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Prevalence of Health-Care Associated Infections in a Tertiary Care Hospital in South Eastern Assam

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Abstract

Background: *Hospital associated infection or Nosocomial infection or Health-care-associated infection (HAIs) are infections that occur while receiving health care, developed in a hospital or other health care facility that first appear 48 hours or more after hospital admission, or within 30 days after having received health care. Hospital acquired infection includes Ventilator Associated Pneumonia (VAP), Central Line Associated Blood Stream Infection (CLABSI), Catheter Acquired Urinary Tract Infection (CAUTI), and Surgical Site Infection (SSI). The purpose of this study is to review the profile of hospital-acquired infections in our hospital, a multi-specialty tertiary care centre, located in the south-eastern part of Assam.*

Methods: *This prospective study was carried out on patients identified to have developed HAIs while admitted to the medical wards, paediatric wards, surgical wards, dialysis unit, and intensive care unit (ICU) of the hospital. A clinical evaluation and relevant laboratory investigations were carried out. The study period was from 1st October, 2019 to 30th September, 2020.*

Results: *An overall HAI prevalence was 15.7% with highest in ICUs (38.5%) followed by paediatric wards (13.5%) and surgical wards (12%). The most common HAI category was urinary tract infection (UTI- 31.1%) followed by respiratory tract infections (RTI- 24.3%)& the most common pathogens isolated were Klebsiella pneumoniae and Staphlococcus aureus.. The incidence of CLABSI was 3.6%, the most common pathogen isolated was Acinetobacter baumanii. CAUTI was diagnosed in 3.8% admitted patients who had foley catheter Most of the HAIs in our ICU were caused by MDR Gram Negative Organism & Acinetobacter baumanni was the commonest of all.*

Conclusions: *The HAI prevalence found in this study was lower than HAI rates reported in some other studies from other parts of Assam. The isolates showed high resistance to common antibiotics. Guidelines for improving HAI surveillance and stringent measures to reduce the prevalence of multidrug-resistant HAIs must be implemented to reduce the rate and the consequences of HAIs.*

Background

Hospital associated infection or Nosocomial infection or Health-care-associated infection (HAI) is localized or systemic condition resulting from adverse reaction to the presence of infectious agent or its toxins acquired from health care settings that was not incubating or symptomatic at the time of admission to the healthcare facility. HAI are a significant cause of increased morbidity and mortality in hospitalized patients. In addition, HAI are a cause of prolonged hospital stay, are inconvenient for the patient, and constitute an

economic burden on health care. HAI includes Ventilator Associated Pneumonia (VAP), Central Line Associated Blood Stream Infection (CLABSI), Catheter Acquired Urinary Tract Infection (CAUTI), and Surgical Site Infection (SSI). HAIs occur in both adult and paediatric patients. Bloodstream infections, followed by pneumonia and urinary tract infections are the most infections in children, urinary tract infections are the most common healthcare associated infections in adults. Around 12–17 microorganisms cause 80%–87% of HAIs: *S. aureus*, *Enterococcus species* (eg, *faecalis*, *faecium*), *E. coli*, coagulase-negative *Staphylococci*, *Candida species* (eg, *albicans*, *glabrata*), *K. pneumoniae* and *Klebsiella oxytoca*, *P. aeruginosa*, *A. baumannii*, *Enterobacter* species, *Proteus* species, *Bacteroides* species, and other pathogens. Among these pathogens, 16%–20% include multidrug-resistant (MDR) phenotypes: MRSA, Vancomycin-Resistant *E. faecium*, Carbapenem-resistant *P. aeruginosa*, Extended-Spectrum cephalosporin-resistant *K. pneumoniae*, *K. oxytoca*, *E. coli*, and *Enterobacter species*, and Carbapenem-resistant *P. aeruginosa*, *K. pneumoniae/K. oxytoca*, *E. coli*, *Enterobacter* species, and *A. baumannii*. Some of these Gram-negative microorganisms have a much higher rate (20%–40%) of resistance than others with the organisms isolated from device-associated HAIs having the highest antimicrobial resistance phenotypes. It is estimated that 80% of all hospital deaths are directly or indirectly related to HAIs (Hughes et al., 2005).

