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INCIDENCE, RISK FACTORS AND OUTCOME OF HOSPITAL ACQUIRED INFECTIONS IN A TERTIARY CARE HOSPITAL IN DHAKA

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ABSTRACT

Context: Hospital acquired infections (HAI) are among major causes of morbidity in developed and developing countries resulting to significant burden both for patients as well as public health (World Health Organization (2002).[1] **Objectives:** To determine the incidence of HAI, their risk factors, the infective agents and the outcome in a tertiary care hospital. **Materials and Methods:** This was designed as analytical type of cross sectional study. The study group comprised1108 patients admitted for more than 48 hours in a tertiary care hospital at Dhaka from January 2015 to July 2015. The organisms were isolated from specimen by inoculation and subculture on blood agar and MacConkey agar media. Identification of the organisms was done by colony morphology, gram staining and standard biochemical tests. All the isolates were tested for sensitivity against antimicrobial agents by disc diffusing method of Kirby Bauer et al (1966).[2] The potency of each batch of disc was standardized by the reference strain of ATCC *Esch. Coli*, No 25922 and *Pseudomonas aeruginosa* No 27853. Zone of inhibition were compared with the standard value and was considered as sensitive (S), Intermediate sensitive (IS) and resistant (R) according to the NCCLS (1998). Data were checked, verified and coded into computer by using IBM SPSS (Statistical Package for Social Science) Programme version 21. **Result:** A total number of 1108 patients with 9.4% (incidence rate 8.75/1000 hospital days) hospital acquired infection rate were studied. Respiratory tract infection was the highest 56.7%

followed by urinary tract infection (15.4%). Most nursing assistance required group had 20 times more risk of developing HAI than those who required no assistance. The Odds ratio (OR) for 3 functional categories were: 0.3, 0.9 and 6.1. The Odds ratio for 4 visitor categories were: 0.2, 0.2, 9.4 and 23.6. 20.8% respondents with invasive device application developed HAI and 2.8% without device and association is statistically highly significant (p=0.000). 3.3% of respondents developed HAI who had the application of invasive device up to 5 days, while 21.8% by 6-10 days, 38.9% by 11-15 days, 21.4% by 16-20 days and 50% by more than 20 days. Gram negative Enterobacteriaceae as a group were most predominant pathogens. The predominant organisms were K. pneumoniae 34 (32.7%) followed by *Acinetobacter baumannii* 18 (17.3%), *Esch. coli* 18 (17.3%) & *Ps. aeruginosa* 14(13.5%).

KEYWORDS: Hospital Acquired Infection (HAI), incidence, tracheal aspirate, blood, urine, endotracheal tip.

INTRODUCTION

The hospital- acquired infections are among major causes of death and increased morbidity in developed and developing countries resulting to significant burden both for patients as well as public health (World Health Organization (2002).[1] Hospital especially Intensive care unit is a specially staffed and equipped hospital ward dedicated to the management of patients with life threaten illness, injuries or complication (Weinstein RA (1998).[3] Patients hospitalized in intensive care units (ICUs) are 5 to 10 times more likely to acquire HAI than other hospital patients. Antimicrobial resistance is more prevalent in nosocomial bacterial strains than in those acquired from the community. In the hospital areas have the highest prevalence of multi drug resistant bacteria and also have the highest rates of use of high level antibiotics (Weber et al 1999).[4] Mechanical ventilation itself has been viewed as major risk factor for HAI in ICU.

MATERIALS AND METHODS

This was prospective analytical type of cross sectional study. Patients who were admitted in the hospital were studied as study population. This study was carried out from January 2015 to July 2015. Patients who died or discharged from the hospital within 48 hours of admission were excluded from this study.

The study population was followed-up 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. After the events of hospital-acquired infections were determined on the basis of clinical evidences, the specimens of infected personnel were sent to Microbiology department to confirm the laboratory diagnosis. If culture yielded growth of microorganism, antibiogram was done. A questionnaire and checklist were used for data collection. 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. After the study population was screened on the day of admission to confirm whether any infection acquired before admission, they were followed up till either development of first event of infection or discharge without infection. Data were entered into the SPSS (Statistical Package for Social Science) Programme Version 21. Univariate analysis was used to compare the variables affecting the development of HAI. To test the statistical significance, the t- test was used for continuous variables while the Chi Square (X^2) test was used for categorical variables. Epi info-7 version were used to analyze Odds ratio (OR), relative risk. Results were considered statistically significant if the p value was <0.05.

