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Device Associated Infections in a Pediatric Intensive Care Unit of a Tertiary Care Hospital, Pakistan.

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ABSTRACT… Objective: To determine the frequency of Ventilator associated Pneumonia (VAP), Central Line Associated Blood Stream Infection (CLABSI) and Catheter Associated Urinary Tract infection (CAUTI) by using standardized criteria established by Center of disease control and prevention. **Study Design:** Cross-sectional study. **Setting:** Pediatric Intensive Care Unit (PICU) of Aga Khan University Hospital (AKUH). **Period:** (August 2015 to January 2016). **Material & Methods:** Data was collected on a pre-coded proforma. Data was entered and analyzed through SPSS. **Results:** 156 patients were enrolled. 102 (65.4%) were male. Mean age was 57.59 months. Mean length of stay was 5.6 days. Patient and Device days were 546 and 958 respectively. Device utilization ratio was 0.56. Four Device Associated Infections (DAI) were identified during study period with a DAI Rate of 4.17 per 1000 device days. All DAI were CLABSIs. Enterococcus was the most frequent bacterial isolate. **Conclusion:** DAI are highly prevalent in low resource countries, especially in intensive care areas including PICUs. In our setup, CLABSI are increasing while VAP and CAUTI are decreasing.

Key words: Central Line Associated Blood Stream infections, Catheter associated Urinary Tract Infections, Pediatric Intensive Care Unit, Ventilator associated pneumonia.

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INTRODUCTION

Device Associated Infection (DAI) is a serious concern associated with high mortality, extra cost and prolonged hospital stay.[1-3] Multiple factors affect the incidence of DAI such as: hand hygiene, clean and safe use of medical devices, local and global infection epidemiology, prevention strategies, nurse-patient ratio, socioeconomic status, antimicrobial drug resistant, antimicrobial prophylaxis, underlying diseases, immunodeficiency, age, weight of patient, type and quality of instruments, use of H_2 blockers or corticosteroids, adequate and qualified medical laboratory services, duration of devices, organizational and institutional characteristics of hospital wards.[3-5] The burden of DAI in developed countries is reported regularly, they use the standard national or local surveillance systems, however it is unknown in a lot of the developing countries because of the complexity of DAI diagnosis and economic limitation.[3,4] In the developed countries, DAI affects as many as 50% of patients in intensive care units (ICU) and approximately 5% -15% of hospitalized patients.[3,6,7] Currently, DAIs are being diagnosed by using standard criteria defined by CDC.[8,9,10] Rates of DAI are 3 to 5 times higher in ICU than rates in other care areas in hospitals.[11,12] Although patients in the ICU represent only 10% of all hospital admissions, they account for majority of all DAI in hospitals.[13,14] Children admitted to pediatric intensive care unit (PICU) are at increased risk of DA-HAI that cause increase length of stay, increase health care cost, increase bacterial resistance and increase morbidity and mortality especially in the developing countries.[12-15] A large amount of scientific literature demonstrates that DA-HAIs are among the main threats to patient's safety in the ICU, including morbidity and mortality.[11,14] Device Associated Infections, including ventilator associated pneumonia (VAP), central line associated blood stream infections (CLABSI)

and catheter associated urinary tract infections (CAUTI) poses greatest threat to ICU patients.[11-13] 41,000 CLABSI occur annually in hospitals in United States, with an estimated mortality of 12-25%.[12,16] Even when these infections are non-fatal they result in increased length of stay and increase cost.[12] According to Gupta et al[18] incidence of DAI in a PICU of a developing country is 61% for health care associated Pneumonia, 27 % Blood stream Infections and 9 % urinary tract infection.[18]

The standards defined by CDC can be used as a benchmark to determine rates of DA-HAI and provides infection control practitioner an in depth look at the institutional problem, so they can design an effective strategy to solve them.[1,6] In this context, most of the relevant studies have been done in developed countries. However, in the developing countries data is scarce.[11-14]

MATERIAL & METHODS

We have conducted a cross sectional study over a period of 6 month (from August 2015 to January 2016) in a pediatric intensive care unit (PICU) of Aga Khan university Hospital (AKUH) after approval from Ethical Review Committee (ERC). of University (4471-Ped-ERC-16). The need of consent form was waived by the ERC. All patients, aged between 1 month to 16 years, admitted and stayed in PICU for more than 72 hours were enrolled. Patients who stayed for less than 72 hours in PICU or had urinary tract infection or blood stream infection at the time of admission were excluded. Center for disease control and prevention (CDC) current National Healthcare Safety Network (NHSN) criteria[(8)] was used to diagnose DAIs. Non-probability consecutive sampling technique was applied. Based on the study conducted in India by Gupta et al[18], who reports 9% incidence of CAUTI in PICU according to CDC's current NHSN guidelines. Assuming a confidence interval of 95%, a sample size of 156 patients was required with margin of error 4.5%. For sample size calculation "WHO sample size determination in health sciences" software was used. Patients were registered through a structured proforma. Demographic variables recorded were medical record number, age, gender and length of stay. Confidentiality was maintained by keeping all data password protected. Outcome Variable i.e. VAP, CLABSI and CAUTI assessed as CDC NHSN criteria and recorded on proforma.

