

## Invasive Device-Associated Hospital Infection Rates and Etiological Agents in Pediatric Intensive Care Unit During Covid-19 Pandemic

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### Abstract

**Aim:** Firstly, compared the rate and etiological agents of invasive device-associated hospital infections (IDAHI) in the Pediatric intensive care unit before and during Covid-19 Pandemic

**Materials and methods:** Between February and December 2020, 73 IDAHI cases (evaluated in 653 patients) compared with the 78 IDAHI cases (evaluated in 768 patients) in same period of the previous year (February – December 2019)

**Results:** Ventilator associated pneumonia were observed in 53 IDAHI cases during 2019 and 42 cases in 2020, that was no statistically significant difference. catheter-associated urinary tract infection observed in 1 IDAHI patient during 2019 and 2 patients in 2020 and p value achieved is not statistically significant. central venous catheter-associated blood stream infection observed in 24 IDAHI patient during 2019 and in 27 patients during pandemic situation that was no statistically significant difference. The most frequently isolated etiological agents before and during COVID-19 pandemic were: klebsiella, coagulase-negative staphylococci (CONS), Candida spp, Acinetobacter, Enterobacter and Non-albicans candida that despite the decrease in the prevalence of these microorganisms during Covid-19 pandemic, there was no significant decrease compared to the previous pandemic.

**Conclusion:** Despite limited studies, our results have shown that the rate IDAHI in Pediatric Intensive Care Unit has not decreased and like before the Covid-19 pandemic and maybe more proper cleaning and sterilization or a high level disinfection of Invasive equipment is essential.

**Key words:** Pediatric Intensive Care Unit, Covid-19, Device-Associated Hospital Infection

## 1. Introduction

In December 2019, the emergence of a novel coronavirus in Wuhan, China beheld. Later, this virus named severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), that responsible for a respiratory disease now known as the coronavirus disease (COVID-19)<sup>1</sup>. After spreading across the universe, the World Health Organization (WHO) declared COVID-19 an international health emergency and as a result, a pandemic has occurred that continues to plunge the world into a major crisis<sup>2</sup>. Unfortunately, literature about covid-19 mainly concern adults and data about children is so limited<sup>3</sup>.

COVID-19 disease highlights the need to pay attention to those bacterial pathogens that could complicate the hospital stay of patients in the intensive care unit (ICU) and Pediatric Intensive Care Unit. Previous studies have reported that the spread of pathogens occurs through direct contact between health personnel, equipment and patients and Hospital infections are the most important cause of morbidity and mortality in pediatric intensive care units (PICUs) and increase the duration of hospitalization and treatment costs<sup>4</sup>. The majority of these infections can be prevented by routine surveillance programs and infection control measures<sup>5</sup>.

The covid-19 pandemic has induced a reinforcement of infection control measures in all the hospital setting, especially in intensive care units(ICU). These include the limited patient visits and movement, use of universal personal protective equipment and reinforcement of cleaning regimens that might have had an impact also on the microorganism colonization. Firstly, Pezzotta et al<sup>6</sup>, reported that rate of Hospital-acquired colonization and infections during the covid-19 pandemic in compared with the before pandemic situation significantly decreased in Neonatal Intensive Care Unit. Limited studies in adults have shown that that bacterial colonization has changed during the corona pandemic.

Due to the lack of studies, about the changes in Device-Associated Hospital Infection in pediatric intensive care units (PICUs) during the COVID-19 pandemic, and considering that understanding microorganism colonization and its relationship to Hospital-acquired infections is central for providing the necessary data to ensure safe and high-quality healthcare specially during covid-19 pandemic, we assessed these prevalence and Etiological Agents of Device-Associated Hospital Infection in pediatric intensive care units (PICUs) and compared it with the pre-covid-19 period.

