Original article:

Incidence of and risk factors for Hospital Acquired Infection in a Tertiary Care Hospital of Dhaka, Bangladesh

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Abstract

Objective: Hospital acquired infection (HAI) is a major concern in hospital settings. ***Methods:*** This study was conducted to evaluate the incidence of Hospital Acquired Infection (HAI), patient and hospital related factor, offending microorganism and their antimicrobial sensitivity. Data were collected prospectively with patients admitted during study period. ***Results and discussion***: 9.4% respondents were found to develop HAI. 60% patients with more than 3 visitor, 11.9% patient with prior antibiotic therapy and 24% patient with underlying illness developed HAI. 14.6% routine operation case and 24.5% emergency operation case developed HAI. 17.1% patients with invasive device therapy whereas 3.8% patients without any device therapy developed HAI. 31.8% patients having immunosuppressive therapy and 37% patients with frequent transfer within hospital whereas only 6.9% patients without transfer developed HAI. Bacteria isolated from HAI cases were identified to be member of nine different genera. *Klebsiella pneumoniae* isolated from 33% HAI case, while *Acinetobacter baumanii* and *Escherichia coli* isolated from 13% case and *Pseudomonas aeruginosa* from 14% cases. Only colistin has sensitivity range from 76 to 100% while almost all other isolates were observed multi drug resistance (MDR). **Conclusion:** Comprehensive strategy should be undertaken to reduce risk of HAI.

Keywords: HAI; Surveillance; Antibiogram; Factors

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Introduction

A Hospital Acquired Infection (HAI) may be defined as any clinically recognizable microbiological disease that affects the patient as a consequence of his being admitted to hospital or attending for treatment or the hospital staff as a consequence of their work, whether or not the symptoms of the disease appear while the affected person in the hospital[1].Despite significant improvement of treatment and hospital environment as well as advances in operative techniques, better understanding of pathogenesis of wound infection and widespread use of prophylactic antibiotics, HAI still remains one of the main causes of morbidity and mortality, leading directly or indirectly to an enormous increase in the cost of hospital care and to the emergence of new health hazards for the community[2-3].The risk of hospital acquired infection was increased three fold by carrying of an operative procedure[4-6].The prevalence rates of nosocomial infection in many countries ranged from 9.2% to21.4%[7]. The pattern of hospital –acquired infection depends on a number of factors, in the structure, organization and activities of the hospital[8]. Most infection acquired in the hospital are caused by microorganisms that are commonly present in the general population, in whom they cause disease less often and usually in a milder from than in hospital patients[9].

Presently, about 60% of hospital-acquired infections are caused by aerobic Gram negative rods and about 30% by Gram positive cocci[10]. Many opportunistic Gram-negative bacilli are capable of causing

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infection in immunocompromised patient[11]. In recent years, groups of micro-organisms, which formerly played no recognized part in hospital infection have emerged as potential threat[12] such as coagulase-negative *Staphylococci* present in normal skin flora[13-14].

Detection of source of infection is an important prerequisite factor for designing a control program of nosocomial infection[15]. Nosocomial infection especially in patient is an alarming problem throughout the world[16]. In Bangladesh, not much study on nosocomial infection in patient with elaborate information was undertaken except a few scattered studies with inadequate information.

Considering all the facts, this study aimed to determine the incidence and type of hospital acquired infection (HAI) as well as to determine prevalence and antibiotic susceptibility of causative microorganism for HAI in a tertiary care hospital of Dhaka, Bangladesh.

Materials and Methods

Study Design

It was a descriptive type of prospective study. Observations were repeated in the same population over a specified period by means of follow up examinations. The researcher planned the study and possibly recorded the exposures before the outcome was apparent.

Study Periods

The duration of the study was a period of 3 months from April to June 2013.

Place of Study

The present study was carried out at Square hospital Ltd., a tertiary care hospital, Dhaka, Bangladesh.

Study Population

The study population comprised of all admitted patients of all the departments/wards such as Cardiology, Neurology, Urology, Orthopedics, Medicine, Surgical wards, Critical Care Unit. The researcher selected the admitted patients as samples who were available after 48 hours and at the time of data collection period.

Selection Criteria of the Study Population

All admitted patients of all mainly general surgery, cardiology, neurology, Oncology, urology, orthopedic, Critical Care Unit during a period of 3 months from April to June 2013 and were willing to participate in the study are included in the study. Patients who died or discharged from the hospital within 48 hours of admission were not included.

Sample size and its distribution

The total number of respondents in the sample was 554. The HAI was determined by reviewing the concurrent medical records and laboratory evidence (culture report). It would the number of respondents who developed HAI. From the culture report, the number of respondent developed HAIs by pathogenic organisms was determined. The sensitivity pattern was confirmed among the respondents developed HAI by antibiogram.

Research Instruments

A questionnaire and checklist were prepared and used for data collection. The instruments were prepared keeping in view the research questions, objectives and variables of the study.

Data Collection Procedure

On the day of admission, screening was carried out by physical examination and reviewing of medical chart to make a note whether the respondents had any infection before admission. If anybody was found already infected, he was considered acquiring hospital-acquired infection (if any) other than those noted on admission. After the study population was screened on the day of admission to confirm whether an infection acquired before admission, they were followed up till either development of first event of infection or discharge without infection.

