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Incidence of hospital acquired infections in paediatric emergency unit–A one year longitudinal observational study

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Abstract
Background: Healthcare-associated infections (HAIs) are an important cause of morbidity and mortality in critically ill children. This prospective surveillance study was performed to estimate the burden of HAIs in a paediatric emergency department of a tertiary care hospital.
Objectives: First, to know the incidence rate of HAIs in patients admitted to pediatric emergency and second, to isolate and identify bacteria causing HAIs with special emphasis on their antibiotic sensitivity.
Methods: The prospective study was conducted in a fourteen-bedded paediatric emergency of a tertiary care hospital for one year. Patients were assessed daily during their stay in emergency ward. Data pertaining to device usage, length of stay (LOS), antibiotic usage, clinical outcome was recorded for the patients admitted for more than 48 hours. On clinical suspicion of HAI appropriate samples were investigated for bacterial infection and their antibiotic susceptibility was analysed. Statistical analysis was expressed in percentages and outcome variables were calculated using Mann Whitney U test.
Results: Of the 410 patients, 5 patients developed 8 episodes of HAI with crude incidence rate (CIR) of 1.95%. Ventilator associated pneumonia (VAP) was the commonest HAI. The mean LOS of patients with HAI was 49.8 + 30.73 days. Gram negative bacilli were the most common isolated pathogens in the HAI subset. Multidrug resistance trait was seen in most of the isolates.
Conclusions: Low CIR in the study population can be attributed to aggressive initial empirical antibiotic management of all patients and limited stay in emergency unit. In congruence with other studies, mean LOS of HAI patients was very high.
Key Message: Prevention of HAI is a team work, wherein each health care provider should follow the hospital protocol. Length of hospital stay and instrumentation were found to be the major risk factors for HAI. Microbiology laboratory support facilitates timely identification of the pathogen and an effective management of HAI.

Keywords: hospital associated/acquired infections (HAI), ventilator associated pneumonia (VAP), paediatric emergency (PEM)

Introduction
Hospital-acquired infections (HAI), are one of the most significant causes of morbidity and mortality in healthcare settings throughout the world [1, 2, 3]. In developing countries, the magnitude of this problem remains unknown largely [4] Emergency Units are the busiest department of any hospital. The aim of this study is to conduct surveillance and document the incidence of HAI in the Pediatric Emergency of a tertiary care hospital. Also, in this study antibiotic sensitivity pattern of the isolates from HAI patients has been analyzed.

Subjects and Methods
This longitudinal prospective surveillance study was conducted in the 14 bedded Pediatric Emergency of a tertiary care centre. The samples were processed in the Department of Microbiology, Jawaharlal Nehru Medical College, KAHER, Belagavi. Study protocol was approved by the Ethical Committee of the institute and written informed consent was obtained from parents/guardians of the patients.

Source of data: Paediatric Emergency Ward of Dr Prabhakar Kore Charitable Hospital, Belagavi.

Study design: Longitudinal study

Study period: from January 2017 to December 2017
Sample size calculated to be 385 taking 10% as prevalence from standard texts and literature.

Statistical analysis: Statistical analyses was performed using software STATA 9.0 (Stata Corp., College Station, TX, USA). Means and standard deviations were used to describe continuous variables. Clinical outcome variable in the form of length of stay was calculated using Mann Whitney Standard U Test.

The study was included 410 children who were admitted with clinical diagnosis of bronchopneumonia, convulsions under evaluation, fever under evaluation, anaemia under evaluation, clinically suspected septicaemia. Included patients were assessed daily during their stay in the Paediatric Emergency. Their blood cultures were sent for microbiological analysis upon admission, before administration of antibiotics, as a routine practice in blood culture bottles containing Brain Heart Infusion broth and 0.05% Sodium Polyanethole Sulfonate. Detailed data regarding Invasive device usage such as peripheral venous catheters, central venous catheters, Foley's catheters, endotracheal tubes, tracheostomy tubes, lumbar puncture, ascitic tap, pleural tap etc was taken for patients who stayed in the Paediatric Emergency Ward for more than 48 hours.

On clinical suspicion of development of HAI, following detailed examination of all patients, a new representative sample for diagnosis of a site-specific HAI was collected, and transported to the laboratory for further processing.

Identification of bacterial isolates was done by conventional biochemical tests after isolation [5]. Antimicrobial susceptibility testing of the bacterial isolates was done by disc diffusion techniques using Kirby Bauer's method as per Clinical Laboratory Standards Institute guidelines [6].

