

# A Study on Hospital Acquired Infections among Patients in a Tertiary Care Hospital of Darjeeling District, West Bengal

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## ABSTRACT

### **Introduction:**

Hospital Acquired Infections (HAI), also called 'Nosocomial Infections' are identified at least 48-72 hours following admission to health institution. In many hospitals, HAI appears to be a hidden, cross-cutting problem. Thus a continuous surveillance is imperative for determining the extent of the problem and its effective prevention and control. Present study determines the incidence and different types of hospital acquired infections and the bacterial pathogens responsible for those.

### **Materials and Methods**

An observational longitudinal study was undertaken during January to June 2014, among 107 patients admitted in ENT wards of North Bengal Medical College and Hospital (NBMCH), selected by consecutive inclusion technique. Information was taken using a predesigned, pretested semi-structured schedule. The collected data were analyzed as frequencies, percentages and means  $\pm$  standard deviations.

### **Results**

The present study found incidence rate of hospital acquired infections as 19.6% and incidence density as 26.35 per 1000 patient days. Surgical site infection was commonest type (57.2%) followed by urinary tract infection (23.8%) and blood stream infection (19.0%) respectively. 15.4% of blood cultures, 100.0% of surgical wound swab cultures and 21.7% of urine cultures were positive and gram negative bacteria were most frequently occurring organisms. Most commonly found bacteria were *Pseudomonas* and *Klebsiella*.

### **Conclusion**

Even if in a tertiary health care facility, hospital acquired infection rate could not be brought down into <10%. So implementation of stringent guidelines on prevention of HAI and continuous surveillance and monitoring system can help to diminish this problem in future.

### **Keywords:**

Hospital Acquired Infections; Nosocomial Infections; Surgical Wound Infection; Urinary Tract Infections; Bacterial Infections

Patient care is provided in facilities which range from highly equipped clinics and technologically advanced tertiary care hospitals to front-line units with only basic facilities. Despite progress in public health and hospital care, infections continue to develop

in hospitalized patients and may also affect hospital staff.

Hospital Acquired Infections (HAI), also called 'Nosocomial Infections', are defined as infections which are not present or not incubating when the patient is hospitalised and are acquired during the hospital stay. It is usually defined as an infection that is identified at least 48-72 hours following admission to health institution.<sup>1</sup> The term 'Health Care Associated Infection' (HCAI) is now widely used instead of the traditional nosocomial infections.<sup>2</sup>

Epidemiological and etiological characteristics of

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hospital acquired infections show variations among countries and even among different hospitals in the same country. Hospital acquired infections occur worldwide and affect both developed and resource-poor countries. Infections acquired in health care settings are among the major causes of death and increased morbidity among hospitalized patients. This adversely affects patients well-being.<sup>3,4</sup>

A prevalence survey conducted under the auspices of World Health Organisation (WHO) in 55 hospitals of 14 countries representing 4 WHO Regions (Europe, Eastern Mediterranean, South-East Asia and Western Pacific) showed an average of 8.7% of hospital patients had nosocomial infections.<sup>5</sup> The highest frequencies of hospital acquired infections were reported from hospitals in the Eastern Mediterranean and South-East Asia regions [11.8 and 10.0% respectively] with a prevalence of 7.7 and 9.0% respectively in the European and Western Pacific Regions.<sup>6</sup> A review of studies performed also revealed an extremely fragmented picture of the endemic burden of HAI in India.<sup>7</sup>

Many different pathogens may cause nosocomial infections such as bacteria which are the most common nosocomial pathogens (eg. *Staphylococcus aureus*, beta haemolytic *Streptococci*, *Pseudomonas*, *E.Coli*, *Klebsiella* etc.); viruses (Hepatitis B and C viruses, Enteroviruses etc.); parasites and fungi (*Candida albicans*, *Aspergillus* spp., *Cryptococcus* etc.). A prospective study of 71 burn patients at Post Graduate Institute of Medical Education and Research (PGIMER) in Chandigarh found that up to 59 patients (83 per cent) had hospital-acquired infections: 35 per cent of pathogens isolated from wounds and blood were *S. aureus*, 24 per cent were *P. aeruginosa*, and 16 per cent were  $\beta$ -haemolytic streptococci.<sup>8</sup>

The most frequent type of infection in the mixed patient populations in developing countries was surgical site infections (29.1%), followed by urinary tract infections (23.9%), blood stream infections (19.1%), hospital acquired pneumonia (14.8%), and other infections (13.1%).<sup>9</sup> Diagnosis of hospital acquired infections includes a detailed physical examination and laboratory test of necessary samples or necessary investigation. The WHO study and others have also shown that the highest prevalence of nosocomial

infections occurs in intensive care units and in different surgical and orthopaedic wards.