The basis of diagnosing the hospital-acquired infection

a. Presence of clinical symptoms and signs of infection.
b. Examination of wounds and catheter entry sites.
c. Reviewing of procedures that might lead to infection.
d. Reviewing of laboratory test results including cultures for blood, urine, sputum, Tracheal aspirate, Endotracheal tube, wound swab, pus, urinary catheter and others catheter etc.
e. X-ray chest (for pneumoniae)

Physical Examination

a. To locate the symptoms and signs of infection
b. Wounds and skin where catheter had been placed were examined for redness, swelling and presence of pus or an abscess.

Method of Prospective Observation

The study population was followed-up first more 48 hours after admission to see any evidence of infection. The study populations were kept under observation till a first event of infection or discharge without infection.

Measurement of Incidence

The incidence was measured as incidence rate which is the number of new event (disease onsets) in a specified quantity of person-time (hospital days) in a

$$\text{Incidence Rate} = \frac{\text{Number of first events of infection}}{\text{Observed time at risk for a first event (Total person-time at risk)}} \times 1000$$

population at risk. It was restricted to first events of hospital-acquired infection (HAI) developed by the respondents. The population at risk was composed of all those who had not yet suffered a first event. After a respondent acquired an event of HAI, that respondent was withdrawn from the population still at risk for a first event of infection. Each respondent who never acquired an event of HAI would contribute all hospital-days to the pool of days at risk, but a respondent who became infected would contribute only those hospital-days before the onset of the HAI[17].

HAI has been expressed as the number of first events of infection in 1000 hospital-days.

Culture and Antibiogram

After the events of hospital-acquired infections were determined on the basis of clinical evidences, the specimen of infected personnel (blood, tracheal aspirate, Endotracheal tube, urinary catheter and others catheter, sputum, urine, tissue etc.) were sent to Microbiology department to confirm the laboratory diagnosis. If culture yielded growth of organism, antibiogram was done.

Ethical approval: This study was approved by local ethical committee of Square Hospital.

Results and Discussion

A total of 554 respondents were studied who were happened to be available for admission during April to June 2013. They were followed up till the development of hospital-acquired infection (HAI) or their discharge, whichever comes early. The total follow up period where all respondents were at risk for 5943 hospital days (person-time).

Socio-demographic characteristics of the respondents

Out of 554 respondents, majority of study respondents were in the productive years of life. The mean age was 45.19 years with standard deviation (SD) 20.0 years and range 0.9-90 years. As illustrated in the table 1, more than two-thirds were aged between 20-59 years. However, up to 12 years of age group and >60 years consisting of around 9.7% and 14.4% respondents respectively. Only 4.3% respondents were adolescents aged 13-19 years. The study respondents were dominated by males. As illustrated in table 1, around 63.5% respondents were males while the remaining 36.5% were females. This was probably due to the fact that the study does not included Gynae and Obstetric wards. Majority of the study respondents were Muslims (98.6%) where around 0.9% were Hindu and 0.5% were Buddhist **(Table 1)**. The study results find that religion could not show any difference in developing HAI, which may be due to very few numbers of respondents from Hindu and Buddhist. Of the study patients, 35.7% were service holder, 32.7% were business man. 10.5% were housewife; around 9.2% retired followed by 6.3% respondents were students. Among other respondents, around 5.4% yet to have

Table 1: Distribution of respondents by socio-demographic characteristics (n=554).

Socio-demographics characteristics		No. of respondents	Percentage
Age in years	Up to 12	54	9.75
	13-19	24	4.33
	20-59	396	71.48
	60 and above	80	14.44
Sex	Male	352	63.5
	Female	202	36.5
Religion	Islam	546	98.6
	Hindustan	5	0.9
	Buddist	3	0.5
Occupation	Service holder	198	35.7
	Businessman	181	32.7
	Housewife	59	10.6
	Student	35	6.3
	Retired	51	9.2
	Not yet applicable	30	5.4
Marital Status	Married	440	79.4
	Unmarried	114	20.6
Family size (number of household members)	2 members	58	10.5
	3-4 members	248	44.8
	5 and above	211	38.1
	Not applicable	37	6.7

any occupation because of tender age. As shown in table 1, 440 (79.4%) respondents were married and 114 (20.6%) respondents were not married. 10% were married and 7% respondents were unmarried. Around 44.8% respondents used to live with family having 3-4 members followed by 38.1% respondents who had family members 5 or above. Around 6.7% respondents were single living whereas 10.5% respondents were living as two member's family. The range of family members was 2-7 and mean of family size was 3.66 **(Table 1)**.

Type of hospital-acquired infection (HAI)

The distribution of respondents by type of infection is illustrated in figure 1, where out of 554 respondents, 52 (9.4%) respondents developed hospital-acquired infection. only six type of HAI were found among the respondents such as, 58.4% Respiratory Tract Infection (RTI) which was the highest followed by 15.4% Urinary Tract Infection (UTI), 11.5% Blood Stream Infection (BSI), 7.0% Ventilator Associated Pneumoniae (VAP), 6.3% Surgical Site Infection (SSI) and 1.4% Skin and Soft Tissue Infection (SSTI). Hussain et al[18] reported a cross-sectional study at Dhaka Medical College Hospital (DMCH) where they found four types of HAI as SSI (36.1%), UTI (23.6%), RI (15.2%) and gastro-intestinal tract infection (12.6%) which differs with present study.