Data Analysis

Collected data was analyzed through Statistical Package for Social Science (SPSS) version 20.0. Mean and Standard deviation was calculated for age and PICU stay. Percentages were calculated for gender, VAP, CLABSI and CAUTI. Stratification was done with respect to age, gender and length of stay to control the effect modifiers. Post stratification Chi-Square test applied. P- value of ≤ 0.05 was taken as significant. Odds ratio (OR) with 95 % Confidence interval (CI) was calculated for Gender and Length of stay.

RESULTS:

One fifty-Six patients were enrolled in the study. 102 patients (65.4%) were male. Mean age was 57.59 standard deviation (SD) $\pm$60.5 months. Mean length of stay (LOS) was 5.6(SD) $\pm$4.1 days. Minimum length of stay was 3 days while maximum length of stay was 40 days. 73 (46.8%) patients were $\leq$ 2 years. Mortality during study period was 10.2%. The case specific mortality was 50%. (Table-I)

156 patients enrolled. Patient days (PD) were 546 days and Device days (DD) were 958 days. Device utilization ratio was 0.56. Four DA-HAI were identified during study period with a Device associated infection Rate of 4.17 per 1000 device days. All the DA-HAI were CLABSIs. No VAP or CAUTI were identified. CLABSI rate was 13.3 per 1000 central line days. 3 out of 4 DA-HAI were mono microbial while one was poly microbial. Microbiological profile, in order of frequency was Enterococcus (40%), Enterobacter (20%), Acinetobacter (20%) and Escherichia coli (20%). Escherichia coli was Carbapenem resistant (CRE) [Figure-1].

Table-IIa & b shows details of surveillance data.

To look for the association between DAI incidences with different categorical variables chi square test has also been used. We checked for

association between gender, length of stay and age of patients with occurrence of DAI using Chi-Square but no significant association identified. P-value was > 0.05. Odds ratio for Gender (Male/ Female) was 0.62 (95 % CI 0.06 - 6.13). Odds ratio for Length of Stay (3-5 days / > 5days) was 4.86 (95% CI 0.49 - 47.85).

Table-III Shows association between various categorical variable and Incidence of DA-HAI which were not significant.

S. No.	Month/ Year	Pooled Data						
		Total Patient	LOS > 72hr	PD	DD	DUR	DA-HAI	Rate
1	Aug 15	28	12	87	152	0.51	1	6.5
2	Sept 15	26	10	85	151	0.50	0	0
3	Oct 15	24	13	89	161	0.59	0	0
4	Nov 15	30	14	91	160	0.61	1	6.2
5	Dec 15	24	16	98	168	0.63	2	11.9
6	Jan 16	24	15	96	166	0.52	0	0
	Total	156	80	546	958	-	4	-
	Average	26	13.3	91	159.6	0.56	0.66	4.17

Table-IIa. DAHAI surveillance data

S. No.	Month/ year	VAP				CLABSI				CAUTI			
		VD	VUR	VAP	Rate	CLD	CLUR	CLABSI	Rate	UCD	UCUR	CAUTI	Rate
1	Aug 15	46	0.52	0	0	47	0.54	1	21.2	59	0.67	0	0
2	Sept 15	48	0.56	0	0	45	0.52	0	0	58	0.68	0	0
3	Oct 15	54	0.60	0	0	52	0.58	0	0	55	0.61	0	0
4	Nov 15	47	0.51	0	0	50	0.54	1	20	63	0.69	0	0
5	Dec 15	52	0.53	0	0	58	0.59	2	34.4	58	0.59	0	0
6	Jan 16	48	0.50	0	0	47	0.48	0	0	71	0.73	0	0
	Total	295	-	0	0	299	-	4	-	364	-	0	0
	Average	49.1	0.54	0	0	49.8	0.54	0.66	13.3	60.6	0.66	0	0

Table-IIb. Breakup of DAHAI surveillance data

Variable	DA-HAI Yes	DA-HAI No	P-Value	OR	95% CI
Gender Male Female	 3 1	 99 53	0.682	0.62	0.06 - 6.13
Age ≤2 years 2-5 years >5 years	 1 2 1	 72 25 55	0.214	-	-
LOS 3- 5 days >5days	 1 3	 94 58	0.136	4.86	0.49 - 47.85

Table-III. Pearson-Chi square statistics for DAI incidence

	Rosenthal VD et al. 2012 [15]	Salomao R et al. 2008[19]	Tao li et al. 2011 [21]	Leblebicioglu et al. 2003-2012[20]	Our Study
DAI rate	1.8	29.8	5.3-6.4	-	4.17
CLABSI Rate	3.0	9.1	3.1	11.1	13.3
VAP Rate	5.2	20.9	20.8	21.4	0
CAUTI Rate	4.2	9.6	6.4	7.5	0
CLUR	0.48	0.77	0.1	0.65	0.54
UCUR	0.29	0.89	0.08	0.88	0.66
VUR	0.42	0.51	0.11	0.54	0.55

Table-IV. Comparison of DA-HAI rate and DUR with Other studies.