Studies have shown that HAI prevalence varies from 3.8% to 18.6% depending on the population surveyed and the definitions used (Jensen, 2008). Although eradication of HAI is impossible, a well-conducted surveillance and prevention program may significantly reduce HAI and associated costs. Continuous prospective surveillance for HAIs is the gold standard but this approach requires comprehensive resources. Infection Control Committee, of any hospital, serves as a major tool for the surveillance of these infections. The hospitals in developed countries generate their infection-control surveillance data from time to time. This is also pertinent for empirically treating infections, especially in the intensive care unit (ICU) setting, where a thorough knowledge of the epidemiology, type, nature, and risk factors for infections as well as the antimicrobial resistance patterns of invading microorganism is needed. It has been observed that there is scanty published data on device-associated infections available from Indian ICUs. The objective of the study was to ascertain the epidemiology and risk factors of health-care-associated infections in ICUs of a tertiary care hospital.The data included the patient's age, gender, admission date, ward type (surgery, medicine, paediatrics and intensive care unit), duration of hospital stay etc.

Materials & Methods

Sample Collection

Samples were collected under aseptic conditions and transported immediately to the Microbiology Department.

Samples include: Urine, blood, Pus, Swabs, etc.

Quantitative analysis for the growth and type of organisms were monitored at 24 and 48 hours.

Type of Study: Prospective Hospital based study

Place of study: Silchar Medical College & Hospital, Silchar, Assam, India.

Period of study: October, 2019 to April, 2021

No. of samples tested: 1320

All admitted patients who had been in the hospital for at least 48 hours were included in the study. The data included the patient's age, gender, admission date, ward type (surgery, medicine, and intensive care unit), duration of hospital stay etc. The HAI was classified as urinary tract, surgical wound, pneumonia, bloodstream, and others (skin and soft-tissue infections, intra-vascular and gastrointestinal system infections).Exposures to invasive devices (urinary catheter, central intravascular catheter, peripheral intravascular catheter, and mechanical ventilation) were also

noted. Prior institutional ethical clearance and informed verbal consent were obtained from the participants who were assured of anonymity and confidentiality of information collected. The individual study subject was briefed about the purpose of the study, possible investigation needed and the possible investigation needed and the possible outcome. The collected samples were then processed for Gram staining, cultures in Blood agar, Nutrient agar, MacConkey agar. Biochemical tests and antimicrobial susceptibility was done based on the growth of the organism. The results were processed, analyzed and statistically evaluated in Microsoft Excel.

Results

Of 1320 patients included in the survey, there were 744 (56.4%) males and 576 (43.6%) females. 514 patients were from medical wards (medicine, psychiatry), 484from surgical wards (surgery, orthopaedics, neuro- surgery, ophthalmology, burns and plastic surgery and ENT), 160 from paediatric wards (paediatric and neonatal), 84 from obstetrics and gynaecology and 78 from ICUs (Medical ICU, Paediatric and neonatal ICU). Of 1320 evaluated patients, 207 patients had hospital acquired infections. Hence the proportion of admitted patients with HAI was found to be 15.7%. 92 patients had single HAI while 24 patients had multiple HAIs. The prevalence of HAI was highest in ICUs (33.3%) followed by paediatric wards (12.5%) and surgical wards (10.3%) as shown in table 1. Surgical procedures, mechanical ventilation, urinary catheters, or intravascular devices were independent risk factors for HAI. Out of 660 patients included in the study, 1152(87.2%) patients had peripheral intravenous catheters (PVC), 220 (16.6%) underwent surgery, 176 (13.3%) had indwelling urinary catheters (UC), 108 (8.1%) had central venous catheters (CVC) and 70 (5.3%) were on mechanical ventilator. While the overall HAI prevalence was 15.7 %, if a patient had a device *in situ* the HAI prevalence was significantly higher (26.6%). The presence of specific devices was associated with higher HAI prevalence: CVC (44.4%), PVC (25.2%), urinary catheter (38.6%) and intubation (51.4%). Also prevalence of HAI was higher for patients undergoing surgery than for those who did not have surgery (27.2% versus 14.4%) (Table 2). Table 3 is showing the prevalence of various HAIs in our hospital. The most common HAI category was urinary tract infection (UTI- 31.1%) followed by respiratory tract infections (RTI- 24.3%), surgical site infection (SSI- 20.3%) and blood stream infection (BSI- 18.2%) as shown in table 3. At least one antibiotic was taken by 1144 patients, which represents prevalence of 86.6%. The most frequently administered antibiotics were amoxicillin clavulanic acid, ceftazidime, ciprofloxacin, metronidazole and piperacillin-tazobactam. Common organisms isolated were *Pseudomonas aeruginosa, Acinetobacter baumanii, Staphylococcus aureus, Escherichia coli* and *Klebsiella pneumoniae*