The development of a surveillance process to monitor nosocomial infection rate is an essential first step to identify local problems and priorities, and evaluate the effectiveness of infection control activity. Incidence study (longitudinal) i.e. prospective identification of new infections requires monitoring of all patients within a defined population for a specified time period. Patients are followed throughout their stay and sometimes after discharge.

In India, there are no mandatory reporting and recording systems for nosocomial infections both at the national and state level.<sup>10</sup> However, there is little doubt that the incidence of HAI has increased over the years and the problem is not less in this country than anywhere else in the world.

In such an overall perspective, with almost non-existent surveillance system for HCAI both at the national and state level, studies on hospital acquired infections at various geographical locations of this diverse country may reveal interesting findings to implement area and setting specific preventive/ control measures. Such kinds of studies are also limited in West Bengal. In this scenario, the present study on hospital acquired infections among patients admitted in ENT wards of North Bengal Medical College and Hospital was undertaken with the objectives to assess the background characteristics of the study population, to determine the incidence of hospital acquired infections among those admitted patients and to identify the different types of hospital acquired infections and the bacterial pathogens responsible for those infections.

### **Materials and Methods**

An observational study with longitudinal design was undertaken during 6 months period (January 2014 to June 2014) among patients admitted in male and female ENT wards of North Bengal Medical College and Hospital (NBMCH), Sushrutanagar, Darjeeling district, West Bengal who were willing to give informed verbal consent. Patients developing any sign/symptom of infection within 3 days of admission (community

acquired infections) and who were discharged/ died within 3 days of admission were excluded from the study.

Sample size was calculated by estimating the incidence rate, with specified relative precision.<sup>11</sup>

$$n = \left( \frac{Z_{1 - \frac{\alpha}{2}}}{\epsilon} \right)^2$$

Where  $\epsilon$  = Relative precision,  $\alpha$  = Alpha error

Estimating the incidence rate of hospital acquired infection to within 20% of its true value, with 95% confidence level;

Sample size was  $= 1.96 \times 1.96 / 0.2 \times 0.2 = 97$  when  $\alpha = 0.05$ ,  $Z_{\alpha} = 1.96$

Attrition of sample population for lose to follow up, not given informed consent and inadequate culture material etc., an additional 10% was included. Thus final sample size became  $= 97 + 10\%$  of  $97 \approx 107$ .

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 outcome.

On the starting day all the patients admitted at ENT wards of NBMCH (Average 14-20 per day) were first selected in the study. Data on background characteristics [like name, age, gender, religion, residence, socioeconomic status according to modified B.G. Prasad scale 201312, duration of preoperative hospital stay(days), total duration of hospital stay (days), cause of admission (diagnosis)] were collected by a pretested, predesigned semi-structured schedule.

Each patient was evaluated clinically for different symptoms like fever; purulent discharge, abscess, cellulitis at surgical site; increased frequency of micturition, burning sensation during micturition; cough, purulent sputum; or others, for first 3 days of admission. If he/ she developed any sign/ symptom within first 3 days, was excluded from the study as community acquired infection.

Rest patients (excluding community acquired infected cases) fulfilling the inclusion and exclusion criteria were included in the study. These patients were clinically examined daily for any sign/symptom of nosocomial infection [based on: Simplified criteria and Common Nosocomial infection sites (adapted from WHO, 2002),<sup>1</sup> starting from third day of admission to till discharge. If any of them developed any sign/ symptom, sample collection and necessary investigations of this patient were carried out based on clinical ground for e.g. blood sample in case of fever; urine specimen in c/o urinary symptom; surgical wound swab culture in c/o discharge or cellulitis at surgical site; chest X-ray in c/o respiratory symptom. Only bacterial pathogens were detected in different cultures.