Results

Demographic characteristics of the study population of the 410 patients, 225 (54.8%) were male and 185 (45.12%) were female. At the time of admission to the Paediatric emergency ward, 104 (25,36%) were aged <1 year (including 26 neonates), 168 (40.97%) were aged ≤6 years, and 138 (33.65%) were aged >6years.

Risk factors

Of 410 patients under study, 398 patients had peripheral venous catheter in situ and none of them developed BSI. 12 patients were managed without intravenous line. 25 patients had Foleys catheter in situ and none of them (0%) developed CAUTI. 12 patients were mechanically ventilated in paediatric emergency ward during the period of study, of whom 4 patients (33.3%) developed VAP. 6 patients had ascitic tap done and 4 patients underwent pleural tapping and 26 patients underwent lumbar puncture and none of them developed HAI. Two patients underwent surgery under general anaesthesia and one of them developed SSI (Table 1).

Table 1: Anticipated risks in patients with HAI.

Risk factors	Number of patients exposed to the risk	Patients developing HAI in the at-risk population	Number of episodes in the patients developing site specific HAI
IV Cannula (Peripheral Venous Catheterization)	398	0 (0%)	0
Foley's catheter (FC)	25	0 (0%)	0
Mechanical ventilation (MV)	12	4 (33.3%)	6
Lumbar puncture (LP)	26	0 (0%)	0
Central venous catheterization (CV)	8	1 (12.5%)	1
Ascitic tap	6	0 (0%)	0
Pleural tap	4	0 (0%)	0
Minor operative procedures (SSI)	2	1 (50%)	1

Incidence rates of HAIs

Figure 1 shows that of 410 included patients, 5 patients developed 8 episodes of HAI, which is a Crude Incidence Rate (CIR) of 1.95%. Incidence density of site-specific HAI was found to be as follows: 24.53% for VAP, 8.7% for Central Line associated Blood Stream Infection (CLABSI) and 16.4% for Surgical Site Infection (SSI).

Mean LOS and outcome

The mean LOS of the 410 study patients was 7.43 days. The LOS in patients who developed an HAI was 49.8± 30.75 days (range: 20 days to 95 days; median: 56 days), and was significantly longer (Mann Whitney test,P< 0.0001) than the mean LOS of patients without an HAI, which was 7.09 ± 5.56 days (range: 2 days to 40 days; median: 9 days).

No mortality was observed in any of the patients who developed HAI in our study. 4 out of 5 patients were discharged from the Paediatric Emergency Ward without any clinical complaints and were asymptomatic. However, the patient who developed SSI shifted out of the hospital without any clinical improvement against medical advice.