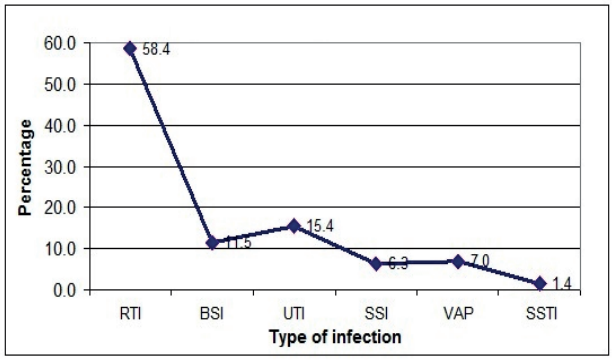


Figure 1: Type of hospital acquired infections developed

Demography of patients developing HAI

12.5% of age group 60 and above (the most susceptible group) developed HAI followed by 9.3% of age group 20-59, 7.4% of up to 12 years developed infection. The minor age group adolescents (between13-19) were less susceptible to HAI as about 4.2% of the respondents of this group developed HAI. However, among the age groups, differences were not found statistically significant ($p>0.05$). Extreme of age and HAI is concerned, where 16.7% of respondents of extreme age group developed infection (out of 84 respondents) comparison to around 8.1% of non-extreme age (out of 470 respondents) **(figure 2)**.

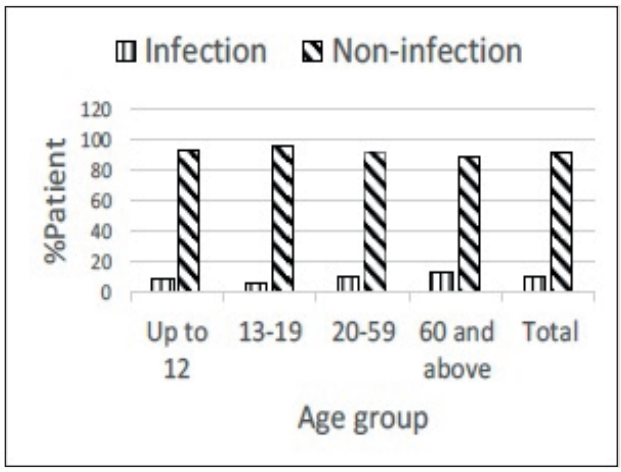
This study is not consistent with the study conducted by Hussain et al[18] where they found that 38.0% of the patients above 60 years and 35.0% of less than 14 years developed infection. The present study result revealed that there was no association between age and development of HAI, but with extreme of age the difference was found statistically significant ($p<0.05$).

The gender distribution of respondents developing HAI shows that 38 (10.8%) respondents developed infection out of 352 male respondents while 14 (6.9%) developed infection out of 202 female respondents. Males were found to be more susceptible to hospital-acquire infection compared to females as depicted in the table 5. However the association between sex and development of HAI was not found statistically significant ($p>0.05$). The similar result of no association between sex and development of HAI (male: 27.9%, female: 34.7%) was reported by Hussain et al.[18].

13.6% (out of 59) house wife participants developed infection followed by retired persons belong to extreme age group (9.8%) (Table 6). Almost equal proportion (8%) of respondents among students and businessman and 6.7% unemployed (due to tender age) respondents developed HAI. However, the association between occupation and development of HAI was found statistically not significant ($p>0.05$). This study does not accord with the study conducted by Hussain et al.[18] who reported HAI development in 18.3% businessman followed by 17.65% student and 16.6% housewife.

As depicted in **figure 2**, distribution of respondents developing HAI by marital status shows that 10.0% (out of 440) married respondents developed infection in comparison to 7.0% (out of 114) unmarried respondents. Married respondents were found to be more liable in developing HAI but the association of marital status and development of HAI was found statistically not significant ($p>0.05$).

The not-applicable group (comprised of unmarried and widowed) were found to be more susceptible to develop HAI as 16.0% (out of 37) of them developed infection followed by group of 5 or more family members (11.0%) (**figure 2)**. 5.2% of 2 member family group and 8% from the group of 3-4 family members developed HAI. The association of HAI with family size was found statistically non-significant ($p>0.05$). Single living who usually led irregular daily life having poor personnel hygiene, malnutrition and low standard of living may be



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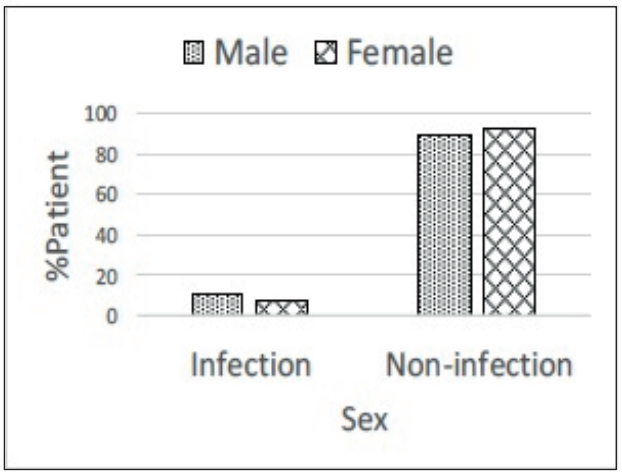