RESULTS

Among 1108 respondents, 704(63.5%) were male while the remaining 404(36.5%) were female (Figure 1). Distribution of respondents at risk of HAI shows that out of 1108 respondents, 1004 (90.6%) respondents did not develop any HAI whereas 104 (9.4%) respondents were developed HAI. In table 1, 1108 respondents have been followed for 11886 hospital days (person time) that yielded infection rate 9.4% & incidence rate 8.75/1000 hospital days.

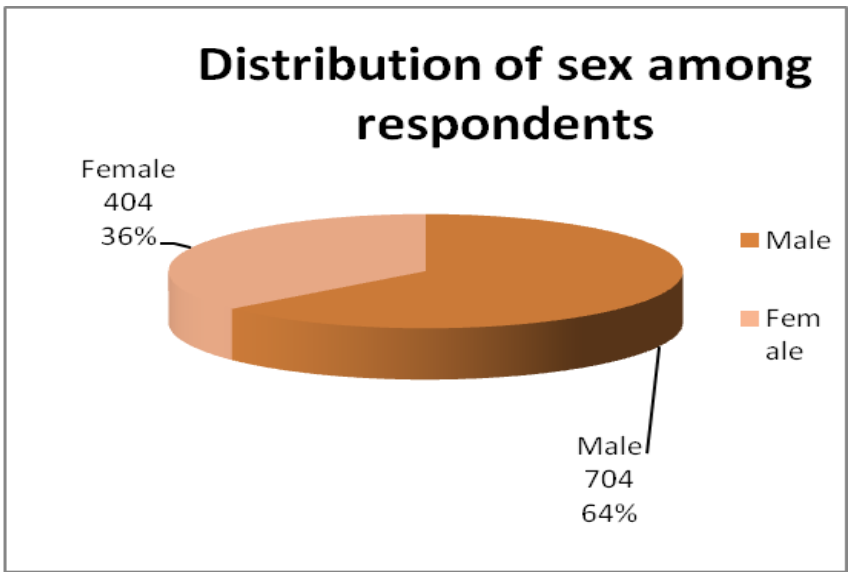

Figure 1: Distribution of respondents according to sex (n=1108)

Table 1: Distribution of respondents at risk for HAI by hospital days.

Hospital days	No. of respondents	%	Total hospital days
Hospital days on discharge (without infection)	1004	90.6	9810
Hospital days on development infection	104	9.4	2076
Total	**1108**	**100**	**11886**

Six types of HAI were found among the respondents such as 56.7% Respiratory Tract Infection (RTI) which was the highest followed by 15.4% Urinary Tract Infection (UTI), 10.6% Blood Stream Infection (BSI), 9.6% Ventilator Associated Pneumoniae (VAP), 4.8% Surgical Site Infection (SSI) and 2.9% Skin and Soft Tissue Infection (SSTI). (figure 2).

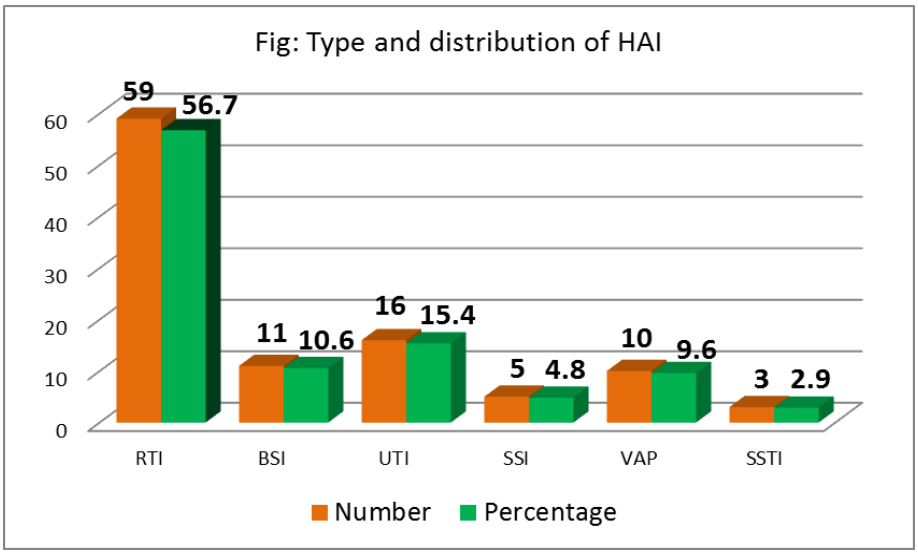

Figure 2: Distribution of HAI by type of infection.

