"Hospital Acquired Infections among the Paediatric Patients in Tertiary Level Hospitals of Dhaka City: Extent, Determinants and, Impact on Cost and Hospital Management"

A thesis submitted in fulfilment of the requirements for the award of-
PhD Degree

Under Faculty of Post Graduate Medicine and Research
University of Dhaka

Supervisor

Prof.Dr.Md. Zaforullah Chowdhury. PhD
Principal, East West Medical College, Dhaka.
Ex-Director, NIPSOM

Researcher-

Khorshed Ali Miah
Reg.No. 163/2012-13 (as new)

Assistant Professor
Dept. of Public Health & Hospital Administration
National Institute of Preventive and Social Medicine (NIPSOM),
Mohakhali, Dhaka

October 2017

Dhaka University Institutional Repository

"Hospital Acquired Infections among the Paediatric Patients in Tertiary Level Hospitals of Dhaka City: Extent, Determinants and, Impact on Cost and Hospital Management"

A thesis submitted in fulfilment of the requirements for the award of-
PhD Degree

Under Faculty of Post Graduate Medicine and Research
University of Dhaka

Supervisor
Prof.Dr.Md. Zaforullah Chowdhury. PhD
Ex-Director, NIPSOM
Principal, East West Medical College, Dhaka.

Researcher-
Khorshed Ali Miah
Reg.No. 163/2012-13 (as new)

Assistant Professor
Dept. of Public Health & Hospital Administration
National Institute of Preventive and Social Medicine (NIPSOM),
Mohakhali, Dhaka

October 2017

Declaration

It's my humble submission that the thesis entitled "*Hospital Acquired Infections among the Paediatric Patients in Tertiary Level Hospitals of Dhaka City: Extent, Determinants and, Impact on Cost and Hospital Management*" has been prepared on the basis of the research work as per duly approved research protocol and submitted to the Faculty of Post Graduate Medicine and Research, University of Dhaka in partial fulfilment of the requirements for the degree of Doctorate of Philosophy (PhD).

This is here by solemnly declared that the study has been conducted by myself and it does not contain any data or materials previously written or published by any other person except the duly incorporated references to the best of my knowledge, believe and confidence. This thesis or any part of it has not been submitted to any other institute, organization or University in and abroad for achieving any degree or diploma.

Dated……………….. **Author**

Dhaka University Institutional Repository

Dhaka.

Supervisor's Certificate

This is to certify that the thesis entitled '*Hospital Acquired Infections among the Paediatric Patients in Tertiary Level Hospitals of Dhaka City: Extent, Determinants and, Impact on Cost and Hospital Management*' submitted by DR. Khorshed Ali Miah, assistant professor, department of the public health and hospital administrstion, NIPSOM, to the Faculty of Post Graduate Medicine and Research, University of Dhaka is a record of trustworthy research work. He conducted the research work and prepared the thesis under my direct supervision and guidance.

In my opinion, this thesis is original and substantive, which has fulfilled the criteria for the award of the degree of Doctorate of Philosophy (PhD) in accordance with the rules and regulations of University of Dhaka. The results embodied in his thesis have not been submitted elsewhere for the award of any degree or diploma.

Supervisor

Prof. Dr. Md. Zaforullah Chowdhury

Dhaka University Institutional Repository

University of Dhaka

Faculty of Post Graduate Medicine and Research

Certificate of Approval by the Examiners

It's the pleasure of the undersigned examiners to certify that we have carefully read and thoroughly examined the thesis entitled '*Hospital Acquired Infections among the Paediatric Patients in Tertiary Level Hospitals of Dhaka City: Extent, Determinants and, Impact on Cost and Hospital Management*' submitted by DR. Khorshed Ali Miah, Assistant Professor, Department of the Public Health and Hospital Administration, NIPSOM.

This is hereby recommended that the submitted thesis has fulfilled the requirements in scope and quality for awarding the degree of Doctorate of Philosophy (PhD) under Faculty of Post Graduate Medicine and Research, University of Dhaka.

Board of Examiners

Convener **Signature:**

Full Name:

Designation:

Member **Signature:**

Full Name:

Designation:

Supervisor **Signature:**

Full Name:

Designation:

Date of Approval:…………………

Acknowledgement

First of all I must express my whole hearted gratefulness and 'shukria' to Allah the Almighty, the most gracious and merciful for his endless kind and compassion to complete this study.

I would like to acknowledge with gratitude the name of my respected supervisor, **Prof. Dr. Md. Zaforullah Chowdhury,** *Ex-Director, NIPSOM and Principal, East West Medical College, Dhaka for his most valuable support and constant guidance in conducting this research. He has given enormous time and taken much pain in supervising the research. Without his heart full cooperation, keen supervision and constant inspiration it would be merely impossible to complete this PhD research.*

I also acknowledge the name of my respected co-supervisor Prof. Dr. Md. Abdur Rahman, Ex-Director, NIPSOM, for his tired less guidance, supervision and cooperation. The final report of the research would not be possible to bring in present shape without his keen and flawless review and scientific inputs.

I am very thankful to Prof. Dr. Baizid Khoorshid Riaz, Director, and Head of the Department of Public Health and Hospital Administration, National Institute of Preventive and Social Medicine (NIPSOM), Mohakhali, Dhaka for his sincere cooperation especially in administrative issues.

It's my solemn responsibility to remember the name of Prof. Dr. Shireen Begum, Ex-Director, NIPSOM, Prof. Dr. Shaila Hossain, Ex-Professor and Head of the Department of Community Medicine, NIPSOM, Dr. Md. Monjurul Haque Khan, Associate Professor and Head of the Department of Occupation and Environmental Health, NIPSOM, Dr. Md. Rezaul Karim, Ex-Associate Professor and Head of the Department of Population Dynamics, NIPSOM and Md. Anowar Hossain, Secretary to Principal Dhaka Medical College for their constant support, sincere inspiration and utmost cooperation for getting

Dean,s approval regarding re-registration of my PhD program, when I was really in trouble due to death of my initial supervisor.

I like to extend my heartiest thanks to Prof. Dr. Margub Morshed, Dean, Faculty of Post Graduate Medicine and Research of Dhaka University for his valuable sympathy and support to extend the period of my study.

My humble submission to the Directors and their teams of Dhaka Medical College Hospital, Bangladesh Medical College Hospital and Dhaka Shishu Hospital for their valuable support and kind approval in collecting data on admitted pediatric patients of their respective hospitals. My best regards to the on-duty doctors, nurses and support staffs of the above mentioned hospitals for their sincere cooperation.

I pray to Allah the Almighty for eternal peace of the departed soul of my initial supervisor Prof DrRawshon Ara Begume, Ex-Head of the department of Public Health and Hospital Administration, NIPSOM.

Finally, I would like to express my heartfelt thanks and gratitude to my wife Mrs. Atia Begum and my daughters Dr. Sumaia Jahan, Dr. Nusrat Jahan and Maliha Jahan for their encouragement and inspiration in conducting the research. They had to take much pain because they were deprived from my love, affection and belongingness as I had to be busy with the research work.

I express my deep appreciation Mr MA Hakim, data analyst for his tired less and laborious efforts he has given in analyzing the data of this research.

I am indebted to all the parents and care givers of the pediatric patients under study for their most valuable information which are the key elements of this study.

Last but not the least I must remember the support staffs of my departments for their excellent cooperation.

Author

Abstract

Background: *The cross sectional study titled- 'Hospital Acquired Infections among the Paediatric Patients in Tertiary Level Hospitals of Dhaka City: Extent, Determinants and, Impact on Cost and Hospital Management'-was conducted from August 2013 to November 2016 on a total of 1055 pediatric patients admitted in three tertiary level hospitals of Dhaka city.* ***Objective:*** *The objectives of the study were to assess the extent and to find out the determining factors of hospital acquired infections and to estimate their impact on cost of treatment and on some indicators of hospital management among the admitted paediatric patients in the hospitals under study.* ***Method:*** *Data were collected through interviewer administered semi-structured questionnaire and observation check-list. Uni-variate, bi-variate and multi-variate analysis were done by using SPSS software program.* ***Results:*** *Among 1055 pediatric patients highest number (46.7%) belonged to the age group of 1-5 years of age, dominated by males (53.5%) by gender and 86.4% of the subjects were Muslim. Highest number (46.7%) came from rural areas and majority (58%) belonged to the family having 1 to 5 members. Regarding educational qualification highest number of fathers (29.8%) and mothers (28.2%) attended from class VI-to-X. By occupation most of the mothers (69.9%) were housewives and highest number (29.9%) of the fathers were engaged in agriculture. Highest number (29.7%) of the study subjects belonged to the group of having monthly family income from Tk. 15,001/ - to- Tk. 20,000/-. More than quarter(26.4%) of fathers and only 1.5% mothers were found as regular smoker. Nearly quarter (22.7%) of the pediatric patients under study were found as severely anemic. More than quarter (25.8%) was born by CS operation. Regarding diseases on admission gastro-intestinal disease and urinary disease were found in leading position representing by 19.7% and 18.6% respectively. More than one third (35.2%) of the pediatric patients had to under gone surgical operation during their stay at hospital. Majority (55%)*

Dhaka University Institutional Repository

of patients was found to have one or more underlying diseases other than those diseases due to which they had been admitted. Most (89.7%) of the study subjects were visited by 3 or more visitors and more than three fourth (76.3%) were given care by 2 or more attendants. Less than one fourth (23.9%) was found to have history of previous hospitalization, only 5.1% had history of previous surgical operation and nearly three quarters (73.3%) were treated with antibiotics within last three months. Over all prevalence and incidence of HAI in all the three study hospitals was 10.9%and 7.5 per 1000 bed days respectively. By major specialty of treatment prevalence of HAI was found higher (14.0%) in surgery ward than that of the medicine wards (9.2%). Surgical wound infection (24%) was found dominating over other types of HAI. Among the isolated organisms Staphylococcus Aureus (38.3%) was at the top of the list which was followed by E Coli (20%). Prevalence of HAI among the pediatric patients was found significantly different with the differences of education levels of the parents but the relation of HAI with the occupation of the parents was not found significant. Significant relationship was found between prevalence of HAI and the smoking habit of the parents. No evidence of significant difference of HAI was found with the geographical difference of residence. Children from bigger size families (>5 members) were found to have higher prevalence of HAI than that of those children came from smaller (1-5 members) families. Significantly higher number of HAI was found among the subjects born by CS operation. Among surgical patients significant relationship of HAI was found with mode of decision for surgery and types of surgical operations. Prevalence of HAI had significant relationship with higher number of visitors (3 or more) and attendants (2 or more). Significantly lower (8.3%) Prevalence of HAI was found among those patients who were given care by their mothers. Higher number of HAI was found significantly related with both the immunosuppressive conditions and the immunosuppressive therapies. Prevalence of HAI was also found significantly related with cleanliness status of pillow cover and bed sheets of the patients, face mask using, gown wearing and hand washing practice of the doctors and personal hygienic status of the *attendants. Prevalence of HAI was also significantly higher among the patients who had positive history of taking antibiotics, being hospitalized and undergone surgery within last 3 months. It was found that if the age of the pediatric patients' decreased likelihood of the HAI increased. But odds ratios were significant only for two groups (up to1 year; 4.10 and 2-5 years; 2.86). As income decreased, the likelihood of HAI increased. But odds ratio only for the 2nd income quartile (2.74) was statistically significant. It was also found that the hemoglobin level decreased likelihood of HAI highly increased. Odd ratio for severe and moderately anemic patients (6.10) was found statistically significant. As duration of operation increased, likelihood of HAI also increased though the odds ratio for none of the groups was statistically significant. Patients with more than 6 days waiting time for operation had 1.4 times likelihood of HAI than those who had to wait for less than 6 days, but the odds ratios were not statistically significant.* ***Conclusion:*** *Prevalence of HAI among the pediatric patients was found significantly different with the differences of hemoglobin level of patients and with the differences of education levels and smoking habit of their parents. Satisfaction level of the respondents was found significantly different among the parents of HAI and non-HAI patients. Mortality was significantly higher among the HAI patients than that of their non-HAI counterparts. Length of hospital stay and treatment cost was found significantly different among the HAI and non-HAI patients.*

Contents

List of Tables

List of Figures

List of Abbreviation

AIDS	Acquired immunodeficiency syndrome
ALS	Average Length of Stay
BDT	Bangladeshi TAKA
BMCH	Bangladesh Medical College Hospital
BMI	Body Mass Index
BOR	Bed Occupancy Rate
CABG	Coronary Artery Bipus Grafting
CDC	Center for Disease Control and Prevention
CI	Confidence Interval
CS Operation	Cesarean Section Operation
DGFP	Directorate General of Family Planning
DGHS	Directorate General of Health Services
DGNMS	Directorate General of Nursing and Midwifery Services
DHHS	Department of Health and Human Services
DMCH	Dhaka Medical College Hospital
DSH	Dhaka Shishu Hospital
DV	Dependent Variable
GHA	Global Health Association
GOB	Government of Bangladesh
HAI	Hospital Acquired Infections

HCAI	Health Care Associated Infections
HAP	Hospital Acquired Pneumonia
HASSI	Hospital Acquired Surgical Site Infection.
HARI	Hospital Acquired Respiratory Infections
Hb	Hemoglobin
HIV	Human Immune Deficiency Virus
ICDDRB	International Center for Diarrheal Disease Research in Bangladesh
ICU	Intensive Care Unit
IDV	Independent Variable
IHR	International Health Regulations
IPD	In-Patient Department
LOHS	Length Of Hospital Stay
LOS	Length Of Stay
MDG	Millennium Development Goals
MDR	Multi Drug Resistant
MOHFW	Ministry of Health and Family Welfare
MPH	Master Of Public Health
MRSA	Methicillin-resistant Staphylococcus Aureus
NGO	Non-Government Organization
NHS	National Health Service
NI	Nosocomial Infections
NICU	Neonatal Intensive Care Unit
NIPSOM	National Institute of Preventive and Social Medicine

NNIS	National Nosocomial Infection Surveillance
OPD	Out Patient Department
PICU	Pediatric Intensive Care Unit
RCT	Randomized Control Trial
RI	Respiratory Tract Infection
RSV	Respiratory syncytial virus
S. Aureus	Staphylococcus Aureus
SDG	Sustainable Development Goals
SHEA	Society of Hospital Epidemiologists of America
SENIC	Study of the Efficacy of Nosocomial Infection
SSI	Surgical Site Infection
SSTI	Skin and Soft Tissue Infections
TB	Tubercle Bacilli
TBI	Tuberculosis Infection
UK	United Kingdom
USA	United States of America
UTI	Urinary Tract Infections
VAP	Ventilator Associated Pneumonia
VRE	Vancomycin-resistant enterococci
WHO	World Health Organization

Chapter One:

1.0 Introduction

1.1 Perspectives

1.1.1 Definition of Hospital Acquired Infection:

A "hospital acquired infection (HAI)"-has been defined by WHO as: "an infection acquired in hospital by a patient who was admitted for a reason other than that infection," or as "an infection occurring in a patient in a hospital or other health care facility in whom the infection was not present or incubating at the time of admission. This includes infections acquired in the hospital but appearing after discharge, and also occupational infections among staff of the facility.[1]" The majority of HAI become evident 48 hours or more following admission. As more health care is now being provided in ambulant patients, the term "health care associated infection" is also used. Such infections have also been called "nosocomial infections" and sometimes- "hospital associated infection."[2] The extent of HAI can be measured by estimating prevalence and incidence rate of HAI.[3]

1.1.2 Past and Present of HAI:

As the existence of microbes are thought to be older than the history of human race so it is logical to say that the infection might first began since the appearance of first man in this world. Hospital acquired infection is not a new problem for mankind. It has been a serious problem ever since sick patients were first congregated in hospitals. Even in the prehistoric era though people had no idea about microbes and infection but they thought about disease transmission. In 400 BC, Hippocrates believed that air, water and places influence the health of populations.[4] In 2nd century A.D; Galen noted that air is the main factor in disease transmission.[5] In 16th century Fracastorius noted that infection could be transmitted by direct or indirect contact and by air.[6] In 19th century the role of contact in infection transmission gained acceptance after the microbial nature of infectious disease was recognised. One hundred and fifty year's ago Lord Lister, a great surgeon of his era was greatly concerned that almost half of the patients of whom he had operated developed infections, which were frequently fatal. He demonstrated the relationship between bacteria and infection and developed the first concept of antisepsis.[7] In 19th century Sommeliers could reduce the rate of hospital acquired puerperal fever by use of antiseptic hand washing techniques in his hospital from over 9% to 3.6% of maternity patients.[8] The current emphasis on surgical wound infection dates from the mid 1950s and this emergence of the epidemics of the penicillin-resistant staphylococcus aureus.[9] First international conference on nosocomial infections held at the CDC (centre for disease control), America in 1970. Following that conference the CDC developed a strong recommendation for the surveillance approach, which was also supported and promoted by the American Hospital Associations (AHA).[4] In 1974, the CDC began a nation-wide study to evaluate the effectiveness of the approach that had been adopted through the country. During the next ten years (1974-1983) the SENIC (Study of the Efficacy of Nosocomial Infection Control) project was conducted, by this the infection control movement in US hospitals were going through a maturation phase. A professional Society of Hospital Epidemiologists of America (SHEA) was formed in 1980.[10] More efficient methods of detecting infection through surveillance were developed by them. By the early 1990s, new developments in infection control revitalised the epidemiological movements. By 1993, >80% of US hospitals were using computers to process infection surveillance data. Finally, by mid 1990s arose a new force in the form of "quality management", and "continuous quality improvement". In present time "infection control committee" of a hospital is thought to be one of the essential components of hospital administration not only in the developed countries, but also in the developing countries of the world.[10, 11]

1.1.3 Magnitude of the problem:

1.1.3.1 Global perspective:

In the US: Nosocomial infections are estimated to occur in 5% of all acute care hospitalizations. The estimated incidence is more than 2 million cases per year, resulting in an added expenditure in excess of $2 billion. The National Nosocomial Infections Surveillance (NNIS) System of the Centres for Disease Control and Prevention performed a survey from October 1986 to April 1998. They ranked hospital wards according to their association with central-line bloodstream infection. The highest rates of infection occurred in the burn ICU, neonatal ICU, and paediatric ICU.[8] In a study conducted by WHO in 55 hospitals of 14 countries representing 4 WHO regions (Europe, Eastern Mediterranean, South East Asia and Western Pacific) showed an average of 8.7% of hospital patients had nosocomial infections, the highest frequencies were reported from hospitals in the Eastern Mediterranean Region (11.8%) followed by South East Asia where it was 10%, with a prevalence of 7.7 and 9.0% respectively in the European and Western Pacific Regions.[1,3] It has been revealed that at any time over 1.4 million people world-wide suffer from infectious complications acquired in hospitals may be due to resistant organism, that further accentuate the problem. It has also been estimated that these infections cost more than US$ 40 million every year in Thailand alone.[2] In the prevalence studies on HAI conducted at Boston City hospital in 1964 and 1967, indicated that the prevalence was similar in both years and that surgical patients were more likely to be infected than were medical patients.[12] A study in England on surgical patients by Coclo et al. (1993) found the incidence of HAI 7.2 percent and a recent study by Ploughman et al. (2001) on patients admitted to medical and surgical specialities reported an overall rate of 7.8 percent.[13] A seven day period prevalence survey was conducted in May' 1998 on 1928 patients in a large number of primary and tertiary health care centres in Geneva, Switzerland, which included all patients in acute, sub acute and chronic care settings and found overall prevalence of HAI was 11.3% (acute-8.4%, sub acute 11.4%, and chronic 16.4%).[14,15] HAI in Auk-land health care hospitals showed that the rate was 12%. HAI among surgical patients in a Brazilian hospital showed that the incidence rate was lowest (2.95%) for bloodstream infection and highest (8.65%) for surgical wound infection patients.[16] American society of Anaesthesiology conducted a study and found the rate was 4.5 per 1000 surgeries. A prevalence survey on 18163 patients in 43 hospitals in the UK in 1980 showed that 19.1% of admitted patients were infected and out of them 9.2% were hospital acquired.[17] HAI surveillance pilot projects in six hospitals of America showed that the overall incidence of HAI at all sites in all the six hospitals was 1.4 per 100 discharges with a range of 0.4 to 2.4 per 100 discharges. Sensitivity of surveillance in these institutions ranged from 15% to 50% with a mean of 40%; the adjusted HAI rate was 3.5 per 100 discharges with a range of 1.1 to 2.3 per 100 discharges. Shearer et al. (1982) reported that HAI could be as high as 25-65 percent in developing countries. Reducing hospital acquired infection by half, exactly as seen in a UK example (Bandolier 67) would be equivalent to building, staffing and running 13 more 400 bed hospitals in England.[10, 18]

1.1.3.2 Country perspective:

It is very difficult to present the detailed national level scenario regarding hospital acquired infection, because, till today no countrywide surveillance study has been conducted in this field. But the collective result of the studies undertaken at different times in several hospitals of Bangladesh by individual or institutional effort is almost similar to that of the WHO study in this region. A study named "Prevalence study of hospital acquired infection" was performed in selected tertiary level hospitals and showed prevalence rate in different hospitals in the range of 6 to 18%. In that study the rate of HAI in SSMC & Mitford hospital was 12%.[19] Another study by Zaman et al showed that the prevalence of HAI was 38% among post operative patients.[20] A study on post caesarean wound infection in Dhaka Medical College Hospital showed that 35.3% of caesarean patients developed hospital acquired infection.[21] There was a sharp rise of HAI when Hb% level was <55%. Women with BMI less than 18 was found more prone (4 times) in developing HAI than those women whose BMI was normal (BMI 18-25). Patients staying in cabin (separate room for each patient) after operation developed significantly less HAI than those patients staying in general ward. In another comparative study on nosocomial infection between public and private hospital, it was found that the surgical wound infection alone occupied the highest share both in public (60.38%) and private (82.86%) hospitals. But in public hospital it was followed by gastro-enteritis (35.5%) whereas in private hospital it was followed by UTI and URTI respectively. The average over stay in all cases of public hospital was by 3.5 days whereas in the private hospital it was by 4.57 days.[22] Golondaz in his study found that after any sorts of operation a total of 40.9% patients developed surgical wound infection. Among the patients who developed HAI average duration of hospital stay was 19.56 ± SD 5.47 days but it was 11.47±SD 2.83 days for those patients who did not develop infection after surgical operation.[23] Hussain Tahmina in her study in a government hospital showed that the hospital stay due to post-operative infection is prolonged by 7 days to 41 days and the mean post-operative hospital stay (25 days) is nearly three times than that of non HAI patients.[24]In another study it was found that prevalence of HAI is lowest (0%) in ophthalmology department and highest (23%) in critical care units.[25] A study on 299 admitted patients of Dhaka Medical College Hospital 34(11.37%) were found affected by HAI. Surgical wound infection was the most prevalent (44.1%) among the various types of HAI with urinary tract infection in the second (26.5%), and skin and soft tissue infection being the third (14.7%) in ranking.[26] Even though there has been some improvement during the last years still we are far behind than the developed countries in reducing hospital acquired infections. Sharif SH found in his study that out of 456 respondents for a period of three months, yielded a total 6030 hospital days at risk. During these period 54 (11.8%) events of infection occurred among the 456 respondents, which yielded incidence rate 8.96/1000 hospital days. In that study, among 456 respondents who were at risk, 54 (11.8%) of them developed hospital-acquired infection (HAI). Out of 54 (11.8%) events of infection, 64.8% surgical site infection (SSI), 22.2% urinary tract infection (UTI), 9.3% respiratory ' infection (RI) and 3.7% was skin and soft tissue infection (SSTI) were found.[88]

1.1.4 Nature of HAI

Almost forty percent of all hospital-acquired infections are urinary tract infection, 80% of them are associated with the use of indwelling catheter. Surgical wound infections are covering 5-15% of HAI depending on the type of operation and patient's physical status.[27-29] About 10% of all HAI are respiratory tract infection. 3% of patients on ventilators usually develop pneumonia. In one study pneumonia was found to be responsible for 60% of all death due to HAI. Septicaemia covers approximately 5% of HAI, among them more them 50% is fatal and the infection usually enters through the skin entry site of the intravascular device.[30-34] Bacteria are the most common nosocomial pathogens and are responsible for occurring more than 80% of HAI. Viruses are accountable for 12% of all HAI. Many fungi and some parasites are opportunistic organisms and cause HAI during extended antibiotic treatment and severe immunosuppression.[35-37] Majority (>60%) of HAI have been found to be acquired from exogenous source (when organism comes from other patients, visitors and staffs). Out of them 75% are transmitted by direct contact and 10-20% by airborne spread. Endogenous source (when patient's own body play role as source of infection) is responsible for 10-15% of HAI. Commensal flora resides in patient's mouth, G.I tract, vagina and skin and cause infection only in immuno-compromised situation. Environmental source (both internal and external environment of hospital) was found accountable for about 5% HAI.[38-43]

1.1.5 Impact of HAI on cost and hospital management:

The impact of hospital acquired infections is considerable, the patient may need longer hospital treatment, readmission, or even further surgery, increasing time off work and extra use of hospital and community resources. As these infections cause the patient to spend longer in hospital, resources such as consumable items, the time of health care professionals and the capacity of capital equipment and infrastructure are used to provide the appropriate care. A patient with a hospital infection might occupy a bed at least for three days longer than normal during which time nursing and medical staff might administer drugs and care for the patient.[44] As these resources could have been used for the care of alternative patients an opportunity cost is incurred.[45] In addition to the opportunity costs incurred by the health sector there might be private costs incurred by the patients and those who provide informal care for them.[46] These costs could be financial, such as additional medications, travel costs or child care costs, or they could be non-financial, such as physical pain and emotional stress. Finally, if the infection delays patients or informal carers access to their usual activities, be they paid or un-paid, then productivity losses could accrue. To provide a comprehensive picture of the burden of HAI all related costs should be considered. The increased length of stay is the greatest contributor to cost of HAI. Prolonged stay and more use of resources will ultimately affect the quality of hospital management, which will again accentuate the occurrence of infections and thereby it makes a cycle in the field of hospital management. Khan MH (2000) found in his study that mean total days of hospital stay on the part of HAI patients was 43.68 days with SD± 21.90 days. He also found that the majority (38.29%) of the respondents spent TK 10001-20000 as extra cost for HAI. Mean extra cost was Tk. 20,435 with SD±15,750.[26] A study by Coella R. et al. (1993) showed that the over all increase in the duration of hospitalisation for patients with surgical wound infections was 8.2 days, ranging from 3 days for gynaecology to 9.9 for general surgery and 19.8

for orthopaedic surgery.[47,48] Plowman and Colleagues (in 2000) reported that HAI cost the NHS £ 986.36 million. Most of this cost £ 930.62 million was borne by inpatient services. Substantial costs £ 55.74 million were also incurred after the patient had left hospital. General practitioners costs were valued £ 8.49 million, OPD £28.83 million and district nursing service £ 20.51 million.[49, 50] Another study in England & Wales on acute hospital beds showed that 5% infection in acute bed was associated with an additional mean stay of 3 days represents 600000 wasted bed days of £ 30,000000 per yr. Prolonged hospital stay also hamper community services, due to loss of working time of the patients and his carers.[51,52] Estimated extra days in hospital and extra charges attributable to nosocomial infections annually in US hospitals are as follows:[53,54]

Types of HAI	Over stay in hospital per infection (in days)	Extra charges per infection (in $)
Surgical wound infection	7.3	3152
Pneumonia	5.9	5683
Bacteraemia	7.4	3517
UTI	1.0	680
Other sites	4.8	1617

Hospital acquired infections add to functional disability and emotional stress of the patient and may in some cases, lead to disabling conditions that reduce the quality of life. HAI also has an impact on mortality, sometimes they are the leading causes of death. In 1986 Haley conducted a study of mortality in England and suggested that 5000 deaths are directly attributable to HAI and further 15000 partially attributable.[55-58]

1.1.6 The benefits of prevention

This study was not directly concerned with estimating the benefits of prevention. However, the estimates presented provide important information on the value of resources that might be released for alternative use if a proportion of infections are prevented. These may be viewed as the gross benefits of prevention. Net benefits will depend on the cost and effectiveness of prevention activities. At the level of the study hospital, a 10% reduction in the observed incidence rate was estimated to result in the release of resources valued at £361 297 (95% MI: 302924; 419670). A similar reduction at the national level was estimated to result in the release of resources valued at £93.06 million (95% CI: 78.03: 108.10 million).[58] In the short term, only a relatively small proportion of these benefits are likely to be in the form of cash savings. However, over a longer period of time it is possible that some of the fixed costs might be avoided and as such, the proportion of benefits that may accrue as cash benefits may increase. In terms of the number of bed days released for alternative use, at the level of the study hospital a similar level of reduction may result in an estimated 1413 (95% CI: 1168; 1659) bed days released for alternative use: equivalent to an estimated 191 finished consultant episodes (95% CI: 158: 224). At the national level 364056 (95% CI: 300 880); 427 223) bed days may be released; equivalent to an estimated 47902 finished consultant episodes (95% CI: 39589; 56214).[58] Several studies have indicated that between 50 and 70 percent of surgical wound infections occur post-discharge and the preliminary results form a comprehensive study in three NHS Trusts would appear to support these findings. But in the present study it would not be possible to include the post-discharge hospital acquired infections patients.