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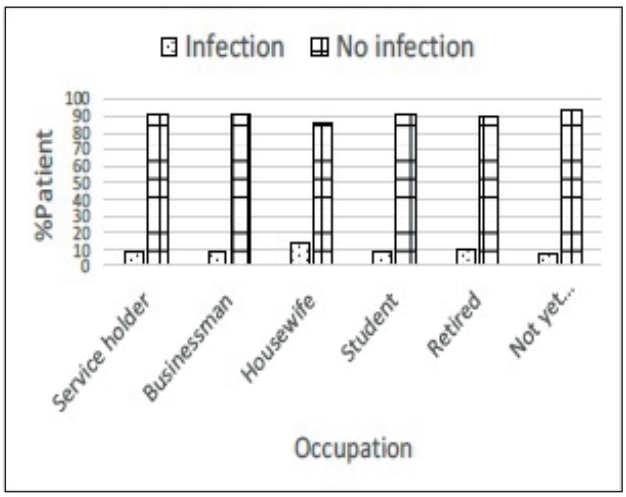

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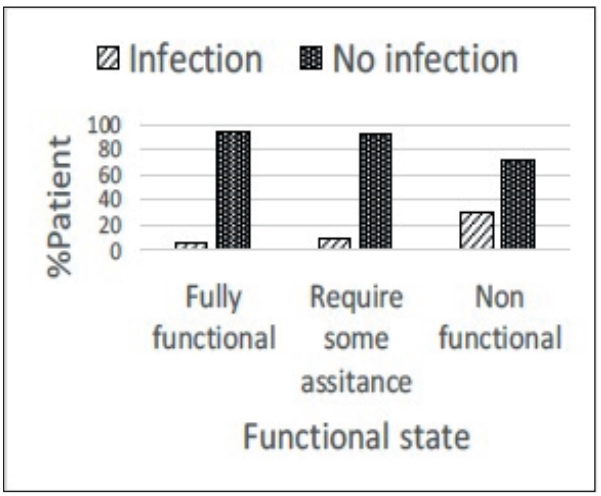

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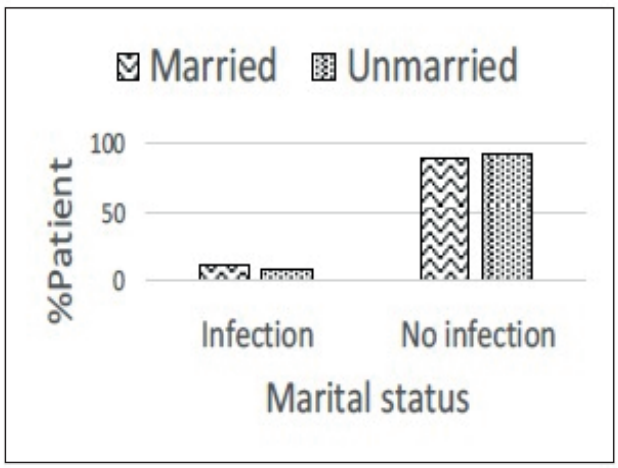

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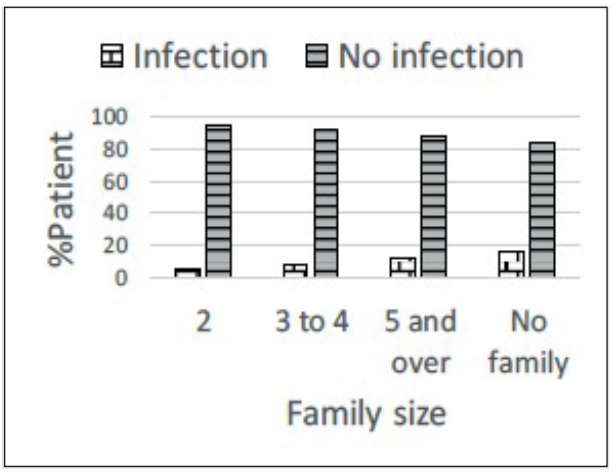

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Figure 2: Demography of patients developing HAI

more susceptible to colonization of resistant bacteria in hospital environment resulting development of higher percentage of HAI.

Majority of the respondents who developed HAI were physically non-independent**.** Among the patients developed HAI, 5% were independent (performing activities at their own) while 8.9% required some assistance and 28.9% respondents required assistance most of the time **(figure 2)**. Those who were physically independent were less likely to developed HAI. However, the study result revealed that physical state of the patients has strong association with development of HAI which was found statistically highly significant (p<0.001).

Patient related factors contributing HAI

Majority of the respondents did not have the history of having antimicrobial therapy within 3 months before admission as demonstrated in the **figure 3**. 188 respondents took antimicrobials within 3 months prior admission. 11.7% out of these 188 patients developed hospital-acquired infection while only 8.2% respondents (out of 366) who did not have any history of antimicrobial therapy developed infection. No association was found between prior antimicrobial therapy and development of HAI (p>0.05). Eileen and Richard[19] also found that association of prior antimicrobial therapy in developing HAI is statistically non-significant.