## 2. Methods

We conducted a prospective observational study in pediatric ICU of Ali-Asghar Children's Hospital, a tertiary referral hospital in Tehran, Iran. PICU is an 18-bed

medical ward that approximately 12-16 patients per day and 700-1000 admissions per year. The nurse-to patient ratio is about 1:4, and varying numbers of nursing students may also be present and take part in clinical activities. The standard infection control measures are in place including daily patient bathing with 2% chlorhexidine gluconate, personal protective equipment for routine patient care (head coverings, mask, and gloves) and adherence monitoring with a focus on hand hygiene. The mean rate of hand hygiene compliance in PICU is about 70-80%. for disinfection of ICU surfaces by air used Anios Special DJP SF (Laboratoires Anios TM, France), and after patient discharge used Surfa'Safe (Laboratoires Anios TM, France), detergent disinfectant foam for non-invasive medical device surfaces.

Approval for the study was obtained from the ethical committee of Iran University of Medical Sciences which is in compliance with the Helsinki Declaration.

patients who were between 28 days and 18 that hospitalized for longer than 48 h in the PICU between February and December 2020 (during COVID-19 pandemic) and February – December 2019 were enrolled in the study. The medical records of 653 patients during 2020(COVID-19 pandemic) were reviewed and compared with 768 patients during 2019 retrospectively for hospital infections related to invasive device and causative microorganisms. Invasive device-related infections are diagnosed according to definition criteria given by the Centers for Disease Control and Prevention (CDC).

For catheter-associated urinary tract infection and central venous catheter-associated blood stream infection, Peripheral blood cultures and blood cultures from the catheters, which were taken from patients followed up at PICU with the preparatory diagnosis of invasive device related hospital infections (IDRHIs) and transferred under sterile conditions, were monitored under BacT/Alert (Biomerieux, France) automated blood culture system. They were passed over eosin-methylene-blue (EMB) and sheep blood agar plaques. Then 2–3cm tip portions of urinary and central venous catheters (CVCs) were implanted semi quantitatively into EMB agar and blood agar under sterile conditions by the Maki method. For Ventilator associated pneumonia, Samples were collected from heated humidifier, inspiratory limb, Y-adapter and expiratory limb of disposable ventilator circuit (VC) and patient's lower respiratory tract (LRT). LRT samples were collected using endotracheal aspiration (ETA). Collected samples were sent to the clinical microbiology laboratory for bacterial culture. Matrix-assisted laser desorption/ionization-time of flight (MALDI110 TOF) was used for bacterial identification.

All statistical analyses were performed using SPSS 22 (SPSS Inc, Chicago, IL, USA) software. Mean, median,

standard deviation, median, frequency and percentage were used to express the data. statistical significance was defined as  $P < 0.05$ .

### 3. Results

In 2020, Out of 653 patients, 73 IDAHI cases were defined and in 2019, out of 768 patients, 78 IDAHI were defined. in 2020, during COVID-19 pandemic, Ventilator-associated pneumonia (VAP), catheter

associated urinary tract infection (CA-UTI), and central venous catheter-associated circulation infection (CVCABSI) were observed in 42, 2, and 27 IDAHI cases, respectively and in 2019, observed in 53, 1 and 24 IDAHI cases. Number of patients internalized into the PICU and hospital infection incidence are shown in Table 1. There was no statistically significant difference between IDAHI in comparisons of 2019 and 2020 ( $P > 0.05$ )

**Table 1.** Rates of device-associated hospital infections

	2019	2020
Patient days	2833	2416
Days on ventilator	1324	1268
Rate of ventilator use	0.46	0.52
VAP rate	6.9	6.4
CVC days	1845	1528
Rate of CVC use	0.65	63.2
CVCA-BSI rate	3.1	4.13
Urinary catheter days	2614	2336
Rate of urinary catheter use	92.2	96.6
UCA-UTI rate	0.13	0.30

**VAP:** Ventilator-associated pneumonia; **UCA-UTI:** Urinary catheter-associated urinary tract infection **CVC:** Central venous catheter; **CVCA-BSI:** CVC associated blood stream infection