1.2 Historical Overview:

1.2.1 Beliefs about infections in history:

Any discussion of routes of transmission of infectious diseases must acknowledge the cyclic nature of beliefs about this topic in history. In 400 b.c., Hippocrates believed that air, water, and places influenced the health of populations. In the 2^{nd} century A.D, Galen noted that when many sicken and die at once, one should consider the air that we breathe; His observations were underscored by the occurrence of dreaded epidemics such as the Black Death in Europe during the 14^{th} century. Two hundred years later. Fracastorius noted that infection could be transmitted by direct contact, by indirect contact, or from a distance, that is through the air.[8] For the next several hundred years, virtually all infectious diseases were thought to be transmitted through the air. So the "miasmic" theory of infection gained credence, leading to names like *malaria.* After the microbial nature of infectious diseases was recognized in the mid-19^{th} century, the role of contact in infection transmission was clearly identified and gained acceptance rapidly. By 1910, Charles Chapin could write in his treatise *On the Sources and Modes of Infection.* Without denying the possibility of [airborne] infection, it may be fairly affirmed that there is no evidence that it is an appreciable factor in the maintenance of most of our common contagious diseases. We are warranted, then, in discarding it as a working hypothesis and devoting our chief attention to the prevention of contact infection." He did waver a bit in the case of tuberculosis (TB), however, and considered that disease more likely than any other to be airborne.Chapin's views persisted for the next 35 years. In 1935, however, William Firth Wells, an engineer at Harvard, began to challenge this dogma, and argued that certain diseases, such as measles, were spread through the air by droplet nuclel. Ultraviolet (UV) lights were introduced into a few schools to test this hypothesis and, initially at least, met with success. As recently as 1946, however, a committee of the American Public Health Association, in its final report, wrote: "Conclusive evidence is not available at present that the airborne mode of transmission of infection is predominant for any particular disease. Among the committee members was Dr. Alexander Langmuir, who later was converted.[8] The next 25 years, sharply changed beliefs about airborne transmission of infectious disease and put epidemiological theory on a more scientific basis. Langmuir, in a thoughtful review published in 1980, identified four areas of study that led to a more substantive understanding of the role of airborne infection. These were, first, an understanding of the creation and behavior of aerosols of microorganisms; second, an understanding of the physiology and function of the respiratory tract, particularly the respiratory host defense mechanisms; third, the study of experimental airborne infections in animals and humans; and fourth, increased understanding of the epidemiology of both naturally occurring and accidentally acquired infection. As we enter the next millennium of infection control, we stand on the shoulders of giants-Jenner, Semmelweis, Nightingale, Oliver Wendell Holmes, and my own personal favorite, Thomas Crapper, the father of indoor plumbing. Modern infection control is grounded in the work of IgnazSemmelweis, who in the 1840s demonstrated the importance of hand hygiene for controlling transmission of infection in hospitals. However, infection control efforts were spotty for almost a century. In 1976, the Joint Commission on Accreditation of Healthcare Organizations published accreditation standards for infection control, creating the impetus andneed for hospitals to provide administrative and financial support forinfection control programs. In 1985, the Centers for Disease Control andPrevention's (CDC's) Study on the Efficacy of Nosocomial Infection Controlreported that hospitals with four key infection control components an effective hospital epidemiologist, one infection control practitioner forevery 250 beds, active surveillance mechanisms, and ongoing control efforts reduced nosocomial infection rates by approximately one third. Over the past 25 years, CDC's National Nosocomial Infections Surveillance (NNIS) system has received monthly reports of nosocomial infections from a nonrandom sample of United States hospitals; more than 270 institutions report. The nosocomial infection rate has remained remarkably stable (approximately five to six hospital-acquired infections per 100 admissions); however, because of progressively shorter inpatient stays over the last 20 years, the rate of nosocomial infections per 1,000 patient days has actually increased 36%, from 7.2 in 1975 to 9.8 in 1995. Itis estimated that in 1995, nosocomial infections cost $4.5 billion andcontributed to more than 88,000 deaths—one death every 6 minutes.[10]

1.2.2 Which Nosocomial Infections Are Emerging?

There have been witnessed a cyclical parade of pathogens in hospitals. In Semmelweis'sera, group A streptococci created most nosocomial problems. For the next 50 to60 years, gram-positive cocci, particularly streptococci and Staphylococcusaureus, were the hospital pathogens of major concern. These problems culminated in the pandemic of 1940 to 1950, when S. aureus phage type 94/96caused major nosocomial problems. In the 1970s, gram-negative bacilli, particularly Pseudomonas aeruginosa and Enterobacteriaceae, becamesynonymous with nosocomial infection. By the late 1980s and early 1990s, several different classes of antimicrobial drugs effective against gram-negative bacilli provided a brief respite. During this time, methicillin-resistant S. aureus (MRSA) and vancomycin-resistant enterococci (VRE) emerged, signaling the return of the "blue bugs." From 1990 to 1996 the three most common gram-positive pathogens;S aureus, coagulase-negative staphylococci andenterococci-accounted for 34% of nosocomial infections and the four most common gram-negative pathogens; Escherichia coli, P. aeruginosa, Enterobacter spp.and Klebsiellapneumoniae-accounted for 32% infections. Bloodstream infections and pneumonias have increased in frequency from 1975 to 1996. However, tracking nosocomial infections by site has become difficult in the last few years because of shorter inpatient stays. For example, the average postoperative stay, now approximately 5 days, is usually shorter than the 5- to 7-day incubation period for Saureus surgical wound infections.Acquired antimicrobial resistance is the major anticipated problem in hospitals.VRE and MRSA are the major gram-positive pathogens of concern. Paeruginosa, Klebsiella, and Enterobacter that harbor chromosomal or plasmid-mediated beta-lactamase enzymes are the major resistant gram-negative pathogens. The contribution of antibiotic resistance to excessivedeath rates in hospitals is difficult to evaluate, often depending on whetherstudies are population-based or case-control, but evidence is mounting thatantimicrobial resistance contributes to nosocomial deaths.While bacterial resistance is clearly the major threat, viral and fungalresistance could become important because of the small number of therapeutic options for these pathogens. Herpes viruses with acquired resistance to acyclovir and ganciclovir have emerged as problems, particularly in HIV-infected patients. Pathogens with intrinsic resistance often have lower pathogenicity and have disproportionately affected immune-compromised patients. For example, Candida spp. with intrinsic resistance to azole antifungal agents (e.g., C. krusei) and to amphotericin B (e.g., C. lusitaniae) has emerged as problem pathogens in oncology units.While we are facing the era of opportunists, including fungi, viruses, and parasites in immune-compromised patients, the one we fear most is the post-antibiotic era. The first nosocomial inkling is MRSA with reduced susceptibility to vancomycin. Beyond the post-antibiotic era lies the era of xenogenic infections as organs, transplanted from nonhuman primates, bring with them a variety of potential zoonotic pathogens. Nevertheless, traditional respiratory pathogens may yet prove to be our greatest challenge; for example, a major shift in strain typecould result in devastating pandemic community and nosocomial influenza A outbreaks.[59]

1.2.3 Who Is Affected by Emerging Nosocomial Pathogens?

Nosocomial infections typically affect patients who are immune-compromised because of age, underlying diseases, or medical or surgical treatments. Aging of our population and increasingly aggressive medical and therapeutic interventions, including implanted foreign bodies, organ transplantations, and xeno-transplantations, have created a cohort of particularly vulnerable persons. As a result, the highest infection rates are in intensive care unit (ICU) patients. Nosocomial infection rates in pediatric ICUs are approximately three times higher than elsewhere in hospitals. The sites of infection and the pathogens involved are directly related to treatment in ICUs. In these areas, patients with invasive vascular catheters and monitoring devices have more bloodstream infections due to coagulase-negative staphylococci. In fact, most cases of occult bacteremia in ICU patients are probably due to vascular access-related infections. Fungal urinary tract infections have also increased in ICU patients, presumably because of extensive exposure to broad-spectrum antibiotics. In the National Nosocomial Infections Surveillance system, Candida spp. are the main cause of nosocomial urinary infections in ICUs.[60]

1.2.4 Why Are Nosocomial Infections Emerging Now?

Three major forces are involved in nosocomial infections. The first is antimicrobial use in hospitals and long-term care facilities. The increased concern about gram-negative bacilli infections in the 1970s to 1980s led to increased use of cephalosporin antibiotics. As gram-negative bacilli became resistant to earlier generations of cephalosporin antibiotics, newer generations were developed. Widespread use of cephalosporin antibiotics is often cited as a cause of the emergence of enterococci as nosocomial pathogens. About the same time, MRSA, perhaps also in response to extensive use of cephalosporin antibiotics became a major nosocomial threat.

Widespread empiric use of vancomycin, as a response to concerns about MRSA and for treatment of vascular catheter-associated infection by resistant coagulase-negative staphylococci, is the major initial selective pressure for VRE. Use of antimicrobial drugs in long-term care facilities and transfer of patients between these facilities and hospitals have created a large reservoir of resistant strains in nursing homes. Second, many hospital personnel fail to follow basic infection control, such as hand washing between patient contacts. In ICUs, asepsis is often overlooked in the rush of crisis care. Third, patients in hospitals are increasingly immune-compromised. The shift of surgical care to outpatient centers leaves the sickest patients in hospitals, which are becoming more like large ICUs. This shift has led to the greater prevalence of vascular access associated bloodstream infections and ventilator-associated pneumonias. Other precipitating factors also can be anticipated in hospitals. Transplantation is a double-edged sword because of the combined effects of immunosuppression of transplant patients and of infectious diseases that come with some transplanted organs. The blood supply will continue to be a source of emerging infectious diseases. Moreover, as hospitals age, infrastructure repairs and renovations will create risks of airborne fungal diseases caused by dust and spores released during demolition and construction. Infections due to other pathogens, such as Legionella, may also result from such disruptions.[60]

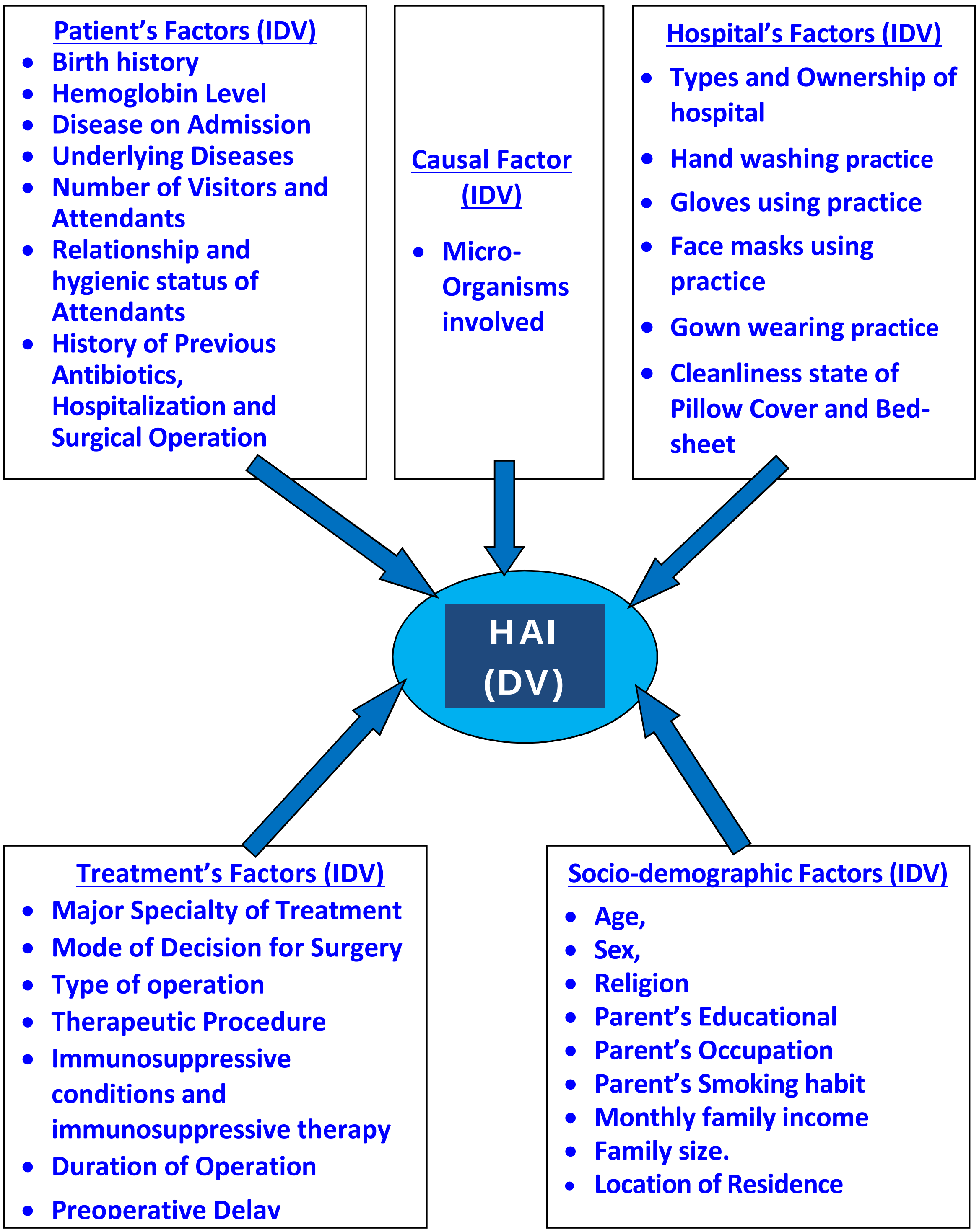
1.3 Rationale

Hospital acquired infections are considered as the important contributors to morbidity and mortality all over the world. Its immediate outcome is prolongation of hospital stay, which not only increases direct costs to patients or parents but also increases indirect cost due to loss of work. The increased use of drugs, the need for isolation and the use of additional laboratory and other diagnostic studies also contribute to the cost. It decreases the availability of beds for other long waiting patients, as well affects facility of services by increasing pressure on medical personnel. According to Nightingales "historical quotation- hospital should do no harm to the sick", but when someone becomes the victim of HAI, harms usually being done not only to him, also to the hospital authority and even to the country. Considering the economic constraints, optimisation of existing health facilities needs to be ensured. Reduction of the incidence of HAI can contribute to the reduction of the length of hospital stay and thus increase hospital bed availability. Study regarding HAI should be updated time to time because true percentage of infections that are preventable probably changes very frequently. New risk factors are constantly appearing, necessary control measures are continually evolving, and the ability to manage the patient care behaviour of hospital personnel is changing. Till today no country-wide surveillance study has been conducted in the field of hospital acquired infection in our country, though several studies have been carried out by individual or institutional efforts, the objective of those studies were mainly to explore the magnitude of the problem in the respective hospitals. But so far I have reviewed, no such study has been conducted among the paediatric population separately and no such effort has been made to estimate the cost of HAI and to see the impact of HAI on hospital management. Two most important dimensions of this study were; firstly the study had been designed to be conducted among a particular section of population (paediatric patients), those constitute 40% of the total population of the country and are the most vulnerable group to be affected by HAI.[61]

Secondly in this study the cost and the impact of HAI on hospital management were especially estimated; which had never been properly highlighted in any study in our country though it is the very important area in relation with managerial point of view. One more aim of this study was to determine the extent and determinants of HAI and to look for suggestive measures for the reduction of the incidence of HAI; with a view to reduce the average length of stay of patient and thus contribute maximum utilisation of bed by highest number of patients within the same resources. Estimates of the cost and impact of HAI, if appropriately estimated, might reflect the economic benefit of preventing an infection. The information expected to be collected by the present study will help the health authority in establishing policy, the hospital managers in developing infection control program, and the medical and nursing staffs by providing with meaningful data on different aspects of HAI. This study will also be able to create awareness about HAI among the patients, care givers and community. As the proposed study is consistent with the field of my teaching profession so it would be able to play role in enriching my knowledge and enabling me dealt with the student more efficiently. The aim of this research was to provide a more comprehensive assessment of the nature, distribution and magnitude of the costs resulting from HAIs. To achieve this status a detailed exploration of the resources used by the hospital as opportunity cost and by the family as private cost had been undertaken. The results of this research could be useful to both receivers and providers of health care, in particular those involved in the planning and management of infection prevention and control programmes.

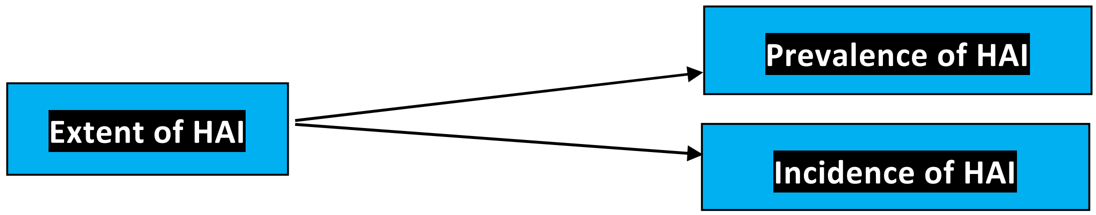
1.4 Conceptual Framework of the Study:

1.4.1 Following Factors considered as Independent Variables for occurring HAI (Dependent Variables)-

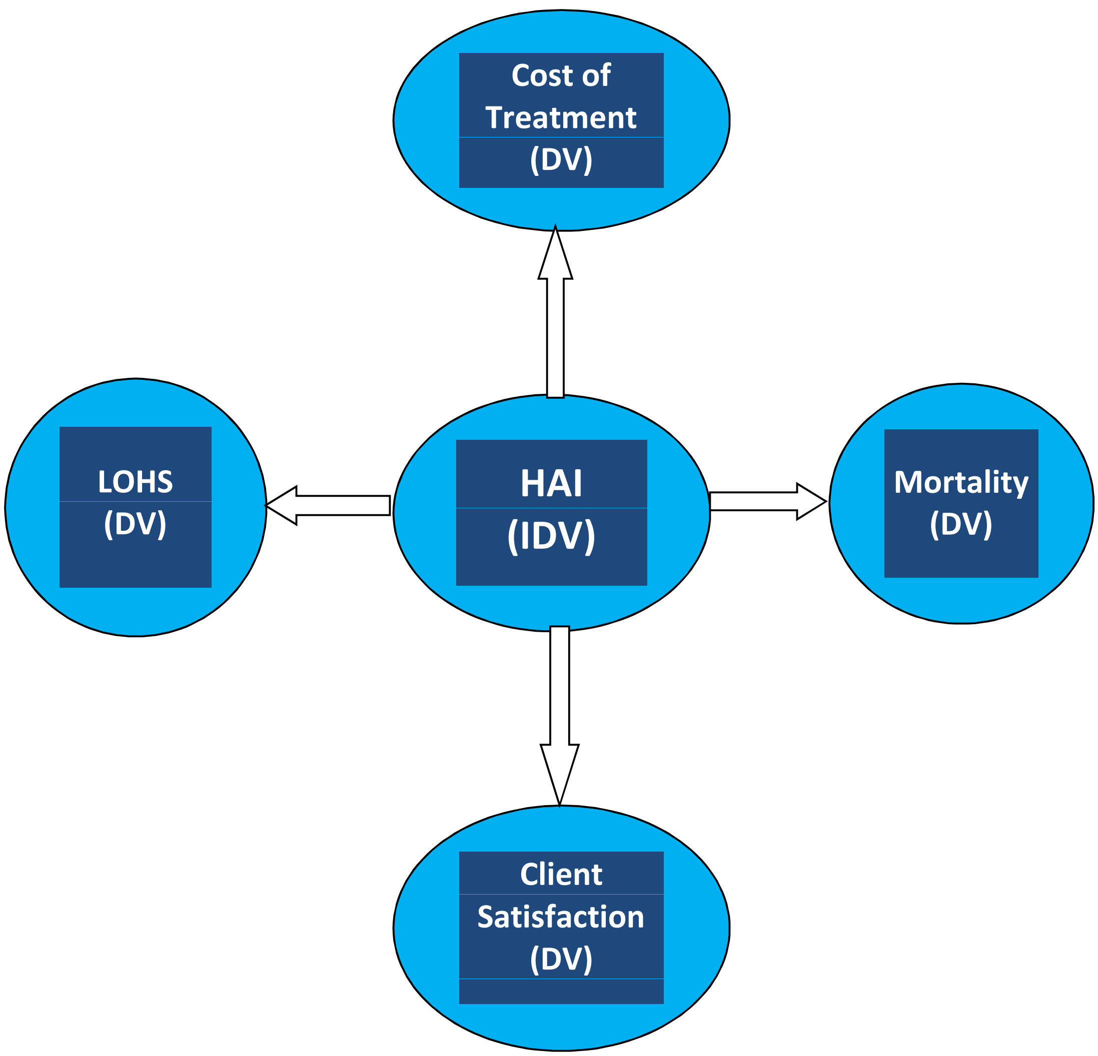


1.4.2 Extent of HAI:

The magnitude of the problem was searched for in terms of Prevalence of HAI and Incidence of HAI.



1.4.3 HAI considered as Independent Variables on the following Impacts (Dependent Variables)-



1.5 Research Questions and Hypothesis

1.5.1 Title:

Hospital Acquired Infections among the Paediatric Patients in Tertiary Level Hospitals of Dhaka City: Extent, Determinants and, Impact on Cost and Hospital Management.

1.5.2 Research questions:

I) What is the extent of hospital acquired infections in terms of prevalence and incidence among the paediatric patients in tertiary level hospitals of Dhaka city?

II) What are the factors determining the occurrence of hospital-acquired infections among the paediatric patients in tertiary level hospitals of Dhaka city?

1.5.3 Hypothesis:

I) The treatment-cost of paediatric patients with HAI is not different from that of paediatric patients without HAI.

II) There is no difference between the HAI and non-HAI paediatric patients regarding length of hospital stay, treatment outcomes in terms of mortality and level of satisfaction of the respondents.

1.6 Objective

1.6.1 General objective

To assess the extent and to find out the determining factors of hospital acquired infections (HAI) among the paediatric patients in tertiary level hospitals of Dhaka city and to estimate their impact on treatment cost and on some indicators of hospital management.

1.6.2 Specific objectives:

(i) To assess the extent of HAI in terms of prevalence and incidence among the admitted paediatric patients in tertiary level hospitals of Dhaka city.

(ii) To determine the factors involved in the occurrence of HAI.

(iii) To find out the relationship of the treatment cost with HAI

(iv) To find out the relationship of the length of hospital stay with HAI

(v) To compare the treatment out-comes (in terms of mortality) among the HAI and non- HAI paediatric patients.

(vi) To estimate the differences of satisfactions level on overall services among the attendants of HAI and non-HAI paediatric patients.

1.7 Variables

A list of variables that are expected to be explored in this study is given below in a tabulated form.

1.7.1 Extent of HAI

i) Prevalence of HAI

ii) Incidence of HAI

1.7.2 Determinants in the occurrence of HAI

1.7.2.1 Socio demographic Factors-

i) Age

ii) Sex

iii) Religion

iv) Parent's Educational

v) Parent's Occupation

vi) Parent's Smoking habit

vii) Monthly family income

viii) Family size.

ix) Location of Residence

1.7.2.2 Agent Factors-

i) Causative organisms in the occurrence of HAI

1.7.2.3 Patient's Factors-

i) Birth history

ii) Hemoglobin Level

iii) Disease on Admission

iv) Underlying Diseases
   - Leukaemia
   - Any other malignant tumour
v) Number of Visitors
vi) Number of Attendants
vii) Relationship of the patients with the Attendants
viii) Hygienic status of Attendants
ix) History of Antibiotics within last 3 months
x) History of Hospitalization within last 3 months
xi) History of surgical operation within last 3 months

1.7.2.4 Treatment Factors-

i) Major Specialty of Treatment
ii) Mode of Decision for Surgery
iii) Type of operations
iv) Therapeutic Procedure
   - Biopsies
   - Endoscopic examination
   - Catheterization
   - Intubation/Ventilation
   - Suction and
   - Surgical procedure
v) Immunosuppressive conditions
   - i.e. Burn injury
vi) Immunosuppressive therapy
   - i.e. Radiotherapy
vii) Duration of Operation
viii) Preoperative Delay for Operation

1.7.2.5 Hospital Factors-

i) Types and Ownership of Hospital

ii) Hand washing Practice of the Doctors

iii) Gloves using Practice of the Doctors

iv) Face masks using Practice of the Doctors

v) Gown wearing Practice of the Doctors

vi) Cleanliness state of Pillow Cover
   - Quality of cleaning

vii) Cleanliness state of Bed-sheet
   - Quality of cleaning

1.7.3 Impact of HAI –

1.7.3.1 Impact on Cost of Treatment

i) Private Cost

ii) Cost variation on Sites of HAI

1.7.3.2 Impact on Hospital Management Factors

i) Average Length of Stay (ALS) at Hospital for HAI patients

ii) Average Length of stay (ALS) at Hospital for non-HAI patients

iii) Treatment Outcome as Hospital Mortality

iv) Client's Satisfaction regarding the Services they have been provided with during their stay in Hospital.

1.8 Operational definition

1.8.1 Infection

It means the deposition of organisms in tissues and their growth with an associated host reaction. If the response of the host is slight or nil, this is usually termed "colonisation". Growth of organisms associated with a tissue reaction (i.e. inflammation) is usually referred to as sepsis or clinical infection.

1.8.2 Hospital Acquired Infection (HAI)

A "hospital acquired infection (HAI)" - has been defined by WHO as: "an infection acquired in hospital by a patient who was admitted for a reason other than that infection," or as "an infection occurring in a patient in a hospital or other health care facility in whom the infection was not present or incubating at the time of admission. In this study infections present at the time of admission or infections appearing within 48 hours or less will not be treated as HAI. Only the infections appearing 48 hours or more following admission will be treated as HAI. The infection acquired in the hospital but appearing after discharge and also occupational infections among staff of the facility will not be counted as HAI.

1.8.3 Extent of HAI:

The extent of HAI will be determined in terms of Prevalence and Incidence of HAI.

1.8.4 Prevalence rate of HAI

It is the number of infected patients due to HAI at the time of study as a percentage of the number of patients observed at the same time.

$$\text{Prevalence of HAI} = \frac{\text{Total no. of HAI patients during study period}}{\text{Total no. of admitted patients during study period}} \times 100$$

1.8.5 Incidence rate of HAI (in bed days):

It is the number of new HAI acquired per 1000 patient days.

$$= \frac{\text{Total no. of new HAI patients during study period}}{\text{Total beds in the wards under study X Total days in study period}} \times 1000$$

1.8.6 Determinants of of HAI

All the factors causing, influencing and facilitating the occurrence of HAI will be Incorporated as determinants of HAI in this study, which have been elaborated in details in the list of variables.

1.8.7 Total length of hospital stay for an individual patient

It consists of the total days in between the date of admission and the date of discharge (or death). If the duration covers two subsequent months, total number of days from beginning to ending is counted. How many days a month consists of (28, 29 30 or 31 days) is not taken in to consideration.

1.8.8 Average length of stay for HAI patients:

$$= \frac{\text{Total patient days used byHAI patients}}{\text{Total No. of HAI-patients}}$$

1.8.9 Average length of stay for non-HAI patients

$$= \frac{\text{Total patient days used by non-HAI patients}}{\text{Total No. of non-HAI patients}}$$

1.8.10 Extra days of hospital stay for an individual HAI-patient

It is the time period counted by total days of stay at hospital on the part of an individual HAI patient minus average length of stay (ALS) at hospital for non-HAI patients.

1.8.11 Pre-operative waiting time

It is the time period counted by days in between the date of admission and date of operation.

1.8.12 Opportunity cost:

It is the extra cost incurred by the hospital authority providing the patients with extra services due to HAI, in terms of resources such as consumable items, the time of health care professionals and the capacity of capital equipment and infrastructure. The opportunity cost had not been taken in to consideration in this study.

1.8.13 Private cost:

It is the cost incurred by the patient's family and by those who provide informal care for them. It included additional medications, travel costs and miscellaneous expenses.

1.8.14 Agent factor

Factors in relation with the agents (organisms) involved, which may influence the occurrence of HAI. It included only the types of organisms but their resistance pattern were not taken in to account in this study.

1.8.15 Host factors

Factors on the part of the individual affected the presence or absence of which actually determines the existence and severity of HAI.

1.8.16 Impact on hospital management:

Impact on hospital management was judged on the basis of some selected indicators i.e. average length of hospital stay (ALS), hospital mortality and client's satisfaction regarding the services they had been provided with during their stay at hospital. HAI is expected to decrease client's satisfaction and to increase the period of hospital stay and hospital mortality.

1.8.17 Quality of cleaning of linen:

Excellent = Very Bright + No Spot + Well-marked crease of laundering.

Good = Bright + No Spot + Less well-marked crease of laundering.

Fair = Not so bright + Spot present (<3) + Fade crease of laundering.

Poor = Dirty + Spot present (3 - 5) + No crease of laundering.

Very poor = Very dirty + Spot present (>5) + Wrinkling.

1.8.18 Grading of anemia: (As per WHO)-

Grade 0 (Normal): Male: 14-18 g/dl, Female: 12-16 g/dl

Grade 1 (Mild Anemia): 10 g/dl - cutoff point for ages

Grade 2 (Moderate Anemia): 7-10 g/dl

Grade 3 (Severe Anemia): below 7 g/dl

1.8.19 Grading of Smoking habit:

Non-Smoker: Never smoked

Irregular Smoker: Smokes but not daily

Regular Smoker: Smokes at least in a day

Chain Smoker: Smokes more than 10 occasions in a day

1.8.20 Hygienic status of the Attendants:

Un-hygienic: (presence of any three of the followings)

Dirty body clothes

Big size nails

Foul smell from cloths

Irregular tooth brushing and mouth washing

Not practiced hand washing before feeding of the patients

Hygienic: Reverse of the characteristics mentioned under 'un-hygienic'

Average: In between hygienic and un-hygienic

1.8.21 History of previous antibiotics intake:

Included:

Oral form of antibiotics irrespective of completeness of course

Oral form of antibiotics irrespective of the status of prescribers

Injectable (in any forms) antibiotics

Excluded:

Ophthalmic, dermal, aural or any other forms of antibiotics

1.8.22 History of previous Hospitalization:

Included:

Patients admitted in IPD

Excluded:

Patients attended in OPD and emergency but had not been admitted

Patients admitted day care and observation centers

1.8.23 History of previous Operation:

Included:

Major operations under G/A or spinal anesthesia

Major operations under noninvasive technology

Excluded:

Minor operations done by local anesthesia

1.9 Limitations of the study

In the journey of the study the researcher experienced the following limitations which were the obstacles to make the study more representative:

- The most important limitation of this study was that as the subjects were pediatric age group, the information could not be collected directly from the patients themselves. So, some of the information might not be the real reflection of the opinion of the study subject if he /she would be in a state of passing opinion. Opinion regarding satisfaction could be one of the best examples in this regard.
- As because only the pediatric patients were included, so the findings of the study can't be generalized for the whole population of the country. It would be better if the all sections of population by age could be brought under the study, so the findings would be more representative and generalized.
- Only the tertiary level hospitals of Dhaka city were brought under study. If the similar hospitals of different cities of the country could be brought under study the findings would be more generalized.
- The study was conducted only in tertiary level hospitals so the situation of primary and secondary level hospitals in this regard was still remaining out of sight. But it was assumed that the scenarios of those levels of hospitals might be worse because of the higher visitor load and less budgetary allocation in infection control program. So, if all those levels of hospitals could be brought under the study the findings would represent the total national scenario.
- It was difficult to collect information for those pediatric patients who were given care by other persons rather than their parents.
- In this study only the numbers of visitors were taken in to consideration but the duration of stay of the visitors could not be taken in to account. If it would

be possible to taken into consideration the impact of visitors in the occurrence of hospital acquired infection could be evaluated in a more authentic way.

- Pattern of microbial resistance to antibiotics had not been detected in this study, so one of the more important dimensions of hospital acquired infections was remain unattended.
- The satisfaction of the respondents was assessed on overall services. The full picture regarding satisfaction of the respondents would be possible to find out if it could be assessed on multiple variables and analyzed accordingly.
- In estimating cost of treatment the cost of wages lost could not be taken in to consideration. If it would be possible to estimate, the real picture in connection with extra cost of treatment in the HAI patients would be possible to explore.
- The extra opportunity cost incurred by the hospital to treat the HAI patients for additional days of stay had not also been included in this study.
- As the data were collected from hospitals simultaneously so it was not feasible for the researcher to collect data from all the study sites by himself alone. The researcher had to appoint two trained data collectors, so there might be little chance of bias regarding those information which was collected on the basis of observation (i.e. cleanliness status of bed sheets and pillow covers).
- The research was conducted as a cross sectional study, if the case control or cohort study design would be possible to adopt the relationship found significant between dependent and independent variables could be claimed as the association in a more logical way.

- Though the researcher tried label best still there might be some limitations in determining for all cases that the present infection (claimed as acquired in hospital) was present earlier, or it was really acquired in hospital.
- It was really difficult to ascertain the exact cause of death for each individual case, whether the HAI was the primary cause, or a contributing factor for the death of the patients could not be identified.
- It was also difficult to ascertain whether the difference in length of stay between the HAI and non-HAI patients was entirely due to the present infection.
- Even by giving highest attention by the researcher there might be some limitations in determining whether the increased length of hospital stay was the cause or effect of HAI.
- It could not be possible to take in to account the infections those had been developed after discharge of the patients from hospital, although some of those might had been acquired during their stay at hospitals.