Out of 554 respondents, 192 (34.7%) had history of previous hospitalization and 362 respondents (65.3%) did not. As depicted in the **figure 3**, 14.6% respondents (out of 192) who had the history of previous hospitalization developed infections, whereas 6.6% respondents who did not have the history of previous hospitalization developed HAI. Previous history of hospitalization have been found significantly associated with development of HAI (p<0.01). The study result is consistent with the study conducted by Eileen and Richard[19] where association of previous hospitalization and development of HAI was reported.

Out of 554 respondents, 25 (4.5%) had coronary heart disease, 13 (2.3%) had chronic genitourinary problems, 23 (4.2%) had diabetes mellitus and 19 (3.4%) had malignant disease and 11 (2.0%) had Ventilator Associated Pneumoniae (VAP). On the contrary, 463 (83.6%) had no underlying disease. Of the patients with underlying illness (91), 24.2% developed HAI whereas this percentage was 6.5% in case of patient without any underlying illness (**figure 3**). The association of hospital-acquired infection among the respondents with underlying illness was found statistically highly significant (p<0.001). The present study does not accord with the study conducted by Steven et al.[21] where no association was found with Diabetes Mellitus, Malignancy, COPD, chronic cardiac disease, chronic genitourinary disorders in developing HAI.

It was found that out of 234 respondents having the application of invasive device, 10(1.8%) were given nasogastric tube, 161(29.1%) were undergone intravascular device, 41 (7.4%) had urinary catheter, 18 (3.2%) mechanical ventilation and 4(0.7%) had orthopedic device, rest 320(57.8%) did not have any invasive device **(figure 3)**. Out of 234 who did have invasive device application, 40(17.1%) of them developed infection where as out of 320 respondents of not having invasive device, only 12(3.8%) of them had infection **(figure 3)**.

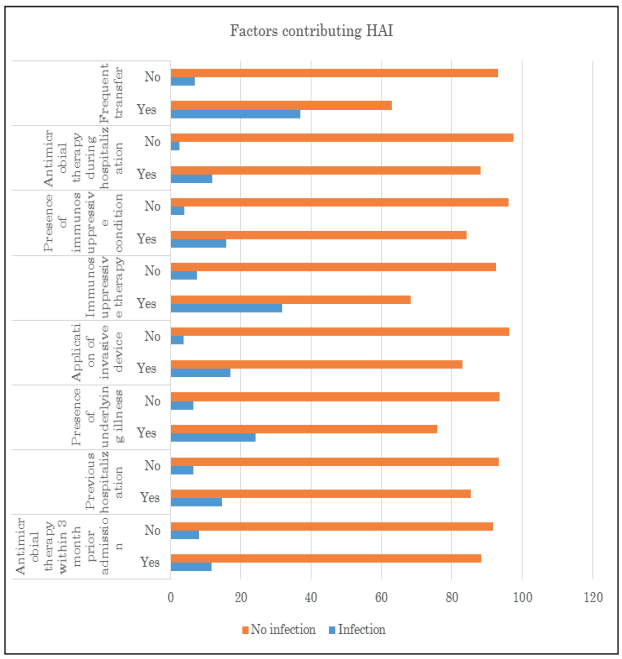

Figure 3: Factors contributing development of HAI

Hospital-acquired infection was found significantly associated with application of invasive device statistically (p<0.001). The present study result does accord with the study conducted by Rosenthal[22] where application of invasive device had association with development of HAI. The reason may be that due to application of invasive devices the patients are more exposed to intervention procedure, which favors the entry of agents having the potential for developing infection.

44 (7.9%) respondents had undergone immunosuppressive therapy (twelve cytotoxic drugs and thirty two steroids therapies) **(figure 3)**. Out of 44 respondents who were given immunosuppressive therapy, 14 (31.8%) developed

infection in comparison to 38 (7.5%) of 510 without immunosuppressive therapy **(figure 3)**. Association of immunosuppressive therapy and development of HAI was statistically highly significant. This study is consistent with that of Leno[23] who reported that infected patients were more likely to have received steroids before developing infection.

Out of 554 respondents, 252 (45.5%) were undergone treatment along with immunosuppressive condition and 302 (54.5%) did not have such condition. Of the patients with immunosuppressive condition, 40 (15.9%) developed infection while 12 respondents (4.0%) out of 19 developed infection who did not have the condition **(figure 3)**. The study result found the association of developing HAI because of treating with immunosuppressive therapy as the difference was found statistically highly significant ($p<0.001$). A study conducted by Cardoso et al.[24] where patients who developed hospital-acquired respiratory infection (HARI) had cancer, DM which is similar to present study as HAIs were influenced in both the cases by immunosuppressive conditions where respondents were more susceptible to infection.