16.7% of respondents of extreme of age group (consider >60 years & <1 year) developed infection out of 168 respondents comparison to around 8.1% of not of extreme of age out of 940 respondents (Table 2). Extreme of age group is found more susceptible to HAI. The association was found statistically significant (x^2=12.341, df=1, p=0.001).

Table 2: Distribution of respondents developed HAI by extreme of age

Extreme of age	HAI				Total	(%)
	Infection		No infection			
	No.	%	No.	%		
Yes	28	16.7	140	83.3	168	100
No	76	8.1	864	91.9	940	100
Total	104	9.4	1004	90.6	1108	100
Test statistics: X2 = 12.341, df=1, p=0.001						

Table 3 showed that 70 respondents (6.3%) were visited by more than three visitors, 96 (9.0%) respondents were 3 visitors, respondents 540 (48.7%) by two visitors, 290 respondents (26.2%) by one visitor. Only 112 (10.0%) respondents did not have any visitors. 60% respondents developed HAI who were visited by more than three visitors while 2.1%, 2.9% and 39.6% respondents developed HAI who were visited by one, two or three visitors respectively (figure 3). The association between visitor and development of HAI was found statistically significant (x^2=182.91, df=4, p<0.001). An individual who was visited by more than three visitors had 118 times more risk of developing HAI and 47 times more risk who are visited by 3 visitors than the respondents who had 1visitor (Table 4) The odds ratio (OR) for the four categories were: 0.2, 0.2, 9.4 and 23.6.

Table 3: Distribution of respondents by number of visitor/patient/day.

Number of visitor/patient/day	No. of respondents	Percentage
1	290	26.2
2	540	48.7
3	96	8.7
>3	70	6.3
No visitor	112	10.1
Total	**1108**	**100.0**

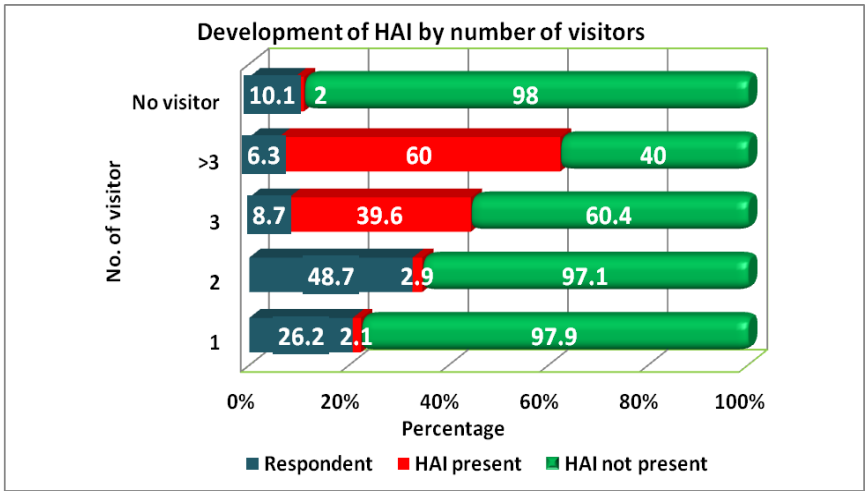

Figure 3: Development of HAI by number of visitors.

Table 4: Comparison of risk among number of visitors for HAI.

Factors	Odds Ratio	95% CI	P value
1 visitor/patient/day	0.2	0.07 - 0.36	<0.05
2 visitors/patient/day	0.2	0.1 – 0.29	<0.05
3 visitors/patient/day	9.4	5.82 – 15.16	0.000
>3 visitors/patient/day	23.6	13.72 – 40.63	0.000

Figure 4 showed that 57.8% patients were performing activities at their own while 28.5% required some assistance and 13.7% respondents required assistance most of the time. Functional states of the respondents were found to be associated with HAI. Around a third (29.0%) developed HAI who required assistance most of the time in comparison to only 5% of those who could perform activities at their own. 8.9% who required some assistance developed HAI (table 5). Different functional state of the patients had statistically significant association in developing HAI (x^2=82.962, df=2, p<0.001). An individual who required nursing assistance most of the time had 20 times more risk of developing HAI and those who required some assistance had 6.78 times more risk than those who required no assistance. The odds ratio (OR) for three functional categories was: 0.3, 0.9 and 6.1(table 6).