2.0 Literature Review

2.1 Extent of Hospital Acquired Infections

It has been suggested that approximately one in ten patients admitted to hospital suffer from one or more HAIs at any one time. There is however variation in the prevalence rates of hospital infection for different categories of patient. Patients in intensive care beds consistently have the highest rates and rates are higher in surgical than in medical patients. Because prevalence studies record the proportion of patients with an HAI at a specific point in time, outbreaks or seasonal variation might bias the estimates upwards. The incidence of HAI is a more useful measure as it illustrates the number of patients that acquire a HAI during a defined time period such as a year and rates may be expressed as a percentage of total discharges. A study in England of surgical patients it was found the incidence of HAI to be 7.2 percent and a recent study by Plowman et al. (2001) of patients admitted to medical and surgical specialities reported an overall rate of 7.8 per cent.[62] HAI also has an impact on mortality. Applying the assumptions from a study of mortality in the US to England suggests that 5,000 deaths are directly attributable to HAI and a further 15,000 partially attributable. Care should be taken interpreting these findings as many patients might have died from other causes, regardless of HAI.[62] As per CDC's study findings, about 1.7 million healthcare-associated infections occurred in U.S. hospitals. Of these, most (1.3 million) were outside of intensive care units. These numbers can also be presented as 9.3 infections per 1,000 patient-days, or 4.5 per 100 admissions. There were an estimated 99,000 deaths associated with these infections. The body sites associated with the greatest number of deaths was the estimated 36,000 deaths from pneumonia, and 31,000 from bloodstream infections.[63] It was found in a surveillance that healthcare-associated infections per 1,000 patient-days and the number of patient-days for 3 subpopulations: newborns in well-baby nurseries, newborns in high-risk units, and adults and children in intensive care units. The rates of infections are listed by body site for the 3 subpopulation. Of these groups, adults and children in intensive care units contributed the greatest number of patient-days and had the greatest risk of healthcare-associated infection.[64] In the United States, the Centers for Disease Control and Prevention estimates that roughly 1.7 million hospital-associated infections, from all types of bacteria combined, cause or contribute to 99,000 deaths each year. In Europe, where hospital surveys have been conducted, the categories of Gram-negative infections are estimated to account for two-thirds of the 25,000 deaths each year. Nosocomial infections can cause severe pneumonia and infections of the urinary tract, bloodstream and other parts of the body. Many types are difficult to attack with antibiotics, and antibiotic resistance is spreading to Gram-negative bacteria that can infect people outside the hospital.[65] The hospital acquired infections are the major issue of headache not only for developing countries but also as well for developed countries. The scenarios of some of the developed countries are given below: United States: estimates that roughly 1.7 million hospital-associated infections, from all types of bacteria combined, cause or contribute to 99,000 deaths each year.[65] Other estimates indicate that 10%, or 2 million, patients a year become infected, with the annual cost ranging from $4.5 billion to $11 billion. France: estimates ranged from 6.7% in 1990 to 7.4% (patients may have several infections). At national level, prevalence among patients in health care facilities was 6.7% in 1996, 5.9% in 2001 and 5.0% in 2006. The rates for nosocomial infections were 7.6% in 1996, 6.4% in 2001 and 5.4% in 2006. In 2006, the most common infection sites were urinary tract infection (30,3 %), pneumopathy (14,7 %), infections of surgery site (14,2 %). infections of the skin and mucous membrane (10,2 %), other respiratory infections (6,8%) and bacterial infections / blood poisoning (6,4 %). The rates among adult patients in intensive care were 13,5% in 2004, 14,6% in 2005, 14,1% in 2006 and 14.4% in 2007. It has also been estimated that nosocomial infections make patients stay in the hospital 4-5 additional days. Around 2004-2005, about 9,000 people died each year with a nosocomial infection, of which about 4,200 would have survived without this infection.[66] Italy: since 2000, estimates show that about 6.7 % infection rate, i.e. between 450,000 and 700,000 patients, which caused between 4,500 and 7,000 deaths. A survey in Lombardy gave a rate of 4.9% of patients in 2000.[67] United Kingdom: estimates of 10% infection rate, with 8.2% estimated in 2006.[68] Switzerland: estimates range between 2 and 14%. A national survey gave a rate of 7.2% in 2004.[69] Finland: estimated at 8.5% of patients in 2005.[70] Healthcare-associated infections (HAIs) exact a significant toll on human life. They are among the leading causes of preventable death in the United States. In hospitals, they are a significant cause of morbidity and mortality. In addition to the substantial human suffering caused by healthcare-associated infections, the financial burden attributable to the infections is staggering. It is estimated that healthcare-associated infections cause $28 to $33 billion in excess healthcare costs each year. For these reasons, the prevention and reduction of healthcare-associated infections is a top priority for the U.S. Department of Health and Human Services (HHS). The HHS Steering Committee for the Prevention of Healthcare-Associated Infections was established in July 2008. The Steering Committee was charged with developing a comprehensive strategy to prevent and reduce healthcare-associated infections and issuing a plan which establishes national goals for healthcare-associated infection prevention and outlines key actions for achieving identified short- and long-term objectives. The plan is also intended to enhance collaboration with external stakeholders to strengthen coordination and impact of national efforts.[70] The actual scenarios of our country regarding HAI is really un known because no country-wide survey has yet not been conducted. Though some of the researches conducted by the MPhil and MPH students, but most of those were conducted on adult and post operative patients. So the prime attention in this research had been given to the paediatric patients who are one of the most vulnerable groups in the society in respect to any sorts of infections because of their inadequate immunity.

2.1.1 Global Trends of HAI in the last 25 years:

Over the past 25 years, the CDC'S National Nosocomial Infections Surveillance (NNIS) system has received monthly reports of nosocomial infections from a nonrandom sampling of more than 270 hospitals in the United States. The have found that the nosocomial infection rate has remained remarkably stable with approximately 5 to 6 hospital acquired infections for every 100 admissions. However, the end rate of nosocomial infections per 1,000 patient days has actually increased from 7.2 in 1975 to 9.8 in 1995, a 36% growth. As of 1995, nosocomial infections cost $4.5 billion and have contributed to more than 88,000 deaths – one death every 6 minutes. These numbers have grown with each passing year. (Weinstein, 1998).[71]

2.1.2 Calculating the Extent of HAI:

In a study on admitted TB patients' regarding calculation of nosocomial infection was done on the following parameters: cumulative incidence; incidence rate; prevalence; and occurrence rate of infection among hospitalized patients on the basis of observational studies and RCTs.

Cumulative incidence was calculated using the following formula:

Cumulative Incidence =

$$= \frac{\text{Number of new cases of infection during hospitalization or ICU stay}}{\text{Total population at risk}}$$

The total population at risk was defined as the number of adult hospitalized patients with TBI who did not have infection at the time of hospital or ICU admission in order to capture only those cases that were entirely new. Incidence rate was determined using the expression:

Incidence rate=

$$= \frac{\text{Number of new cases of infection during hospitalization or ICU stay}}{\text{Total person-time at risk}}$$

Person-time was defined as the length of hospital or ICU stay in days among adult patients with TBI. Prevalence was defined as:

Prevalence=

$$= \frac{\text{Number of existing cases of infection at a specific point in time during hospitalization or ICU stay}}{\text{Total defined population at the same point in time}}$$

The defined population was adult hospitalized patients with TBI. As it is often difficult to distinguish between truly incidents versus prevalent cases, it was estimated the occurrence rate of infection, which was calculated using the following formula:

Occurrence rate =

$$= \frac{\text{Number of cases of infection during hospitalization or ICU stay}}{\text{Total number of patients examined / enrolled in the study}}$$

The patients examined/enrolled in the study were adult hospitalized patients with TBI. The standard error and 95% confidence interval of these proportions was then determined using the Clopper-Pearson exact binomial method.[72] Though in the above mentioned study the extent of HAIs were estimated by all the possible parameters i.e. cumulative incidence; incidence rate; prevalence; and occurrence rate of infections. But all the available study in our country only the prevalence rate has been calculated. In the present study both the prevalence and incidence rate of hospital acquired infections have been taken in to consideration but the.

2.1.3 Post-discharge Infection

Over the course of a 13 month period 7.8% of patients acquired an infection during their stay in the study hospital which presented during the in-patient period. A further 19.1% of patients who did not present with an infection during the in-patient phase, reported symptoms of, and in some cases received treatment for, an infection manifesting post discharge which may be associated with their hospital admission. Patients with one or more infections incurred costs that were on average 2.8 times greater than uninfected patients, an average additional cost of £2.917 per case (ranging from £1.122 for urinary tract infections to £6.209 for blood transmission infection.[73] Post discharge infection was not taken in to consideration in this present study.

2.2 Contributing Factors of HAI

Several large studies have examined potential risk factors for nosocomial bacterial pneumonia. Although specific risk factors may differ between study populations, they can be grouped into the following general categories: 1) host factors such as extremes of age and severe underlying conditions, including immunosuppression; 2) factors, such as administration of antimicrobials, admission to the ICU, underlying chronic lung disease, or coma, that enhance colonization of the oropharypx and/or stomach by microorganisms; 3) conditions favoring aspiration or reflux, including endotracheal intubations, insertion nasogastric tube, or supine position 4) conditions requiring prolonged use of mechanical ventilatory support with potential exposure to contaminated respiratory equipment and/or contact with contaminated or colonized hands of healthcare workers; and 5) factors that impede adequate pulmonary toilet, such as surgical procedures involving the head, neck, thorax, or upper abdomen, and immobilization due to trauma or illness.[69] The major contributing factors to this outbreak seemed to be 1) inadequate environmental controls 2) a high degree of infectiousness of the source patient and 3) prolonged infectiousness due to multidrug resistant disease. The interaction of these three factors most likely produced the high level of transmission observed.[69]

2.2.1 The microbial agent

The patient is exposed to a variety of microorganisms during hospitalization. Contact between the patient and a microorganism does not by itself necessarily result in the development of clinical disease other factors influence the nature and frequency of nosocomial infections. The likelihood of exposure leading to infection depends partly on the characteristics of the microorganisms, including resistance to antimicrobial agents, intrinsic virulence, and amount (inoculum) of infective material. Many different bacteria, viruses, fungi and parasites may cause nosocomial infections. Infections may be caused by a microorganism acquired from another person in the hospital (cross-infection) or may be caused by the patient's own flora (endogenous infection). Some organisms may be acquired from an inanimate object or substances recently contaminated from another human source (environmental infection). Before the introduction of basic hygienic practices and antibiotics into medical practice, most hospital infections were due to pathogens of external origin (foodborne and airborne diseases, gas gangrene, tetanus, etc.) or were caused by microorganisms not present in the normal flora of the patients (e.g. diphtheria, tuberculosis). Progress in the antibiotic treatment of bacterial infections has considerably reduced mortality from many infectious diseases. Most infections acquired in hospital today are caused by microorganisms which are common in the general population, in whom they cause no or milder disease than among hospital patients (*Staph.aureus,* coagulase-negative staphylococci, enterococci, Enterobacteriaceae).[74]

2.2.2 Patient susceptibility

Important patient factors influencing acquisition of infection include age, immune status, underlying disease, and diagnostic and therapeutic interventions. The extremes of life –infancy and old age are as sociated with a decreased resistance to infection. Patients with chronic disease such as malignant tumours, leukaemia, diabetes mellitus, renal failure, or the acquired immunodeficiency syndrome (AIDS) have an increased susceptibility to infections with opportunistic pathogens. The latter are infections with organism(s) that are normally innocuous, e.g. part of the normal bacterial flora in the human, but may become pathogenic when the body's immunological defences are compromised. Immunosuppressive drugs or irradiation may lower resistance to infection. Injuries to skin or mucous membranes bypass natural defence mechanisms. Malnutrition is also a risk Many modern diagnostic and therapeutic procedures, such as biopsies, endoscopic examinations, catheterization, intubation/ventilation and suction and surgical procedures increase the risk of infection. Contaminated objects or substances may be introduced directly into tissues or normally sterile sites such as the urinary tract and the lower respiratory tract.[69]

2.2.3 Hospital Environmental factors

Health care settings are an environment where both infected persons and persons at increased risk of infection congregate. Patients with infections or carriers of pathogenic microorganisms admitted to hospital are potential sources of infection for patients and staff. Patients who become infected in the hospital are a further source of infection. Crowded conditions within the hospitals frequent transfers of patients from one unit to another and concentration patients highly susceptible to infection in one area (e.g. newborn infants, burn patients, intensive care) all contribute to the development o nossocomial infections. Microbial flora may contaminate objects, devices, and materials which subsequently contact susceptible body sites of patients. In addition, new infections associated with bacteria such as waterborne bacteria (atypical mycobacterial) and/or viruses and parasites continue to be identified.[75] Ward cleaning is important to ensure that proper hygiene practices are being followed and that they are working as intended. Poor hygienic practice and improper cleanliness of the ward may invite the infections, which may endanger the life of the admitted patients. Hand washing is another crucially important agenda which is regarded by many as one of the most effective preventative measures against hospital acquired infection. Poor and inadequate hand washing practice may contribute in increasing the prevalence and incidence of hospital acquired infections.

2.2.4 Bacterial resistance

Antibiotics have been used successfully for more than 50 years to control, and in many instances overcome bacterial infections. While antibiotics have proved useful in the treatment of infection, their use has led to the emergence of highly resistant strains of bacteria. These drug resistant infections are commonest in hospitals where high levels of antibiotic usage allow organisms to evolve, and the close concentration of people with increased susceptibility to infection allows the organisms to spread. Many patients receive antimicrobial drugs. Through selection and exchange of genetic resistance elements, antibiotics promote the emergence of multidrug resistant strains of bacteria, microorganisms in the normal human flora sensitive to the given drug are suppressed, while resistant strains persist and may become endemic in the hospital. The widespread use of antimicrobials for therapy or prophylaxis (including topical) is the major determinant of resistance. Antimicrobial agents are, in some cases, becoming less effective because of resistance. As an antimicrobial agent becomes widely used, bacteria resistant to this drug eventually emerge and may spread in the health care setting. Many strains of pneumococci, staphylococci, enterococci, and tuberculosis are currently resistant to most or all antimicrobials which were once effective. Multi resistant Klebsiella and Pseudomouns arruginosa are prevalent in many hospitals. This problem is particularly critical in developing countries where more expensive second-line antibiotics may not be available or affordable. Nosocomial infections are widespread. They are important contributors to morbidity and mortality. They will become even more important as a public health problem with increasing economic and human impact because of: increasing numbers and crowding of people; more frequent, impaired immunity (age, illness, and treatments); now microorganisms; increasing bacterial resistance to antibiotics.[76] Healthcare-associated infections are infections that patients acquire while receiving treatment for medical or surgical conditions. HAIs occur in all settings of care, including acute care within hospitals and same day surgical centers, ambulatory outpatient care in healthcare clinics, and in long-term care facilities, such as nursing homes and rehabilitation facilities. HAIs are associated with a variety of causes, including (but not limited to) the use of medical devices, such as catheters and ventilators, complications following a surgical procedure, transmission between patients and healthcare workers, or the result of antibiotic overuse. Four categories of infections account for approximately three quarters of HAIs in the acute care hospital setting: (i) Surgical site infections; (ii) Central line-associated bloodstream infections; (iii)

Ventilator-associated pneumonia, and; (iv) Catheter-associated urinary tract infections. In addition, infections associated with Clostridium defficile and Methicillin-resistant Staphylococcus aureus (MRSA) also contribute significantly to the overall problem. The frequency of HAIs varies by location. Currently, urinary tract infections comprise the highest percentage (34%) of HAIs followed by surgical site infections (17%), bloodstream infections (14%), and pneumonia (13%). In addition to the substantial human suffering exacted by HAIs the financial burden attributable to these infections is staggering.[76]

2.3 Types of HAI

2.3.1 Surgical wound infections

Surgical wound infections occur in up to 10% of patients. Clean surgery, with the incidence varying with complexity of surgery, intrinsic patient risk and surgical skills. Most surgical wound infections result from contamination of the surgical wound with the patient’s own flora or that of operating room personnel or environment at the time of the surgery, Postperative haematogenous seeding of the wound size is uncommon. Infection may present clinically during hospitalization. However, the current trend to shorter postoperative stays and day surgery result in more than 50% of surgical wound infections becoming apparent after discharge rom hospital (case report, Box 3). Clinical infection may occur up to four weeks after deep surgery (eg, CABG) and up to 12 months after surgery involving an implanted prosthesis (eg, joint replacement).

The common clinical features of surgical wound infection are localized pain, fever, redness and discharge.[77]

2.3.1.1 Strategies that may decrease the risk of surgical wound infection include:

- Different choice of antibiotic (ie, vancomycin rather that the standard choice of a cephalosporin, if MRSA colonization was known preoperatively for example from history);
- Higher than standard antibiotic dose consistent with the patient’s obesity;

- Optimal preoperative timing of prophylactic antibiotic to provide adequate tissue levels by the time of surgery;
- Reduction of personal risk factors for infection (eg. Optimal pre and postoperative control of diabetes. Preoperative weight loss and cessation of smoking); and
- Perioperative mupirocin to eliminate nasal carriage of staphylococci (sometimes used in high-risk patients and in units with high rates of wound infection).

2.3.2 Pneumonia-

is the second most common nosocomial infection in the United States and is associated with substantial morbidity and mortality. Most patients with nosocomial pneumonia are those with extremes of age, severe underlying disease, immunosuppression, depressed sensorium, and cardio-pulmonary disease, and those who have had thoraco-abdominal surgery. Although patients with mechanically assisted ventilation do not comprise a major proportion of patients with nosocomial pneumonia, they have the highest risk of developing. Most bacterial nosocomial pneumonias occur by aspiration of bacteria colonizing the oropharynx or upper gastrointestinal tract of the patient intubation and mechanical ventilation greatly increase the risk of nosocomial bacterial pneumonia because they alter first-line patient defenses. Pneumonias due to *Legionella* Aspergillus, and influenza virus are often caused by inhalation of contaminated aerosols. Respiratory syncytial virus (RSV) infection usually follows viral inoculation of the conjunctivae or nasal mucosa by contaminated hands. Traditional preventive measures for nosocomial pneumonia include decreasing aspiration by the patient, preventing cross-contamination or colonization via hands of personnel, appropriate disinfection or sterilization of respiratory therapy devices, use of available vaccines to protect against particular infections, and education of hospital staff and patients. New measures under investigation involve reducing oro-pharyngeal and gastric colonization by pathogenic microorganisms. NNIS reports that pneumonias (diagnosed on the basis of the CDC surveillance definition of nosocomial pneumonia) account for approximately 15% of all hospital-associated infections and are the second most common nosocomial infections after those of the urinary tract. In 1984, the overall incidence of lower respiratory tract infection was 6 per 1000 discharged patients. The incidence per 1,000 discharged patients ranged from 4.2 in non-teaching hospitals to 7.7 in university affiliated hospitals, probably reflecting institutional differences in the level of patients' risk for acquiring nosocomial pneumonia. Nosocomial bacterial pneumonia often has been identified as a postoperative infection. In the study of the Efficacy of Nosocomial Infection Control in the 1970s, 75% of reported cases of nosocomial bacterial pneumonia occurred in patients who had a surgical operation; the risk was 38 times greater for thoraco-abdominal procedures than for those involving other body sites. More recent epidemiologic studies, including NNIS studies, have identified other subsets of patients at high risk of developing nosocomial bacterial pneumonia: patients with endotracheal intubation and / or mechanically assisted ventilation, depressed level of consciousness (particularly those with closed head injury), prior episode of a large-volume aspiration, or underlying chronic lung disease, and patient > 70 years of age. Other risk factors include 24 hour ventilator – circuit changes, fall-winter season, stress bleeding prophylaxis with cimetidine with or without antacid, administration of antimicrobials, presence of a nasogastric tube, severe trauma, and recent bronchoscopy. Recently, NNIS stratified the incidence density of nosocomial pneumonia by patients' use of mechanical ventilator and type of intensive care unit (ICU). From 1980 to 1990, the median rate of ventilator associated pneumonia per 1,000 ventilator days ranged from 4.7 in pediatric ICUs to 34.4 in burn ICUs. In contrast, the median rate of non-ventilator associated pneumonia per 1000 ICU days ranged from 0 in pediatric and respiratory ICUs to 32.2 in trauma ICUs. Nosocomial pneumonia has been associated with high fatality rates. Crude mortality rates of 20%-50% and attributable mortality rates of 30%-33% have been reported; in one study, pneumonia comprised 60% of all deaths due to nosocomial infections. Patients receiving mechanically assisted ventilation have higher mortality rates than do patients not receiving ventilation support; however, other factors such as a patient's underlying diseases(s) and organ failure, are stronger predicators of death in patients with pneumonia. Analyses of pneumonia-associated morbidity have shown that pneumonia could prolong hospitalizations by 4-9 days. A conservative estimate of the direct cost of excess hospital stay due to pneumonia is 612 billion a year for the nation. Because of its reported frequency associated high fatality rate, and attendant costs, nosocomial pneumonia is a major infections control problem. [77] On the basis of sites of infection the HAI has been classified in to following types irrespective of the involved causative organisms and influence of risk factors.[38-45] Urinary tract infection: It covers approximately 40% of all HAI. This is the most common nosocomial infection; 80% of these infections are associated with the use of an indwelling catheter. Surgical site infection: The incidence varies from 0.5 to 15% depending on the type of operation, underlying disease and patient's status. Manifestation after 7 days is considered to be due to infection in ward. Infection acquired in the operation theatre may be superficial or deep-seated while infection in the ward is usually superficial in nature. Respiratory tract infection: These infections (about 10% of all HAI) occur in several patients groups, especially those patients on ventilators in intensive care units, where the rate of pneumonia is 3% per day. In one study pneumonia was found to be responsible for 60% of all deaths due to nosocomial infections. Bacteraemia: It covers only a small proportion of nosocomial infections (approximately 5%) but case fatality rates are high - more than 50% for some microorganisms. Infection may occur at the skin entry site of the intra-vascular device, or in the subcutaneous path of the catheter (Tunnel infection). Others: There are some other types of an infection, which are sometimes found to be acquired in hospitals and usually cover approximately 20-25% of all HAI. Infections in this category are skin and soft tissue infection; gastro-enteritis; sinusitis; conjunctivitis endometriosis and nosocomial hepatitis.[77] Regarding types of HAI the views of the researcher was to find out the actual proportion of different types in our country situation especially among the paediatric patients in tertiary level hospitals. Because the previous studies of this country were conducted mainly on the post-operative hospital acquired infections, though some of the studies revealed out the proportion of different types of HAIs but those were on the adult patients not on the paediatric patients.

2.4 Causative organisms involved in HAI

The organisms that cause hospital –acquired infections usually originate from the patient's own microbial flora, which may be altered by the addition of hospital-based organisms. The causative organisms cover a spectrum, with the relative importance of individual species varying over time, between units and hospitals, and between countries. The infecting organisms vary among different patient populations, different health care settings, different facilities and different countries. The following organisms have been found to be involved in different studies.[78]

2.4.1 Bacteria:

These are the most common nosocomial pathogens which can be classified mainly in to two groups (Commensal and pathogenic):

2.4.1.1 Commensal bacteria:

Found in normal flora of healthy humans. They have a significant protective role by preventing colonisation of pathogenic microorganisms. Some Commensal bacteria may cause infection if the natural host is compromised.

2.4.1.2 Pathogenic bacteria:

Have greater virulence, and cause infections (sporadic or epidemic) regardless of host status. The common pathogenic bacteria are: Clostridium (mainly responsible for gasgangrene); Staphylococcus aureus; Beta-haemolytic streptococci; Proteus; Klebsiella; Enterobacter; Serratia marcescens, Pseudomonas and Legionella species may cause pneumonia.

2.4.1.3 Multi-resistant bacteria:

The common hospital pathogens are methicillin-resistant Staphylococcus aureus, antibiotic resistant gram-negative bacilli and, more recently, vancomycin-resistant enterocci.[78] In 1986, more than 50% of the nosocomial strains of Staphylococcus aureus isolated from patients from university hospitals in the city of Sao Paulo were methicillin resistant. By 1990, the rate of Methicillin Resistant Staph Aureus (MRSA) in six Brazilian hospitals ranged from 38% to 78%, leading to a significant increase in vancomycin use. In 1993 the rate of MRSA at the Children's Hospital of the University of Sao Paulo School of Medicine was 79% and 47% of the strains also were quinolone resistant. Likewise, a great increase in multi-resistant gram-negative bacteria has been observed. Seventy percent of Enterobacter and 65% of Klebsiella isolates were resistant to third generation cephalosporin. The increasing prevalence of imipenem-resistant Pseudomonas aeruginosa (28%) has led to increased use of colistin (polymixin E) in this setting. Acinetobacter calcoaceticus accounted for 64 (6.5%) of 1991 positive blood cultures in 1993 at the Hospital do Servidor Publico Estadual de Sao Paulo, a 500 bed teaching hospital in the city of Sao Paulo. It was the third most common cause of nosocomial bloodstream infection; coagulase negative staphylococci (25.8%) and S aureus (23%) were the two most common. The cause of the widespread occurrence of multi-resistant bacteria is not well known, but it probably is multifactorial and occurs not only in hospitals but in the community as well. In the city of Belem, in the northern state of Para, a study regarding the resistance pattern of 343 isolates of Shigella species from 4,508 stool cultures collected from 1980 to 1990 has shown that 92.4% of them were resistant to sulfonamides, 91.8% to tetracycline, 53.3% to trimethoprim sulfa, and 33.2% to ampicillin. In Brazil antibiotics are sold over the counter in drugstores without any kind of regulation, obviously contributing to the dissemination of resistant bacteria in the community. Another possible cause is the great number of pharmaceutical preparations containing more than one antibiotic that are licensed in Brazil. There are 186, one antibiotic, and 143 (76.9%) of these do not have any scientific basis for their use. This number contrasts with only 22 combinations licensed for human use in the United States, all of them scientifically justifiable. As for nosocomial multi-resistant bacteria poor antimicrobial practices are believed to be a very important factor for their high prevalence in Brazilian hospitals.[78]

2.4.2 Viruses:

A study showed that viruses accounted for 12% of all nosocomial infections. Possible viruses causing nosocomial infection are hepatitis- C virus, respiratory syncytial virus (RSV), rotavirus and enterovirus. Other viruses are cytomegalovirus, HIV, Ebola, influenza virus, herpes simplex virus and vericella zoster virus.

2.4.3 Parasites and Fungi:

Some parasites (e.g. giardialamblia) are transmitted easily among adults or children. Many fungi and other parasites (Candida albicans, Aspcrgillus spp, cryptococcusneoformans, cryptosporidium, etc.) are opportunistic organisms and cause infections during extended antibiotic treatment and severe immunosuppression.[78]

2.4.4 Role of different types of pathogens:

Viruses are the leading aetiologies of nosocomial infections, especially the viral respiratory infections (rotavirus infections in winter, or enterovirus infections in the summer). Bacterial and fungal infections are less common. However they are significantly associated with more morbidity and mortality. Most patients who are infected with nosocomial bacterial and fungal pathogens have a predisposition caused by invasive supportive measures such as intubation and the placement of intravascular lines and urinary catheters. Fungal infections more likely to arise from the patient’s own flora; occasionally, they are caused by contaminated solutions (eg, those used in parenteral nutrition).

2.5 Sources and transmission of HAI:

Organisms responsible for occurring nosocomial infections can be acquired from many sources, and in a several ways they can be transmitted to the affected individual. The sources or reservoirs and the mechanism of transmission can be summarised in the following way.[79]

2.5.1 Endogenous source:

(When source is within patient's own body)- The Commensal flora resides in patient's mouth, gastrointestinal tract, vagina and skin, and causes infection only in immunocompromised situation. Common causes are: transmission of the organisms to sites outside the natural habitat, damage to the tissue, inappropriate antibiotic therapy, abdominal surgery (causing surgical site infection) and catheterization (causing UTI).

2.5.2 Exogenous sources:

(When organisms come from other patients, visitors and hospital staffs)-
They are transmitted in a variety of ways: direct contact between patients (hands, saliva droplets or other body fluids); via hospital staff contaminated through patient care (hands, clothes, nose and throat) who become permanent or transient carriers, subsequently transmitting bacteria to other patients by direct contact during care; air-borne transmission (by droplets or contaminated dust), in a national surveillance in USA air borne spread accounted for 10%-20% of all endemic nosocomial infections; via contaminated objects (i.e. equipment.)

2.5.3 Environmental source:

2.5.3.1 Internal environment

(Within the hospital)- comprises of water damp areas; items such as linen, equipment and supplies used in care; food; fine dust and droplet nuclei generated by coughing or speaking; infective aerosols; ventilation and air conditioning system.

2.5.3.2 External environment:

(Outside the hospital)- Comprises of soil; Water (e.g. cooling towers); decaying organic materials and dust from construction or renovation etc.

2.5.3.3 Airborne transmission:

At International Conference on Nosocomial Infection, held at the Centers for Disease Control (CDC), Brachman reviewed the topic and concluded that although airborne spread certainly accounted for some nosocomial infections, the exact, size of the piece was unknown. He estimated, based largely on data available from the then-infant National Nosocomial Infections Surveillance Study, that airborne spread accounted for 10% to 20% of all *endemic* nosocomial infections. In a 1980 review of airborne contagion, sponsored by the new York Academy of Sciences Kundsin concluded, based largely on studies carried out at the Peter Bent Brigham hospital during the previous 20 years that airborne spread in the operating theater accounted for 20% to 24% of all postoperative wound infections. Others doubted that the proportion was that high and were skeptical of the importance of absolute levels of bacteria in operating room air, although instances of staphylococcal transmission from a surgeon to patients in the operating room had been documented thoroughly. The Cooperative Ultra-violet Light Study, although it did not show a dramatic effect of UV light in reducing rates of postoperative wound infection, did not evaluate directly possible routes of transmission of bacteria causing postoperative wound infection. In a thoughtful review, Ayliffe cited an unpublished study carried out in Birmingham, England, in which the postoperative wound infection rate in an unventilated postoperative wound infection rate in an unventilated operating suite during the year preceding installation of a ventilation system was 8.8%; in the year following installation of a plenum ventilation system with 20 air changes per hour, the infection rate was 12.6%! Furthermore, there was a 50% reduction in airborne bacterial counts after the ventilation system was installed in this admittedly uncontrolled study. He cited evidence that most wound infections are acquired in the operating room from the patient’s own microbial flora, the balance being acquired mainly from staff present in the operating room during surgery. Since air is an important source of infection involving insertion of prostheses of various kinds, the use of ultra clean air and exhaust-ventilated clothing frequently is recommended. The value of this technology in other kinds of surgical procedures, however, is doubtful. It appears likely today that Brachman was not far off in his 1970 estimate, and a more recent estimate of the relative incidence of airborne infections is about 10% of the whole of endemic nosocomial infection. Epidemic nosocomial infections must be considered, as well. The CDC studies carried out during the early 1970s suggested that outbreaks of nosocomial infection in seven hospitals participating in an intensive surveillance study represented only about 2% of all patients with nosocomial, infection. Wenzel et al. estimated that outbreaks accounted for 3.7% of nosocomial infections in a large university tertiary care referral center. Among nosocomial outbreaks investigated by the CDC from 1986 from 1986 to 1990, more than 67% were related to product, procedures, or devices. Thus, airborne outbreaks of nosocomial infection have not been prominent, at least on a simple statistical basis.[79]

2.6 Diagnosis of HAI:

An infection is suspected any time a hospitalized patient develops a fever that cannot be explained by a known illness. Some patients, especially the elderly, may not develop a fever. In these patients, the first signs of infection may be rapid breating or mental confusion.