Anyone diagnosed as a case of hospital acquired infection based on available investigation report, was followed up till discharge. In each week patients admitted on three days (Monday, Wednesday and Friday) have been included in the study and selected on the same basis as described above, while continuing follow up of previous sets of patients. Further inclusions of study subjects were continued consecutively, till required sample size has reached.. All cases of diagnosed nosocomial infections were treated subsequently.

Collected data were entered and analysed using IBM Statistical Package for Social Science version 20 (SPSS, Inc., Chicago, IL, USA). Descriptive statistics were performed. The results were recorded as frequencies, percentages and means  $\pm$  standard deviations (SD).

## Results

The study was conducted to determine the incidence of hospital acquired infections among admitted patients. Inclusion of the eligible study subjects from the admitted patients fulfilling the stated criteria was started on January, 2014 and it has been continued till desired sample size has been reached.

During that period a total of 223 patients were admitted in ENT wards, out of them 24 were discharged and 6 died within three days of admission. Four patients did not give informed consent. Among the rest 189 patients, total 77 developed signs / symptoms of community-

**Table I: Background characteristics of the study population**

VARIABLES	CHARACTERISTICS	NO.	(%)
Gender (n=107)	Male	49	45.8
	Female	58	54.2
Age groups (years) (n=107)	<15	13	12.1
	15-29	20	18.7
	30-44	31	29
	45-59	27	25.2
	≥ 60	16	15
Religion (n=107)	Hindu	70	65.4
	Muslim	26	24.3
	Christian	11	10.3
Residence (n=107)	Rural	62	57.9
	Urban	45	42.1
Socioeconomic class (n=107)	II	6	5.6
	III	51	47.7
	IV	36	33.6
	V	14	13.1
Mode of admission (n=107)	Referred	44	41.1
	Direct	63	58.9
Pre-operative stay (days) (n=77)*	<3	55	71.4
	≥3	22	28.6
Total duration of hospital stay (days) (n=107)	≤ 7	68	63.6
		39	36.4

\*30 patients (5 non-operated cases and 25 cases operated on the day of admission) were excluded.

acquired infections within 3 days of admission. Finally 107 patients were selected for the study based on their clinical ground. These 107 study participants were followed up for a total 797 patient days, however follow up period varied between patients to patients. Findings of these 107 study subjects are presented below in different sections:

1. Background characteristics of the study subjects
2. Hospital acquired infections and its types

### 3. Clinical features and necessary investigations

The present study revealed that 45.8% of the study populations were males and 54.2% were females. Maximum study subjects (29%) belonged to 30-44 years of age groups and mean age was  $38.5 \pm 17.83$  years. Majority of the study population were Hindus (65.4%); residing in rural area (57.9%); belonged to socioeconomic (S.E.) class III according to modified B. G. Prasad scale 2013 (47.7%); admitted directly in the hospital (58.9%). Most of the study participants (71.4%)

**Table II: Distribution of study subjects according to development of hospital acquired infections (HAI). (n=107)**

HOSPITAL ACQUIRED INFECTIONS	FREQUENCY	PERCENT
Positive	21	19.6
Negative	86	80.4
Total	107	100

had duration of preoperative hospital stay less than 3 days and mean duration of preoperative stay was 2.04 + 1.52 days, whereas majority of the admitted patients (63.6%) stayed in the hospital for less than or equal to 7 days and mean duration of total stay was 2.04 + 1.52 days. (Table I) Out of the 107 patients, 21 (i.e. 19.6%) developed any hospital acquired infections. (Table II)

Different rates of hospital acquired infections (HAI):

- Cumulative incidence rate (Attack rate)<sup>2</sup>

$$= \frac{\text{Number of new infections acquired in a period}}{\text{Number of patients observed in the same period}} \times 100$$

$$= \frac{21}{107} \times 100$$

$$= 19.6\%$$

- Incidence density<sup>2</sup>

$$= \frac{\text{Number of new infections acquired in a period}}{\text{Total of patient-days for the same period}} \times 1000$$

$$= \frac{21}{797} \times 1000$$

$$= 26.35 \text{ per } 1000 \text{ patient days.}$$

Out of total 21 hospital acquired infected cases, surgical site infection was commonest (57.2%) followed by urinary tract infection (23.8%) and blood stream