Table 1 Prevalence of HAI in various wards

S. No	Wards	No. of Admitted Patients	No. of HAI Patients	%age of HAI
1	Medical Wards	514	16	3.1%
2	Surgical Wards	484	50	10.3%
3	Paediatric Wards	160	20	12.5%
4	Obstetrics & Gynaecology Ward	84	4	4.7%
5	ICUs	78	26	33.3%

Table 2 Distribution of HAI by intrinsic risk factors

S. No	Risk Factors	No. of Patients	Presence of HAI	HAI Prevalence Percentage
1	Invasive device *in situ*	1156	154	13.3%
2	PVC	1152	146	12.6%
3	CVC	108	24	22.2%
4	Urinary catheter	176	34	19.3%
5	Intubation	70	18	25.7%
6	Without any invasive device	164	0	Nil
7	Any surgery done	220	30	13.6%
8	No surgery	1100	80	7.2%

Table 3 Prevalence of various hospital acquired infections in our hospital

S. No	HAI Groups	No of HAI	Percentage of HAI
1	Urinary tract infection	46	29.9%
2	Respiratory tract infections	36	23.3%
3	Surgical site infection	30	19.5%
4	Bloodstream infection	28	18.2%
5	Burn wound infection	12	7.8%
6	Others (skin infection)	2	1.3%
	TOTAL	154	

Discussion

In this study we documented an overall HAI prevalence of 15.7%, which is in accordance with other studies particularly from developing countries (13.9%–17.9%) (Jroundi et al., 2007; Allegranzi et al., 2011), but is higher when compared with point prevalence studies from developed countries (5.7%–6.8%) (Sartor et al., 2005). Disease, death, and economic costs associated with HAI are increasing especially in the last few decades. There are certain risk factors associated with high rate of HAIs like length of stay in the hospital, underlying immunocompromised conditions, age of the patient, any surgical procedure during hospital stay and presence of invasive medical devices *in situ* (e.g., vascular catheters, urethral catheters, intubation of the respiratory tract). The prevalence of HAI was highest in ICUs (33.3%) followed by paediatric wards (12.5%) and surgical wards (10.3%). This may be due to the high frequency of invasive procedures, high frequency of serious illness, and use of large therapeutic agents (Metintas et al., 2004). In our study, the presence of specific device was associated with higher HAI prevalence: CVC (22.2%), PVC (12.6%), urinary catheter (19.3%) and intubation (25.7%). The device associated infections identified within this survey further emphasise the importance of improving practices around insertion and maintenance of medical devices. Also prevalence of HAI was higher for patients undergoing surgery than for those who did not have surgery (13.6% versus 7.2%).

The most common HAI category was UTI followed by RTI, SSI and BSI which are similar to those reported in other studies and should call importance to the strong association between urinary tract infection and urinary catheter (Zarb et al., 2012; ECDC, 2011). High rate of RTI and SSI could be because of the fact that it is a tertiary care hospital and hence complicated cases are referred which requires emergency intubation and surgical procedure. BSI are potentially serious infections, which often require lengthy courses of intravenous antimicrobials, may result in metastatic infection to cardiac valves, bones and joints and are associated with patient morbidity and mortality. BSI associated with intravascular catheter infections are potentially preventable via simple measures, which include; avoiding unnecessary use of catheters, inserting and

maintaining catheters with care and removing catheters when they are no longer required (All Wales, 2011).