2.6.1 Diagnosis of a hospital-acquired infection is based on:

a) Symptoms and signs of infection
b) Examination of wounds and catheter entry sites
c) Review of procedures that might have led to infection
d) Laboratory test results.

- A complete **physical examination** is conducted in order to locate symptoms and signs of infection. Wounds and the skin where catheters have been placed are examined for redness, swelling, or the presence of pus or an **abscess**. The physician reviews the patient's record of procedures performed in the hospital to determine if any posed a risk for infection.

- Laboratory tests are done to look for signs of infection. A complete blood count can reveal if the white blood cell count is high. White blood cells are immune system cells that increase in numbers in response to an infection. White blood cells or blood may be present in the urine when there is a UTI.
- Cultures of blood, urine, sputum, other body fluids, or tissue are done to look for infectious microorganisms. If an infection is present, it is necessary to identify the microorganism so the patient can be treated with the correct medication.[80]

2.7 Increased Cost of Treatment:

Three broad components of cost comprise the socio-economic costs of HAI: direct medical costs, the indirect costs related to productivity and non-medical costs, and intangible costs related to diminished quality of life. The vast majority of economic and cost analyses of HAI focus primarily on direct medical costs as these costs directly impact hospital finances. Given the current Diagnosis Related Group classification system does not have specific codes for HAIs, hospitals may not be able to recover the extra patient costs to treat HAIs from third party payers. Most researchers perform their analysis from the hospital perspective only to provide evidence that hospitals can see economic benefits through investment in infection control programs. However, there are other analytical perspectives that incorporate broader interpretations of the costs of HAIs, particularly in terms of the economic impacts resulting from diminished worker productivity (resulting from additional morbidity due to an HAI) or the loss of life. While such impacts affect patients, third party payers and society as a whole, there is little empirical evidence on the costs associated with these long term outcomes. Additionally, these impacts probably do not affect hospital administration and decision making. For the purposes of this report, only studies that provide evidence on the direct hospital costs associated with treating HAIs are considered. However, study populations and methods vary and include differing economic evaluation methods (cost analysis, cost-effectiveness analysis, or cost-benefit analysis), observational study designs (prospective versus retrospective, concurrent versus comparative design, matched versus unmatched analysis, selection and number of confounders used), patient populations and settings (e.g. ICU, specific disease), and cost information used (charges, adjusted charges, or micro-cost data). A recent systematic review of the economic analyses of HAIs conducted by Stone and colleagues noted that, given the differences in study methods, the published literature on the cost of HAI shows considerable variation in the cost estimates for the various sites of infection. As the purpose of this report is to provide representative cost estimates for the entire population of infected patients with any HAI, the analysis reported here considered only cost estimates from systematic reviews or studies that were based on larger, hospital-wide study populations that captured more of the potential variation in hospital costs in patients with a HAI.[81] The costs of HAI are distributed between many different agents. As these infections cause the patient to spend longer in hospital, resources such as consumable items, the time of health care professionals and the capacity of capital equipment and infrastructure are used to provide the appropriate care. A patient with a hospital infection might occupy a bed for three days longer than normal during which time nursing and medical staff might administer antibiotics and care for the patient. As these resources could have been used for the care of alternative patients an opportunity cost is incurred. Following discharge patients who suffered a hospital infection might consult primary and community care services, such as general practitioners or district nurses more frequently. An opportunity cost would arise because had the infection not occurred then primary and community care resources would have been available for alternative uses. In addition to the opportunity costs incurred by the health sector there might be private costs incurred by the patient and those who provide informal care for them. These costs could be financial, such as additional medications, travel costs or child care costs, or they could be non-financial, such as physical pain and emotional stress. Finally, if the infection delays patients or informal careers access to their usual activities, be they paid or un-paid, then productivity losses could accrue. Still little is known about the costs incurred by the primary health care sector, community care services, individual patients and their family and friends.[81]

2.7.1 Opportunity costs to health services;

2.7.1.1 Hospital services-

Inpatient stays (inpatient days, investigations, treatments)

Outpatient consultations (consultations, investigations, treatment)

2.7.1.2 Primary care services-

General Practitioner (consultations, investigations, treatment)

District nursing and other (nursing care, investigations, treatments)

2.7.2 Private costs to patients and informal care givers;

Out of pocket expenditures (travel, medicines, and miscellaneous expenses)

Other consequences (death, anxiety, pain/discomfort)

2.7.3 Other costs to society:

2.7.3.1 Production losses due to morbidity and caring activities-

To provide a comprehensive picture of the burden of HAI all costs should be considered. Researchers working in the area of HAI rarely include costs that fall outside the hospital sector. Haley argues this is because researchers perceive hospital administrators as the group to be convinced that scarce hospital resources are being unnecessarily employed by HAI. The importance of including costs that fall on health services other than the in-patient sector, and so representing the true economic cost of hospital infection, is rarely acknowledged. The simplest approach to estimating the cost of HAI is to identify patients with HAI and estimate by how many days their hospital stay is prolonged. Haley suggests such estimates are used to create political urgency and raise awareness of the problem rather than provide accurate estimates of the additional resources employed. Two more sophisticated approaches are the concurrent and comparative methods. The concurrent method requires professionally qualified staff to estimate the additional resources that should be attributed to HAI. For example, Wakefield et al. used specially trained staff who worked to carefully prepared protocols that assessed each day of the patient's hospital stay according to whether it was: attributable to the reason for admission; jointly attributable to the reason for admission and the HAI; or attributable to the HAI alone. The comparative method requires that data are collected on resources used by patients with and without infection and the level of resource use is compared between the two groups. As these patient groups may have quite different characteristics, which might impact on resource use, infected patients are matched with uninfected controls on key characteristics such as sex, age, diagnosis, treatment procedures and co-morbidities. This requires a large sample of controls and there may well be bias from omitting patients for whom no mathc can be found (Haley, 1991). In order to minimise this bias Hyryla and Sintonen (1994) and Plowman et al. (2001) adopted an approach that analysed a prospective cohort of patients admitted to hospital. The infection status and costs of each patient were used in regression models, alongside a number of control variables, to identify the marginal effect of HAI on cost outcome. This statistical approach is a more rigorous method for matching in which all patients are included and has the added advantage of providing confidence intervals around the estimates of additional cost due to HAI. Quite apart from the difficulties in identifying the pure effect of HAI on costs there are issues over how the baseline patient costs should be estimated. The most common approach is to use the same cost for each day of the hospital stay. This method assumes that all bed days attract equal resource use regardless of the diagnosis, age, speciality or infection status of the patient. The only way to discriminate between the cost of patients is by their length of stay, which might conceal the real pattern of resource use. The most rigorous approach, known as *micro-costing,* was recommended by Haley (1991) who suggested that data are collected on all the components of care supplied to the patient and cost estimates are derived in conjunction with the individuals who supply the components of care. A recent study (Plowman et al., 1999) used micro-costing to determine the cost of resources used by patients during their hospital stay. Data were collected on all the resources used by patients, including information or (1) all investigations the patient received such as x-ray, laboratory tests, endoscopies or cardiac tests (2) all medical and surgical procedures such as surgical interventions, insertion of intra-vascular catheters, insertion of urinary catheters (3) all drugs and infusions administered; and (4) all care administered by nursing staff and other health care professional. The economic cost of using these resources was estimated and attributed to the patients. The economic cost of using part of the capacity of the hospital overheads, management function and capital assets were also assessed and attributed to patients. All the methods used were derived from economic theory with the aim of reflecting the opportunity cost of using hospital resources.[82] In this study only the private cost has been taken into consideration in connection with the treatment of paediatric patients for the extra days due to appearance of hospital acquired infections which were yet not been addressed in our country especially in tertiary level hospitals.

2.7.4 Heads of expenditure for the costs of hospital-acquired infections:

Hospital overheads, capital charges and the cost of man-agement time accounted for 33% of the additional costs incurred, while nursing care accounted for 42% medical care 6%, operations and consumables 6%, paramedics and specialist nurses 4%, antimicrobials 2%, other drugs 3%, microbiology tests 1%, and other tests and investigations 3%.[83]

2.7.5 Costs due to Multiple HAI:

Patients who acquired more than one HAI incurred the highest expenses, with costs, on average, 6.6 times greater than those incurred by uninfected patients. In these patients, this is equivalent to an additional £1952 per patient.[83]

2.7.6 Economics of preventing hospital-acquired infections:

The underlying concepts and mechanisms are rarely made explicit but should be understood for research and policy-making. Graves N defined the key economic concepts and specify an illustrative model that uses hypothetical data to identify how two related questions might be addressed: i) how much should be invested for infection control, and ii) what are the most appropriate infection-control programs? They aimed to make explicit the economics of preventing hospital-acquired infections. Approximately 1 in 10 hospitalized patients acquired an infection after admission, resulting in substantial economic cost. The primary cost is that patients with hospital-acquired infections had their stay prolonged, during which time they occupy scarce bed-days and require additional diagnostic and therapeutic interventions. Estimates of the cost of these infections, in 2002 prices, suggest that the annual economic burden is $6.7 billion per year in the United States and £1.06 billion (approximately $1.7 billion) in the United Kingdom. The economic rationale for preventing hospital-acquired infections has been discussed and summarized as follows: hospital-acquired infections take up scarce health sector resources by prolonging patients' hospital stay; effective infection-control strategies release these resources for alternative uses. If these resources have a value in an alternative use, then the infection control programs can be credited with generating cost savings; these infection control programs are costly themselves, so the expense of infection control should be compared to the savings. For many hospital infections, the costs of prevention are likely to be lower than the value of the resources released, even when costs "are estimated liberally and the benefits presented conservatively". Under these circumstances, infection control should be pursued, since more stands to be gained than lost. They attempted to make explicit the concepts on which these arguments rely and, in particular, concentrate on providing a framework for answering two questions: (i) how much in total should we invest in prevention for any given infection-control situation, and (ii) how should this investment be allocated among competing infection-control strategies? [84]

2.7.7 Incremental and Marginal Analyses

Incremental and marginal analyses are concerned with changes to "cost" and "benefit" in respect to the status quo (existing hospital expenditures and their outcomes). If the existing budget for infection control is $100,000 and a new infection-control program costs $40,000, the total cost of infection control will increase to $140,000. The incremental cost of the new program is the change in total cost from $100,000 to $140,000, or $40,000. If implementing this program avoids 50 bloodstream infections, then the incremental benefits are 50 avoided infections. Marginal analysis is similar but refers to a change of just one unit, say $1 or one infection. Most infection-control programs would cause incremental changes, not pure marginal changes.[84]

2.8 Consequences of hospital acquired infections

These infections impose a burden on the secondary, tertiary and primary health-care sectors, community care services, the patients themselves and those who care for them. These burdens may be both financial and non-financial.

2.8.1 Consequences for Hospital authority:

- Added revenue from additional treatment $25,000 to $250,000
- Added profit from additional treatment $1,750 to $17,500
- Patient census goes up **five to 20 patient days**
- Added work for infectious disease doctors and lab specialists
- Slim chance of a hit on a public report in 27 states for a few procedures
- Greatly added revenue for pharmacy
- Might cause a move from a two-patient room to a private room (usually compensated)

2.8.1.1 Increased Hospital Stay:

People who develop hospital- acquired infections often require longer hospital stays. Longer stays put patients at an even higher rate for developing more complications. Hospital-acquired infections (HAIs) are at the forefront of healthcare conversation and have a direct impact on hospitals' bottom line. And no wonder- HAIs are one of the leading causes of deaths in the U.S., the fourth leading cause of death in Canada, and cost the industry billions of dollars a year. When patients enter a healthcare facility, they do so with the hope that they will leave in a healthier state than when they arrived. Tragically, that was not the case for Kim Smith, a community corrections employee in Winnipeg who went in for a routine hysterectomy and ovary removal. Within six days of the surgery, Kim's life was hanging in the balance. Staff did not adequately ensure that they disinfected Kim's stomach prior to performing the hysterectomy, which would have prevented the bacteria from entering the incision. Kim went through varying degrees of pain prior to undergoing an emergency surgery: gastrointestinal bloating and discomfort, heartburn, nausea, projectile vomiting, gas pains, self-destructive thoughts and strange purple discolouring of her feet – the sign that finally raised an alarm. When Kim went in for the emergency surgery, the doctors found that the infection had already expanded through the lining of the abdomen and abdominal muscles and a successful recovery was highly unlikely given that a bacterial infection has a 70% death rate. Kim's death was a tragedy that occurs all too frequently. While HAIs cause thousands of needless deaths across the globe, they negatively affect lives of even more people. A dedicated researcher, who built her career around quality and process improvement in hospitals, knows all too well the severity of these infections. Day in and day out, she has worked on improving quality in healthcare and never imagined that she would fall victim to an HAI in her own facility. Just one month after her hysterectomy for stage II uterine cancer, she developed a large mass of dead tissue in her abdomen, which led to MRSA. After eight months of treatments and missed work, three additional hospitalizations and two major surgeries, Ellen successfully beat the infection and is now sharing her story to bring awareness to the human tragedies that are associated with HAIs. She survived but her painful experience impacted her life in many ways and could certainly have been avoided. Not all HAIs can be prevented but they can be significantly reduced if healthcare facilities take action in precautionary measures. Knowing that germs leading to HAIs are most commonly spread on hands of healthcare workers, proper hand hygiene education and measurement of hand hygiene compliance can dramatically reduce the number of patients infected. Patients matter. They deserve the right to enter a healthcare facility and feel confident that they will indeed be better off, not worse, when they leave. Taking a small step, such as increasing hand hygiene compliance can help make a great deal of difference and provide a higher level of care while reassuring patients that they are in good-and clean-hands.[85] The extended hospital stay experienced by patients with an HAI varied with site of infection. Patients who acquired more than one infection were observed to have the greatest increase in mean length of stay. Patients with bloodstream infections had the lowest increase. However, as mentioned above, there were only four patients in this group, two of whom died while still in hospital.[85]

2.8.2 Consequences for Hospital Staff:

- Possible guilt feelings for an individual or team
- Usually don't know who caused infection
- Usually don't know which patients received an infection
- Not recorded in any performance reviews
- No change in compensation
- Major headache for infection control professionals

2.8.3 Consequences for Patients:

- Significant **chance of death**
- Significant chance of permanent **disability**
- Full emotional burden
- Full physical burden
- Full financial cost (sometimes bankruptcy)
- Highly likely loss of workdays
- Haunted by fear of recurrence
- Greatly increased chance of infection in future surgeries

Consequences are one of the few events in life that, depending on context, will produce either action or apathy. Healthcare is learning that one of the side effects of infections is an ever growing, extremely passionate family of infection victims and survivors who will no longer accept infections as an inevitable cost of treatment.[86] The impact of hospital-acquired infections is consideration the patient may need longer hospital treatment, readmission, or even further surgery, increasing time off work and use of hospital and community resources.[86]

2.8.3.1 Increase morbidity and mortality:

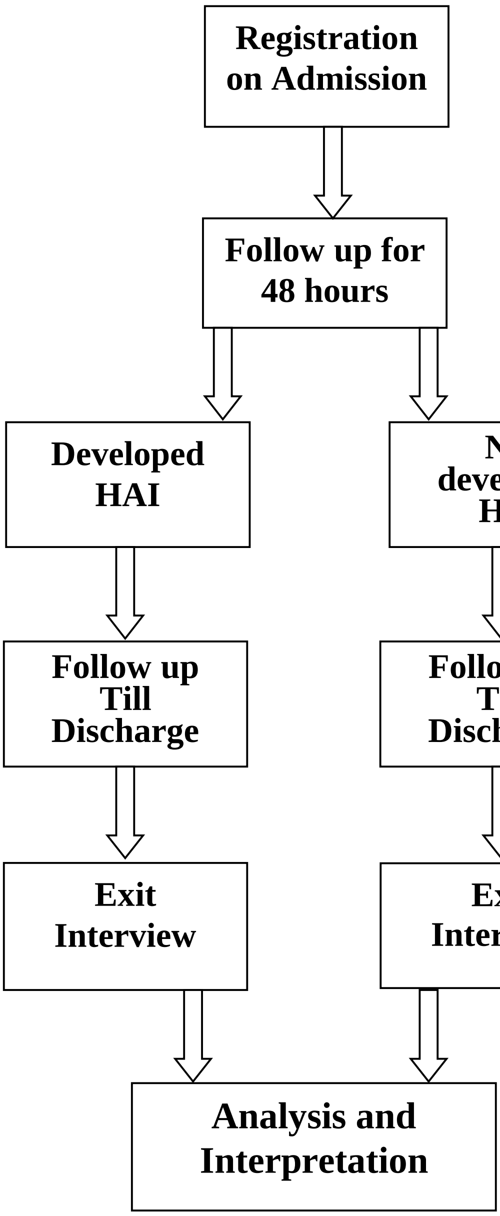
Hospital-acquired infection (HAI) results in an enormous burden of excess morbidity, mortality and cost in both adults and children. The in-patient death rate was found to be considerably higher in patients with an HAI which presented during the hospital stay: 13% of patients with a HAI died compared with 2% of patients who did not present with an HAI in hospital. After adjustment for the effects of age, sex, diagnosis, number of com-morbidities, admission specialty and admission type, patients with an HAI were found to be 7.1 (95% CI: 4.3; 11.7) times more likely to die in hospital than uninfected patient.[87]

3.0 Methodology

3.1 Materials and Methods:

3.1.1 Study Design:

The proposed study had been designed as a descriptive type of cross sectional study. **Direction of inquiry was as follows:**



3.1.2 Place of study:

The study was conducted in three purposively selected tertiary level hospitals in Dhaka City. The selected hospitals were Dhaka Medical College Hospital (DMCH), Dhaka Shishu Hospital (DSH) and Bangladesh Medical College Hospital (BMCH). In selecting these hospitals the view was that they would cover all categories (in terms of governance and ownership) of tertiary hospitals (i.e. purely non-profit based Govt. hospital, Govt. aided limited profit based private hospital and purely profit based private hospital) so that the study would be representative for all categories of tertiary level hospitals of Dhaka City.

DMCH was the largest tertiary level public hospital in the country and is treated as the academic hospital of Dhaka Medical College. It was established in 1946 as a treatment centre for the British army and hosted in a building, which was constructed as the secretariat of the then East Bengal Government. Initially the bed strength was 500, by 1960, which was raised to 700. At the time of survey the sanctioned bed strength was 1400, although there were 600 beds in addition. Out of them the sanctioned bed for paediatric medicine and for paediatric surgery are 55 and 10 respectively, although the number of patients staying in the wards was almost always double to the number of allotted beds. As the paediatric patients are the target group of this study, so in DMCH only the wards for paediatric patients (Both paediatric medicine and paediatric surgery wards) were brought under study.

DSH was the only full-fledged child hospital in our country. This limited profit based private hospital is governed by a trustee board with its own income, though there is provision of receiving govt. aid for its continuous development. It was established in 1972 and was shifted at Sher-E-Banglanagar, Dhaka, in 1977 and started functioning in one part of the building of RIHD (now renamed as NITOR- publicly well known as “Pongu Hospital”). Within the same infrastructure Bangladesh Institute of Child Health (BICH) was established in the year 1982. Now DSH is treated as the academic hospital of BICH. At present the total bed strength of DSH is 345 Out of which 270 beds are allocated for paediatric medicine and 75 beds for paediatric surgery patients. In DSH the proposed study would cover all the medical and surgical wards, irrespective of the disease concern.

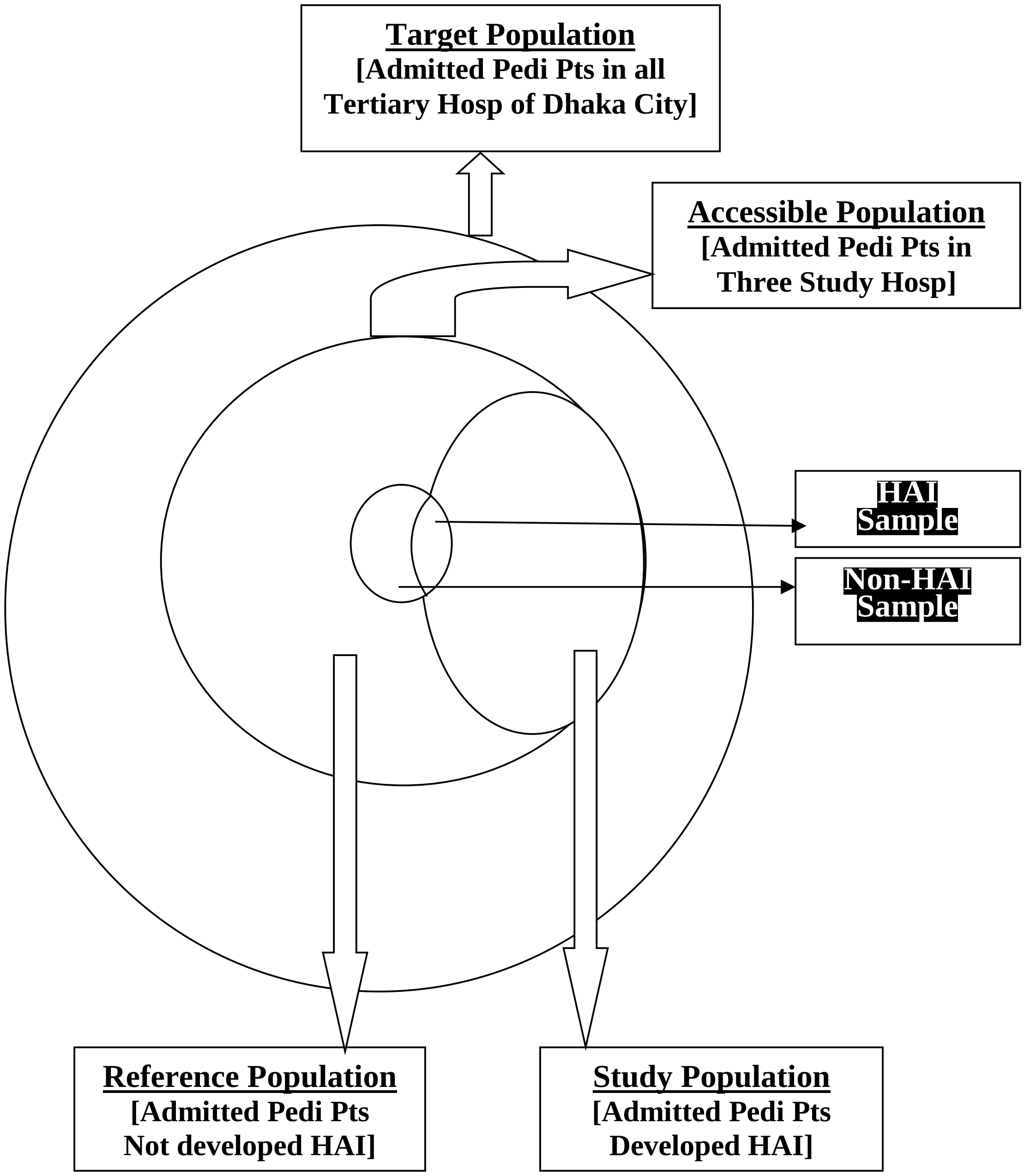
Bangladesh Medical College Hospital is one of the oldest tertiary level private teaching hospitals, which was established in 1986 at Dhanmondi, Dhaka. BMC is the first private medical college in Bangladesh. In establishing this hospital the view was to provide quality medical education, research and services to people of this country at reasonable cost. The College and the Hospital are run by Bangladesh Medical Studies and Research Institute (BMSRI). Bangladesh Medical College Hospital is a 500 bed tertiary care medical facility and provides medical, surgical, obstetrics and gynaecological services. Paediatric department is one of the most priority areas of this hospital and comprises of 42 beds for paediatric medicine and 8 beds for paediatric surgery patients. All of the paediatric patients brought under study. BMCH had about 150 doctors and at least 100 junior doctors (interns) working in various departments.

3.1.3 Period of study:

The study was conducted over a period of two years starting from a convenient time after approval of the protocol. First **three** months was utilized for further reviewing of literature followed by **three** months for development of questionnaire. Pre-testing and finalisation of questionnaire took another **three** months. Data were collected during next **two** months, if the required number of HAI patients could not be available within the schedule time, there was provision for extension in the schedule of the study. Further **three** months was required for data analysis and **three** months for report writing. Finally **three** months spent for printing and **two** months were spent for binding and submission of report. The graphic presentation of work schedule is shown in the annexure.

3.1.4 Study population:

The study population comprised of all the admitted paediatric patients irrespective of sex and basic diseases who were found present during data collection period as admitted patients in the paediatric wards of the hospitals under study.



3.1.5 Sample size:

As on the basis of available data the bed occupancy rate (BOR) was 90%, average length of stay (ALS) for HAI patients was around 21.5 days, prevalence of HAI was arround 11.5% and the total days of observation (data collection period) was 60 days, so the number of patients expected to be affected by HAI during data collection period calculated in the following way:

$$\text{Expected number of HAI patients that can be found during data collection period} = \frac{\text{9o\% (Total bed under observation)} \times \text{Total days of observation} \times \text{Prevalence of HAI}}{\text{Average length of stay x 100}}$$

$$= \frac{90\% (65+305+50) \times 60 \times 11.5}{21.5 \times 100} = 121$$

$$\textbf{Sample Size} = \frac{\text{Expected number of HAI patients x 100}}{\text{Prevalence of HAI}}$$

$$= \frac{121 \times 100}{11.5}$$

$$= \mathbf{1052}$$

Though the calculated sample size were 1052 but in practice a total of 1055 patients were observed for finding out HAI patients. Sample size in three study hospitals was as follows:

DMCH: 165 + BMCH: 125 + DSH: 765 = **1055**

3.1.6 Sampling Technique:

For convenience of data collection, sample was selected purposively on the basis of some set **criteria**. If the sample would be randomly selected then many of the paediatric patients fulfilling the criteria of HAI might not had the chance to be included as sample.

3.1.6.1 Inclusion and exclusion criteria for sample selection are:

i) Only those patients who had passed 48 hours or more after admission was considered as sample.

ii) Basic diseases for which the patients had been admitted was not taken into consideration in selecting sample.

iii) Patients who presented with features of infection at the time of admission were included as non-HAI sample.

iv) Patients developing infection within 48 hours after admission were also included as non-HAI sample.

v) Ambulant patients who had not been admitted were not included in sample.

During the initial days of data collection period all the admitted patients who had been selected as sample irrespective of sex and diseases involved was carefully screened for finding out the HAI patients.

Screening was done by reviewing the patient's daily diagnostic and treatment records, by physical examination and by arranging laboratory tests by researcher himself when and where necessary.

3.1.6.2 Screening for HAI sample was done on the basis of positive findings: (Which are specific for the **different types of HAI)-**

3.1.6.2.1 Positive findings for surgical site infection -

I. Any purulent discharge from the surgical site.

II. Any Abscess beneath or around the surgical site.

III. Spreading cellulities at the surgical site.

3.1.6.2.2 Positive findings for urinary tract infection (UTI) -

I. Positive urine culture (at least 10^5 bacteria/ml.) with or without clinical symptoms but presence of pyuria (≥ 5 -10 WBC/HPF) is present. OR

II. Positive urine culture with symptoms but no pyuria,

3.1.6.2.3 Positive finding for respiratory tract infection -

(Respiratory symptoms with at least two of the following signs)-

I. Presence of cough

II. Purulent sputum (>25 WBC with 10-25 squamous epithelial cells/LPF)

III. New infiltrate on chest radiograph consistent with infection.

3.1.6.2.4 Positive findings for vascular catheter infections -

I. Inflammation around the insertion site or along the vascular pathway.

II. Lymphangitis

III. Purulent discharge at the insertion site of catheter

3.1.6.2.5 Positive findings for blood Stream infection (Septicaemia) -

I. Isolation of any pathogen from one or more blood cultures with clinical symptoms of fever.

II. Hypotension

III. Chills

IV. Decreased urine output, and

V. Lethargy

3.1.6.2.6 Positive findings for all other types of infections -

I. On the basis of recognized diagnostic criteria specific for the particular infection.

After screening finished the sampled patients were taken as sample to be interviewed and observed till discharge or death.

3.1.7 Research Tools:

Data were collected through an interviewer administered questionnaire and observation check-list. All the concern variables in the light of objectives had been incorporated in the questionnaire and checklist. The research tools and methods of data collection applicable with the specific variables of the study is given in the following table-

Variables	Research Tools
Extent of HAI	
i) Prevalence of HAI	Check List
ii) Incidence of HAI	Check List
Socio demographic Factors- i) Age ii) Sex iii) Age, iv) Sex, v) Religion vi) Parent's Educational vii) Parent's Occupation viii) Parent's Smoking habit ix) Monthly family income x) Family size. xi) Location of Residence	Questionnaires
Agent Factors-	
i) Causative organisms in the occurrence of HAI	Check List
Patient's Factors-	
i) Birth history	Questionnaires
ii) Hemoglobin Level	Check List
iii) Disease on Admission	Check List
iv) Underlying Diseases - Leukaemia - Any other malignant tumour	Check List
v) Visitors	Check List
vi) Number of Attendants	Check List

vii) Relationship of the patients with the Attendants viii) Hygienic status of Attendants ix) History of Antibiotics within last 3 months x) History of Hospitalization within last 3 months xi) History of surgical operation within last 3 months	Questionnaires Check List Questionnaires Questionnaires Questionnaires
Treatment Factors- i) Major Specialty of Treatment ii) Mode of Decision for Surgery iii) Type of operation iv) Therapeutic Procedure - Biopsies - Endoscopic examination - Catheterization - Intubation/Ventilation - Suction and - Surgical procedure v) Immunosuppressive conditions - i.e. Burn injury vi) Immunosuppressive therapy - i.e. Burn injury vii) Duration of Operation viii) Preoperative waiting time	Check List Check List Check List Check List Check List Check List Check List Check List
Hospital Factors- i) Types and Ownership of Hospital ii) Hand washing Practice of the Doctors iii) Gloves using Practice of the Doctors iv) Face masks using Practice of the Doctors v) Gown wearing Practice of the Doctors	Check List Check List Check List Check List Check List Check List

vi) Cleanliness state of Pillow Cover - Quality of cleaning vii) Cleanliness state of Bed-sheet - Quality of cleaning	Check List Check List
Impact on Cost of Treatment i) Private Cost ii) Cost variation on Sites of HAI	Check List Check List
Impact on Hospital Management Factors i) Average Length of Stay (ALS) at Hospital for HAI patient ii) Average Length of stay (ALS) at Hospital for non-HAI patient iii) Treatment Outcome as Hospital Mortality iv) Client's Satisfaction regarding the Services they had been provided with during their stay in Hospital.	Check List Check List Check List Questionnaires

3.1.8 Data collection procedure:

Data were collected by the researcher himself on the basis of interviewer–administered structured questionnaire and observation checklist. To find out the prevalence and incidence of HAI required data had been be collected by checklist on the basis of follow up observation. To determine the total length of hospital stay and to estimate the cost incurred by HAI accurately the patient were observed from beginning of observation up to the last moment of his stay at hospital. In selecting non-HAI patients' chief attention was given in matching the two groups so that the infected patients were matched with the non-infected patients on key characteristics such as age, sex, diagnosis, treatment procedure and co-morbidity.