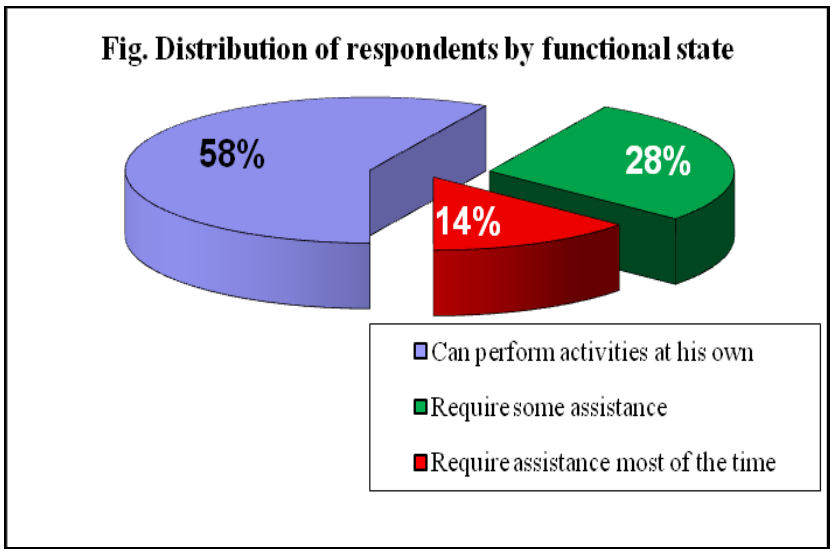

Figure 4: Distribution of respondents by different functional states.

Table 5: Distribution of respondents developed HAI by functional state.

Functional state of respondents	HAI				Total	(%)
	Infection		No infection			
	No.	%	No.	%		
Can perform activities of its own	32	5.0	608	95.0	**640**	100
Require some assistance	28	8.9	288	91.1	**316**	100
Require assistance in most activities	44	28.9	108	71.1	**152**	100
Total	**104**	**9.4**	**1004**	**90.6**	**1108**	**100**

Table 6: Comparison of risk among functional status for HAI.

Factors	Odds Ratio (OR)	95% CI	Relative Risk (RR)	P value
Can perform activities of its own	0.3	0.19-0.45	3.85	0.705
Require some assistance	0.9	0.58-1.44	5.40	<0.05
Require assistance in most activities	6.1	3.93-9.42	12.98	0.000

Table 7 showed that out of 404 patients using invasive device, 84(20.8%) developed infection; whereas out of 704 respondents without invasive device, only 20(2.8%) had infection. HAI was found significantly associated with application of invasive device statistically (X^2 = 69.66, df=1, p=0.000). In figure 5, it shows that only 3.3% of respondents developed HAI who had the application of invasive device up to 5 days, while 21.8% by 6-10 days, 38.9% by 11-15 days, 21.4% by 16-20 days and 50.0% by more than 20 days. The association of developing HAI with duration of use of invasive device was statistically significant (t=12.063, p=0.000). The incidence of HAI was significantly higher among the respondents who had been applied invasive device for long duration than those with short duration. An individual who was applied device for more than 20 days were 32 times at risk of developing HAI than those who had 5 days or less of device use. (Table 8). The odds ratios for the four categories were: 0.1, 1.8, 1.61, 1.6 and 3.2.

Table 7: Distribution of respondents developed HAI by the presence of invasive device.

Presence of application of invasive device	HAI				Total	(%)
	Infection		No infection			
	No.	%	No.	%		
Yes	84	20.8	320	79.2	404	100
No	20	2.8	684	97.2	704	100
Total	104	9.4	1004	90.6	1108	100

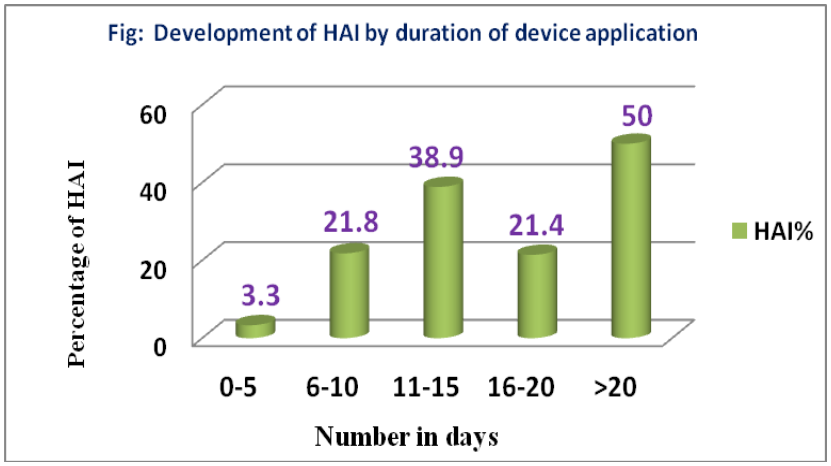

Figure 5 Development of HAI by duration of invasive device use.

