. According to WHO NI incidence in countries with limited resources or low and medium income, it varies from 4.4% - 88.9% [26]. The incidence density in our study was estimated to be 30.5 per 1,000 patient-days, higher than estimated in the US and developed countries (13.6 per 1000 patient-days), but similar to developing countries, which pooled incidence density is 47.9 per 1000 patient-days [26, 27].

As in most studies from PICUs [20, 22, 25, and 28] and adult ICUs [23], in our study PNE and LRTI were most prevalent NIs and accounted for 46.4%, followed by UTI accounted for 34.2% and BSI 18.6% of all NIs.

However, there are reports from PICUs where BSI [21, 25, 29, and 30] and UTI [31] are the main sites of NIs. The overall ventilator-associated pneumonia (VAP) incidence

rate was very high when compared to data from other studies (34.4 vs. 8.9-18.7) [20, 21, 31-33]. The aforementioned VAP rate and ventilator utilization ratio of 0.52 considerably exceeded the 90th percentile as compared to NNIS data [34]. This pointed out the need to reevaluate the current respiratory care practices, hygienic regulations. Anyway the VAP rate was similar to some reports coming from developing countries ranging from 19.08-30 per 1000 VM-days [35-37].

The mean rate of CLABSI in our PICU (30.5 per 1000 central-catheter-days) was very high compared with the mean rate of CLABSI reported by systematic review conducted by WHO which varies from 2.1-4.3 episodes per 1000 catheter days in developed countries, but similar to 10.2-60 episodes per 1000 catheter days in developing countries [26, 27, 38]. Richard *et al.* examined BSI in 61 PICUs in the USA and found it to be the most common nosocomial infection with a rate ranging from 0.0 to 20/1000 catheter-days [3]. Stover *et al.* reported PICU BSI rates from 23 US hospitals with wide variations in the rates ranging from 0.0 to 18.5/1000 catheter-days [6]. This variability depends on unit related parameters such as size and settings, patient related parameters such type of illness, sites and conditions under which the catheter was placed which are missing data in this study.

The mean rate of CAUTI in our study (32 per 1000 CU-days) and DUR 0.54, were very high, compared with data from NNIS surveillance for PICUs, with pooled mean 4.0 per 1000 CU-days and DUR 0.28 (0.1-0.39) [39]. Systematic reviews conducted by WHO for developing countries, the level of CAUTI is 8.8 per 1,000 CU-days (95% CI 7.3-10.4) [26]. Besides the characteristics of the study population, the reason for the high rate partly may be explained by the fact that we often use the monitoring of diuresis in young children through the bladder catheterization, which increases the potential for contamination or infection. On the other hand in 22 (50%) cases, CAUTI have been associated with other site of NI, 15 VAP and 7 CLABSI, which shows the gravity of the illness while VM and CVC are additional risk factors for CAUTI [40].

It is difficult to explain the reason for our high rate in the three affected tract as there are no previous data with which to compare. Firstly, this study was conducted in a single unit so it is only indicative of the situation in our PICU. Secondly, this study was conducted in a university hospital that is known to have higher levels of NIs, so generalisation of data is questionable. Factors that may influence the high level NIs in the study are the characteristics of our PICU population in the study. The majority of our patients were young infants (61%). It is well known that NIs more common in young infants [41]. It is well demonstrated in more than one study the high rate of CLABSI, VAP and CAUTI in NICU patients and younger age [34]. The medical-surgical character of our PICU is another reason of high NIs rate, as is stressed in the analysis made by Singh-Naz *et al.* and Figueiredo *et al.*, that being in post-operative phase is a risk factor [42, 43]. The lack of sufficient nursing staff especially during the night shifts, inadequate measures to control infections, not good adherence to hand hygiene,

the absence of strict policies in the appropriate use of antibiotics may have also influenced the NI incidence.

We determined similar pathogens to the reported data in our study, where *Pseudomonas* among gram- negative and *S. aureus* among gram- positive, were prevailing [20, 22, 25, and 42].

The prevalence of *Candida* was low (n=16, 12%) and it was not obtained from blood but only from urine culture. In addition, the prevalence of MRSA was medium (n=6, 27%). Length of stay at PICUs was longer for patients with NI vs. without NI as it is reported in most studies [1, 2, 20, and 21]. In some reports, NI is claimed to be responsible for a higher mortality rates, as it resulted to be in our study in PICUs (20, 21, 31, and 33). The severity of underlying condition (PRISM III) was recorded only in 200 patients during the study period and resulted to be related significantly to NI occurrence as found by Singh-Naz et al. and El-Nawawy et al. [21, 42].

## 12. Conclusion

It was revealed in this study that the NI in our PICU operating with full occupancy was higher than those reported in various studies of the developed countries, but similar to some reports coming from developing countries. The NIs was mainly seen at the age-group 1 month -1 year old. The most prevalent systems were established as LRTI (including VAP), UTIs (including CAUTI), BSIs (including CLABSI) and majority of these were device related. This study has established a benchmark for future comparisons. The reported high rates stress the role of infection control programs including surveillance and guidelines, to lower this baseline rate.

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