The increasing incidence of hospital-acquired infections caused by antibiotic resistant pathogens are due to selection of resistant mutant strain from patients own flora during antibiotic treatment as a result of excessive antibiotic prescribed by hospital doctors. Subsequently, these resistant strains spread among patients in the hospital. Increasing antibiotic resistant is also caused by transmission of resistant bacteria within hospital by cross colonization of patients. **Figure 3** shows that out of 554 respondents, 402 respondents were given antimicrobial therapy during hospitalization. Of them, 48 respondents (11.9%) developed hospital-acquired infection whereas 4 (2.6%) of those who were not given antimicrobials developed infection. Association between antimicrobials therapy during hospitalization and development of hospital-acquired infection was found statistically highly significant ($p<0.001$). The present study accords with Marc[25] where antimicrobial therapy during hospitalization was found as a factor for promoting antimicrobial resistance due to failure in achieving bactericidal drug levels at the site of infection due to alteration of endogenous micro flora.

Hospital related factors contributing HAI

Visitor play a significant role in the developed of HAI as they are a means of transfer of micro-organisms. Majority respondents in this study were visited by at least two visitors. 35 respondents (6.3%) were visited by more than three visitors, 48 (8.7%) respondents by 3 visitors, 270 (48.2%) by two visitors and 145 (26.2%) by one visitor. Only 56 (10.6%) respondents did not have any visitors. 60% respondents who were visited by more than three visitors developed hospital- acquired infection. 2.1%, 2.9% and 39.6% respondents developed HAI who were visited by one, two or three visitors respectively. On the other hand, respondents who did not have any visitor, had the lowest HAI (2%) (**figure 4**). The association between visitor and development of hospital-acquired infection was found statistically highly significant ($p<0.001$). Present study accord with the study by Hussain et al. (18) where 37.5% respondents developed infection having 9 visitors/ day in comparison to 21.8% with 0-2 visitor/day. According to Mohiuddin and Khorshed[20] number of visitor/day/patient was associated with development of HAI.

Patient undergone emergency operation are found to be more prone to develop HAI than those with routine operation. Out of 252 respondents undergoing operation, 199 of them had routine operation and 53 had emergency operation. Among the respondents undergone routine operation, 29 (14.6%) developed infection in comparison to 13 (24.5%) with emergency operation **(figure 4)**. The association between development of hospital acquired infection and type of operation was found statistically non-significant ($p>0.05$). The present study does accord with the study done by Hussain et al.[18] where no association was found in developing HAI between emergency and ordinary cases.

Out of 554 respondents, 252 respondents undergone surgery. Among them 42 respondents (16.7%) developed infection (post-operative) while 10 respondents (3.3%) out of 302 developed infections who did not undergo any surgery at that period **(figure 4)**. The association between surgery at present and development of hospital-acquired infection was found statistically significant ($p<0.001$). This study accords with Hussain et al.[18] where they found higher postoperative cases (49%) developed HAI in comparison to preoperative cases (15.9%) and the association was statistically significant ($p<.05$). The present study reveals that higher postoperative infection may be due to failure of aseptic measures during operation, breach of asepsis in the post operative period, prolonged stay in hospital due to operation and exposure to a large number visitors.

HAI were found to be different across different wards of admission. As depicted in **figure 4**, among 554

respondents 252 (45.5%) were treated in Cardiology ward, 48 (8.7%) were treated in general surgical ward, 138 (24.9%) in neurosurgery, 62 (11.2%) in Urology, 32 (5.8%) in Orthopedic ward and 22 (4%) in ICU. 6.7% cardiology ward patients, 12.5% general surgery patients, 9.42% neurology patients, 18.75% urology patients, 11.2% orthopedic patients and 13.6% ICU patients develop HAI.

The present study shows that frequent transfer from one ward to another played a role in developing HAI. 46 respondents (8.3%) were transferred frequently from one ward to other and 37% of them developed HAI. Among the patients who has not been transferred frequently (508), 6.9% developed HAI. Frequent transfer played an important role in hospital-acquired infection. The association of hospital-acquired infection and patients transfer between wards was found statistically highly significant ($p<0.001$).

Distribution of respondents by general cleanliness of wards/department/cabin shows that out of 554 respondents, 390 respondents (70.4%) lodged in wards whose general cleanliness was satisfactory **(figure 4)**. Around 9.0% respondents developed infection lodging in wards /departments/cabin with satisfactory general cleanliness, while around 10.4% developed infection who lodged in wards which was dirty. The association of general cleanliness and HAI was found statistically non-significant ($p>0.05$).

38 respondents (9.5%) developed infection out of 402 respondents where cleaning object /material were regularly used, while 14 (9.2%) out of 152 respondents developed HAI where cleaning of objective /material were not regularly used. The association of cleaning object/material use and development of hospital-acquired infection was not found statistically significant ($p>0.05$). The object/materials that come in contact with patients should be considered as potential source of contamination. Cleaning of patients-care items, beside equipment, and frequently touched surfaces of patients named as contact precaution played a major role for HAI **(figure 4)**.

Microbiology of Hospital-acquired infection (HAI)

Nine different types of microorganisms were isolated from 52 patients who developed HAI. The most common one was *K. pneumoniae* 17 (32.7%) followed by *Acinetobacter baumannii* 9 (17.3%), *E.coli* 9 (17.3%), *P. aeruginosa* 7 (13.5%), *Staphylococcus aureus* 3 (5.8%), *Streptococcus pneumoniae* 2 (3.8%), *Streptococcus pyogenes* 2 (3.8%), *Enterococcus faecalis* 2 (3.8%) and *Enterobacter sp.* 1 (2.0%) **(figure 5)**. In an earlier study in Bangladesh, Mohiuddin et al.[26] found that majority of the organisms responsible for nosocomial infection was *Escherichia coli* (55.9%) followed by *Pseudomonas* spp. (33.3%) and *Proteus* spp. (12.7%).