Table 8: Comparison of risk among duration of invasive device use for HAI

Factors (Duration of invasive device use)	Odds Ratio	95% CI	P value
1-5 days	0.1	0.03-0.60	0.000
6-10 days	1.8	1.14-2.96	0.000
11-15 days	2.6	1.31-5.20	0.000
16-20 days	1.6	0.89-2.78	0.000
>20 days	3.2	0.52-19.28	0.000

The rate of culture positivity of tracheal aspirate 28 (26.92%), blood 11(10.58%), Endotracheal tip 20(19.23%), sputum 19(18.27%), urine 10(9.62%), Urinary catheter 6(5.77%), Infected wound 5(4.81%), Umbilical swab 2(1.92%) and BAL (Broncho alveolar lavage) 3(2.88%) samples were reported (Table 9). In Figure 6 showed that 9 (nine) different types of microorganisms caused HAI among 104 (9.4%) respondents. Isolates were *K. pneumoniae* 34 (32.7%) followed by *Acinetobacter baumannii* 18 (17.3%), *Esch. coli* 18 (17.3%), *Ps. aeruginosa* 14(13.5%), *Staphylococcus aureus* 6 (5.8%), *Streptococcus pneumoniae* 4(3.8%), *Streptococcus pyogenes* 4(3.8%), *Enterococcus faecalis* 4(3.8%) and *Enterobacter sp.* 2(2.0%).

Table 9: Number of isolates from different specimens.

Specimens	Number	%
Blood	11	10.58
Tracheal aspirate	28	26.92
Urine	10	9.62
Endotracheal tip	20	19.23
Sputum	19	18.27
Infected wound	5	4.81
U. Catheter	6	5.77
Umbilical swab	2	1.92
BAL	3	2.88
Total	104	100

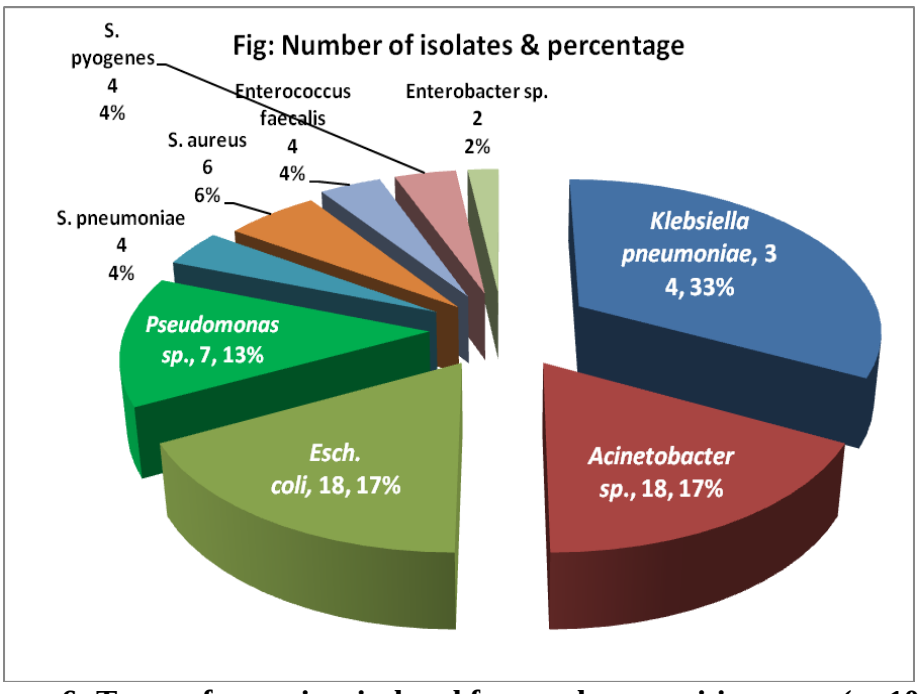

Figure 6: Types of organism isolated from culture positive cases (n=104).