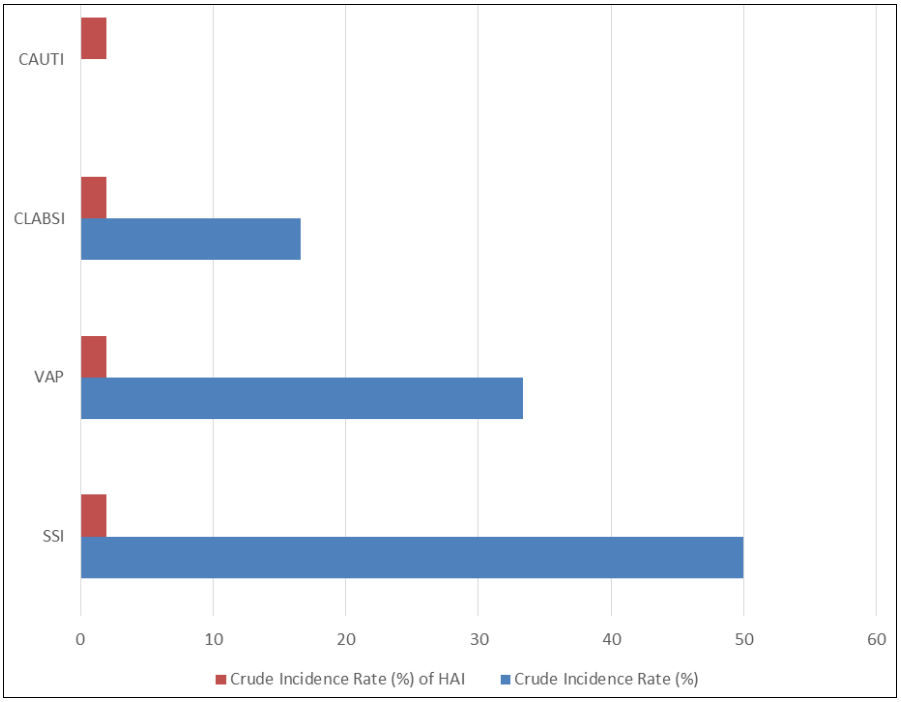

Fig 1: Site specific infections in comparison with hospital associated infections (HAIs).
CAUTI: Catheter Associated Urinary Tract Infection, CLABSI: Central Line Associated Blood Stream Infection, VAP: ventilatory Associated Pneumonia, SSI: Surgical Site infection.

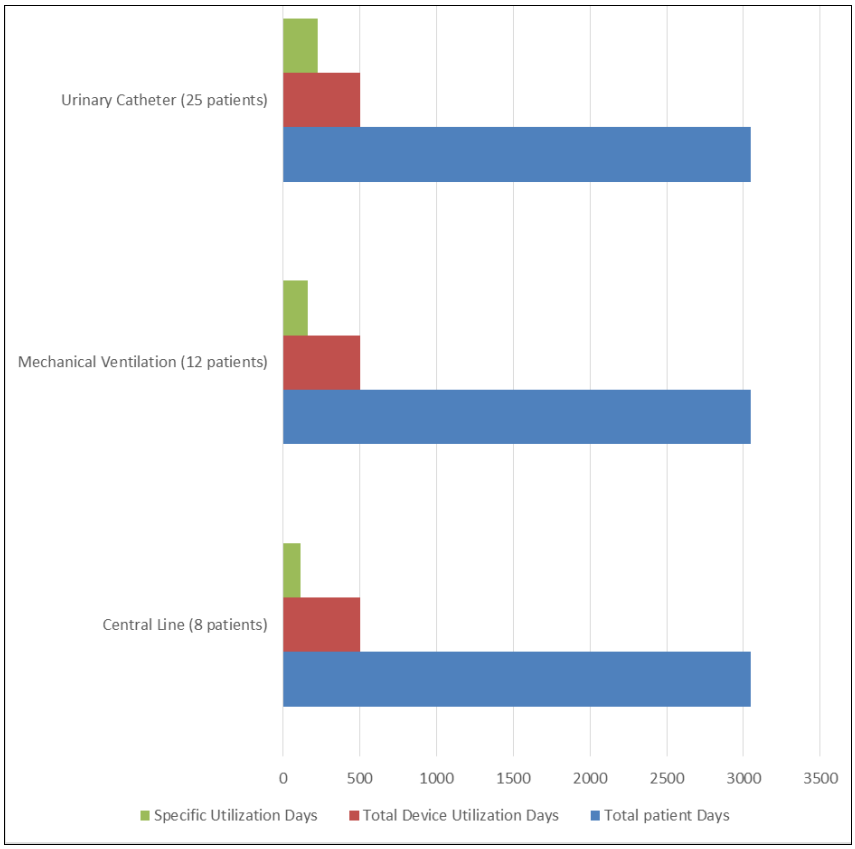

Fig 2: Device specific utilization days in the study cohort.

Bacterial isolates

In 5 patients that experienced HAI, 1 patient experienced SSI, 1 patient had single episode of VAP, 2 patients developed 2 episodes of VAP each and one patient developed episodes of VAP and CLABSI each. 6 different types of bacterial isolates were obtained in 8 episodes of HAI. Streptococcus pneumoniae, Acinetobacter baumannii, Citrobacter freundii and Escherichia coli were isolated in 4 episodes of VAP. Pseudomonas aeruginosa was isolated from patient who developed CLABSI. Klebsiella pneumoniae was isolated both from a patient with SSI and another patient who developed VAP.

Antimicrobial susceptibility profile of bacterial isolates

5 gram negative isolates and 1 gram positive isolate were obtained from the patients who developed VAP. Out of these, Acinetobacter baumannii and Klebsiella pneumoniae were found to be pan resistant to all the tested antibiotics.