3.1.8.1 Extra days of stay at hospital:

For an individual HAI- patient extra days of stay at hospital was calculated by deducting the average length of stay (ALS) of non-HAI patient from the total length of stay for that individual patient. If the extra hospital days were calculated by counting the days from the date of appearance of HAI up to the date of discharge / death of a particular patient, there might be a scope of mistake in calculating the extra days. Because if the patient would not be affected by HAI he/she might not suppose to be discharged / died on the same date on which he/she had been discharged / died due to appearance of HAI. Either he would not die or would be discharged earlier.

3.1.8.1.1 The Treatment Cost for HAI patients- (cost on the part of patient's family) was calculated in the following way (**in Taka**):

Items	Per day cost	Extra days	Total cost
a) Cost of medicine			
b) Cost of investigation			
c) Food expenses for patients			
d) Food expenses for attendants			
e) Travel cost of attendant			
f) Income loss of the parents or care givers			
g) Miscellaneous expenses			
Grand Total			

As the HAI causes the patient to spend longer days in hospital, so that resources such as consumable items, the time of health care professionals and the capacity of capital equipment and infrastructure are used to provide the patient with appropriate care. Had the infection not occurred then these health care resources could have been used for the care of the alternative patients, so that an opportunity cost would also arise.

But in this study the opportunity cost had not been taken in to consideration.

3.1.8.1.2 The Treatment Cost for non-HAI patients- (cost on the part of patient's family) was calculated in the following way (**in Taka**):

Items	Per day cost	Extra days	Total cost
a) Cost of medicine			
b) Cost of investigation			
c) Food expenses for patients			
d) Food expenses for attendants			
e) Travel cost of attendant			
f) Income loss of the parents or care givers			
g) Miscellaneous expenses			
Grand Total			

Mortality and referral rate had been found out by reviewing records and day to day observation of the patients. Patients were also observed for morbidity due to HAI up to his / her discharge from hospital. Satisfaction level of the patient's parents (or of care givers in absence of parents) was assessed by face to face interview according to structured questionnaires. To detect the causative organisms patient's treatment sheet and laboratory reports were reviewed, if the organisms involved already been isolated, the checklists had been filled up on the basis of these available reports, other wise the appropriate samples was sent to the laboratory for culture and sensitivity test and later on the checklists had been filled up on the basis of those reports. Information regarding age, sex, immune status, underlying disease, diagnostic and therapeutic intervention and about antibiotic use were collected mainly by face to face interview and some times with the help of observation check list and by reviewing treatment records. Visitors' situation and cleanliness status of pillow cover and bed-sheet was assessed by scheduled observation. Information regarding some other factors (i.e. history of previous hospitalisation and surgical operation, preoperative delay, smoking habit of parents' etc) which were assuming to influence the occurrence of HAI had been gathered by interviewing the patient's parents (or care givers in absence of parents). Observation checklist incorporated the information on preoperative haemoglobin level and basic disease for which the patient got admitted. Typing of HAI had been done on the basis of sites and nature of infection.

3.1.9 Data Processing and analysis:

Collected data were checked and verified at the end of each day's work for accuracy, consistency and completeness. Incomplete questionnaires and checklists were completed by repeated visits and interviews with the concern persons. As for checklist relating to laboratory examination had been reviewed repeatedly. If the available report would be confusing or less dependable the test was done again (cost of which was borne by the researcher himself). Data obtained had been entered in SPSS programmes for analysis. Then the data was analyzed in line with the objectives of the study. Univariate, bivariate and multivariate regression analysis was carried out using both descriptive and inferential statistics. During analysis special attention was given in finding out the cost and impact of HAI on hospital management. Highest care was given to calculate the cost of treatment accurately. Regarding calculating the private cost of HAI the additional services and the resources utilized by the patient’s family was in to consideration. To see the impact of HAI on some selected indicators of hospital management (i.e. average length of stay at hospital, hospital mortality and client’s satisfaction on hospital services) comparability of findings of the groups interns of sociodemographic characteristics, types of hospitals, categories of treatment (medicine/surgery) were assessed by using appropriate tests x^2 test and regression analysis and other appropriate statistical tests. As the data were non-normally distributed Mann-Whitney U test and Kruskal Walis tests were done instead of t-test and ANOVA test. The data had been stratified by contributing factors and subsequently analyzed making adjustment with these factors. Regression analysis was done for controlling potential co-factors and for predicting independent risks of patient factors (i.e.

number of visitors, number of attendants and hemoglobin levels), socio-demographic factors (age, sex and income group) and of treatment factors (duration of operation, pre-operative waiting time and length of hospital stay) for developing HAI. Relationship of length of hospital stay with HAI was analyzed in one way as the contributing or determining factors by doing regression analysis and in another way as the impact or consequences of HAI by doing Mann-Whitney U test.

3.2 Ethical issues

Involvement in this study as being a sample or any sorts of participation or contribution as parents, care givers or service provider was completely on voluntary basis. Each of the participants of this study was listed out in a register and before that they had been provided with consent forms. As the study was conducted among the paediatric patients so, on behalf of them their parents or care givers were interviewed on some issues in relation with the study and the consent form had been signed by them accordingly. The consent form was also translated in Bengali (Bangla) medium. For illiterate parents or care givers the form was read out in front of them. The contents of the consent form encompassed the aims and nature of the study and the procedure they needed to undergo if they would be enrolled in the study. The form also stated that even after giving consent they had the right to refuse in responding to any or all of the interview-questions and may decline to provide any specimen for laboratory tests if needed. Each patients (who had been selected as sample) was enrolled as a study participant after having the consent of their parents or care givers by putting their signature or thumb impression on the consent form.

The enrolled participants were provided with written assurance that information acquired in course of the study would not be released to any other individual unless authorized by the participant and the information gained would be used in such a way that identity of the participant would not be revealed.

No experimental drugs or placebos had been administered as part of this study.

In general no laboratory tests had been planned to do except in some rare cases only when the available reports would be confusing and not dependable. In most of the cases the procedure of specimen collection (if needed) was non-invasive in nature. When blood culture test was required then the sample of blood was collected from cubital vein by puncturing it with appropriate dispose able needle and syringe. All aseptic measures had been taken before and after doing veni-puncture. Though it was very rare case when any participant would require any emergency care in relation with veni-puncture he or she was provided with all sorts of appropriate medical care. The risk coverage by the researcher had been clearly spelled out to the participants (parents or care givers) during the recruitment process.

The part of the results of this study seemed to be beneficial for the participants, would be disseminated to them with the view to build up their awareness in preventing hospital acquired infections.

4.0 Results and Discussion

4.1 Results

A total of 1055 pediatric patients were brought under study from three different categories of tertiary level hospitals in Dhaka city. The results of this study have been described in the following sub sections as per chronology of specific objectives except the socio-demographic factors which have been shown first.

4.1.1 Frequency Distribution on Contributing Factors:

Findings on the contributing factors have been shown under four categories; i.e. socio demographic factors, patient's factors, treatment factors and hospital factors.

4.1.1.1 Socio demographic Factors:

The following factors i.e. age, sex, religion, parent's educational qualification, parent's occupation, parent's smoking habit, monthly family income, family size and geographical location of residence had been considered as socio demographic factors in this study.

The following table (Table-1) shows that out of 1055 pediatric patients highest number {493(46.7%)} belonged to the age group of up to 5 years and the lowest number {274(26.0%)} belonged to the age group 6-10 year. The number of pediatric patients belonged to the age group of 11-15 years were 288 (27.3%). Mean age was 6.7 years ± Std. deviation 4.6 years.

.**Table-1: Distribution of the pediatric patients by Age**

Age in years	Frequency	Percentage
Up to 5 years	493	46.7
6 to 10 years	274	26.0
11 to 15 years	288	27.3
Total	**1055**	**100.0**
Mean: 6.7 years ± Std. deviation: 4.6 years, Median:6.0years,		

Figure-1 shows that the study subjects were dominated by males in gender. As illustrated in the following graph it was found that 556 (53.5%) patients were male and remaining 499 (47.5%) were female.

Figure-1: Distribution of the patients by Sex

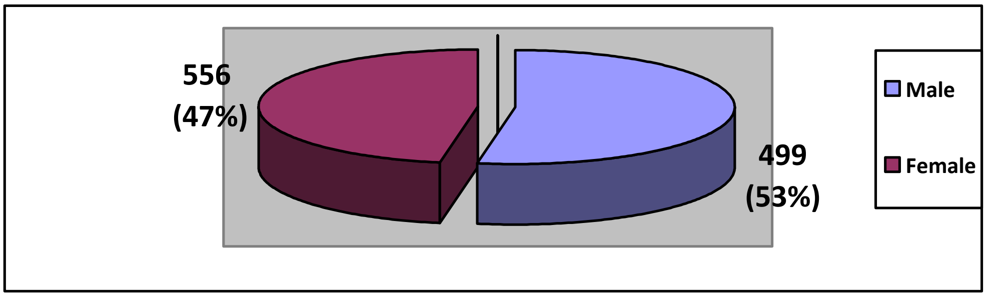
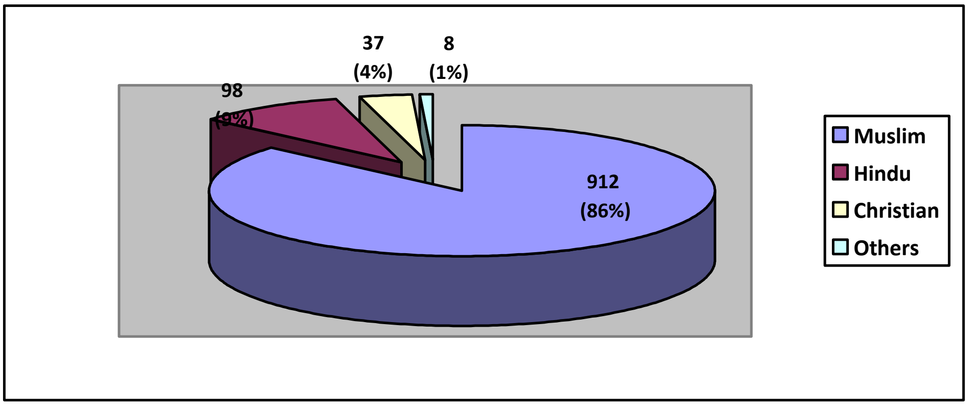


Figure-2 shows that the Most of the respondents {912(86.4%)} were Muslim and 98 (9.3%) were Hindus by religion. Respondents representing Christian and other religions were 37(3.5%) and 8(0.8 %) respectively.

Figure-2: Distribution of the patients by Religion



As illustrated in the following table (Table-2) the highest number {298(28.2%)} of mothers were representing the group of having education from class VI-to-X. Next highest position was occupied by primary level educated mother {229(21.2%)}, which was followed by SSC & HSC passed mothers {216(20.5%)}. Only 88(8.3%) mothers had graduation or above level education and 224(21.2%) mothers were found to have no education and 173(16.4%) fathers had no education.

Table-2: Distribution of the pediatric patients by Mother's Educational qualification

Educational qualification of Mother	Frequency	Percentage
No education	224	21.2
Primary	229	21.7
Class VI-to-X	298	28.2
SSC & HSC	216	20.5
Graduate & above	88	8.3
Total	**1055**	**100.0**

As illustrated in the following table (Table-3) highest number {314(29.8%)} of fathers were representing the group of having education from class VI-to-X. Next highest number of fathers 234(22.2%) were found to have primary and SSC or HSC level education. Only 100(9.5%) fathers had graduation or above level education.

Table-3: Distribution of the pediatric patients by Father's Educational qualification

Educational qualification of Father	Frequency	Percent
No education	173	16.4
Primary	234	22.2
VI-to-X	314	29.8
SSC & HSC	234	22.2
Graduate & above	100	9.5
Total	**1055**	**100.0**

Regarding occupation the following table (Table-4) shows that most of the mothers {728(69.9%)} were housewives. Factory workers and service holder mothers were only 154(14.6%) and 109(10.3%) respectively. Only 64(6.1%) mothers (6.0%) were found to be engaged in various other occupations.

Table-4: Distribution of the pediatric patients by Mother's Occupation

Mother's Occupation	Frequency	Percent
House wife	728	69.0
Factory workers	154	14.6
Service	109	10.3
Others	64	6.1
Total	**1055**	**100.0**

As per the following table (Table-5) it was found that the highest number {315(29.9%)} of the fathers were engaged in agriculture, which was followed by factory workers {313(29.7%)}. Third highest number {276(26.2%) of respondents were government or private service holders. Respondents found to work as day laborer and engaged in other nonspecific occupation were 101(9.6%) and 50(4.7%) respectively.

Table-5: Distribution of the pediatric patients by Father's Occupation

Mother's Occupation	Frequency	Percent
Agriculture	315	29.9
Day laborer	101	9.5
Factory worker	313	29.7
Govt. or private Service	276	26.2
Others	50	4.7
Total	**1055**	**100.0**

The following table (Table-6) describes that 1019(96.6%) mothers of the pediatric patients under study were found as non-smoker. Only 20(1.9%) mothers were irregular smoker and 16(1.5%) mothers were found as regular smoker. None of the mother was found as chain smoker.

Table-6: Distribution of the pediatric patients by Mother's Smoking habit

Mothers smoking habit	Frequency	Percent
Non smoker	1019	96.6
Irregular smoker	20	1.9
Regular smoker	16	1.5
Chain smoker	0	00
Total	**1055**	**100.0**

It is evident from the following table (Table-7) that less than half 441(43.1%) fathers of the pediatric patients under study were found as non-smoker. Irregular and regular smokers fathers were 226(21.4%) and 284(26.9%) respectively. Only 104(9.9%) fathers were found as chain smoker.

Table-7: Distribution of the pediatric patients by Father's Smoking habit

Fathers smoking habit	Frequency	Percent
Non smoker	441	41.8
Irregular smoker	226	21.4
Regular smoker	284	26.9
Chain smoker	104	9.9
Total	1055	100.0

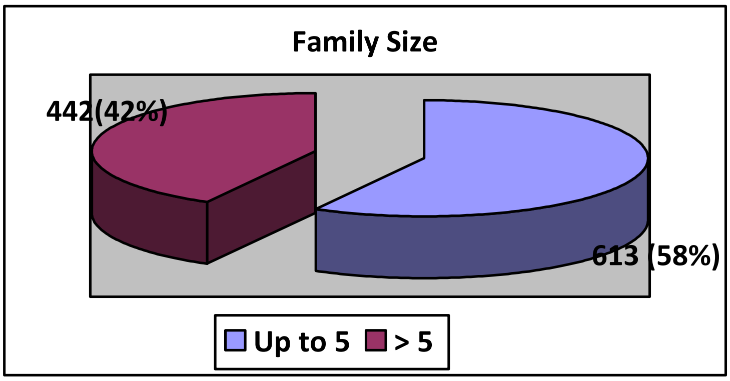
It is revealed from the following table (Table-8) that the highest number {313(29.7%)} of the respondents belonged to the group of having monthly family income from Tk. 15,001/ - to- Tk. 20,000/- and the second highest number of the respondents {301(28.5%)} were representing the group of having monthly family income from Tk. 10,001/ - to- Tk. 15,000/-. Monthly family income from Tk. 5,001/ - to- Tk. 10,000/- and from Tk. 20,001/ - to- Tk. 25,000/- were represented by 143(13.6%) and 121(11.5%) respondents respectively. The lowest (up to Tk. 5,000/-) and highest (from Tk. 25,001/-to- 30,000/-) income groups were represented by only 71(6.7%) and 106(10.0%) respondents respectively.

Table-8: Distribution of the pediatric patients by Monthly Family income

Monthly family income	Frequency	Percent
up to Tk. 5000/-	71	6.7
Tk. 5001/- to-Tk. 10000/-	143	13.6
Tk. 10001/- to -Tk. 15000/-	301	28.5
Tk. 15001/- to -Tk. 20000/-	313	29.7
Tk. 20001/- to -Tk. 25000/-	121	11.5
Tk. 25001/- to -Tk. 30000/-	106	10.0
Total	**1055**	**100.0**
Mean-Tk.15,538/- ± Sd. Tk. 6,722		

It is revealed from the following graph (Figure-3) that majority {613(58%)} of the pediatric patients belonged to the family having up to 5 members and only {442(42%)} had more than 5 members in their family.

Figure-3: Distribution of the pediatric patients by Family Size



As per the following table (Table-9) majority of the subjects {493 (46.7%)} came from rural areas. Subjects came from semi-urban and urban areas were 372(35.3%) and 190 (18.0%) respectively.

Table-9: Distribution of the pediatric patients by Geographical distribution of Residence

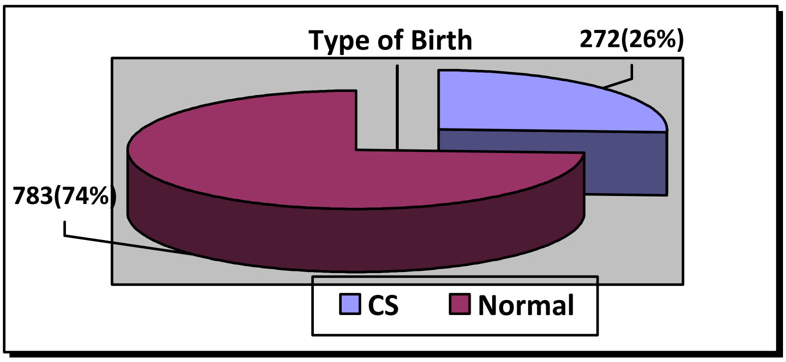
Geographical distribution of Residence	Frequency	Percentage
Rural	493	46.7
Semi urban	372	35.3
Urban	190	18.0
Total	**1055**	**100.0**

4.1.1.2 Patient's Factors:

The following factors i.e. types of birth, hemoglobin level, diseases on admission, underlying disease, history of taking antibiotics, hospitalization and operation within last three months had been considered as patient's factors in this study.

As per the following graph (Figure-4) more than a quarter {272(25.8%)} of the pediatric patients under study were born by caesarean section operation and nearly three quarters {783(74.2%)} were born by normal vaginal delivery.

Figure-4: Distribution of the pediatric patients by Types of Birth



The following table (Table-10) describes that one third {348(33%)} of the pediatric patients were found having normal range of hemoglobin. Less than one fifth {197(18.7%)} were found as severely anemic. Moderately and mildly anemic patients were {229(21.7%)} and {281(26.6%)} respectively.

Table-10: Distribution of the pediatric patients by Hemoglobin Status

Hemoglobin level	Frequency	Percent
Severe anemic (Less than 7g/dl)	197	18.7
Moderate anemic (7g/dl-10.5g/dl)	229	21.7
Mild anemic (10.5g/dl-12.5g/dl)	281	26.6
Normal (12.5g/dl & above)	348	33.0
Total	**1055**	**100.0**
Mean-10.6 g/dl ± Sd. 2.8 g/dl		

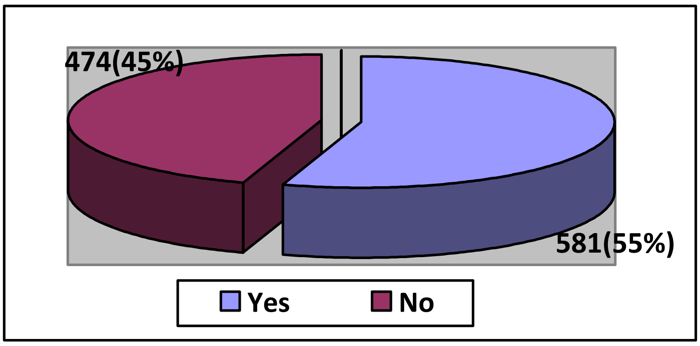
The following table (Table-11) describes that the highest number {276(26.2%)} of pediatric patients were admitted with respiratory diseases and the lowest number {64(6.1%)} were admitted with congenital anomalies. Gastro-intestinal disease and urinary disease were represented by 208(19.7%) and 196(18.6%) patients respectively. Only 162(15.4%) and 149(14.1%) pediatric patients were being admitted with Nonspecific Fever and other diseases respectively.

Table-11: Distribution of the pediatric patients by Diseases on Admission

Diseases on admission	Frequency	Percent
Congenital Anomalies	64	6.1
Respiratory Disease	276	26.2
Gastro-intestinal Disease	208	19.7
Urinary disease	196	18.6
Nonspecific Fever	162	15.4
Others	149	14.1
Total	**1055**	**100.0**

The following graph (Figure-5) depicts that majority {581(55%)} of pediatric patients under study was found to have underlying diseases other than the disease due to which they had got admitted. The remaining 474(45%) was found to have no such underlying diseases other than the disease of admission.

Figure-5: Distribution of pediatric patients by Underlying Diseases other than the disease of admission



The following table (Table-12) describes that out of 1055 study subjects majority of the subjects 630(89.7%) were visited by 3 or more visitors and only 425 (40.3%) were visited by up to 2 visitors.

Table-12: Distribution of the pediatric patients by number of Visitors

Number of visitors	Frequency	Percent
up to 2	425	40.3
3 or more	630	59.7
Total	**1055**	**100.0**

It is depicted by the following table (Table-13) that nearly one quarter of the study subjects {250(23.7%)} were given care by single attendant and more than three quarters {805(76.3%)} were given care by 2 or more attendants.

Table-13: Distribution of the pediatric patients by number of Attendants

Number of Attendants	Frequency	Percent
One	250	23.7
2 or more	805	76.3
Total	**1055**	**100.0**

The following table (Table-14) describes that among all the pediatric patients highest number {781(74.0%)} were attended by mothers and the lowest number {51(4.8%)} were attended by fathers. Grandmothers (either paternal or maternal) and other relatives attended 138(13.1%) and 85(8.1%) patients respectively.

Table-14: Distribution of the pediatric patients by Categories of Attendants

Relationship with the Attendants	Frequency	Percent
Mother	781	74.0
Grand Mother	138	13.1
Father	51	4.8
Others	85	8.1
Total	**1055**	**100.0**

Regarding hygienic status of the attendants (Table-15) who were engaged for giving whole time care to the patients, hygienic and unhygienic respondents were 417(39.5%) and 395(37.5%) respectively. Only 243(23.0%) respondents were found at average level of hygienic status.

Table-15: Distribution of the pediatric patients by Hygienic status of the Attendants

Hygienic status of the Attendants	Frequency	Percent
Hygienic	417	39.5
Average	243	23.0
Unhygienic	395	37.5
Total	**1055**	**100.0**

It is evident from the following table (Table-16) that out of 1055 pediatric patients almost three quarters {773(73.3%)} were found to have history of taking any sorts of antibiotics within last three months. Remaining 282 (26.7%) had no history of taking antibiotics within last three months.

Table-16: Distribution of the pediatric patients by History of antibiotics within last 3 months

History of antibiotics within last 3 months	Frequency	Percent
Yes	773	73.3
No	282	26.7
Total	**1055**	**100.0**

As per the following table (Table-17) out of 1055 pediatric patients majority {803(76.1%)} were found to have no history of hospitalization within 3 months. Less than one fourth {252(23.9%)} were found to be hospitalized within the last 3 months.

Table-17: Distribution of the pediatric patients by History of Hospitalization within last 3 months

History of Hospitalization within 3 months	Frequency	Percent
Yes	252	23.9
No	803	76.1
Total	**1055**	**100.0**

Regarding history of surgery within last 3 months, the following table says (Table-18), most {1001(94.9%)} of the pediatric patients were found to have no history of surgery. Only 54(5.1%) patients were found to under gone surgery within the last 3 months.

Table-18: Distribution of the pediatric patients by History of Surgery within last 3 months

History of Surgery within last 3 months	Frequency	Percent
Yes	54	5.1
No	1001	94.9
Total	1055	100.0

4.1.1.3 Treatment Factors:

The following factors i.e. major specialty of treatment, types of surgical operation, types of therapeutic procedures, immunosuppressive conditions and therapy, duration of operation and pre-operative waiting time had been considered as treatment factors in this study.

Out of all the 1055 patients under study majority {684(64.8%)} were treated in medicine department and only 371(35.2%)} were treated by surgical intervention (Table-19).

Table-19: Distribution of the pediatric patients by Major Specialty of Treatment

Major specialty of Treatment	Frequency	Percent
Medicine	684	64.8
Surgery	371	35.2
Total	**1055**	**100.0**

Out of 371 surgical patients the decision for operation was taken on emergency basis for nearly one third {122(32.9%)} of the pediatric patients. And for more than two third {249(67.1%)} of the patients the decision for operation was taken as per pre-planned schedule. (Table-20)

Table-20: Distribution of the pediatric patients by Mode of Decision for Surgery

Mode of decision for surgery	Frequency	Percent
Emergency surgery	122	32.9
Planned surgery	249	67.1
Total	**371**	**100.0**

It is revealed from the following table (Table-21) that out of 1055 pediatric patients almost two third {684(64.8%)} had not under gone any sorts of surgical operation during treatment period. Other than the non-surgical patients highest number {119(11.3%)} of patients were treated by doing gastro-intestinal operation and the lowest number {21(2.0%)} by multiple operation. Urogenital, neurological and soft tissue operations were conducted in 103(9.8%), 87(8.2%) and 41(3.9%) pediatric patients respectively.

Table-21: Distribution of the pediatric patients by Types of Surgical Operation

Surgical Operation	Frequency	Percent
Gastro-Intestinal Operation	119	11.3
Urogenital Operation	103	9.8
Neurological operation	87	8.2
Soft tissue Operation	41	3.9
Multiple Operation	21	2.0
None	684	64.8
Total	**1055**	**100.0**

Regarding application of therapeutic procedure it is evident from the following table (Table-22) that the highest {303(28.7%)} and lowest {66(6.3%)} position was occupied by nasogastric feeding and endoscopic examination respectively. Second {211(20.0%)} and third {204(19.3)} highest position was occupied by Nasogastric Suction and Catheterization respectively. Biopsy and ventilation were done for 135(12.8%) and 81(7.7%) pediatric patients respectively. Only 55 (5.2%) patients were given other different types of therapeutic procedures.

Table-22: Distribution of the pediatric patients by Types of Therapeutic Procedures

Types of Therapeutic Procedures	Frequency	Percent
Nasogastric Feeding	303	28.7
Nasogastric Suction	211	20.0
Catheterization	204	19.3
Biopsy	135	12.8
Intubation/Ventilation	81	7.7
Endoscopic examination	66	6.3
Others	55	5.2
Total	**1055**	**100.0**

The following table (Table-23) shows that out of 1055 pediatric patients only 67 (6.4%) had underlying immunosuppressive condition and the 988(93.6%) had no such situation.

Table-23: Distribution of the pediatric patients by Presence of Immunosuppressive condition

Presence of Immunosuppressive condition	Frequency	Percent
Yes	67	6.4
No	988	93.6
Total	**1055**	**100.0**

It is evident from the following table (Table-24) that only 59 (5.6%) pediatric patients had been treated by immunosuppressive therapy and the 996(94.4%) did not need such type of therapy.

Table-24: Distribution of the pediatric patients by Presence of Immunosuppressive Therapy

Presence of Immunosuppressive Therapy	Frequency	Percent
Yes	59	5.6
No	996	94.4
Total	1055	100.0

Out of 371 surgical patient only 88(23.7%) needed less than one hour for completing the operation but more than three fourth {283(76.3%)} of the patient needed more than one hour for operation. (Table-25)

Table-25: Distribution of the surgical patients by Duration of Operation

Duration of Operation	Frequency	Percent
Up to 1hour	88	23.7
More than 1hour	283	76.3
Total	**371**	**100.0**

As per the following table (Table-26) it is evident that out of 371 surgical patients, majority {160(43.1%)} had to wait for >6 days for schedule of operation. Waiting period up to 3 days and 4-6 days were for 116(31.3%) and 95(25.6%) patients respectively.

Table-26: Distribution of the surgical patients by Pre-operative Waiting Time for Operation

Pre-operative Waiting period for Operation	Frequency	Percent
Up to 3 days	116	31.3
4-6 days	95	25.6
> days	160	43.1
Total	**371**	**100.0**

4.1.1.4 Hospital Factors:

The following factors i.e. types of hospitals, hand washing practice of doctors, face mask and gown wearing practice of doctors, cleanliness status of pillow cover and bed-sheets had been considered as hospital factors in this study.

Regarding types of the hospital by ownership the following table (Table-27) shows that out of 1055 patients 165(15.6%) belonged to govt. hospital, 765(72.5%) belonged to non-profit based private hospital and lastly 125(11.9%) belonged to profit based private hospital.

Table-27: Distribution of the pediatric patients by Types of Hospital

Owner ship of Hospital	Frequency	Percent
Govt. (DMCH)	165	15.6
Non-profit based private (DSH)	765	72.5
Profit based Private (BMCH)	125	11.9
Total	**1055**	**100.0**

It is evident from the following table (Table-28) that regarding hand washing practice of the doctors, more than half {571(54.1%)} of the patients was found to be treated by doctors practicing hand wash inadequately and less than half {484(45.9%)} of the patients was treated by doctors who practiced hand wash adequately.

Table-28: Distribution of the pediatric patients by Hand washing practice of the Doctors

Hand washing practice of the Doctors	Frequency	Percent
Adequately practicing	484	45.9
Not adequately practicing	571	54.1
Total	**1055**	**100.0**

Regarding face mask using practice of the doctors it is stated by the following table (Table-29) that majority {613(58.1%)} of the patients was given treatment by the doctors using face mask properly and less than half {442(41.9%)} of them was treated by the doctors did not use face mask properly.

Table-29: Distribution of the pediatric patients by Face mask using practice of the Doctors

Face mask using practice of the Doctors	Frequency	Percent
Served by the doctors with properly using face mask	613	58.1
Served by the doctors without properly using face mask	442	41.9
Total	**1055**	**100.0**

Regarding gown wearing practice of the doctors it was evident from the following table (Table-30) that nearly two third {654(62.0%)} of the patients was given treatment by the doctors wearing gown and more than one third {401(38.0%)} of them was treated by the doctors who did not wear gown at all.