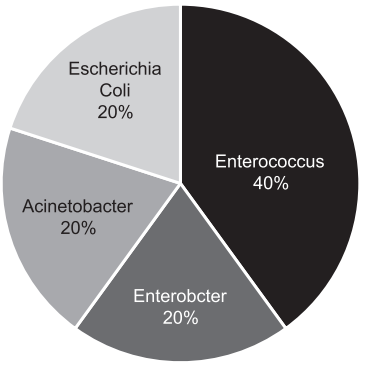

Figure-1. Microbiological Profile

Mean Age (Months)	57.59 (54.67 – 57.59)
• < 2 years	73 (46.8%)
• 2 – 5 years	27 (17.3%)
• > 5 years	56 (35.9%)
Mean Length of stay (days)	5.65 (4.18 – 7.12)
• 3 – 5 days	95 (60.9%)
• > 5 days	39.1 %
Gender	
• Male	102 (65.4%)
• Female	54 (34. 6%)
Mortality	16 (10.2%)
Case specific mortality	50%

Table-I. Patient characteristics (n= 156)

DISCUSSION

DAI continue to be a major cause of patient's morbidity and mortality.[19] This is supported by studies conducted in developed countries where integrated infection control programs including targeted surveillance of DAIs have been implemented.[19] Our study is one of the few studies that determine the incidence of DAI in PICUs of Pakistan using standardized definitions. The DAI rate in our study was found to be 4.17 per 1000 DD. All of DAI that we encountered were CLABSIs. No VAP or CAUTI was observed during our study. CLABSI rate in our study was 13.3 per 1000 CLD.

In a study done by Leblebicioglu H et al[20] in which they showed the finding of INICC from 2003 – 2012 in Turkish ICUs. Their CLABSI rate was 11.1 per 1000 CLD, VAP rate was 21.4 per 1000 VD and CAUTI rate was 7.5 per 1000 UCD. DUR were 0.65, 0.88 and 0.54 for CLUR, UCUR and VUR respectively.[20] In Turkish ICUs, DAI rates were higher than the Global INICC Report and U.S. NHSN's data. Likewise, the antimicrobial resistance rates found in their ICUs were higher than U.S. NHSN and INICC.[20] They attributed these rates to hospital over-crowding, lack of medical supplies, outdated medical supplies and an insufficient number of experienced nurses.[20] Same situation exists in almost all developing countries therefore rate of DAI is higher in this region of the world.

Salomao R et al[19] in 2008, evaluated the rates of DAI in Brazilian PICU. Their DAI rate was 29.8 per 1000 ICU days. Device specific rates for CLABSI were 9.1 per 1000 CLD, for VAP 20.9 per 1000 VD and CAUTI were 9.6 per 1000 UCD. DUR was 0.73 – 0.96 for CLUR, 0.85-0.92 for UCUR and 0.31-0.67 for VUR.[19] They indorsed these high rates secondary to lack of rules and regulations concerning the implementation of infection control programs, lack of adherence to infection control bundles, lack of infection control surveillance and low nurse-to-patient staffing ratios.[19] In our study, we observed lower DAI rate than reported. CLABSI rate was higher but in contrast we did not observed any VAP or CAUTI. Our DUR was

higher because we receive terminally ill patient in condition in which use of invasive devices is mandatory. The DUR reported by Tao li et al[21] was extra ordinary low as compare to other studies in limited resource setting. They ascribed this low rate to infrequent evaluation of severity of illness. Pakistan does not have a surveillance system of Healthcare associated infections, no legal frame work and no law regarding it. There is shortage of PICU, lack of structured infection control policies and protocols, lack of proper hand hygiene, experienced staff, funds and organization.

AKUH has a well-developed infection control department with well-organized infection control policies and protocols. We have multidisciplinary rounds involving clinical pharmacist and infection disease specialists with input from microbiologists. We follow strict infection control policies this explain our low rates of DAI including VAP and CAUTI. But our CLABSI are higher than most of the studies because of higher utilization of central line, rapid turnover, lack of continuous training and shortage of staff. By virtue of this study we have focused our attention in areas in which we are lacking. In our study most of the infections were caused by gram negative organism which is consistent with other studies.[19-22]

In comparison to current NHSN benchmark our PICU has well controlled CAUTI and VAP rates but our CLABSI rate are high. Our VUR and CLUR is high but UCUR is optimal.

This study is limited by being a single center, private sector study of very short duration so results are not generalizable. We do not cater immunocompromised and transplant patients. Further studies with longer duration and sample size needed to know actual situation of DA-HAI.

CONCLUSION

In Conclusion, we observed high incidence of CLABSI in our PICU emphasizing the need for focused training and education. DAIs are significant cause of increased patient morbidity and mortality.

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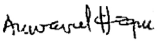
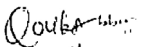
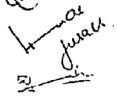
2	Anwarul Haque	Conceptualization, Revised the manuscript, Data interpretation, Guarantor.	
3	Qalab Abbas	Data analysis, Review manuscript.	
4	Humaira Jurair	Review manuscript, Guarantor.	
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