**Table III: Distribution of symptomatic study subjects according to nature of signs/symptoms developed after three days of admission. (n=63)\***

NATURE OF SIGNS/ SYMPTOMS	FREQUENCY	PERCENT
Fever	26	41.3
Surgical wound discharge	12	19
Urinary symptom	23	36.5
Respiratory symptom	9	14.2

infection (19.0%) respectively. (Fig. 1)

It has been found that, 63 (58.8%) out of total 107 study participants had developed any sign/symptom after three days of admission. Among them 41.3% developed fever, followed by 36.5% urinary symptom, 19% surgical wound discharge and 14.2% of them developed respiratory symptom after three days of admission. (Table III)

The symptomatic patients underwent different investigations accordingly. Fig. 2 shows that 4 (15.4%) out of 26 blood cultures, 12 (100.0%) out of 12 surgical wound swab cultures and 5 (21.7%) out of 23 urine cultures were found to be positive. All chest X-ray reports found to be negative. Although more than one investigation needed in few patients according to presence of signs/ symptoms, but a single positive result has been found in each 21 cases e.g., if a patient complained of fever and urinary symptoms; blood culture as well as urinary culture were performed but either positive blood culture or positive urine culture was found.

Only bacterial organisms were detected in different cultures. Most commonly occurring pathogens found as Pseudomonas and Klebsiella (both in 23.8% cases), followed by Staphylococcus aureus and E. coli (both in 19% cases), followed by Staphylococcus epidermidis (in 9.6% cases) and Streptococcus pneumoniae (in 4.8% cases). In case of blood stream infections;

Staphylococcus aureus, Staphylococcus epidermidis and Streptococcus pneumoniae were found. Surgical site infections revealed Pseudomonas aeruginosa, Klebsiella pneumoniae and Staphylococcus aureus. Escherichia coli and Klebsiella pneumoniae were the causative organisms for urinary tract infections. (Table IV)

## Discussion

Hospital acquired infections (HAIs) are becoming increasing problems for hospitalized patients.<sup>13</sup> They are major causes of death and disability worldwide. Thus a continuous surveillance and monitoring system is imperative for determining the extent of the problem and its effective prevention and control. In this context the findings of the present study on incidence of hospital acquired infections among admitted patients in ENT wards of North Bengal Medical College and Hospital can be interpreted.

Among the total 107 study participants 45.8% were male and 54.2% were female. (Table I) As the study was carried out simultaneously in both male and female surgical wards, there was not much difference in gender wise distribution of study subjects. Mean age of study participants was  $38.5 \pm 17.83$  years. This age distribution may be due to preponderance of surgical interventions in the age group of 30-59 years. A study in Ethiopia also found mean age of admitted patients in surgical wards and surgical intensive care unit (SICU) as  $38.02 \pm 14.82$  years.<sup>14</sup>

58.9% of study population admitted directly in the hospital and 41.1% of them were referred from other health care facilities. (Table I) This large number of referral may be due to the specific geographical location of this tertiary care Medical College Hospital in North Bengal catering to five districts along with neighbouring states and adjacent countries like Nepal, Bangladesh.

In this study majority of the patients (71.4%) stayed preoperatively in the hospital for <3 days with mean duration  $2.04 + 1.52$  days. (Table I) This result corroborates with the findings by Ancheril, where 71.9% of patients having preoperative hospital stay of less than 3 days with mean stay of 3.1 days.<sup>10</sup>

It was shown in Table I that; most of the study subjects (63.6%) stayed in the hospital for less than equal to 7 days with mean duration of stay was  $7.45 + 2.60$  days. This mean duration is consistent with the average length of stay in surgical ward in Indian Hospital (7.2 days).<sup>15</sup>

According to a WHO report hospital acquired infection rates in developing countries vary from 5.7% to 19.1% (but mostly >10%).<sup>7</sup> Present study also found that cumulative incidence rate (attack rate) of hospital acquired infections was 19.6% (Table II) and incidence density was 26.35 per 1000 patient days. Possible determinants of this burden of health-care-associated infection in this facility may include : inadequate environmental hygienic conditions; poor infrastructure; insufficient equipment; understaffed facility; overcrowding; paucity of knowledge and improper application of basic infection-control measures.