While the use of antimicrobial agents has revolutionised our ability to treat infections, it is associated inevitably with the risk of development and spread of antimicrobial resistance. In our study, 86.6% of patients were prescribed antimicrobials. Antimicrobial resistance is a cause for concern as HAIs are difficult and more expensive to treat and associated with increased patient morbidity and mortality. Also there is emergence of multidrug resistant organisms in the hospital like methicillin resistant staphylococcus aureus, extended spectrum ß-lactamase, Amp C production and carbapenemase production over the past few decades and there are extremely limited treatment options for these infections and there will be no new antimicrobials available in the foreseeable future. Hence it is important that all hospitals should implement appropriate use of antimicrobials and good prescribing practices. Adaption of such a framework by doctors, specifically for antimicrobial prescribing, may be a useful tool to improve prescribing practices (Scottish Antimicrobial Prescribing Group, 2010).

Data fields on the types of micro-organisms causing HAI were poorly completed, with only 57.1% of the HAI having an associated micro-organism. In general, the most common HAI pathogens (*P. aeruginosa* and *A. baumanii*) identified in our survey were similar to those identified in other published investigations (Hung et al., 2008; Allegranzi et al., 2011). Multidrug resistance among gram-negative bacteria has rendered therapy of HAIs more difficult or likely to fail and has increased the attributable morbidity and mortality (Hulscher et al., 2010). Thus, for developing countries like India, surveillance of antimicrobial resistance is essential for preventing the emergence and transmission of multidrug-resistant pathogens in healthcare facilities. Our findings suggest that infection control practices and procedures need to be strengthened further and also training and reinforcement of aseptic techniques in healthcare personnel for performing invasive procedures is required. Hence it is necessary to provide comprehensive educational programs for healthcare workers, addressing basic infection control (IC) issues, such as standard precautions, device utilization, and evidence-based practices and procedures, and to establish more effective institutional IC policies. However, even though the prevalence surveys are a rapid, inexpensive, and easy way to estimate the HAI problems, they are less acceptable and less reliable than prospective surveillance studies because it is a snapshot at one particular point in time and may not represent the prevalence at all other times in the same hospital, or at different times of year, such as seasonal variations. Also, despite standardised training, there may be variations in the interpretation of definitions and the availability of data items necessary for the fulfilment of definitions, between data collecting teams and hospitals (Hopmans et al., 2007). Despite these limitations PPS (point prevalence survey) data are very valuable as they give the best available estimate of the total burden of HAI and antimicrobial use to inform the targeting of appropriate quality improvement plans and interventions. Our study had some limitations. One-day point prevalence studies tend to overestimate persistent infections and underestimate infections with shorter durations. This study did not cover all risk factors leading to HAIs, such as underlying disease, previous hospitalisations, frequency of days before surgery, admission to the emergency ward and the need to perform invasive procedures under emergency conditions. Also data regarding micro-organisms causing HAIs and their antimicrobial resistance were not complete.

Conclusion

Hospital acquired infections (HAI) develop inpatients while receiving care in health facilities and represent one of the frequent preventable adverse patient outcomes in health care settings. By searching several studies in the scientific

literatures, it can be stated that, the burden of HAI worldwide is very high in terms of morbidity, mortality, extra-costs, and emotional stress and other outcome indicators. Surveillance systems for HAI exist in several high-income countries but are virtually non-existent in most low- and middle-income countries.

This study provides baseline information of HAIs and associated risk factors for future surveillance.The present study found incidence rate of hospital acquired infections as 15.7%

Thus even in a tertiary health care facility where most of the health care staff are well trained, hospital acquired infections rate could not be brought down to <10%. This might be because of extremely limited awareness of the problem, reluctance to take precautionary measures, lacking the maintenance of aseptic technique during invasive procedures, empirically misuse and overuse of antimicrobials and also very importantly precedence of other health priorities over patient safety considerations. Further researches on other causative agents and risk factors of HAI can help to identify specific preventive measures in future.Efforts are needed to strengthen Infection control programs, appropriate national strategies for prevention of HAIs, antibiotic stewardship and repeated prevalence studies in our institution in order to decrease the prevalence of HAI. Our results highlight the need for anational HAI database and reporting system using standardized surveillance definitions to monitor HAI trends and patient outcomes.

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