

## Hospital Acquired Infection (HAI) in relation to the Age, Gender and Educational Level of the Patient

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### ABSTRACT

**Background:** The term [Nosocomial or Hospital Acquired Infection (HAI)] refers to infections acquired by the patient during his or her stay in the hospital, in which s/he was not infected before entering the hospital, and whose symptoms appear only 72 hours or more after entering the hospital. Hospital acquired infections has been a major concern in recent years due to its rapid spread in hospitals and the difficulty of controlling it. They are widespread because hospitals are depositories contain many microorganisms such as microbes, some of which may be pathogenic and others opportunistic. The hospital environment as well as patient's age, gender and the educational level plays an important role in hospital acquired infections.

**Methods:** A total of 140 samples were collected over a period of one year from patients admitted in the hospital for three days or more in order to identify the most common bacterial isolates within the infections acquired from hospital and its relation to the age, gender and educational level of the patient. The samples included 75 urine samples, 28 stool samples, 28 wound swabs, and 9 sputum samples.

**Results:** The percentage of HAI was (45.7%), where the highest percentage were among UTIs (50.7%) from the total of 75 samples, followed by wound infections (42.9%) from the total of 28 samples, gastrointestinal infections (39.3%) from the total of 28 samples, and pneumonic infections (33.3%) from the total of 9 samples.

**Conclusions:** This study concludes that patient's age, gender and educational level plays an important role in hospital acquired infection.

**Keywords:** Hospital acquired infection, Bacteria, Urinary tract infection, Wound infections Gastrointestinal infections and Respiratory infections.

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### INTRODUCTION

The term [Nosocomial or Hospital Acquired Infection (HAI)] refers to infections acquired by the patient during his or her stay in the hospital, in which s/he was not infected before entering the hospital, and whose symptoms appear only 72 hours or more after entering the hospital. These are exogenous infections which are transmitted by the air, hospital floor and working staff of the hospital or endogenous infections in which the patient carries various types of microorganisms on his skin.<sup>1,2</sup> Hospital acquired infections has been a major concern in recent years due to its rapid

spread in hospitals and the difficulty of controlling it.<sup>3</sup> They are widespread because hospitals are depositories contain many microorganisms such as microbes, some of which may be pathogenic and others opportunistic. These depositories consist of the patients themselves, airborne particles, non-sterile solutions, etc. From these depositories, pathogens are transmitted through air, contact and food to patients and hospital personnel.<sup>4</sup> The hospital environment plays an important role in hospital acquired infections, as it is an

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important source of reservoir and transmission of germs that cause infections.<sup>5</sup>

Surgical operations rooms are also considered the most important component of clean wounds infections,<sup>6</sup> therefore, any infringement or deficiency in following the instructions or health directions and the steps of disinfection and sterilization inside the operating room may lead to the spread of pathogens, which is difficult to control later.<sup>7</sup> The risk of infection and its severity increase in some special units in hospitals like the intensive care units, child care units, burns units and units for patients with weak immunity.<sup>8</sup> The problem of hospital acquired infections is considered as one of the most important and serious health problems in the whole world. This is due to the fact that it increases the mortality rate and complications of the disease, increases the length of patient stay in the hospital, affects significantly the quality of medical work in which the patient needs more supervision as well as the increase of cost.<sup>9</sup> The most common diseases that can be acquired in hospitals are urinary tract infection, wounds infection, respiratory tract infection, gastrointestinal infection and Septicemia.<sup>10</sup> The most important bacteria that can cause hospital infections are Staphylococcus spp., Streptococcus spp. Entrobacter spp. Citrobacter spp. Klebsiella spp, Proteus spp., Escherichia coli and Pseudomonas aeruginosa.<sup>11</sup> In a study by the researchers Jean-Louis Vincent et al. on acquired diseases within the intensive care unit, 2064 from a total of 4501 patients were found to have hospital acquired infections.<sup>12</sup> The study also showed that the most common infection was Pneumonia with 46.9% then 17.8% for lower respiratory tract infections, followed by urinary tract infections 17.6% and to a lesser extent for septicemia with 12%. Whereas Richards et al.<sup>13</sup> noted in a study of intensive care units in the United States, that the primary acquired infection was urinary tract infection 31% followed by pneumonia 27% and Septicemia 19%. The medical studies on the subject of hospital acquired infections are still few, despite the importance and seriousness of this issue in India due to the poor environmental and health care conditions of hospitals and the high pollution of the environment in general and hospitals in particular; we decided to conduct this study.