K. pneumoniae were 76% sensitive to colistin followed by imipenem 65%. On the other hand, the high resistance rates to ceftriaxone and cefixime were found in equal proportion (94%). Resistances were observed to amoxyclavonic acid (82%), cefepime (71%), ceftazidime (76%), ciprofloxacin (71%) and amikacin (65%). *A. baumannii* were 78% sensitive only to colistin followed by cefepime and ceftazidime 44% each. High resistances were found 89% against amoxyclavonic acid, Cefixime and aztreonam. Amikacin, imipenem and piperacillin-tazobactam were noted resistance to 78% each and 67% gentamicin. *E. coli* were sensitive (89%) to Colistin followed by amikacin and imipenem 67% but 100% resistance were found against amoxyclavonic acid, Cefixime and ceftriaxone. 78% resistance were observed from cefepime and ciprofloxacin. *P. aeruginosa* were 86% sensitive to ceftazidime and piperacillin-tazobactam but 100% resistant to ceftriaxone. Sensitive of colistin showed 71%. However, 86%, 71% resistant were detected against cotrimoxazole and netilmycin respectively. *Enterobacter sp.* showed 100% sensitive against amikacin, cefepime, ciprofloxacin, imipenem and colistin but 100% resistant to amoxyclavonic acid, ceftriaxone and gentamicin **(figure 5)**.

Staphylococcus aureus showed 100% sensitive to amoxyclavonic acid, vancomycin each but 100% resistant against Cefixime and oxacillin Penicillin and Erythromycin were found 67% resistance rate each. *S. pneumoniae* were observed 50% sensitive against amoxyclavonic acid and ciprofloxacin. 100% sensitive to doxycycline, penicillin and erythromycin. *S. pyogenes* showed 100% sensitive to doxycycline, erythromycin and vancomycin but 50% resistant to amoxyclavonic acid, cefepime and ciprofloxacin. *Entrococcus* sp. were found 100% sensitive against amoxyclavonic acid, doxycycline, linezolid and vancomycin but 100% resistant from cefepime and penicillin **(figure 5)**.

The emergence of multidrug-resistance gram-negative organisms causing HAI is a growing problem worldwide. The Antibiogram pattern in this study showed *K. pneumoniae* and *A. baumannii* resistant to commonly used antimicrobial drugs have been important cause of HAI. The high rate of antibiotic resistance of major isolated organisms in this study might be due to wide spread use of antibiotics.