Almost similar result i.e. HAI rate of 21.9% has been found by Patel et al (2006) in a prospective study of hospital acquired infections among 100 admitted patients in the general surgical wards of a tertiary care centre hospital in Ahmedabad, Gujarat, West India.<sup>16</sup> However, the present HAI incidence rate of 19.6% does not corroborate with a study by Agarwal et al (2006) in respiratory intensive care unit of PGI Chandigarh, where HAI rate was found to be 33.5%.<sup>17</sup> Possible reasons behind this elevated rate may be, patients in intensive care units are more prone to HAI compared to surgical patients.

In contrast, Rathore et al. (2011) revealed lower incidences (10.93%) of nosocomial infections among patients admitted in medicine wards of Nariender Mohan Hospital, Ghaziabad, India.<sup>18</sup> This lower infection rate is reported to be due to a presence of an effective infection control program run by the hospital infection control committee. In other countries, higher infection rate was observed by Faruquzzaman (2008),<sup>19</sup> Ogwang et al. (2010).<sup>20</sup> In this study only bacterial pathogens were assessed in infections without detection of fungal and viral pathogens due to unavailability of technology and laboratory facilities. On the other hand most of above mentioned studies included fungi and viruses in their study.

A lower infection rate was reported by N. Endalafer

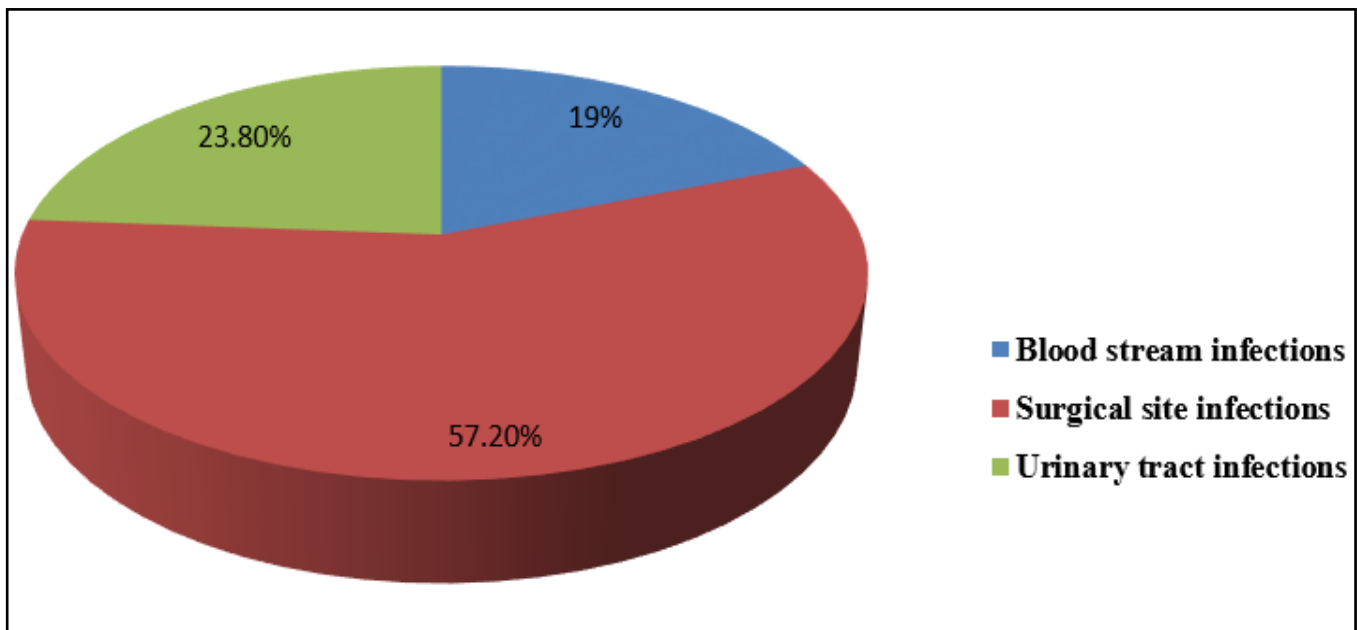


Fig. 1. Pie diagram showing different types of hospital acquired infections

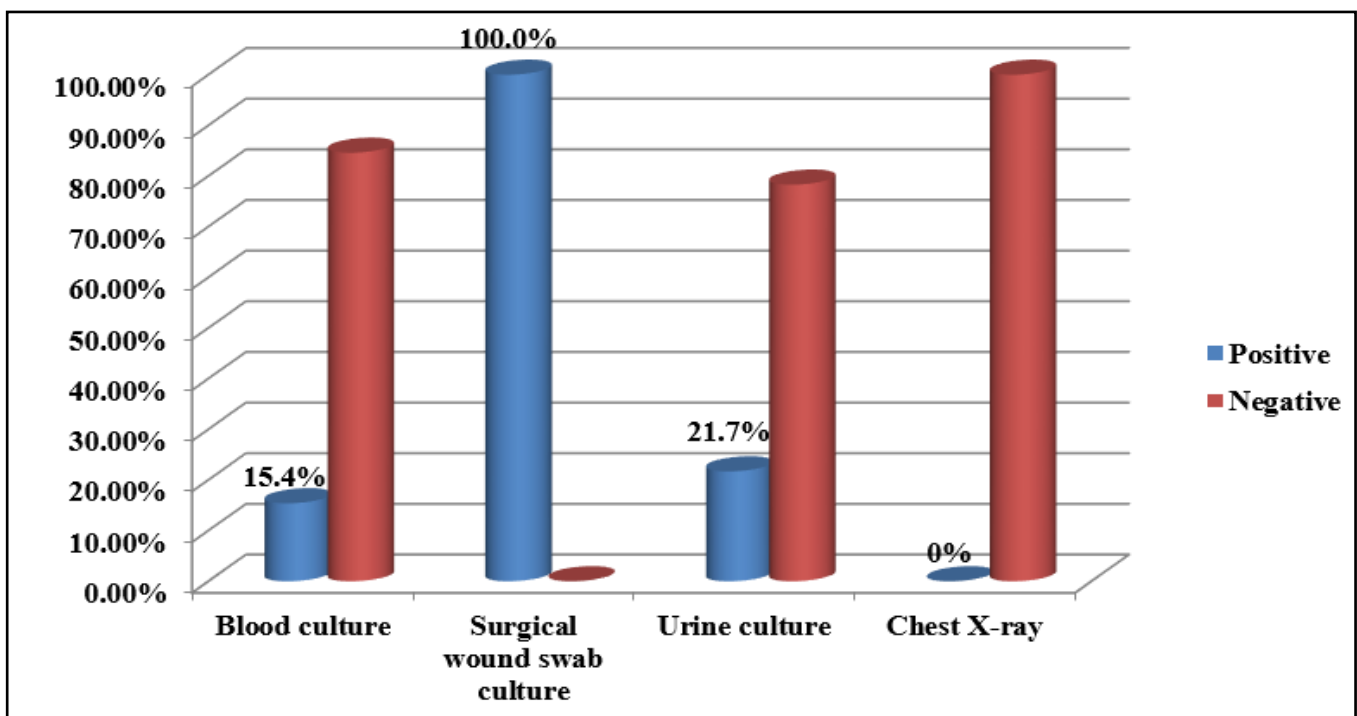


Fig. 2. Multiple Bar Diagram showing distribution of symptomatic patients according to results of different types of investigations.

**Table IV: Distribution of major pathogens according to the sites of hospital acquired infection.**

NAME OF PATHOGENS	BLOOD STREAM INFECTION	SURGICAL SITE INFECTION	U R I N A R Y T R A C T INFECTION	TOTAL NO (%)
<i>Pseudomonas aeruginosa</i>	0	5	0	5(23.8)
<i>Klebsiella pneumoniae</i>	0	4	1	5 (23.8)
<i>Staphylococcus aureus</i>	1	3	0	4 (19.0)
<i>Escherichia coli</i>	0	0	4	4 (19.0)
<i>Staphylococcus epidermidis</i>	2	0	0	2 (9.6)
<i>Streptococcus pneumoniae</i>	1	0	0	1 (4.8)
<b>Total</b>	<b>4</b>	<b>12</b>	<b>5</b>	<b>21 (100)</b>