## METHODS

**Samples Collection:** The current study included collection of 140 clinical samples of patients who had been staying for three days or more at Vedantaa Institute of Medical Sciences and Research Hospital in Palghar a tribal area in Maharashtra over a period of one year.

All 140 samples were collected from the patients admitted with different clinical conditions like renal failure, diabetes, hypertension, fractures, burns, COPD etc. Out of these 75 urine samples were from the patients having high grade fever and burning micturition, 28 stool samples from patients having fever, vomiting and diarrhea while 28 wound swabs from patients undergone surgical operations showing operated site gapping and 9 sputum samples from the patients who developed productive cough and fever. All the samples were collected using sterile containers except wound swabs which were collected by using sterile cotton swabs.

The samples were transferred to the Microbiology laboratory and cultured within 10 minutes. The information was recorded in a questionnaire form for each patient which included (sex, age, educational level, address, date of

admission to the hospital and reason for admission to hospital).

**Samples Culture:** The collected samples were cultured on the Blood agar and MacConkey agar and incubated at 37 ° C for 24 hours.

### Identification of Bacterial Isolates:

1. Microscopic examination: Urine, stool, sputum and wound swab collected from patients in sterile container were subjected to gram stain to observe the presence of gram positive and gram-negative organisms in these primary smears.

2. Morphology and Cultural Characteristics: The characteristics of the developing colonies were observed on the blood agar and MacConkey agar in terms of shape, size, edge, and color, type of hemolysis, fermenting lactose sugar or non- fermenting lactose sugar and the phenomenon of swarming. The swab was taken from the colonies of each isolates and stained with gram stain to observe the presence of gram positive and gram-negative organisms.

3. Biochemical tests: These consists of Oxidase test, Catalase test, Indol test, Methyl red test, Vogas prouskauer test, Citrate utilization test, Motility test, Carboxylic group clearance of lysine test,<sup>14</sup> Coagulase test,<sup>15</sup> Sugar fermentation test.<sup>16</sup>

## RESULTS

Table no. 1 shows the number of samples collected from different sources according to the clinical conditions.

**Table: 1 Number of samples collected from different sources.**

Sources of sample	Number
Urine	75
Stool	28
Wound swab	28
Sputum	09
Total	140

Table no. 2. shows the numbers and percentages of bacterial growth taken from different clinical samples. The results showed that bacterial growth was found in total 64 samples with 45.7%, while there was no bacterial growth in 76 samples with 54.3%. This result was similar to that found by Jean-Louis<sup>12</sup> who studied 4501 samples collected from patients staying in the hospitals in the United States for 72 hours and above. He found that 2064 samples with 45.8% gave a positive result, while 2437 samples with 54.1% showed no growth.

**Table: 2 Numbers and percentages of bacterial growth from different clinical samples**

Source of samples	Positive cultures		Negative cultures		Total
	No.	Percentage	No.	Percentage	
Urinary tract infections	38	50.7	37	49.3	75
Wound infections	12	42.9	16	57.1	28
Gastrointestinal infections	11	39.3	17	60.7	28
Respiratory infections	03	33.3	06	66.7	09
Total	64	45.7	76	54.3	140

**Identification:**

This included microscopic examination and observation of colony characteristics of bacteria grown on Blood agar, MacConkey agar and Nutrient agar as well as biochemical tests.

In our study we isolated both gram positive and negative bacteria in different samples.

Table 3&4 shows the biochemical tests used for the identification of the Gram negative and Gram-positive bacteria.

**Table: 3 Biochemical tests of Gram-negative bacteria isolated from different clinical specimens.**

Biochemical Tests											Isolated bacteria	
Lysine	Urease	Motility	H <sub>2</sub> S	Gas	Citrate	VP	MR	Indole	LF	Oxidase		Catalase
-	+	-	+	-	-	+	+	+	+	-	+	E. coli
-	+	+	-	+	+	-	+	+	+	-	+	Citro.koseri
+	+	-	-	+	+	-	+	+	+	-	+	K.ornithinolytica
+	-	-	+	+	-	+	-	+	-	-	+	K.cozaenae
+	-	-	+	+	+	-	-	+	-	-	+	K.pneumoniae
+	+	+	+	-	-	+	+	-	-	-	+	P.vulgaris
+	+	+	+	+	+	-	+	-	-	-	+	P.mirabilis
+	+	-	+	+	+	-	-	+	-	-	+	E.cloacae
-	+	-	+	+	+	-	-	+	-	-	+	E.aerogenes
+	+	-	-	+	-	+	+	-	-	-	+	Prov.rettgerii
+	+	-	-	+	-	+	+	-	-	-	+	Prov.stuartii
-	+	-	+	+	-	+	+	-	-	-	+	Prov.alcalifaciens
+	+	+	+	-	-	+	+	-	-	-	+	Morganellamorganii
-	-	-	+	-	-	+	+	-	-	-	+	Shigella flexneri