Table-30: Distribution of the pediatric patients by Gown Wearing practice of the Doctors

Gown Wearing practice of the Doctors	Frequency	Percent
Served by the doctors with Wearing gown	654	62.0
Served by the doctors without Wearing gown	401	38.0
Total	**1055**	**100.0**

Pillow cover of the highest number {356(33.7%)} of the pediatric patients was found dirty and that of second highest number {341(32.3%)} was found clean. Very clean, average and very dirty pillow cover was found for 106(10.1%), 99(9.4%) and 153(14.5%) pediatric patients respectively. (Table-31)

Table-31: Distribution of the pediatric patients by Cleanliness status of Pillow cover

Cleanliness status of pillow cover	Frequency	Percent
Very clean	106	10.1
Clean	341	32.3
Average	99	9.4
Dirty	356	33.7
Very dirty	153	14.5
Total	**1055**	**100.0**

Bed sheet of the highest number {338(32.1%)} of the pediatric patients was found dirty and that of second highest number {329(31.%)} was found clean. Very clean, average and very dirty bed sheet was found for 113(10.7%), 127(12.0%) and 148(14.0%) pediatric patients respectively. (Table-32)

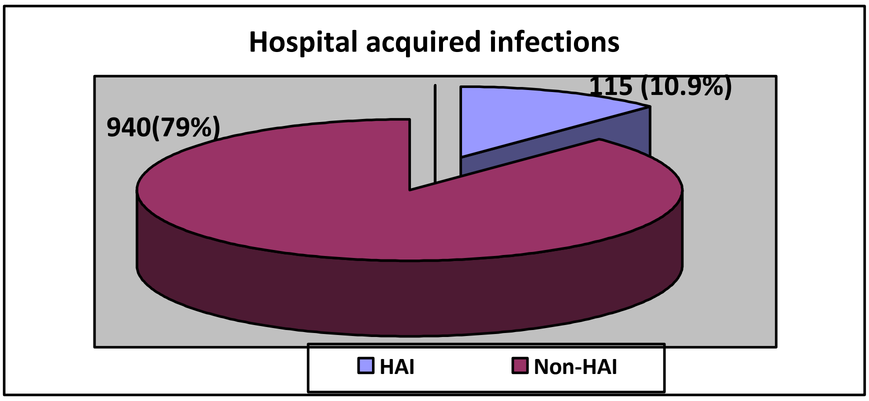
Table-32: Distribution of the pediatric patients by Cleanliness status of Bed sheet

Cleanliness status of bed sheet	Frequency	Percent
Very clean	113	10.7
Clean	329	31.2
Average	127	12.0
Dirty	338	32.1
Very dirty	148	14.0
Total	**1055**	**100.0**

4.1.2 Extent of Hospital acquired infections:

As per the following graph (Figure-6) it is evident that among 1055 pediatric patients admitted in all the three hospitals under study a total of 115 were affected by hospital acquired infections and 940 were not being affected. So the calculated overall prevalence HAI was 10.9%.

Figure-6: Distribution of the pediatric patients by overall prevalence of Hospital Acquired Infections (HAI)



The following table (Table-33) reveals that highest prevalence (11.5%) of Hospital-Acquired Infections (HAI) was found in Dhaka Medical College Hospital (DMCH) and the lowest prevalence (9.6%) of HAI was found in Bangladesh Medical College Hospital (BMCH). In Dhaka Shishu Hospital (DSH) the prevalence of HAI was 10.9%.

Table-33: Prevalence of HAI in different hospitals under study

Study Hospitals	Total number of patients observed	Total number of HAI patients	Prevalence of HAI (%)
DMCH	165	19	11.5
BMCH	125	12	9.6
DSH	765	84	11.0
Total	**1055**	**115**	**10.9**

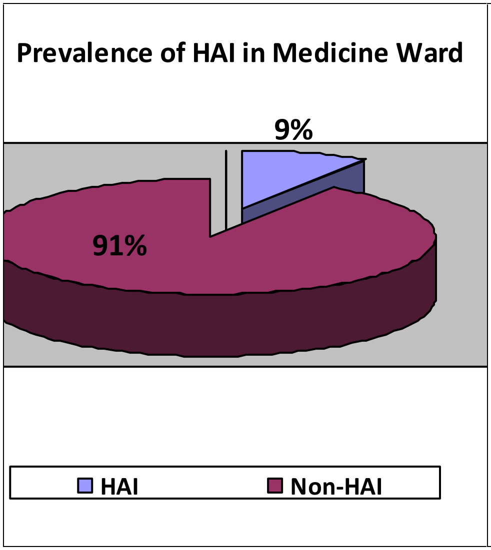
The following table (Table-34) reveals that the highest incidence (8.1 per 1000 bed-days) of HAI was found in Dhaka Medical College Hospital (DMCH) and the lowest incidence (6.8 per 1000 bed-days) was found in Bangladesh Medical College Hospital (BMCH). The incidence of HAI in Dhaka Shishu Hospital (DSH) was 7.5 per 1000 bed-days. Considering the three hospitals collectively the overall incidence of HAI was 7.5 per 1000 hospital days.

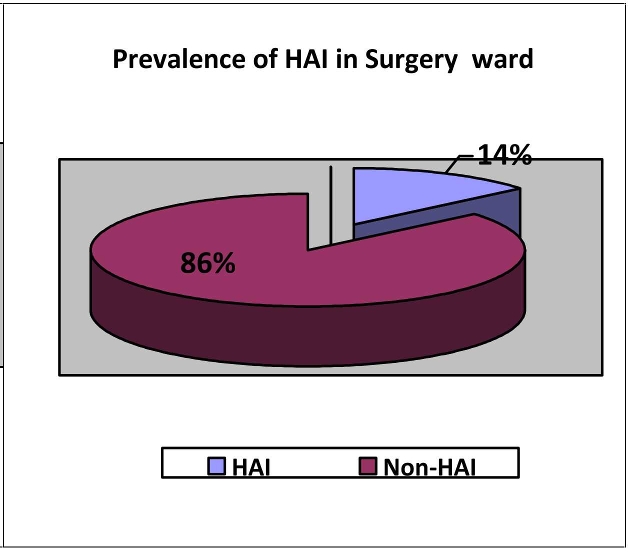
Table-34: Incidence of HAI in the different Hospitals under study

Hospitals	Number of HAI patients	Hosp-days of HAI patients till onset of infec.	Number of Non-HAI patients	Hosp-days of Non-HAIpts. Till discharge	TotalHosp. days For all patients	Incidence of HAI(Per1000 Hosp-days)
DMCH	19	134	146	2204	2338	8.1
BMCH	12	94	113	1683	1777	6.8
DSH	84	588	681	10555	11143	7.5
Total	**115**	**805**	**940**	**14570**	**15375**	**7.5**

The following table (Figure-7 & 8) shows that higher prevalence (14.0%) of Hospital-Acquired Infections (HAI) was found in surgery ward and the lower prevalence (9.2%) of HAI was found in medicine ward.

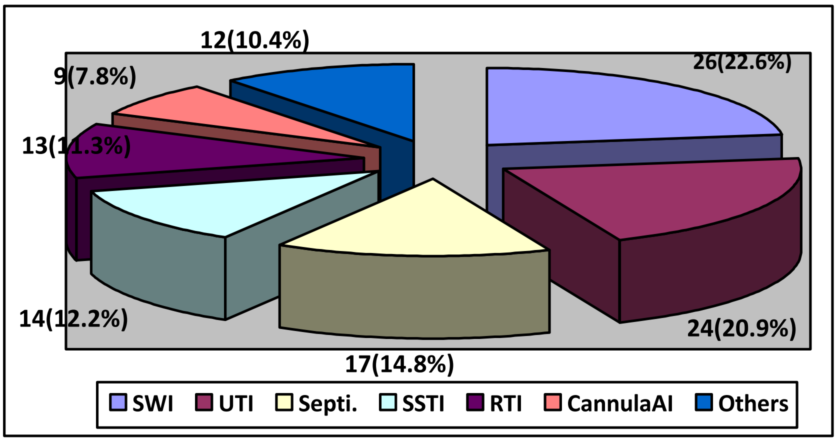
Figure-7 and 8: Prevalence of HAI in Medicine and Surgery wards





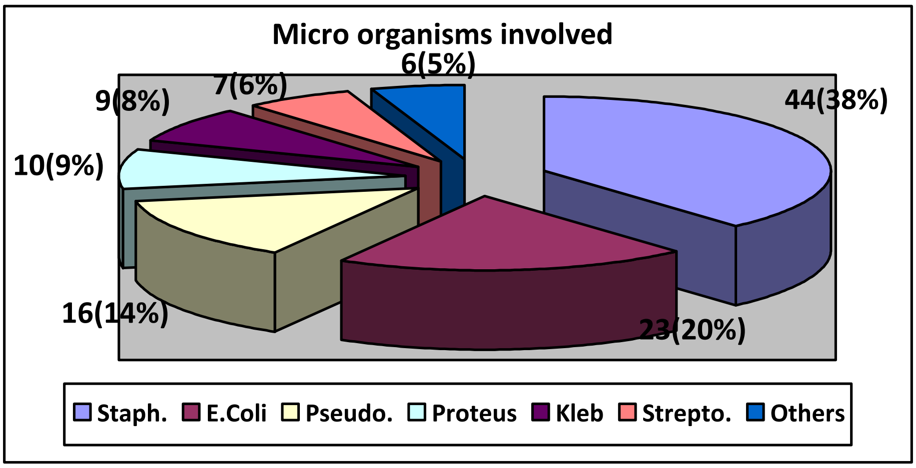
It is evident from the following graph (Figure-9) that out of 115 HAI patients highest number {26(22.6%)} was affected by Surgical Wound Infection (SWI) and the lowest number {9(7.8%)} was affected by Cannula Associated Infection. Second highest number {24(20.9%)} of patients was affected by Urinary Tract Infection (UTI). Septicemia or Bacteremia was represented by 17(14.8%) HAI patients. Skin & Soft Tissue Infection (SSTI) and Respiratory Tract Infections (RTI) were represented by 14(12.2%) and 13(11.3%) patients respectively. Only 12(10.4%) patients were found to be affected by others type of infections.

Figure-9: Distribution of HAI patients by Sites of Infections



It is shown by the following graph (Figure-10) that out of 115 HAI patients highest number {44(38.3%)} were affected by staphylococcus aureus and the lowest number {7(6.1%)} was affected by Srteptococcus Pneumonae. Second highest number {23(20%)} of patients were affected by E Coli. Pseudomonas and klebsiella were responsible for infecting 16(13.9%), 10(8.7%) and 9(7.8%) patients respectively. Only 6(5.2%) patients were being infected by other types of microorganisms.

Figure-10: Distribution of HAI patients by Isolated Microorganisms



4.1.3 Treatment outcomes for both HAI and non-HAI patients

Treatment outcomes for both the HAI and non-HAI pediatric patients had been assessed in terms of length of hospital stay (LOHS), treatment cost, mortality of the patients and satisfaction level of the respondents (parents or other care givers of the patients).

The following table (Table-35) reveals that the highest number {54(46.9%)} of HAI patients had to stay at hospital for 21-25 days and the lowest number {3(2.6%)} of HAI patients had to stay at hospital for up to 5 days. But among the non-HAI patients highest {475(50.5%)} and lowest {8(0.9%)} number had to stay at hospital for 6-10 days and 26-30 days respectively.

Table-35: Distribution of HAI and non-HAI patients by Length of Hospital stay

Length of hospital stay	HAI	non-HAI	Total
up to 5 days	3(2.6%)	77(8.2%)	80(7.6%)
6-10 days	12(10.4%)	475(50.5%)	487(46.2%)
11-15 days	14(12.3%)	176(18.7%)	190(18.0%)
16-20 days	16(13.9%)	171(18.2%)	187(17.7%)
21-25 days	54(46.9%)	33(3.5%)	87(8.2%)
26-30 days	16(13.9%)	8(0.9%)	24(2.3%)
Total	**115(100%)**	**940(100%)**	**1055(100%)**

It is evident from the following table (Table-36) that the highest number {79(68.7%)} of HAI patients had to spend Tk. 20,001/- - Tk.30,000/- and the lowest number {2(1.7%)} of HAI patients had to spend >Tk.30,000/- as treatment cost. But among the non-HAI patients highest {420(44.7%)} and lowest {9(0.95%)} number had to spend for their treatment Tk. 10,001/- - Tk.20,000/- and >Tk.30,000/- respectively.

Table-36: Distribution of HAI and non-HAI patients by Treatment Cost

Treatment Cost	HAI	non-HAI	Total
Up to Tk. 10,000/-	7(6.1%)	169(18.0%)	176(16.7%)
Tk. 10,001/- - Tk.20,000/-	27(23.5%)	420(44.7%)	447(42.4%)
Tk. 20,001/- - Tk.30,000/-	79(68.7%)	342(36.4%)	421(39.9%)
>Tk.30,000/-	2(1.7%)	9(0.9%)	11(1.0%)
Total	**115(100%)**	**940(100%)**	**1055(100%)**

As per the following table (Table-37) it is shown that out of 1055 pediatric patients the mortality was 3.8%. But among the HAI and non-HAI patients separately the mortality was 10.4% and 3.0% respectively.

Table-37: Distribution of HAI and non-HAI patients by Treatment Outcomes in terms of Mortality.

Mortality	HAI	non-HAI	Total
Death	12(10.4%)	28(3.0%)	40(3.8%)
Cure	103(89.6%)	912(97.0%)	1015(96.2%)
Total	**115(100%)**	**940(100%)**	**1055(100%)**

The following table (Table-38) states that the highest number {46(40.0%)} of the respondents on behalf of the HAI patients was found highly dissatisfied and the lowest number {3(2.6%)} expressed their opinion as average level of satisfaction. But on behalf of the non-HAI patients highest {588(62.6%)} and lowest {18(1.9%)} number of the respondents were found satisfied and dissatisfied respectively.

Table-38: Distribution of the respondents on behalf HAI and non-HAI patients by their Level of Satisfaction.

Satisfaction Level	HAI	non-HAI	Total
Highly Dissatisfied	46(40.0%)	19(2.0%)	65(6.2%)
Dis-satisfied	39(33.9%)	18(1.9%)	57(5.4%)
Average	3(2.6%)	33(3.5%)	36(3.4%)
Satisfied	15(13.0%)	588(62.6%)	603(57.1%)
Highly Satisfied	12(10.5%)	282(30.0%)	294(27.9%)
Total	**115(100%)**	**940(100%)**	**1055(100%)**

4.1.4 Relationship of the prevalence of HAI with contributing Factors

The following sub-sections will show the differences of the prevalence of hospital acquired infections (HAI) with the different levels of the factors (i.e. socio-demographic factors, patient's factors, causal factors, treatment factors, hospital factors. etc.) which were thought to determine the occurrences of HAI.

4.1.4.1 Relationship with Socio-demographic Factors

The relationship of the prevalence of HAI with socio-demographic factors had been discussed under following tables (Table-39 to Table-48):

As per the following table (Table-39) apparently it shows that the prevalence of HAI was more (11.8%) in female than their male counterpart among whom the prevalence was 10.1%. But this difference was not statistically significant.

Table-39: Prevalence of HAI by Sex of the Patients

Sex of the Patient	HAI		Total	Test Statistics
	Yes	No		
Male	56 (10.1%)	500 (89.9%)	556 (100.0%)	χ^2 = 0.831 p>0.05
Female	59 (11.8)	440 (88.2)	499 (100.0%)	
Total	**115 (10.9)**	**940 (89.1)**	**1055** (100.0%)	

Apparently it is seen in the following table (Table-40) that there were some differences of the prevalence of HAI in different religious groups but actually these differences were not statistically significant.

Table-40: Prevalence of HAI by Religion of the patients

Religion of the patient	HAI		Total	Test Statistics
	Yes	No		
Muslim	97 (10.7%)	806 (89.23%)	903 (100.0%)	χ^2 = 0.204 p>0.05
Hindus	11(11.7%)	83 (88.3%)	94(100.0%)	
Christian	4(11.4%)	31(88.6%)	35(100.0%)	
Others	3 (13.0%)	20 (87.0%)	23(100.0%)	
Total	**115** (10.9%)	**940** (89.1%)	**1055** (100.0%)	

As per the following table (Table-41) the children of the highest proportion (16.1%) of mothers who had no education was being affected by HAI but the children of the lowest proportion (7.9%) of mothers had been affected by HAI who belonged to highest level (graduation or above) of education.

Table-41: Prevalence of HAI by Mother's education of the patients

Mother's education	HAI		Total	Test Statistics
	Yes	No		
No education	36 (16.1%)	188(83.9%)	224(100.0%)	χ^2 = 17.224 p=0.002
Primary	34(14.8%)	195(85.2%)	229(100.0%)	
VI-to-X	21(7.1%)	277(92.8%)	298(100.0%)	
SSC & HSC	17(7.9%)	199(92.1%)	216(100.0%)	
Graduate & above	7(7.9%)	81(92.1%)	88 (100.0%)	
Total	**115** (10.9%)	**940** (89.1%)	**1055** (100.0%)	

It is evident from the following table (Table-42) that the children of the 15.6% fathers who had no education was being affected by HAI but among the fathers who had graduation and above level of education only 7.0% children was affected by HAI. The difference of the prevalence of HAI was found significantly different with the differences of education levels of fathers.

Table-42: Prevalence of HAI by Father's education of the patients

Father's education	HAI		Total	Test Statistics
	Yes	No		
No education	27(15.6%)	146 (84.4%)	173 (100.0%)	χ^2 = 10.589 p= 0.032
Primary	33 (14.1%)	201 (85.9%)	234 (100.0%)	
VI-to-X	28 (8.9%)	286 (91.1%)	314 (100.0%)	
SSC & HSC	20 (8.5%)	214 (91.5%)	234 (100.0%)	
Graduate & above	7 (7.0%)	93 (93.0%)	100 (100.0%)	
Total	**115** (10.9%)	**940** (89.1%)	**1055** (100.0%)	

As per the following table (Table-43) it is shown that the prevalence of HAI was highest (11.7%) among the pediatric patients whose mothers were factory workers and lowest among the patients whose mothers were engaged in service but this difference was not statistically significant.

Table-43: Prevalence of HAI by Mother's occupation of the patients

Mother's occupation	HAI		Total	Test Statistics
	Yes	No		
House wife	79 (10.8%)	649 (89.1%)	728 (100.0%)	χ^2 = 0 .174 p>0.05
Factory workers	18 (11.7%)	136 (88.3%)	154 (100.0%)	
Service	11(10.0%)	98 (90.0%)	109 (100.0%)	
Others	7(10.9%)	57(89.1%)	64 (100.0%)	
Total	**115** (10.9%)	**940** (89.1%)	**1055** (100.0%)	

As per the following table (Table-44) it is shown that the prevalence of HAI was highest (18.0%) among the pediatric patients whose fathers were engaged in other nonspecific occupation and lowest (9.8%) among the patients whose fathers were engaged in service. But this difference was statistically non-significant.

Table-44: Prevalence of HAI by Father's occupation of the patients

Father's occupation	HAI		Total	Test Statistics
	Yes	No		
Agriculture	36 (11.4%)	279(88.6%)	315 (100.0%)	χ^2 = 3.46 p>0.05
Day laborer	12(11.9%)	89(88.1%)	101(100.0%)	
Factory worker	31(9.9%)	282(90.1%)	313(100.0%)	
Service	27(9.8%)	249(90.2%)	276(100.0%)	
Others	9(18.0%)	41(82.0%)	50(100.0%)	
Total	**115** (10.9%)	**940** (89.1%)	**1055** (100.0%)	

The following table (Table-45) describes that the prevalence of HAI was significantly higher among the children of smoker mothers than the children of non-smoker mothers. Among the children of regular smoker mother the proportion of HAI was 25.0% but among the children of non-smoker mother it was only 10.5%.

Table-45: Prevalence of HAI by Mother's smoking habit of the patients

Mother's smoking habit	HAI		Total	Test Statistics
	Yes	No		
Non smoker	107(10.5%)	912(89.5%)	1019(100.0%)	χ^2 = 5.148 $p < 0.05$
Irregular smoker	4(20.0%)	16(80.0%)	20(100.0%)	
Regular smoker	4(25.0%)	12(75.0%)	16(100.0%)	
Total	**115** (10.9%)	**940** (89.1%)	**1055** (100.0%)	

The following table (Table-46) describes that the prevalence of HAI was significantly higher among the children of smoker fathers than the children of non-smoker fathers. Among the children of chain smoker father the proportion of HAI was 16.3% but among the children of non-smoker father it was 8.2%.

Table-46: Prevalence of HAI by Father's smoking habit of the patients

Father's smoking habit	HAI	Total	Test Statistics	
	Yes	No		
Non smoker	36 (8.2%)	405 (91.8%)	441(100.0%)	χ^2 = 8.394 p= 0.039
Irregular smoker	24 (10.6%)	202 (89.4%)	226 (100.0%)	
Regular smoker	38 (13.4%)	246 (86.6%)	284(100.0%)	
Chain smoker	17 (16.3%)	87(83.7%)	104 (100.0%)	
Total	**115** (10.9%)	**940** (89.1%)	**1055** (100.0%)	

It is evident from the following table (Table-47) that the prevalence of HAI was significantly higher (12.9%) among the patients of bigger family (>5 members) than the prevalence among the patients of smaller family (up to 5 members) (8.1%).

Table-47: Prevalence of HAI by Family size of the pediatric patients

Family size	HAI		Total	Test Statistics
	Yes	No		
Upto 5	36 (8.1%)	406 (91.9%)	442 (100.0%)	χ^2 =5.948 p= 0.015
>5	79 (12.9%)	534(87.1%)	613 (100.0%)	
Total	**115** (10.9%)	**940** (89.1%)	**1055** (100.0%)	

As per the following table (Table-48) apparently it is seen that there was differences of prevalence of HAI among the rural (10.1%), semi urban (11.0%) and urban (12.6%) pediatric patients but there was no evidence of significances of this differences of prevalence of HAI.

Table-48: Prevalence of HAI by Residence of the pediatric patients

Residence of patients	HAI		Total	Test Statistics
	Yes	No		
Rural	50 (10.1%)	443(89.9%)	493 (100.0%)	χ^2 =0.884 p> 0.05
Semi urban	41(11.0%)	331(89.0%)	372 (100.0%)	
Urban	24(12.6%)	166(87.4%)	190 (100.0%)	
Total	**115** (10.9%)	**940** (89.1%)	**1055** (100.0%)	

4.1.4.2 Relationship with Patient's Factors

The relationship of the prevalence of HAI with patient's factors had been discussed under following tables (Table-49 to Table-59):

As per the following table (Table-49) significantly higher number (14.7%) of pediatric patients delivered by CS operation were being affected by HAI than their counterpart who born by normal vaginal delivery (9.6%).

Table-49: Prevalence of HAI by Birth history of the pediatric patients

Birth history	HAI		Total	Test Statistics
	Yes	No		
Normal	75 (9.6%)	708 (90.4%)	783 (100.0%)	χ^2 =5.464 p= 0.019
CS Operation	40 (14.7%)	232 (85.3%)	272 (100.0%)	
Total	**115** (10.9%)	**940** (89.1%)	**1055** (100.0%)	

It is found from the following table (Table-50) that 19.8% severe anemic patients was found to develop HAI, whereas only 4.3% patients having normal range of hemoglobin were suffering from HAI. Among the moderate and mild anemic group of pediatric patients the prevalence of HAI were 17.0% and 7.8% respectively. The difference of prevalence of HAI among the four groups in terms of hemoglobin level was found statistically significant. (χ^2 =32.55, p= 0.000).

Table-50: Prevalence of HAI by anemic status of the pediatric patients

Family size	HAI		Total	Test Statistics
	Yes	No		
Severe anemic	39 (19.8%)	158 (80.2%)	197 (100.0%)	χ^2 =43.205 p= 0.000
Moderate anemic	39 (17.0%)	190(83.0%)	229 (100.0%)	
Mild anemic	22(7.8%)	259(92.2%)	281(100.0%)	
Normal	15(4.3%)	333(95.7%)	348(100.0%)	
Total	**115** (10.9%)	**940** (89.1%)	**1055** (100.0%)	

As per the following table (Table-51) the prevalence of HAI was highest (14.1%) among those pediatric patients who had got admitted with congenital anomalies and was lowest (7.4%) among those who were admitted with urinary disease and nonspecific fever. Statistically significant differences were found among the groups of patients on the basis of diseases on admission.

Table-51: Prevalence of HAI by Diseases on admission of the pediatric patients

Diseases on admission	HAI		Total	Test Statistics
	Yes	No		
Congenital anomalies	9 (14.1%)	55 (85.9%)	64 (100.0%)	χ^2 =6.03 p= 0.0300
Respiratory disease	35 (12.7%)	241(87.3%)	276 (100.0%)	
Gastro-intes. disease	26 (12.5%)	182 (87.5%)	208 (100.0%)	
Urinary disease	22 (11.2%)	174 (88.8%)	196 (100.0%)	
Nonspecific fever	12 (7.4%)	150 (92.6%)	162 (100.0%)	
Others	11(7.4%)	138 (92.6%)	149 (100.0%)	
Total	**115** (10.9%)	**940** (89.1%)	**1055** (100.0%)	

The following table (Table-52) indicates that prevalence of HAI was found significantly higher (12.9%) among those patients who were suffering by one or more underlying diseases which were not present at the time of admission than their counterpart (8.4%) who were not suffering from any sorts of underlying diseases.

Table-52: Prevalence of HAI by Presence of underlying diseases

Presence of Underlying disease other than the disease on admission	HAI		Total	Test Statistics
	Yes	No		
Yes	75 (12.9%)	506 (87.1%)	581(100.0%)	χ^2 =5.370 p= 0.020
No	40 (8.4%)	434 (91.6%)	474(100.0%)	
Total	**115** (10.9%)	**940** (89.1%)	**1055** (100.0%)	

It was evident from the following table (Table-53) that only 4.2% of the pediatric patients were affected by HAI who were visited by up to 2 visitors but on the other hand 15.4% patients were affected by HAI who were visited by 3 or more visitors. The difference of prevalence among the two groups was found statistically significant (χ^2 =32.55, p= 0.000).

Table-53: Prevalence of HAI by number of visitors

Number of visitors	HAI		Total	Test Statistics
	Yes	No		
Up to 2	18(4.2%)	407(95.8%)	425(100.0%)	χ^2 =32.55 p= 0.000
3 and above	97(15.4%)	533(84.6%)	630(100.0%)	
Total	**115** (10.9%)	**940** (89.1%)	**1055** (100.0%)	

It was evident from the following table (Table-54) that only 2.8% of the pediatric patients were affected by HAI who were given care by only one attendant but on the other hand 13.4% patients were affected by HAI who were given care by 2 or more attendants. The difference of prevalence among the two groups was found statistically significant (χ^2 =22.13, p= 0.000).

Table-54: Prevalence of HAI by number of attendants

Number of Attendants	HAI		Total	Test Statistics
	Yes	No		
Up to 1	7(2.8%)	243(97.2%)	250(100.0%)	χ^2 =22.13 p= 0.000
2 and above	108(13.4%)	697(86.6%)	805(100.0%)	
Total	**115** (10.9%)	**940** (89.1%)	**1055** (100.0%)	

It is evident from the following table (Table-55) that significant difference was found between the prevalence of HAI and the relationship of the pediatric patients with their care givers. Lowest prevalence (8.3%) was found among those patients who were given care by their mothers. Prevalence of HAI among the pediatric patients who were attended by grandmother, father and other person were 15.2%, 21.5% and 21.2% respectively.

Table-55: Prevalence of HAI by Relationship with the attendants of the pediatric patients

Relation with the care giver	HAI		Total	Test Statistics
	Yes	No		
Mother	65 (8.3%)	716(91.7%)	781(100.0%)	χ^2 =23.209 p= 0.000
Grandmother	21(15.2%)	117(84.8%)	138 (100.0%)	
Father	11(21.5%)	40(78.5%)	51(100.0%)	
Other person	18(21.2%)	67(78.8%)	85 (100.0%)	
Total	**115** (10.9%)	**940** (89.1%)	**1055** (100.0%)	

It is evident from the following table (Table-56) that the prevalence of HAI was significantly different with the differences of personal hygienic status of the attendants. The highest (16.2%) prevalence was found among those patients whose attendant's personal hygienic status were very unhygienic and the lowest (8.8%) prevalence was found among those patients whose attendant's personal hygienic status were adequately hygienic.

Table-56: Prevalence of HAI by Personal hygienic status of the attendants of the patients

Personal hygienic status of the attendants	HAI		Total	Test Statistics
	Yes	No		
Adequately hygienic	20 (8.7%)	210 (91.3%)	230 (100.0%)	χ^2 =3.948 p<0.05
Hygienic	17 (9.1%)	170 (90.9%)	187(100.0%)	
Average	28 (11.5%)	215 (88.5%)	243 (100.0%)	
Unhygienic	26 (11.9%)	193 (88.1%)	219 (100.0%)	
Very unhygienic	24(13.6%)	152 (86.4%)	176 (100.0%)	
Total	**115**	**940**	**1055** (100.0%)	

As per the following table (Table-57) apparently it seems that higher (11.9%) prevalence of HAI was found among the pediatric patients who had been treated by antibiotics within last three months than their counterparts (8.2%) who had not been treated by antibiotics within last three months. But the significance was not statistically significant.

Table-57: Prevalence of HAI by History of antibiotics within last 3 months

History of antibiotics within last 3 months	HAI		Total	Test Statistics
	Yes	No		
Yes	92 (11.9%)	681(88.1%)	773 (100.0%)	χ^2 =2.985 p >0.05
No	23 (8.2%)	259 (91.8%)	282 (100.0%)	
Total	**115** (10.9%)	**940** (89.1%)	**1055** (100.0%)	

The following table (Table-58) shows that significantly higher (14.7%) prevalence of HAI was found among the pediatric patients who had been hospitalized within last three months than their counterparts (9.7%) who had not been hospitalized within last three months.

Table-58: Prevalence of HAI by History of Hospitalization within 3 months

History of Hospitalization within 3 months	HAI		Total	Test Statistics
	Yes	No		
Yes	37 (14.7%)	215 (85.3%)	252 (100.0%)	χ^2 =4.876 p= 0.027
No	78 (9.7%)	725 (90.3%)	803 (100.0%)	
Total	**115** (10.9%)	**940** (89.1%)	**1055** (100.0%)	

It is evident from the following table (Table-59) that significantly higher (20.4%) prevalence of HAI was found among the pediatric patients who had undergone surgery within last three months than their counterparts (10.4%) who had not undergone surgery within last three months.

Table-59: Prevalence of HAI by History of Surgery within last 3 months

History of Surgery within last 3 months	HAI		Total	Test Statistics
	Yes	No		
Yes	11(20.4%)	43(79.6%)	54(100.0%)	χ^2 =5.255 p= 0.022
No	104(10.4%)	897(89.6%)	1001(100.0%)	
Total	**115** (10.9%)	**940** (89.1%)	**1055** (100.0%)	

4.1.4.3 Relationship with Treatment Factors

The relationship of the prevalence of HAI with treatment factors had been discussed under following tables (Table-60 to Table-67):

The following table (Table-60) states that the higher prevalence (14.0%) of HAI was found among surgical patients than their non-surgical counterpart who had not undergone any sorts of surgery among whom the prevalence was only 9.2%. The difference of prevalence of HAI with the difference of major specialty of treatment was found statistically significant (χ^2 =5.72, p= 0.012).

Table-60: Prevalence of HAI by Major specialty of treatment

Major specialty of treatment	HAI		Total	Test Statistics
	Yes	No		
Medicine	63(9.2%)	621(90.8%)	684 (100.0%)	χ^2 =5.72 p= 0.012
Surgery	52(14.0%)	319(86.0%)	371 (100.0%)	
Total	**115** (10.9%)	**940** (89.1%)	**1055** (100.0%)	

As per the following table (Table-61) it is seen that the prevalence of HAI was significantly higher (20.5%) among the patients who had undergone surgery on emergency basis than their counterpart (10.8%) who had undergone planned routine surgery.