Conclusion

Nosocomial infections are complications of hospitalization that lead to increased morbidity and mortality.[1,2] These infections prolong hospitalization, require more extensive diagnostics and treatment, and are associated with additional costs.[3,4] Infection with multidrug-resistant pathogens can also further complicate treatment. The current study was carried out in paediatric emergency ward of a tertiary care center. Crude incidence rate of HAI was found to be 1.95% which was significantly lower than crude incidence rates documented in other ICU HAI surveillance studies. However,this was found to be in accordance to a study conducted by Raymond J, wherethe overall incidence of nosocomial infections in general paediatrics ward ranged between 1 to 4%.[7] According to Milliken J *et al*, the incidence rate was around 6.1%.The risk of Hospital Acquired infection was known to increase with interventions like central line usage, prolonged intubation and other comorbid conditions.[8] In a study conducted at AIIMS delhi by Gupta etal in a Paediatric Intensive Care Unit, the incidence rate was found to be around 19.3%. This high incidence rate was attributed to the set up having its resource constraints and high usage of invasive devices.[9]

.In our study, low incidence rates have been attributed to shorter length of stay of patients in Paediatric emergency ward, immediate transfer out of critical patients to ICUs and lesser frequency of invasive interventions

There was a statistically significant difference ($p < 0.0001$) in mean Length of Stay (LOS) between patients who developed HAI (49.8 ± 30.75) and those who did not (7.09 ± 5.56). The longer stay developed HAI already had severe or complicated conditions. Added infections delayed the recovery time. Second, non-critical care areas are under equipped to promptly diagnose and manage nosocomial infections.

In our study, VAP was found to be the most common site specific infection. The incidence of VAP in other studies ranges between 9 to 21%.[10,11,12] The high incidence rate (33%)of VAP in our study, could be due to some of the patients were mechanically ventilated in the Paediatric emergency ward where strict asepsis while intubations and care of patients is not feasible. PICU remains overburdened leading to intubation, mechanical ventilation and maintenance of patients in the paediatric emergency unit. Moreover, half the patients who had first episode of VAP later developed recurrent episode of VAP. This might have been probably due to prolonged duration of mechanical ventilation which leads to repeated intubations, following co-morbid conditions like bronchiectasis, bronchopneumonia, Guillan-Barre Syndrome. Device utilization rate of Mechanical ventilation was higher as compared to device utilization rates of Central line in paediatric emergency ward. This correlated with highest proportion of VAP cases among all site specific nosocomial infections.

In this study, incidence of CAUTI was found to be zero. Also, in a study by Gupta et. al, no case of CAUTI was found associated with urinary catheterisation. The authors suggest negligible incidence could be due to loss of patients on follow up or even undiagnosed asymptomatic bacteriuria. The nil incidence rate of CAUTI in our study was probably because of the widespread use of condom catheters than Foleys catheter in emergency unit. Also, of note, most catheterizations were done by the trained and dedicated senior nursing staff under strict aseptic cover.

There were only 2 cases in the study in which surgical interventions were done and one out of the two had developed a surgical site infection. Thus, we are unable to comment on incidence of SSI in the study.

Nosocomial infections in Paediatric Intensive Care Units (PICU) caused by multidrug-resistant bacterial organisms are increasing and are known to lead to poor prognosis [13, 14, 15]. In this study, Acinetobacter baumannii and Klebsiella pneumoniae were found to be pan-resistant. These organisms pose a great challenge for the clinicians to choose the appropriate antibiotic therapy and the prognosis generally remains poor. Acinetobacter is known to colonise the open wounds and are known to produce biofilms as a part of their virulence in hospital settings [16]. We have not studied the virulence factors of the isolates.

In the current study it was found that gram negative bacilli were responsible for 5 out of 6 episodes of VAP. Citrobacter freundii was the predominant isolate followed by Klebsiella pneumoniae, Escherichia coli and Acinetobacter baumannii. There was only a single isolate of gram-positive cocci (Streptococccus pneumoniae). These organisms are the predominant pathogens found in other studies as well [9, 16].

However, in this study all the patients recovered from HAI. But the patient with surgical site infection due to pan-resistant Klebsiella pneumoniae was discharged with infection, against medical advice. Based on this study, appropriate HAI prevention steps were recommended and implemented after due consultation with Hospital Infection Control experts. Lack of source tracing remain the limitations of the study. Further follow up and similar surveillance in the general wards is recommended in the Paediatric emergency ward to assess the measures taken and their impact on HAI reduction and compliance.

Crude Incidence rate of 1.95% is attributed to stringent adherence to aseptic preventive measures. The study emphasizes the need of continuous surveillance of HAI to diagnose and treat Antibiotic resistant HAI promptly as there were no mortality in patients with HAI.

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