Table no. 5 shows the relationship between hospital infection and age. The average age of patients in this study ranged from 2 months to 89 years. The ages of patients were divided into five groups. The first group included the ages below 5 years, which comprised 15 patients with a percentage of 23.4%. In the second group, the ages ranged between 6-20 years and included 6 patients with 9.4%. The third group included ages 21-35 comprising 8 patients with a percentage of 12.5%. The fourth group included ages 36-50 years with 12 patients and a percentage of 18.8%. The fifth group included ages 51-89 years comprising 23 patients with 35.9%.

The results showed that the highest percentage of infections was in the fifth group 51-89 years with a percentage of 35.9% from the total cases, followed by the first group (under 5 years), then the fourth group 36-50 years, followed by the third group 21- 35 years and finally the second group 6-20 years.

**Relationship between Hospital Acquired Infection and gender:**

**Table: 6 Relationship between Hospital acquired Infection and gender**

Infection	Sex				Total number	Percentage
	Male		Female			
	No.	%	No.	%		
Pneumonia	01	33.3	02	66.7	02	66.7
Gastrointestinal infection	07	63.6	04	36.4	11	17.2
Wound infection	07	58.3	05	41.7	12	18.7
Urinary tract infection	16	42.1	22	57.9	38	59.4
Total	31	48.4	33	51.6	64	100

**Table: 4 Biochemical Tests of Staphylococcus spp.**

Novobiocine sensitivity	Biochemical tests								Staphylococcus spp.
	Sugar fermentation								
	Mannitol	Mannose	Sucrose	Motility	Mannitol salt agar	Coagulase	Catalase	Oxidase	
-	+	+	+	-	+	+	+	-	Staph.aureus
-	-	+	+	-	+	-	+	-	Staph.epidermidis
+	-	-	+	-	+	-	+	-	Staph.saprophyticus
-	-	+	-	-	+	-	+	-	Staph.schleiferi
-	-	-	+	-	+	-	+	-	Staph.warneri

**Relationship between Hospital Acquired infection and Age:**

**Table: 5 Relationship between Hospital acquired infection and Age**

Age in years	HAI patients	Percentage (%)
5yrs and less	15	23.4
6-20	6	9.4
21-35	8	12.5
36-50	12	18.8
51-89	23	35.9
Total	64	100

During the current study, random samples were collected from both sexes (males and females). The highest percentage of infection was recorded in females who were 33 patients with a percentage of 51.8% compared to males who were 31 patients with a percentage of 31.4% as indicated in Table [5]. Percentage of infection in females was 66.7% compared to males with 33.3%. As for wound infection, the percentage of infection in males was higher with 58.3% compared to females with 41.7%.

**Relationship between Hospital Acquired infections and Educational Level.**

**Table: 7 Relationship between Educational Level and Hospital acquired infection**

Educational level	No. of HAI patients	Percentage
Uneducated	47	73.43
Educated	17	26.57
Total	64	100

The above table shows the percentage of both educated and uneducated infected patients. It is clear from the results that the number of uneducated patients with hospital acquired infections were 45 with a percentage of 70.32% while the

number of educated patients were 19 with a percentage of 29.68% (Graduates of primary schools, institutes and universities).

## DISCUSSION

The high bacterial growth percentage shown in this study maybe due to the continuous use of protective antibiotics in the hospital, which has led to the spread of bacteria resistant to these antibiotics, as well as leaving the doors and windows open and sometimes cooling devices being out of order allowing the passage of air from the outside into the inside carrying germs and other pathogens.<sup>17</sup> In addition, the failure to follow the correct methods of cleaning and disregarding the rules of sterilization by hospital staff as well as other factors related to the hygiene of the patient himself.<sup>18</sup> The highest percentage of infection was recorded in UTIs 50.7% while pneumonia infections 33.3% were less frequent. This result was similar to that of Weinstein<sup>19</sup> in the United States, where the highest rate was recorded in UTIs followed by wound infections and Septicemia, while the lowest percentage was pneumonia infections.