Table-61: Prevalence of HAI by Mode of decision for surgery

Mode of decision for surgery	HAI		Total	Test Statistics
	Yes	No		
Emergency surgery	25 (20.5%)	97(79.5%)	122 (100.0%)	χ^2 =6.325 p= 0.012
Planned routine surgery	27(10.8%)	222 (89.2%)	249 (100.0%)	
Total	**52** (14.0%)	**319** (86.0%)	**371** (100.0%)	

As per the following table (Table-62) highest prevalence (19.3%) was found among the patients who had under gone gastro intestinal operation and other than the non-surgical patients the lowest prevalence (8.1%) was found among the patients who had under gone neurological operations. Significant difference was found between the types of operations done and the prevalence of HAI.

Table-62: Prevalence of HAI by Types of operation done

Types of operation	HAI		Total	Test Statistics
	Yes	No		
Gastro-Intest. operation	23(19.3%)	96(80.7%)	119 (100.0%)	
Urogenital Operation	16(15.5%)	87(84.5%)	103 (100.0%)	
Neurological operation	7(8.1%)	80(91.9%)	87(100.0%)	χ^2 =13.816 p= 0.017
Soft tissue Operation	4(9.8%)	37(90.2%)	41(100.0%)	
Others	2(9.5%)	19(90.5%)	21(100.0%)	
None	63(9.2%)	621(90.8%)	684 (100.0%)	
Total	**115** (10.9%)	**940**(89.1%)	**1055** (100.0%)	

As per the following table (Table-63) it was found that there were differences of prevalence of HAI with the differences of therapeutic procedure and this difference was proved statistically significant. Highest (15%) prevalence of HAI was found among those patients who were under catheterization and the second (12.2%) prevalence of HAI was found among the patients who were given nasogastric feeding.

Table-63: Prevalence of HAI by Types of Therapeutic procedure

Types of Therapeutic procedure	HAI		Total	Test Statistics
	Yes	No		
Catheterization	31(15.2%)	173(84.8%)	204(100.0%)	
Nasogastric Feeding	37(12.2%)	266(87.8%)	303(100.0%)	
Nasogastric Suction	19(9.0%)	192(91.0%)	211(100.0%)	
Biopsy	12(8.9%)	123(91.1%)	135(100.0%)	χ^2 =7.677
Intubation/Ventilation	7(8.7%)	74(91.3%)	81(100.0%)	$p > 0.05$
Endoscopic examin.	5(7.6%)	61(92.4%)	66(100.0%)	
Others	4(7.3%)	51(92.7%)	55(100.0%)	
Total	**115** (10.9%)	**940** (89.1%)	**1055** (100.0%)	

The following table (Table-64) depicts that significantly higher (22.4%) prevalence of HAI was found among the pediatric patients who were suffering from immunosuppressive condition than their counterparts (10.1%) who were not suffering from such conditions.

Table-64: Prevalence of HAI by Presence of Immunosuppressive condition

Presence of Immunosuppressive condition	HAI		Total	Test Statistics
	Yes	No		
Yes	15 (22.4%)	52 (77.6%)	67(100.0%)	χ^2 = 9.721
No	100 (10.1%)	888 (89.9%)	988 (100.0%)	$p = 0.022$
Total	**115** (10.9%)	**940** (89.1%)	**1055** (100.0%)	

It was evident from the following table (Table-65) that prevalence of HAI was higher (18.6%) among the pediatric patients who were under immunosuppressive therapy than their counterparts (10.4%) who were not under immunosuppressive therapy. The difference was found marginally significant.

Table-65: Prevalence of HAI by Immunosuppressive therapy

Immunosuppressive therapy	HAI		Total	Test Statistics
	Yes	No		
Yes	11(18.6%)	48(81.4%)	59(100.0%)	χ^2 =3.858
No	104(10.4%)	892(89.6%)	996(100.0%)	$p = 0.049$
Total	**115** (10.9%)	**940** (89.1%)	**1055** (100.0%)	

It was revealed from the following table (Table-66) only 8.0% of the pediatric patients whose operation completed within one hour found affected by HAI. On the other hand 15.9% of those patients had been affected by HAI who needed more than one hour to complete their operation. The difference of prevalence of HAI between these two groups was statistically significant. (χ^2 =3.9178, $p< 0.05$)

Table-66: Prevalence of HAI by Duration of Operation

Duration of Operation	HAI		Total	Test Statistics
	Yes	No		
Up to 1 hour	7(8.0%)	81(92.0%)	88(100.0%)	χ^2 =3.9178 $p< 0.05$
More than 1 hour	45(15.9%)	238(84.1%)	283(100.0%)	
Total	**52** (14.0%)	**319** (86.0%)	**371** (100.0%)	

It was also found from the following table (Table-67) only 8.6% of the pediatric patients were affected by HAI who had to wait for operation for up to 3 days. From the second group 11.6% patients were affected by HAI who had to wait for operation for 4 to 6 days. On the other hand 19.4% patients were found to be affected by HAI who had to wait for operation for 7days or more. The difference of prevalence of HAI among these three groups was found statistically significant. (χ^2 =7.083, $p= 0.029$).

Table-67: Prevalence of HAI by Pre-operative Waiting period for Operation

Waiting period for Operation	HAI		Total	Test Statistics
	Yes	No		
Up to 3 days	10(8.6%)	106(91.4%)	116(100.0%)	χ^2 =7.083 $p= 0.029$
4 to 6 days	11(11.6%)	84(88.4%)	95(100.0%)	
7 days and more	31(19.4%)	129(80.6%)	160(100.0%)	
Total	**52** (14.0%)	**319** (86.0%)	**371** (100.0%)	

4.1.4.4 Relationship with Hospital Factors

The relationship of the prevalence of HAI with hospital factors had been discussed under following tables (Table-68 to Table-73):

The following table (Table -68) states that the prevalence of HAI was highest (11.5%) in govt. hospital (DMCH) and lowest (9.6%) in profit based private hospital (BMCH). In non-profit based private hospital (DSH) the prevalence of HAI was in between these two (11.0%). But these differences of HAI among the three hospitals were not statistically significant (χ^2 = 0.866, p>0.05).

Table-68: Prevalence of HAI by Ownership and size of the hospitals

Ownership of hospital	HAI		Total	Test Statistics
	Yes	No		
Govt. (DMCH)	19 (11.5%)	146 (88.5%)	165 (100.0%)	χ^2 = 0.866 p>0.05
Non-profit based private (DSH)	84 (11.0%)	681 (89.0%)	765 (100.0%)	
Profit based Private (BMCH)	12(9.6%)	113 (90.4%)	125 (100.0%)	
Total	**115 (10.9)**	**940 (89.1)**	**1055** (100.0%)	

As per the following table (Table-69) It is evident that that the prevalence of HAI was significantly higher (14.2%) among those patients who were served without adequate hand washing practice than their counterparts (7.0%) who were served after adequate hand washing practice.

Table-69: Prevalence of HAI by Hand washing practice of the Doctors

Hand washing practice of the Doctors	HAI		Total	Test Statistics
	Yes	No		
Adequately practicing	34 (7.0%)	450 (93.0%)	484(100.0%)	χ^2 =13.830 p= 0.000
Not adequat. practicing	81(14.2%)	490 (85.8%)	571(100.0%)	
Total	**115** (10.9%)	**940** (89.1%)	**1055** (100.0%)	

It is seen from the following table (Table-70) that the prevalence of HAI was significantly higher (16.1%) among those patients who were served by the doctors without using face mask than their counterparts (7.2%) who were served by the doctors after using face mask properly.

Table-70: Prevalence of HAI by Face mask using practice of the Doctors

Face mask using practice of the Doctors	HAI		Total	Test Statistics
	Yes	No		
Served by the doctors with using face mask	44(7.2%)	569(92.8%)	613(100.0%)	χ^2 =20.877 p= 0.000
Served by the doctors without using face mask	71(16.1%)	371(83.9%)	442(100.0%)	
Total	**115** (10.9%)	**940** (89.1%)	**1055**(100.0%)	

It is evident from the following table (Table-71) that the prevalence of HAI was significantly higher (14.2%) among those patients who were served by the doctors without wearing gown than their counterparts (8.9%) who were served by the doctors after wearing gown practice properly.

Table-71: Prevalence of HAI by Gown Wearing practice of the Doctors

Gown Wearing practice of the Doctors	HAI		Total	Test Statistics
	Yes	No		
Served by the doctors with wearing gown	58 (8.9%)	596(91.1%)	654(100.0%)	χ^2 =7.315 p= 0.07
Served by the doctors without wearing gown	57(14.2%)	344(85.8%)	401(100.0%)	
Total	**115** (10.9%)	**940** (89.1%)	**1055** (100.0%)	

The following table (Table-72) shows that the prevalence of HAI was significantly different with the differences of cleanliness status of pillow cover of the patients. The highest (16.3%) prevalence was found among those patients whose pillow covers were very dirty and the lowest (7.5%) prevalence was found among those patients whose pillow covers were very clean.

Table-72: Prevalence of HAI by Cleanliness status of pillow cover of the patients

Cleanliness status of pillow cover	HAI		Total	Test Statistics
	Yes	No		
Very clean	8 (7.5%)	98 (92.5%)	106(100.0%)	
Clean	26 (7.6%)	315 (92.4%)	341(100.0%)	
Average	8 (8.1%)	91(91.9%)	99(100.0%)	χ^2=12.911
Dirty	48 (13.5%)	308 (86.5%)	356(100.0%)	p= 0.12
Very dirty	25 (16.3%)	128 (83.7%)	153(100.0%)	
Total	**115** (10.9%)	**940** (89.1%)	**1055** (100.0%)	

The following table (Table-73) shows that the prevalence of HAI was significantly different with the differences of cleanliness status of bed sheet of the patients. The highest (16.2%) prevalence was found among those patients whose bed sheets were very dirty and the lowest (8.8%) prevalence was found among those patients whose bed sheets were very clean.

Table-73: Prevalence of HAI by Cleanliness status of bed sheet of the patients

Cleanliness status of bed sheet	HAI		Total	Test Statistics
	Yes	No		
Very clean	10 (8.8%)	103 (9.1%)	113(100.0%)	
Clean	25 (7.6%)	304(92.4%)	329(100.0%)	
Average	11(8.7%)	116 (91.3%)	127(100.0%)	χ^2 =11.170
Dirty	45 (13.3%)	293 (86.7%)	338(100.0%)	p= 0.025
Very dirty	24(16.2%)	124(83.8%)	148(100.0%)	
Total	**115** (10.9%)	**940** (89.1%)	**1055** (100.0%)	

4.1.5. Impact of HAI on Treatment Outcomes

As the increase of hospital acquired infections proportionally increases the LOHS, treatment cost, mortality and satisfaction level, so these outcomes had been considered as the impact or consequences of HAI in this study.

As per the following table (Table-74) it could be stated that satisfaction level of the respondents were found significantly different with the differences of prevalence of hospital acquired infections. Highest number (62.6%) of the respondents from non-HAI group was found satisfied whereas highest number (40.0%) of the respondents from HAI group was found highly dissatisfied.

Table-74: Satisfaction level of the respondents by Prevalence of HAI

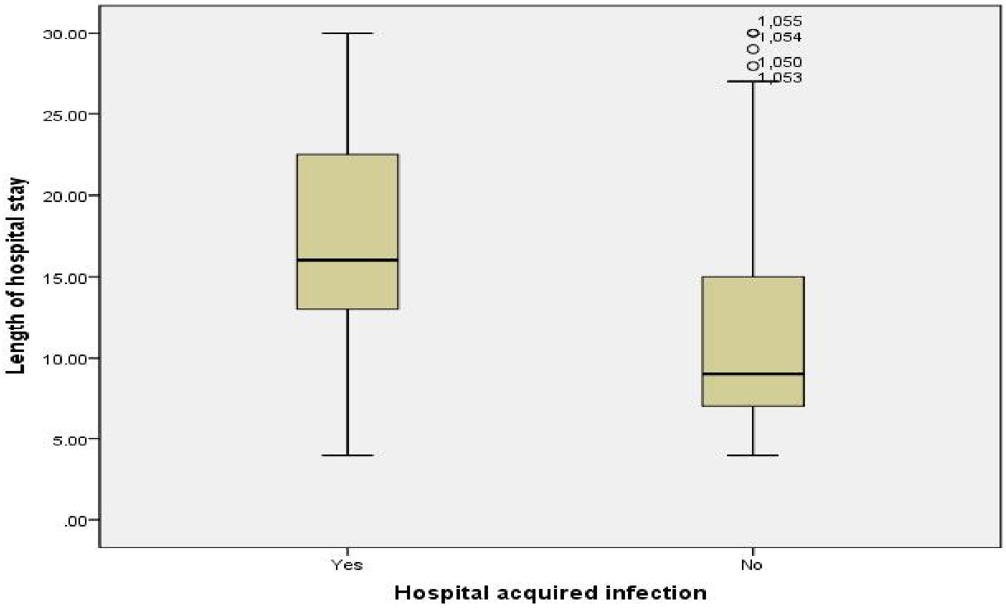
HAI Status	Satisfaction level					Total
	Highly Dissatisfied	Dis-satisfied	Average	Satisfied	Highly Satisfied	
HAI	46 (40.0%)	39 (33.9%)	3 (2.6%)	15 (13.4%)	12 (10.4%)	115 (100.0%)
Non-HAI	19 (2.0%)	18 (1.9%)	33 (3.5%)	588 (62.6%)	282 (30.0%)	940 (100.0%)
Total	**65** (6.2%)	**57** (5.4%)	**36** (3.4%)	**603** (57.2%)	**294** (27.9%)	**1055 (100.0%)**
Test Statistics	χ^2 = 492.320, p=0.000					

It is evident from the following table (Table-75) that outcome of the treatment was found significantly different among the HAI and non-HAI patients. Among the non-HAI patients cure rate was 97.1% but among the HAI patients the cure rate was only 89.6%. Reversely higher mortality (10.4%) was found among the patients who had been affected by HAI and among the Non-HAI patients the mortality was only 2.9%. Mortality among the HAI and Non-HAI patients was found significantly significant.

Table-75: Outcome of the treatment by Prevalence of HAI

HAI Status	Outcome of the treatment		Total	Test Statistics
	Death	**Cure**		
HAI	12 (10.4%)	103 (89.6%)	115(100.0%)	χ^2 = 15.616 p=0.000
Non-HAI	28 (2.9%)	912 (97.1%)	940(100.0%)	
Total	**40 (3.8%)**	**1015 (96.2%)**	**1055 (100.0%)**	

Figure-11: Normality test of Length of Hospital Stay (LOHS)



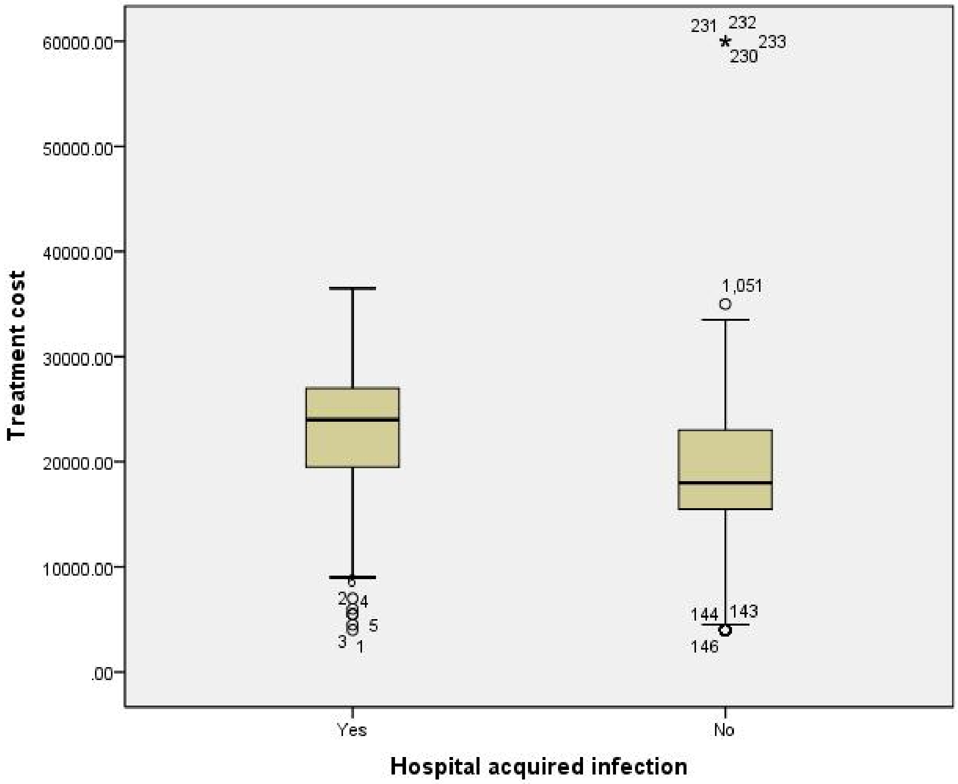
As per the above normality test done on Length of Hospital Stay the data were not normally distributed so the non-parametric Mann-Whitney U test was done. As per the following table (Table-76) Length of hospital stay was found significantly associated with the prevalence of Hospital Acquired Infection (HAI).

Table-76: Length of Hospital Stay by Prevalence of HAI

Ranks of Mann-Whitney U test

	Hospital acquired infection	N	Mean Rank	Sum of Ranks
Length of hospital stay in 6 groups	Yes	115	789.20	90757.50
	No	940	496.05	466282.50
Total		**1055**		
Test Statistics	Mann-Whitney U: 24012.500, Asymp. Sig. (2-tailed): .000			

Figure-12: Normality test for treatment cost



As per the above normality test done on treatment cost done the data were not normally distributed so the non-parametric Mann-Whitney U test was done. As per the following table (Table-77) the treatment cost was found significantly associated with the prevalence of Hospital Acquired Infection (HAI).

Table-77: Treatment Cost by Prevalence of HAI

Ranks of Mann-Whitney U test

	Hospital acquired infection	**N**	**Mean Rank**	**Sum of Ranks**
Treatment cost in 4 groups	Yes	115	740.87	85199.50
	No	940	501.96	471840.50
Total		**1055**		
Test Statistics	Mann-Whitney U: 29570.500, Asymp. Sig. (2-tailed): .000			

As per Kruskal Walis test the following table (Table-78) reveals that the Length of Hospital Stay was found significantly associated with the types of Hospital Acquired Infection (HAI).

Table-78: Length of Hospital Stay by Types of HAI

Ranks of Kruskal Walis test			
	Type of HAI	**N**	**Mean Rank**
Length of hospital stay in 6 groups	Surgical wound infection	26	24.37
	Urinary Tract Infection	24	62.25
	Septicaemia/Bacteraemia	17	77.74
	Skin and soft Tissue Infection	14	61.50
	Respiratory Tract Infection	13	73.50
	Cannula associated infection	9	54.28
	Others	12	76.33
	Total	**115**	
Test Statistics: Kruskal Wallis Test- 39.635, Asymp. Sig. .000			

As per Kruskal Walis test the following table (Table-79) reveals that the Treatment Cost was found significantly associated with the types of Hospital Acquired Infection (HAI).

Table-79: Treatment Cost by Types of HAI

Ranks of Kruskal Walis test			
	Type of HAI	**N**	**Mean Rank**
Treatment Cost in 4 groups	Surgical wound infection	26	15.71
	Urinary Tract Infection	24	37.52
	Septicaemia/ Bacteraemia	17	57.18
	Skin and soft Tissue Infection	14	90.86
	Respiratory Tract Infection	13	90.92
	Cannula associated infection	9	87.89
	Others	12	95.33
	Total	**115**	
Test Statistics	Kruskal Walis test: 99.635,df-6 Asymp. Sig. .000		

4.1.5. Logistic Regression analysis:

Logistic regression analysis had been shown in the following two tables to measure the independent risk for occurring HAI.

4.1.5.1 **Regression analysis** (Table-80) **showing the likelihood of occurring HAI for socio-demographic and treatment factors:**

4.1.5.1.1 Age and likelihood of hospital acquired infection:

Compared to 11 – 15 years old respondents, 1 year old respondents have 4.1 times the likelihood of hospital acquired infection; 2-5 years old respondents have 2.9 times the likelihood of hospital acquired infection and 6-10 years old respondents have 1.2 times the likelihood of hospital acquired infection. Thus it is seen that as age of the respondents' decreases likelihood of hospital acquired infection increases. Odd ratio for the age groups 1 year and 2-5 years are statistically significant but for the age group 6-10 years, it is not.

4.1.5.1.2 Income group and likelihood of hospital acquired infection:

Regarding income group and likelihood of hospital acquired infection, respondents falling in the 1st Income Quartile have 2.2 times the likelihood of hospital acquired infection as last (4th) Income Quartile. Respondents falling in the 2nd Income Quartile have 2.7 times the likelihood of hospital acquired infection as last (4th) Income Quartile. Respondents falling in the 3rd Income Quartile have .9 times the likelihood of hospital acquired infection as last (4th) Income Quartile. It is seen that as income decreases, the likelihood of hospital acquired infection increases excepting the 3rd Income Quartile where the likelihood is a little less than the highest Income Quartile. Odds ratio for the 2nd income quartile is statistically significant but the odds ratio for the 1st and 3rd quartiles are not statistically significant.

4.1.5.1.3 Gender and likelihood of hospital acquired infection:

Gender and likelihood of hospital acquired infection females have 1.4 times the likelihood as males; but it is not statistically significant.

4.1.5.1.4 Duration of operation and likelihood of hospital acquired infection:

Compared to respondents with 1 hour duration of operation, respondents whose operation time was 2-3 hours have 1.4 times the likelihood of hospital acquired infection, respondents whose operation time was more than 3 hours have 1.7 times the likelihood of hospital acquired infection. Thus as duration of operation increases, likelihood of hospital acquired infection also increases. But the odds ratio for none of the groups is statistically significant.

4.1.5.1.5 Waiting time and likelihood of hospital acquired infection:

Respondents with 4-6 days waiting time have slightly less (0.8 times) likelihood of hospital acquired infection compared to those with less than 4 days waiting time. On the other hand respondents with more than 6 days waiting time have 1.4 times likelihood of hospital acquired infection. However, the odds ratios are not statistically significant.

4.1.5.1.6 LOHS and likelihood of hospital acquired infection:

Length of hospital stay more than 5 days increases the likelihood that someone will have hospital acquired infection by 3.5 times as hospital stay more up to 5 days. The result is statistically significant.

Table-80: Logistic regression for predicting independent risk of socio-demographic and treatment factors for developing of HAI

Variables in the Equation						
	B	**S.E.**	**Wald**	**df**	**Sig.**	**Exp(B)**
Age in years			9.521	3	.023	
1 year	1.413	.562	6.332	1	.012	4.109
2 – 5 years	1.053	.535	3.871	1	.049	2.865
6 – 10 years	.216	.648	.111	1	.739	1.241
11 – 15 years						**rc**
Income Quartile (taka)			8.533	3	.036	
Q1:< 11000 taka	.778	.454	2.937	1	.087	2.176
Q2:>=11000 - <16000	1.010	.444	5.178	1	.023	2.744
Q3:>=16000 - <20000	-.101	.535	.035	1	.851	.904
Q4:>=16000 - <20000						**rc**
Gender						
Female	.352	.326	1.170	1	.279	1.422
Male						**rc**
Duration of operation			.337	2	.845	
1 hour						**rc**
2 – 3 hours	.361	.761	.225	1	.635	1.434
4 hours	.522	.900	.337	1	.562	1.686
Waiting time in days			.956	2	.620	
Up to 3 days						**rc**
4 – 6 days	-.193	.730	.070	1	.792	.825
7 – 10 days	.336	.771	.190	1	.663	1.400
Length of hosp stay						
Up to 5 days						**rc**
Above 5 days	1.259	.633	3.954	1	.047	3.522
Constant	-4.89	.901	29.55	1	.000	.007

a. DV: hai (Hospital acquired infection), **b**. IDV: agegr, inc_quartile, Sex, durop, waiting_time, lohstay. **c: rc- Reference category**

4.1.5.2 Regression analysis (Table-81) showing the likelihood of occurring HAI for patient's factors:

4.1.5.2.1 Number of visitors and likelihood of hospital acquired infection:

Compared to 1 visitor, 2 or more visitors have 2.4 times the likelihood of hospital acquired infection. Thus it was seen that as number of the visitors increase likelihood of hospital acquired infection increases. Odd ratio for 2 or more visitors (2.478) was statistically significant.

4.1.5.2.1 Number of attendants and likelihood of HAI

Compared to 1 attendant, 2 or more attendants have 21.8 times the likelihood of hospital acquired infection. As number of the attendant increase likelihood of hospital acquired infection highly increases. Odd ratio for 2 or more attendant (21.884) was strongly statistically significant.

4.1.5.2.1 Hemoglobin levels of the pediatric patients and likelihood of hospital acquired infection:

In the same time severe and moderately anemic group of pediatric patients were found to 6.1 times the likelihood of hospital acquired infection than there mild anemic and normal counterpart. So, as the level of hemoglobin level decreases likelihood of hospital acquired infection highly increases. Odd ratio for severe and moderately anemic patients (6.10) was found statistically significant.

Table-81: Logistic regression for predicting independent risk of patient's factors for developing of HAI

Variables in the Equation						
Number of visitors	**B**	**.E.**	**Wald**	**df**	**Sig.**	**Exp(B)**
1(rc)						
More than 1	.907	.327	7.719	1	.005	2.478
No. of attendants						
1(rc)						
More than 1	3.086	.412	55.974	1	.000	21.884
Hb level						
Severe and moderate anemic	1.810	.272	44.161	1	.000	6.109
Mild anemic and normal group				**rc**		
Constant	-6.237	.480	168.654	1	.000	.002

a.Dependent variables: hai_r , **b**. Independent variables: visitgrprl ,attengrpr, hbgrprl
c: **rc Reference category**

4.2 Discussions

The findings of the study titled- "*Hospital Acquired Infections among the Pediatric Patients in Tertiary Level Hospitals of Dhaka City: Extent, Determinants and, Impact on Cost and Hospital Management*" was discussed in the following sections in contrast with the finding of the others surveys and studies published in different national and international journals. The results of this study clearly indicated that HAIs impose a substantial burden on tertiary level hospitals, on infected patients and their informal care givers. The results provided important information on the nature, magnitude and distribution of the economic burden.

4.2.1 Extent of HAI:

It was found from this study that the overall prevalence of Hospital Acquired Infection (HAI) among 1055 pediatric patients admitted in all the three hospitals under study was (*Figure-6*) 10.9%, and overall incidence of HAI in all the three hospitals was 7.5 per 1000 hospital days (*Table-34*). Prevalence of HAI was 18.9% in Gulandaz's study among all age groups of patients in tertiary level hospitals.[23]After five years, Khan M.H. found that the prevalence was 15.5% in his study on similar group of patients in a selected tertiary level hospital.[26] Sharif found in his study that 54 (13.8%) respondents developed hospital-acquired infection out of 456 admitted patients.[88] Comparing the findings of the present study with the above mentioned previous studies, it can be concluded that the prevalence of HAI in the tertiary level hospitals of our country is declining to some extent. The findings of the present study were almost similar with a seven day period prevalence survey in Switzerland that included all patients in acute, sub-acute and chronic care settings. Overall prevalence of NI of that study was 11.3% in the 1928 patients studied, and ranged from 0% in ophthalmology to 23% in critical care units.[89] In other study in Denmark it was found that during the study period, 10.9% (55/506) patients (95% CI 8.2-13.6) developed one or several HAI during admittance. The overall incidence of HAI was 7.1 (62/3,568) per 1000 bed days at risk (95% CI 1.4-2.2). [90] In a multi country study at paediatric oncology hospitals in Europe on 5,031 patients, 12% of the patients were found to develop nosocomial infections. The overall incidence of nosocomial infections during study period was 6.27 infections per 1,000 patient days.[91] In a study at paediatric hospital in England 7.8% (95% CI: 7.0, 8.6) of patients were identified during the in-patient phase as having acquired one or more HAIs.[92] WHO reported that out of every 100 hospitalized patients at any given time, 7 in developed and 10 in developing countries will acquire at least one health care-associated infection.[74] It is obvious from the above references that, in global perspective the prevalence and incidence of HAI is declining with time. In our country though it is declining from the previous rate but it is still higher especially in the pediatric patients than that of developed countries at present.

4.2.1.1 Extent of HAI and Types of Hospitals:

The three hospitals under study were different by ownership and size (bed strength). Dhaka Medical College Hospital (DMCH) is a government owned hospital and larger than the other two hospitals under study. Dhaka Shishu Hospital (DSH) is a non-profit based private hospital and Bangladesh Medical College Hospital (BMCH) is a profit based private hospital; these two hospitals are smaller than DMCH. Highest prevalence (11.5%) of HAI was found in DMCH and the lowest (9.6%) was in BMCH, In DSH the prevalence of HAI was 10.9% (*Table-33*). Apparently it was found that the prevalence of HAI was different among the three hospitals. But the difference of the prevalence of HAI with the difference of the ownership of hospitals was not proved statistically significant (*Table-68*). The incidence of HAI was also different in the three hospitals, highest incidence of HAI (8.1 per 1000 bed-days) was found in DMCH and the lowest incidence (6.8 per 1000 bed-days) was found in BMCH. The incidence (7.5 per 1000 bed-days) of HAI in DSH was in between these two hospitals (*Table-34*). The findings of the present study was supported by a nosocomial survey on 28643 admitted patients in Australia that found significant association of infection rates with size and ownership of hospitals. The nosocomial infection prevalence rate increased from 4.2% in hospitals with 50-99 beds to 7.6% in hospitals with 500 or more beds. After adjusting for hospital size, public hospitals had significantly-higher prevalence (10.6%) of nosocomial infection than did private hospitals (6.3%).[93] In a point prevalence survey in Europe it was also found that the prevalence of HAIs varied according to the hospital type and varied considerably within each hospital type. Primary hospitals recorded the lowest HAI Prevalence of 4.8% (median HAI prevalence 3.9%, IQR 1.9-6.1%), in secondary hospitals HAI prevalence was 5.0% (median HAI prevalence 4.5% IQR 2.7-6.8%), in tertiary hospitals 7.2% (median HAI prevalence 6.9%, IQR 4.0-9.7%) and in specialized hospitals 6.0% (median HAI prevalence 4.0%, IQR 1.6-6.7%).[94] Oli AN in a study on relative prevalence of hospital-acquired infections in Nigeria found HAIs having more prevalence in government hospitals compared to other hospitals.[95] As per research design it was not the view of the present researcher to compare the prevalence among the three hospitals under study but still in the analysis process it was found that there was some differences in terms of prevalence among the three hospitals though it was not statistically proved. But the findings regarding difference of prevalence of HAI among the three hospitals under study had been supported by the previous studies in different parts of the world.

<u>4.2.1.2 Extent of HAI and Major specialty of Treatments:</u>

The present study was conducted on pediatric patients of both the medicine and surgery specialty. The prevalence of HAI was found higher (14.0%) among the surgical patients than the patients of medicine specialty who had not undergone any surgery among whom the prevalence was only 9.2% (*Figure-7&8*). The difference of prevalence with the difference of major specialty of treatment was found statistically significant (*Table-60*). The pediatric infectious disease journal of European society during their 4-year period study on 78,120 patients found occur 4,684 nosocomial infections. Prevalence of nosocomial infections varied from 0.17% to 14.0% on different wards or services. The highest rates (>5.6) were found in the surgery units.[96] As per a study published in American journal of infection control it was found that the patients with surgery had a statistically significantly higher prevalence (11.4%) of HAI than the group without surgery ($P < .001$).[97] As the chance of exposure of the body tissue and fluids to the external environments for the surgery patients is much higher than the non-surgical patients, so it is usual and logical that they would have the higher chance to be infected by hospital acquired infections. But the proportion could be minimized by strictly following WHO guidelines for safe surgery and by taking appropriate precautions in different stages of surgery.