(2008),<sup>14</sup> Cotter et al. (2011).<sup>21</sup> This decrease in the rate of nosocomial infections in those health care settings may be paralleled to paying attention to well-established processes for decontamination and cleaning of soiled instruments and other items, followed by sterilization and high-level disinfection processes and improving safety in operating rooms and other high-risk areas where the most serious and frequent injuries and exposures to infectious agents occur. Another factor that can account for the lower infection rate may be due to the availability of high number of health personnel and superior setup of the hospital.<sup>14</sup>

In this study out of total 21 hospital acquired infected cases, surgical site infections/ SSI was commonest (57.2%) followed by urinary tract infections/ UTI (23.8%) and blood stream infections/ BSI (19.0%) respectively. (Fig.1) Since all the patients excluding only 5, were exposed to surgical procedures, this infection can be acquired from contaminated surgical equipments or from health care workers. Also the susceptibility to surgical wound infections were enhanced by poor wound care and prolonged hospitalization. Urinary tract was the second infection site in the present study. Since, some of the admitted patients had urinary catheters and catheterization increased the rate of infection. The

other common infection was BSI. Many intervention measures which were risk factors for BSI frequently done in the ENT wards like use of invasive-devices (e.g. venous catheterization, tracheostomy, urinary or nasogastric tubes); suctioning of material from the throat and mouth; the utilization of drugs such as sedatives; or the influence of surgical procedures.

According to WHO also, the most frequent type of infection in the mixed patient populations in developing countries was SSI (29.1%), followed by UTI (23.9%), BSI (19.1%), Hospital Acquired Pneumonia/HAP (14.8%) and other infections (13.1%).<sup>7</sup> The pattern of nosocomial infections in present study also matches with the study by Patel et al. in surgical wards of tertiary care hospital in Ahmedabad.<sup>16</sup>

In this study 63 (58.8%) out of total 107 study subjects had developed any sign/symptom after three days of admission. Most commonly presenting feature was fever (41.3%), followed by urinary symptom (36.5%), surgical wound discharge (19%) and respiratory symptom (14.2%) respectively. (Table III) Fever is a common symptom in majority of infections, although 4 out of 26 blood cultures found to be positive. (Fig. 2) Urinary organisms were detected only in 5 out of 23 urine cultures. (Fig. 2) Clinically,



discharges from postoperative surgical wounds were sufficient to diagnose SSI, but surgical wound swab cultures were performed for identification of causative organisms, therefore all 12 wound swab cultures found to be positive. (Fig. 2) Surprisingly all 9 patients with respiratory signs/symptoms had negative chest X-ray. (Fig. 2) Although more than one investigation needed in few patients according to presence of signs/ symptoms, but a single positive result has been found in each 21 cases. Possible reason may be the patient having multiple clinical features usually not developed all the features simultaneously. After appearance of first sign/symptom and performance of necessary investigation, antimicrobials have been started before getting the result. Therefore second investigation showed bacteriologically negative result even though second sign/symptom aroused.

It was observed that; most commonly occurring pathogens were gram negative bacteria such as *Pseudomonas* and *Klebsiella* (both in 23.8% cases), followed by *Staphylococcus aureus* and *E. coli* (both in 19% cases), followed by *Staphylococcus epidermidis* (in 9.6% cases) and *Streptococcus pneumoniae* (in 4.8% cases). (Table IV) WHO also reported gram-negative rods as the most common nosocomial isolates in developing countries and the most frequent single pathogens were *S. aureus* in mixed patient populations.<sup>7</sup> However commonest single most organisms varied like *Pseudomonas*,<sup>19</sup> *Klebsiella*,<sup>16</sup> *E.coli*.<sup>14</sup>

## Conclusion

Hospital acquired infections (HAI) develop in patients 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, emotional stress and other outcome indicators. Surveillance systems for HCAI exist in several high-income countries but are virtually nonexistent in most low- and middle-income countries.

The present study found incidence rate of hospital acquired infections as 19.6% and incidence density

as 26.35 per 1000 patient days. Surgical site infection was commonest and gram negative bacteria were most frequently occurring organisms. So this study can provide information for the prevention strategies of HAI at improved health care service level as well as it can help to raise interest to conduct further research in this field.

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.

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