The high percentage of HAI that was found in this study may be attributed to the lack of proper personal hygiene of the patient as well as lack of health education regarding cleanliness which ruins the immune barrier i.e. skin of these patients in spite of using all the aseptic precautions as well as implementing all the sterility protocols. This provides the best conditions for the invasion and settlement of germs in patients not only on the ruined layer but having access to the internal organs causing serious complications such as cases of Septicemia that may lead to death.<sup>18</sup>

The high percentage obtained for UTIs may be the result of frequent use of urinary catheterization as this is considered one of the most important means to transfer infections to patients as well as lack of following the healthy practices of hygiene. Studies have indicated that the large educational hospitals feature increasing numbers of those who enter it daily.<sup>20</sup>

As for the wound infections, it was with a percentage of 42.9%. The bacterial growth appeared in 12 samples from a total of 28 samples and this was similar to that of Zeamanuel Tesfahunegn<sup>21</sup>, which showed that the percentage of wound infections was 44.1%. On the other hand, Teye<sup>22</sup> showed that the percentage of wound infections was 14.8%.

As for gastrointestinal infections, it was with a percentage of 39.3%. The bacterial growth appeared in 11 samples from a total of 28 samples and these results agreed with AL-Rifai<sup>23</sup> with 32.4%. The high percentage of gastrointestinal infections that have emerged in this study may be due to the congestion of these lounges with patients, frequent entry of visitors and escorts to the lounges without following any means to avoid the transfer of germs to these lounges, not taking care of the food provided to patients, providing unsafe drinking water by the relatives to the patients and the patient's own personal hygiene.<sup>18</sup>

Concerning pneumonia infections, it was with a percentage of 33.3%. The bacterial growth appeared in 3 samples from a total of 9 samples and these results were similar to that of Eriksen et al.<sup>24</sup> who indicated that the percentage of pneumonia infections was 29%, while this result was higher than that of Osman et al.<sup>25</sup> who found that the infection percentage was 9.9%. The high percentage that emerged in this study is due to the same reasons mentioned in previous

cases such as poor ventilation and low health awareness of some patients.

The results showed that the highest percentage of infections was in the fifth group 51-89 years with a percentage of 35.9% from the total cases, followed by the first group (under 5 years), then the fourth group 36-50 years, followed by the third group 21- 35 years and finally the second group 6-20 years. These findings were in agreement with the findings of Stephan Francois et al.,<sup>26</sup> who indicated that the highest percentage of hospital infections was in the age group 60-75. In addition, Nasseab<sup>27</sup> noted that the highest percentage was in the age group of more than 50 years. Zeamanuel tesfahunegn<sup>21</sup> showed that the highest rate of hospital acquired infection was in the age group of more than 50 years, followed by ages 5 years or less, and this result agreed with the results obtained. The reason behind the high percentage of infection in the first and fifth groups is due to the fact that children and the elderly are more responsive to and affected by infection than others because of the incomplete maturity of the immune system in children and the elderly have a weakened immune system.

During the current study, random samples were collected from both sexes (males and females). The highest percentage of infection was recorded in females who were 33 patients with a percentage of 51.8% compared to males who were 31 patients with a percentage of 31.4% as indicated in Table.<sup>5</sup> In the case of urinary tract infections, the highest percentage of infection in females was 57.9% compared to males with 42.1%. This is in agreement with Stamm<sup>28</sup> who found that the percentage of female infections of the urinary tract is higher than that in males. Buzayan & Taher<sup>29</sup> also obtained the same results as ours, and this may be due to the female physiological condition such as the shortened urethra which facilitates the transmission of pathogens.<sup>30</sup>

Similar results were obtained in pneumonia infections where the highest percentage of infection in females was 66.7% compared to males with 33.3%. As for wound infection, the percentage of infection in males was higher with 58.3% compared to females with 41.7%. This is in line with what was reached by Zeamanule tesfahunegn.<sup>18</sup> This may be due to the nature of men's work and their presence outside the home for long periods, which makes them more likely to be infected with such kinds of infections. In the gastrointestinal tract infection, the highest infection percentage was recorded in males with 63.6% compared to females with 36.4% which was in agreement with AL-Rifai.<sup>23</sup>

It is clear from the results that the number of uneducated patients with hospital acquired infections were 45 with a percentage of 70.32% while the number of educated patients were 19 with a percentage of 29.68% (Graduates of primary schools, institutes and universities).

## CONCLUSION

The appearance of this high percentage for uneducated infected patients in our study may be the main cause of the increase in hospital acquired infections reaching a percentage of 45.7% because failure to follow health instructions during the period of stay in the hospital is more among uneducated patients due to lack of health awareness.

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