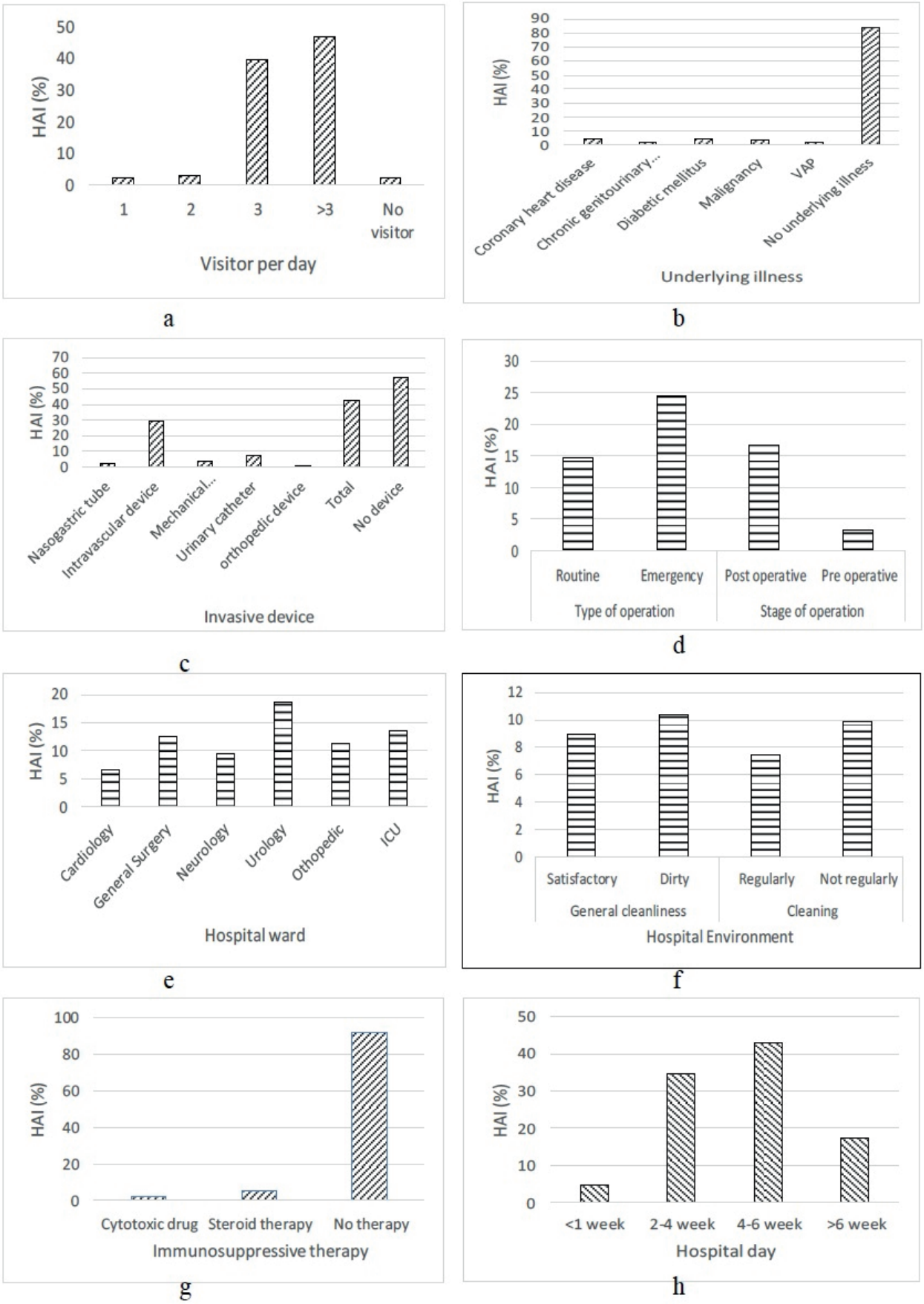

Figure 4: Factors contributing development of HA

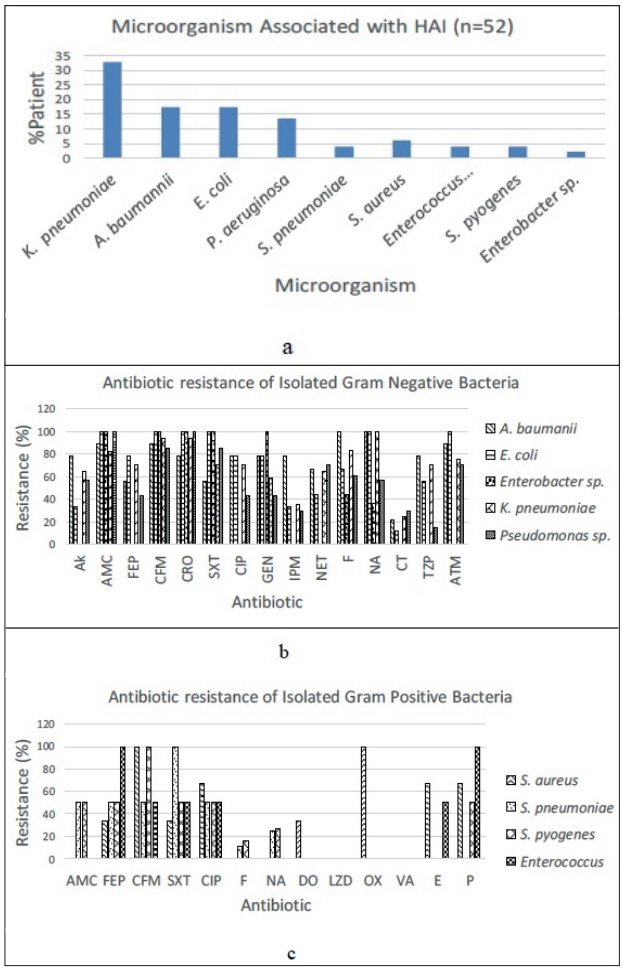

Figure 5: Microbiology of HAI developed

This study has documented hospital-acquired infections (HAI) as a global threat for a major cause of morbidity and mortality. A high frequency of HAI means a poor quality of health care services which may lead to avoidable cost[27]. Despite rapid advances of medical science in both therapeutic and diagnostic arena, HAI persist as a bane in hospital throughout the world. Although the situation in Bangladesh is largely unknown, a tertiary level hospital data showed a clear increases in 2003 in hospital-acquired infection in Bangladesh[20, 28-29]. It is believed around 80% of HAI are caused by microbial flora that patients bring upon admission. This "stay at home" flora appears to be opportunistic to new environment and is able to take advantage of new routes that medical procedures offer[30]. A number of risk factors have been linked with the development of HAI specially the organisms with antibiotic resistance properties. Perhaps, the most important is prior antimicrobial therapy, especially broad-spectrum agent which has been shown to suppress normal microbial flora which protect body from pathogenic ones. This may result in growth of microorganisms resistant to antibiotic used[31]. The extent and pattern of its resistance to different antimicrobials are largely unknown in Bangladesh because of lack of studies on this field. This study would contribute to the knowledge on socio demographic and economic correlates as well as patient and hospital related information associated with development of HAI. The research may provide information of value to health planners in taking timely measures and future investigators for further research. The following subsections will now delineate the discussion on the study findings in details:

Conclusion

Hospital Acquired infection is an alarming problem in Bangladesh as well as worldwide. This study provides a short glimpse of current situation of the problem and large scale studies including larger sample size should be employed to find out the overall magnitude of the problem. A proper surveillance system should be established to determine the pattern of nosocomial infection in hospital so that a long-term program should be undertaken to control the problem and to determine sources of nosocomial infection for effective control measures to be taken for the prevention of nosocomial infections in Bangladesh.

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