DISCUSSION

The study shows that majority of respondents 704 (63.5%) were male and 404 (36.5%) were female. 104 (9.4%) events of infection occurred among the 1108 respondents, which yielded incidence rate 8.75/1000 hospital days. A study was conducted in Sugata Dasgupta et al 2012[5] in a public tertiary teaching hospital of Eastern India showed HAI rate is 11.98% (95% confidence interval 7.89–16.07%). Shalini S et al 2010[6] carried out a study in 2010 in India showed the rate of HAI was 27.4% which is much higher than our study. Jumulitrat S et al[7] conducted a prospective study in 2002 in Thailand where they found an incidence rate as 8.0/1000 patient days which is similar to present study. This may be due to socio cultural similarity and inclusion of all types of patients.

Out of 104 (9.2%) events of infection, 56.7% respiratory infection (RTI), 15.4% urinary tract infection (UTI), 10.6% blood stream infection, 4.8% surgical site infection (SSI), 9.6% ventilator associated pneumoniae (VAP) and 2.9% skin and soft tissue infection (SSTI) were found. Shalini S et al[6] carried out a study in 2010 in India showed the rates of the urinary, respiratory and the intravascular catheter related infections were 55.52%, 35.78% and 11.52% respectively which is not similar at all with our study. A study was conducted by Sugata Dasgupta et al 2012[5] showed Pneumonia was the most frequently detected infection (62.07%), followed by urinary tract infections and central venous catheter associated bloodstream infections

It is revealed in the present study that 16.7% of the respondents of extreme of age developed HAI. A study conducted by Dr. Anand Saxena et al 2012[8] of tertiary care centre in Central India. Age of more than 50 years was found to be a risk factor for developing HAI which is consistent with our study. This study is also consistent with the study conducted by Hussain et al[9] where they found that (38.0%) of the patients above 60 years and (35.0%) of less than 14 years developed infection which might be due to difference in grouping of age.

It is evident from the present study that majority of respondents (58.0%) could perform their activities independently of whom (5.0%) developed HAI. The respondents (28.0%) who required some assistance, out of them (8.9%) developed infection. On the contrary 14.0% respondents who required assistance most of the time, 28.9% of them developed infection. Physical mobility has been found significantly associated with HAI. Those who were physically independent were less likely to developed HAI. Respondents who require

assistance most of the time were twenty times more at risk of developing HAI than who were independent.

The study result found that there is strong association between visitor and development of infection as it was found statistically highly significant. The respondents having >3 visitors had around 118 times more risk of developing infection than those who had fewer/no visitor. The present study result accord with the study done by Hussain et al[9] where 37.5% respondents developed infection having 9 visitors/day in comparison to 21.8% with 0-2 visitor/day. According to khan Hossain Mohiuddin et al[10] where number of visitor/day/patient was associated in developing HAI ($t=13.526$, $p<0.001$). The study result found that there is strong association between visitor and development of infection as it was found statistically highly significant. The respondents having >3 visitors had around 118 times more risk of developing infection than those who had fewer/no visitor. The study reveals that respondents having more visitors than others developed maximum number of events of infection since direct transmission of infection become easier with respondents visited by large number of visitors.

It has been found in the present study that 9 different types of microorganisms were identified and *Klebsiella pneumoniae* 34 (32.7%) the most common. The present study support with the study carried out by Claudia Wollheim et al[11] 2006 in Brazil where *Klebsiella pneumoniae* (43.7%) was the prevalent agent. Also similar study conducted by Sadeta et al 2012[12] showed common agent was *Klebsiella pneumonia.* Another study conducted by Vincent J.L.et al47 where Staphylococcus aureus was (30.1%) and Pseudomonas aeruginosa (28.7%). The present study does not accord with this study.

In 2014, a retrospective study Keshni Naidu et al[13] in Fiji's ICU (2011-12) showed 66% had isolates from a respiratory specimen (endotracheal tube) 49% from a urinary specimen (indwelling catheter or clean catch), 67% from a blood specimen (peripheral or central line), and 41% from a surgical site (wound swab or surgical drain). Respiratory tract infection was highest which is consistent with our study. The present study result does accord with the study conducted by visitor D Rosenthal 2004[14] where application of invasive device had association in developing HAI.

Present study showed that 9 different types of organisms were identified and *Klebsiella pneumoniae* 34 (32.7%) the most common. Our study support with the study carried out by

Claudia Wollheim et al 2006[11] in Brazil where *Klebsiella pneumoniae* (43.7%) was the prevalent agent. Also similar study conducted by Sadeta et al 2012[12] showed common agent was *Klebsiella pneumonia.*

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