The most common clinical conditions during 2019 were respiratory diseases (38.4%), renal failure not dialyzed (2.5%), neurological diseases (24.3%), sepsis (11.5%) and other (23%). During COVID-19 pandemic situation, most clinical condition were respiratory diseases (32.8%), renal failure not dialyzed (12.3%), neurological diseases

(9.5%), sepsis (15%) and other (30.1). There was no statistically significant difference between most clinical condition in comparisons of 2019 with 2020 ( $P > 0.05$ ).

the 3 most frequently isolated etiological agents during 2019 were klebsiella, Candida spp and coagulase-negative staphylococci(CONS) and during pandemic situation were klebsiella, CONS and Candida spp. Compared to 2020 with the same period of the previous year (2019), There was no statistically significant difference between prevalence of etiological agents ( $P > 0.05$ ). table.2

**Table 2.** Distribution of isolated microorganisms before and after COVID-19

Microorganism	group	group		Total	P
		before covid	During covid		
klebsiella		24	19	43	0.326
CONS		14	10	24	0.559
candida alb		11	12	21	0.930
acineto		5	8	15	0.237
enterobacter		5	7	12	0.858
candida non		5	3	5	0.537
other		6	5	13	0.849
pseudomona		3	2	6	0.621
staph aureous		3	4	7	0.692
Ecoli		2	1	3	0.178

enterococcus	-	1	1	0.776
citrobacter	-	1	1	0.796
<b>Total</b>		78	73	151

In our study, during 2019, 57.6% of the pathogens causing IDAHI were Gram negative and 21.7% were Gram positive and 20.5% were fungi but during vovid-19 pandemic, 57.5% of the pathogens causing IDAHI were Gram negative and 24.6% were Gram positive and 17.8% were fungi and no statistically significant difference were seen between pathogenic causing in comparisons of 2019 with 2020 ( $P > 0.05$ ).

#### 4. Discussion

Nosocomial colonization and infection development are inevitable in care unit especially pediatric intensive care unit, because of invasive procedures being performed, close contact between patients and healthcare personnel, rate of infection in these units is high. Now, in the context of the Covid-19 disease pandemic, the need to environmental hygiene and control infections, especially nosocomial infections, has become more and more clear. it seemed that due to the special conditions created by the Covid-19 Pandemic, especially the more limited visits to the PICU, universal personal protective equipment in treatment staff, the type of microorganisms' colonization and its nature Nosocomial infections especially in ICUs are reduced.

Unfortunately, no studies have been performed on the invasive device-associated hospital infections and its changes due to the coronary pandemic condition not only in children but also in adults. In the only and first study, Pezzotta et al compared the Candida colonization over the period of covid-19 with same period of the previous year (before covid-19) in Neonatal Intensive Care Unit. The results showed that statistically significant reduction of extended-beta-lactamase-positive bacteria colonization from 8% (17/211) to 2.5% (6/239) and high statistically significant reduction of prevalence of Gram-negative bacteria colonization from 38% (80/211) to 20% (47/239), also Candida spp. Colonization significantly decreased from 8% (17/211) to 2% (5/239) ( $P = 0.001$ )<sup>6</sup>. But our results showed the opposite. Our resulted showed invasive device-associated hospital infections not only not decrease but also the. distribution of isolated microorganisms before and after COVID-19 did not changed.

Our study had several limitations. This study was a single center study, so, our findings may not be representative in other institutions. Unfortunately, in this study, we did not evaluate antibiotic resistance. However, to our knowledge,

due to a lack of data, our study is the first to analyze colonization, especially in PICU admission.

#### 5. Conclusion

As before, the Covid-19 pandemic, in order to decrease invasive device-associated hospital infection in PICUs, continuation of surveillance should be noticed, unnecessary catheter use should be avoided, and patients detached from ventilators as soon as possible. Increasing compliance to standard isolation measures, qualified personnel training, and hand hygiene should be more considered in PICUs specially during covid-19 pandemic.

#### Declaration of conflict of interest

The author(s) declare that they have no competing interests.

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