4.2.1.3 Extent of HAI and Sites of infections:

As per the findings of the present study (*Figure-9*) it was found that highest number (24%) of the pediatric patients was affected by Surgical Wound Infection (SWI) and the lowest number (7%) was affected by Cannula Associated Infection. Second highest number (21%) of patients was affected by Urinary Tract Infection (UTI). Septicemia or Bacteremia was represented by 15% HAI patients. Skin & Soft Tissue Infection (SSTI) and Respiratory Tract Infections (RTI) were represented by 12% and 11% patients respectively. Sharif MSH found in his study that only four types of HAI were found among the respondents such as; 64.8% Surgical Site Infection (SSI) followed by 22.0% Urinary tract infection (UTJ), 9.3% Respiratory infection *(RI)* and 3.7% Skin and Soft tissue Infection (SSTI).[88] As per an US study on 110709 patients with 6290 nosocomial infections bloodstream infections (28%), pneumonia (21%), and urinary tract infections (15%) were most frequent and were almost always associated with use of an invasive device.[98] Sydnor ERM found in his study that the respiratory tract was the most common site of infection, followed by bloodstream, surgical wound, and urinary tract infection.[99] In a study of US oncology society it was found that Bloodstream infections- 28%, Ventilator-associated pneumonia-21%, Urinary tract infection (UTI)-15%, Lower respiratory infection-12%, Gastrointestinal, skin, soft tissue- and cardiovascular infections- 10%, Surgical-site infections- 7% and ENT infections-7%.[100] In a study on 4684 paediatric patients it was found that the proportional frequencies of the sites of infections were: 35% gastrointestinal; 21% bacteremia; 16% respiratory (10% upper, 6% lower); 7% postoperative wound; 6% urinary tract;

5% skin (32% of these skin infections were related to intravascular lines); 5% eye; 3% cerebrospinal fluid; and 2% other.[96] As per WHO facts sheet regarding global survey on hospital acquired infections, urinary tract infection is the most frequent health care-associated infection in high-income countries, surgical site infection is the leading infection in settings with limited resources, affecting up to one-third of operated patients; this is up to nine times higher than in developed countries.[101] The variation of proportions of the sites of infections in different studies might be due to differences of study population, sample size and research design. Geographical differences and time gap among the studies had also played some roles in revealing the different proportions of the sites of infections in different studies.

4.2.1.4 Extent of HAI and isolated Micro-organism:

It was found in the present study (*Figure-10*) that out of 115 HAI patients highest number (38.3%) were affected by Staphylococcus aureus and the lowest number (6.1%) was affected by Srteptococcus Pneumonae. Second highest number (20%) of patients was affected by E Coli. Pseudomonas and klebsiella were responsible for infecting 13.9%, 8.7% and 7.8% patients respectively. Only 5.2% patients were being infected by other types of microorganisms. Sharif MSH also found in his study that Staphylococcus aureus was responsible for occurring infections in 29.6% cases which was followed by E Coli and Ps aerogenosa by 27.8%.[88] Khan HA, of National Healthcare Safety Network along with Centers for Disease Control for surveillance has classified nosocomial infection the micro organisms involved in hospital-acquired infections include Streptococcus *spp.*, Acinetobacter *spp.*, enterococci, Pseudomonas aeruginosa, coagulase-negative staphylococci, Staphylococcus aureus, Bacillus cereus, Legionella and Enterobacteriaceae family members, namely, Proteus mirablis, Klebsiella pneumonia, Escherichia coli, Serratia marcescens.[102] In a study in Ethiopia a total of 42 bacterial pathogens were identified of which S. aureus was the leading isolates accounting 26.2% followed by E. coli and Coagulase negative Staphylococcus species each 21.4%. Nearly 100% of Gram positive and 95.5% of Gram negative bacterial isolates showed resistance against two or more antimicrobial drugs.[103] A study in Erie County Medical Center, New York, it was found that Overall, Staphylococcus aureus and enterococci were the most commonly identified colonizing organisms. Escherichia coli and Pseudomonas aeruginosa were the most commonly identified colonizing gram-negative bacilli.[104] Razine R in a study in Morocco found that Staphylococcus was the organism most commonly isolated (18.7%) among the patients affected by hospital acquired infections.[105] Most of the previous studies were conducted to explore the details about micro biological aspects in relation with HAI, where as the prime view of the present study was to find out the extents, determinants and impacts of HAI. Even though the findings of the previous studies are almost in the same line of the present study though there are some variations in proportion of role of the microorganisms in occurring HAI. These variations may happen due to the variation of time, study places and study subjects.

4.2.2 Relationship of HAI with Contributing Factors:

4.2.2.1 Socio demographic Factors:

4.2.2.1.1 Prevalence of HAI versus Age of the pediatric patients-

As per the age distribution (*Table-1*) it was found that highest number (46.7%) belonged to the age group of up to 5 years and the lowest number (26.0%) belonged to the age group 6-10 year. In the regression analysis (*Table-76*) compared to 11-15 years old respondents, 1 year old respondents have 4.1 times the likelihood of hospital acquired infection; 2-5 years old respondents have 2.9 times the likelihood of hospital acquired infection and 6-10 years old respondents have 1.2 times the likelihood of hospital acquired infection. Thus it is seen that as age of the pediatric patients decrease likelihood of hospital acquired infection increases. Odd ratio for the age groups 1 year and 2-5 years are statistically significant. In a previous study in our country by Bhuiyan MU found that, the children < 1 year of age were more likely to develop hospital-acquired infection than older children.[106] But Sharif MSH in his study on adult population found that age had no significant relationship in the occurrence of HAI.[88] In another study coducted by BCCP found that Significantly higher number of younger infants (>02 months of age) (case-13.4%, control-7.2%) were found to suffer by respiratory problems than their counter part whose age was >2 months (case-10.5%, control-7.0%).[107] But in a study in Denmark they found no significant correlation of the overall risk of HAI with age.[108] In several studies it was found that the relationship of hospital acquired infections with the age was changed with the change of the types of infections. In a study in European hospitals it was found that infections were most common in patients <23 months (prevalence: 11.5%), less common in the 2-4 years age group (prevalence: 3.6%) and occurred least frequently in patients >5 years (prevalence: 2.6).[94] In another study in USA on pediatric patients it was found that primary bloodstream infections and surgical site infections were reported more frequently in infants aged 2 months or less as compared with older children. Urinary tract infections were reported more frequently in children >5 years old compared with younger children.[97] In the present study variation of prevalence of HAI with the difference of age group was estimated, but the variation of the types or sites of HAI with the difference of age group had not been taken in to consideration. On the basis of the present study it is not possible to comment that which type of HAI is higher in what age groups. So, further study could be conducted with the view to measure the vulnerability of the age groups to different types of infections.

4.2.2.1.2 Prevalence of HAI versus Gender of the pediatric patients -

As per *Figure-1* it was found that majority (53.5%) of the patients was male and remaining (47.5%) were female. Though apparently it was found that the prevalence of HAI was more (11.8%) in female than their male counterpart among whom the prevalence was 10.1%. But as per cross table analysis (*Table-39*) the difference was not found statistically significant. As per regression analysis *(Table-80)* on gender and likelihood of hospital acquired infection, females had 1.4 times the likelihood as males to be infected by HAI; but the increased likelihood was not proved statistically significant. Sharif MSH in his study on adult population also found that gender had no significant relationship in the occurrence of HAI.[88] In a study in Denmark it was also found that there was no significant correlation of the overall risk of HAI with gender of the respondents.[108] Though it was not statistically significant but apparently higher number of female babies were found to be infected by HAI, this weak finding is still enough to draw the attention of the society towards the more vulnerability of the female babies to infections than that of their male counterpart.

4.2.2.1.3 Prevalence of HAI versus Religion of the pediatric patients -

Most of the respondents (86.4%) (*Figure-2*) were Muslim and only 9.3% were Hindus by religion. Among the Muslims the prevalence was lowest (10.7%) and in other religion it was highest (13.0%), though apparently it was seen that there were some differences of the prevalence of HAI in different religious groups but these differences were not statistically significant *(Table-40)*. Sharif MSH in his study on adult population also found that religion had no significant relationship in the occurrence of HAI.[88] B. Allegranzi commented in the World Alliance for Patient Safety of WHO that the cultural background and even religious beliefs can play an important role in hindering good practices which may subsequently increase the chance of transmission of infection either in hospital or in community.[109] In the above mentioned study the researcher commented regarding religious believes but he did not try to establish any relationship between the religion and the probability of transmission of different types of infections. Even after rigorous searching no such study was available that was conducted with the view to find out the relationship between religion and prevalence of HAI. Strong ethical issues might be the probable reason behind that.

4.2.2.1.4 Prevalence of HAI versus Parent's education -

As per *Table-2* and *Table-3*, only 8.3% mothers and 9.5% fathers had graduation or higher level education. And on the other hand 28.2% mother and 16.4% father had no formal education. Regarding prevalence of HAI 16.1% children of the non-educated mothers and only 7.9% children of the mothers were found to be affected by HAI. The relationship of prevalence of HAI mother's education was found significant (*Table-41*). Similarly 15.6% children of the non-educated fathers and only 7.0% children of the graduation and above level educated fathers were affected by HAI. The prevalence of HAI was also found significantly different with the differences of education levels of fathers (*Table-42*). In a US study on organ transplantation pediatric patients it was found that educational level of children's mothers had no significant correlation with the late post-transplantation infection (p=0.45). Neither maternal (p=0.59) nor paternal (p=0.607) education had significant effect on the late post-transplantation mortality.[110] As the patients having organ transplantation are usually given intensive care with high precaution by the service providers of the hospital, so the role of parents and care givers are not so much important in the occurrence of hospital acquired infections among those patients. Probably for this reason in the above mentioned study, no significant relationship was found between mother's education and the occurrence of post-transplantation infection. But in a study on pediatric patients in Argentina the rate of nosocomial infection was found significantly higher (63/611 vs 14/470; P<.001) among the children of less educated parents (both father and mother) than that of their more educated unterpart.[111] So, it was evident that parents education exerts role as a factor in the occurrence of hospital acquired infections. It was also found that mother's education had more significant relationship with the prevalence of HAI, So, more attention should be given to increase mother's education level.

4.2.2.1.5 Prevalence of HAI versus Parent's Occupation -

As per *table-4* and *table-5* majority of the mothers (69.9%) were housewives and nearly one third (29.9%) of the father of the pediatric patients were farmer. Prevalence of HAI was highest (11.7%) among the pediatric patients whose mothers were factory workers and lowest (10.0%) among the patients whose mothers were service holders; the difference of prevalence of HAI was not statistically significant (*Table-43*). In relation with father's occupation highest prevalence of HAI (18.0%) was found among the pediatric patients whose fathers were engaged in nonspecific occupation and lowest (9.8%) among the children of service holder fathers. Here also the difference was statistically non-significant (*Table-44*). Sharif MSH in his study on adult population also found that there was no significant relationship between occupation and hospital acquired infections (x^2=2.44)[88]. Ahmed AEA in a study in Egypt found that the majority of the mothers of pediatric patients affected by hospital acquired infections were housewives and 5.0% of them were professionals. More than one quarter of the fathers were skilled workers, 21.1% were agricultural workers, 18.6% were professionals and 16.5% of them worked in sales and services.[112] Almost similar findings were found in a study on RTI of pediatric patients and smoking habit of the parents conducted by a researcher of BCCP in our country. He found difference of suffering from respiratory problems in pediatric patients with the parent's occupation. The difference was significant for the parents who were engaged in service ($p<0.05$), business ($p<0.001$) and household work ($p<0.001$), but the difference was not found significant among the respondents who were engaged in daily labor.[107] The reason of the finding of the above mentioned study probably due to less opportunity of the daily laborer to be close contact with their kids.

4.2.2.1.6 Prevalence of HAI versus Parent's smoking habit -

Regarding parent's smoking habit of the parents of the pediatric patients under study it was found that 96.6% mothers and 43.1% fathers were non-smoker (*Table-6 &7*). Regarding prevalence of HAI, 25% children of the regular smoker mothers and only 10.5% children of the non-smoker mothers were found to be affected by HAI. The prevalence of HAI was found significantly higher among the children of smoker mothers than the children of non-smoker mothers (*Table-45*). Similarly 16.3% children of the chain smoker fathers and only 8.2% children of the non-smoker fathers were found to be affected by HAI. The prevalence of HAI was also found significantly higher among the children of smoker fathers than the children of non-smoker fathers (*Table-46*). In a study in BCCP it was found that significantly higher number of infants of smoker parents was found to suffer from respiratory problems than the infants of non-smoker parents.[107] In a study in Denmark analyzing the impact of potential HAI predisposing factors, they found no significant correlation between the overall risk of HAI and alcohol, tobacco or drug abuse.[108] A study in USA on tobacco use and bacterial infection it was found that active smokers and those exposed to secondhand smoke are at increased risk of bacterial infection.[113] As per a study on passive smoking and the outcome of infection, abundant data indicated that children exposed to environmental tobacco smoke including parental smoking suffered from more severe infections.[114] Hwang SH on the basis of his research on Environmental tobacco smoke and children's health concluded that passive exposure to tobacco smoke significantly contributes to morbidity and mortality in children.[115] The objectives and population of none of the previous studies were similar with the present study, and even after rigorous searching the similar studies could not be made available. More over recommendation of the findings of the available studies were not in the same line. Some of the studies found that passive smoking had no relationship with the occurrence of infection, and another studies commented that passive smoking contributed in increasing morbidity and mortality in children, but they had no specific comment regarding hospital acquired infections. In the present study maternal smoking was found to be more significant role than the paternal smoking in occurring HAI. Probable reasons of this difference might be closeness and duration of exposure, which is definitely more in case of the children of smoker mother than that of their smoker fathers. *This finding might be claimed as new one in the field of research, which could be established in further studies by following appropriate study design.*

4.2.2.1.7 Prevalence of HAI versus Monthly Family Income -

As per *Table-8* it was found that highest number (29.7%) of the respondents belonged to the group of having monthly family income from Tk. 15,001/ - to- Tk. 20,000/- and the second highest number of the respondents (28.5%) were representing the group of having monthly family income from Tk. 10,001/ - to- Tk. 15,000/-. The lowest (up to Tk. 5,000/-) and highest (from Tk. 25,001/-to- 30,000/-) income groups were represented by only 6.7% and 10.0% respondents respectively. As per the regression analysis (*Table-80*) it was found that as income decreases, the likelihood of hospital acquired infection increases excepting the 3rd Income Quartile where the likelihood is a little less than the highest Income Quartile. Odds ratio for the 2nd income quartile is statistically significant but the odds ratio for the 1st and 3rd quartiles are not statistically significant. Sharif MSH in his study among all age group also found no significant relationship between family income and hospital acquired infections.[88] But Ahmed AEA in Egypt found that 38.7% of the parents of pediatric patients those had been affected by nosocomial infections were poorest according to the wealth index.[112] As per WHO Bulletin on 'The burden of health care-associated infection worldwide'- the burden of HCAI is several fold higher in low- and middle-income countries than in high-income ones and also in the poorer section of people of all countries.[116] Another study in India it was found that patients with MRSA had significantly lesser family income and lower education levels compared to patients without MSSA.[117] Sarah S commented in his book that rates of nosocomial infections is higher in developing countries and among the low income groups in developed countries.[118] The previous studies were more concern about the economic status of the country than the house hold family income, because the role of the state in much more important than that of the family to prevent HAI. But the prime focus of the present study was to find out the relationship of the total monthly income with the prevalence of HAI. Even though, some of the previous studies supported the findings of the present study. So, it can be concluded in such a way that if the national economy would be stronger the household income is expected to be increased which will ultimately decrease the prevalence of HAI.

4.2.2.1.8 Prevalence of HAI versus Family size -

As per *figure-3* it was found that majority (58%) of the pediatric patients belonged to the smaller family (up to 5 members) and only 42% patients belonged to bigger family (more than 5 members). Prevalence of HAI was found significantly higher (12.9%) among the pediatric patients of bigger family than that of the smaller family where it was only 8.1% (*Table-47*). But Sharif MSH in his study on adult population found that family size had no relationship with prevalence of HAI (x^2=3.67).[88] Strachan DP in London found variations of infections between larger and smaller families.[119] Ujunwa FA in Nigeria found significant relationship of hospital acquired ARI in under-five children with large family size.[120] In several other studies in different countries, the prevalence of HAI was found independent to the family size of the respondents. Probable reasons of significant relationship in this study might be that the parents of the larger family would have less time and opportunity to care the admitted baby under this study.

4.2.2.1.9 Prevalence of HAI versus Location of Residence -

In the present study majority of the respondents 46.7% came from rural areas. Respondents came from semi-urban and urban areas were 35.3% and 18.0% respectively (*Table-9*). Apparently it was found that there was difference of prevalence of HAI among the rural (10.1%), semi urban (11.0%) and urban (12.6%) pediatric patients but there was no evidence of significances of this difference (*Table-48*). In a study conducted by BCCP it was found that there was difference of suffering among the case and control from respiratory problem in all the study area of urban, semi-urban and rural areas. The statistical results were found significant variations of infant suffering from respiratory problem between case and control and within each area.[107] Ahmed AEA in Egypt found in his study that about three quarters of the hospital acquired ARI patients among under five children came rural areas.[112] Ujunwa FA in Nigeria found significantly higher hospital acquired ARI in under-five children living in the urban area.[120] Yadav S, in Nepal found that there was statistically significant association between hospital acquired ARI and rural environment ($p<0.001$).[121] It's really difficult to relate the geographical location with the prevalence of HAI. Reports of the previous studies are almost conflicting. Some researchers found higher rate of infections in rural patients and some others found almost reverse findings. The situation of opposite findings might happen because; the rural urban gap regarding health and other facilities might not be similar in different countries under studies.

4.2.2.2 Relationship with Patient's Factors

4.2.2.2.1 Prevalence of HAI versus Birth history of the pediatric patients -

More than a quarter (25.8%) of the pediatric patients under study was born by caesarean section operation and nearly three quarters (74.2%) were born by normal vaginal delivery (*Figure-4*). Prevalence of HAI was found higher (14.7%) among the pediatric patients who were born by CS operation. It was only 9.6% among those patients who were born by normal vaginal delivery. The difference of prevalence was found statistically significant (*Table-49*). In a previous study on mode of delivery and other risk factors to HAI incidence of E. coli infections was 5.4% and 2.0/1,000 patient-days. In that study the occurrence of E. coli infections was found depended significantly on the mode of delivery and varied between 3.9% and 17.9%. Multivariate analysis took into account the combined effect of demographic data (gender, gestational age and birth weight) and mode and place of birth.[122] In another study by Rutayisire E commented that Caesarean Section (CS) was associated with higher abundance and diversity of infection from birth to 3 months of life.[123] The probable reasons for more significant relationship between birth history and prevalence of HAI in the present study might be due to higher proportion of premature babies in the neonatal wards in comparison with the developed countries as a result of non-obeying of the principles of indications for conducting cesarean section operation. Ultimately these premature babies born by cesarean section operation would become the easy victims of HAI on getting admission in hospitals due to their weak immune system.

4.2.2.2.2 Prevalence of HAI versus Hemoglobin Level -

It was found in this study (*Table-10*) that nearly one fifth (18.7%) was found as severely anemic. Moderately and mildly anemic patients were 21.7% and 26.6% respectively. As per cross tab analysis (*Table-50*) it was found that among the severe anemic group of pediatric patients 19.8% were suffering from HAI, whereas only 4.3% patients having normal hemoglobin were found to be affected by HAI. The relationship between prevalence of HAI level of hemoglobin was found statistically significant. As logistic regression analysis

(*Table-81*) severe and moderately anemic group of pediatric patients were found to 6.1 times the likelihood of hospital acquired infection than there mild anemic and normal counterpart. Odd ratio for severe and moderately anemic patients (6.109) was found statistically significant. Muñoz M of Spain in his study on consequences pre-operative anemia on hospital acquired infection found that pre-operative anemia (<13 g/dL) is associated with increased rates of postoperative morbidity and mortality and longer stays in hospital.[124] Pathak A of India mentioned severe anemia (hemoglobin <7 g%) as one of the risk factors for postoperative surgical site infections on the basis of his study on 'incidence and risk factors for surgical site infections'.[125] In another study in India Hussain SQ commented that anemic patients were found to be 4.6 times more susceptible to hospital acquired ALRTI (Odds Ratio was 4.63, p-value <0.01).[126] The reasons for the relationship between hemoglobin level and HAI might be due to decreased immune status of the individuals. The aim of the present study was only to find out the difference of HAI with the difference of levels of hemoglobin, not to determine the cause of difference. Moreover previous studies were conducted mostly on adult patients, none of the study was conducted purely on pediatric patients, so the findings of the present study could be claimed as new in this field. Further study could be conducted to explore the specific causes of increased HAI among the anemic pediatric patients.

4.2.2.2.3 Prevalence of HAI versus Disease on Admission -

Regarding the disease on admission (*Table-11*) highest number (26.2%) of pediatric patients was admitted with respiratory diseases and the lowest number (6.1%) was admitted with congenital anomalies. But prevalence of HAI was found highest (14.1%) among those pediatric patients who had got admitted with congenital anomalies and was lowest (7.4%) among those who were admitted with urinary disease and nonspecific fever. Statistically significant differences were found among the groups of patients on the basis of diseases on admission (*Table-51*). Orlando G conducted a study in Italy on 'Trends in hospital admissions at a Department for Infectious Diseases' and found increased number of patients got admitted with respiratory, cardiovascular, renal problems being admitted by hospital acquired infections.[127] Boehme AK conducted a study on 334 patients in Birmingham, Alabama and found that 23.1% were found to have either an infection at the time of admission. Among them 24.4% patients had bacteremia, 64.1% had UTI, 37.2%) had PNA and 28.2% patients had more than 1 infection.[128] Kritsotakis E in Greece conducted a study on 108 occurrences of HAIs were recorded in 99 patients (CI: 12.1-16.7%), who got admitted with lower respiratory tract (53%), urinary tract (10%), bloodstream (9%) and other (28%) infections.[129] It was supported by the previous research that probability of hospital acquired infection was more among those patients who had got admitted with any sorts of infections. But still there exists some difference of the findings of the present study with that of the previous study. That might be due to differences of time, study design, population, size of the sample and objectives of the studies.

4.2.2.2.4 Prevalence of HAI versus Underlying Diseases -

It was found from the present study (*Figure-5*) that majority (55%) of pediatric patients under study was found to have underlying diseases other than the disease due to which they had got admitted. And as per the *Table-52* Prevalence of HAI was found significantly higher (12.9%) among those patients who were suffering by one or more underlying diseases and it was only 8.4% among those who were not suffering from any sorts of underlying diseases. Sharif MSH in his study also found that underlying diseases significant relationship with underlying disease on admission (x^2=28.33).[88] Collins AS stated in his book that the higher likelihood of infection was reflected in patients who were found to suffer by additional underlying diseases.[130] Both the national and international studies supported the findings of the present study. There might be multiple reasons behind the increased rate of infections of this group of patients.

4.2.2.2.5 Prevalence of HAI versus Number of Visitors -

In the present study (*Table-12*) it was found that majority of the respondents 630 (89.7%) were visited by 3 or more visitors and the remaining 40.3% were

visited by up to 2 visitors. Prevalence of HAI was 15.4% among those patients who were visited by 3 or more visitors and it was only 4.2% among those who were visited by up to 2 visitors. As per cross tab analysis the difference of prevalence among the two groups was found statistically significant (*Table-53*). As per logistic regression analysis (*Table-81*) compared to 1 visitor, 2 or more visitors have 2.4 times the likelihood of hospital acquired infection, number of the visitors increase likelihood of hospital acquired infection increases. Odd ratio for 2 or more visitors (2.478) was statistically significant. Sharif MSH in his study also found significant relationship between number of visitors and hospital acquired infections (t=6.02).[88] Khan MH found in his study that number of visitors had significant role in the occurrence of HAI (t=13.526, df=51, p<.000).[26] As per WHO practical guide on Prevention of hospital-acquired infections visitor or attendants can increase the proportion of occurrence of HAI by several ways- (a) through direct contact be-tween patients (hands, saliva droplets or other body fluids), (b) in the air (droplets or dust contaminated by a patient's bacteria) or (c) via objects contaminated.[131]
Banach DB in USA commented that as the role of visitors as vectors for organism transmission in the healthcare setting the restriction of visitors should be taken into account to control hospital infections.[132] Cohen B and his team in USA found that among all visitors (i.e. doctors nurses and other hospital staffs) personal visitors were responsible for 23% transmission of diseases. He further commented that visitors are not only risk factors for transmitting organisms but they are also at the position of potential risk for acquiring disease from the admitted patients.[133] The aim of the present study was only to find out the role visitors occurring the hospital acquired infections but risk of visitors to be infected by admitted patients was not taken in to consideration, which was considered by some of the previous studies.

4.2.2.2.6 Prevalence of HAI versus Number of Attendants -

It is depicted from the study that (*Table-13*) more than three quarter respondents (76.3%) were given care by 2 or more attendants nearly one quarter respondents (23.7%) were given care by single attendant. Prevalence of HAI was 13.4% among those patients who were given care by 2 or more attendants and it was only 2.8% among those who were given care by only one attendant. As per cross tab analysis (*Table-54*) the difference of prevalence among the two groups was found statistically significant. As per logistic regression analysis (*Table-81*) compared to 1 attendant, 2 or more attendants have 21.8 times the likelihood of hospital acquired infection. As number of the attendant increase likelihood of hospital acquired infection highly increases. Odd ratio for 2 or more attendant (21.884) was strongly statistically significant. Sultana R conducted a study on 'role of patients' attendants in transmission and prevention of nosocomial infections in tertiary level hospitals of Dhaka city' and found that in our cultural context family attendants provide most of the hands on care, and so are at significant risk for infectious disease transmission.[134] Bhuiyan MU conducted a study in three tertiary care public hospitals in Bangladesh and found at the time of survey, there was an average of 1.67 attendants for each patient in the ward. A higher proportion of attendants in pediatric wards (1.4%) reported having infected on the day of the survey than attendants in adult wards (0.6%) ($P < 0.001$).[135] Islam MS reported that in Bangladesh Family caregivers are at risk for hospital-acquired infection from their repeated exposure to infectious agents combined with their inadequate hand hygiene and knowledge about disease transmission.[136] Unlike the present study the previous studies were more concern about the risk of the attendants to be affected by the patients to whom care was given. Although one of the above mentioned study supported the findings of the present study. The risk of the family attendants of the pediatric patients could be estimated by further study. The issue of attendants was given less importance in the international journals probably due to less practice of family attendants for the care of admitted patients.

4.2.2.2.7 Prevalence of HAI versus Attendant's status-

In the present study (*Table-14*) highest number (74.0%) of the pediatric patients were attended by their mother and the lowest number (4.8%) were attended by father. Prevalence of HAI was lowest (8.3%) among the pediatric patients who were attended by their mother. Prevalence among the patients' fathers, grandmothers and other relatives were 21.5%, 15.2% and 21.2% respectively. Significant relationship was found between the caregivers and the prevalence of HAI (*Table-55*). Lacey S and her team of USA reported in their handbook on patient safety and quality that the rate of infections was found dependent on the relationship with the caregivers of the children especially for those who are very young and/or nonverbal.[137] Barron IK found in his study on pediatric patients that knowledge, practice, closeness and duration of care giving contribute to the proportion and types of nosocomial infections.[138] Actually the views of the previous researches were to reveal the relationship of the rate of infections with the closeness and duration of given care and the categories of the caregivers by their training status not to see the role of family relationship (parents or others) of the patients in the occurrence of HAI which was the prime aim of this study. The variations of findings might happen due to our cultural variation with the western world, where the household care givers (parents or other family members) had minimum role in case of admitted patients.

4.2.2.2.8 Prevalence of HAI versus Hygienic status of the Attendants -

Regarding hygienic status of the attendants (*Table-15*), hygienic and unhygienic respondents were 39.5% and 37.5% respectively. Only 23.0% respondents were found at average condition. Prevalence of HAI among the patients attended by hygienic and unhygienic attendants was 16.2% and 8.8% respectively. Relationship of the prevalence of HAI with the hygienic status of the attendants was statistically significant (*Table-56*). Raza S stated in a briefing on healthcare associated infections that the rate of infection was diminished after completion of intervention program on personal hygiene of hospital staffs, patients, attendants and visitors.[139] As per the chief public health officer's report on the state of public health in Canada, about 80% of common infections are spread by healthcare workers, patients, visitors and attendants.[140] Regarding transmission of infection some of the researchers thought that the role of visitors and attendants are of both ways, sometimes they become the source of infections for patients and sometimes they become affected by the patients. Such happenings are more for those visitors and attendants who did not comply with the infection control guidelines laid the hospital authority.[141] As the care givers (either household or professionals) stay in close conduct with the patients for a long period so, they might have the opportunity for both way transmission of organisms. As a result most of the times the admitted patients become infected by the opportunistic organisms harbored by the poorly hygienic care givers.

4.2.2.2.9 Prevalence of HAI-versus History of antibiotics within last 3 months

It is evident from this study (*Table-16*) that nearly three quarters (73.3%) of the pediatric patients were found to have history of taking any sorts of antibiotics within last three months. And apparently higher prevalence of HAI (11.9%) was found among the pediatric patients who had been treated by antibiotics within last three months that of (8.2%) than their counterparts who had not been treated by antibiotics within the same period of time. But the difference was not statistically significant (*Table-57*). In a study in Argentina it was found that antibiotic administration continued to be a risk factor for increased resistance rates regardless of the hospital ward or the source of the infection.[142] Another study in Portugal it was found that antibiotic therapy was inadequate in 19% of patients with HAI whose treatment did not follow international recommendations. In a study in Portugal Hospital acquired infections were found independently associated with inadequate antibiotic therapy (adjusted OR=1.99).[143] In another study in Philippines general hospital previous antibiotics use was found as independent predictor (OR 2.57, 95% CI 1.37-4.84) for HAI using multiple logistic regression analysis.[144] Data regarding past history in this study were collected on the basis of the documents preserved by the parents of the patients. In our cultural and socioeconomic settings the peoples are still not so aware to preserve the health documents with special care. Non significances of relationship between previous treatments with antibiotics within last 3 months of admission with the development of present HAI might be due to inadequacy of information regarding past history of treatment.

4.2.2.2.10 Prevalence of HAI versus Previous hospitalization -

As per t*able-17* majority (76.1%) of the pediatric patients were found to have no history of hospitalization within last 3 months. And significantly higher prevalence of HAI (14.7%) was found (*Table-58*) among the pediatric patients who had been hospitalized within last three months than that of their counterparts (9.7%) who had not been previously hospitalized. Darouiche R found in his study that HAI patients with SSI are more than five times more likely to be readmitted to the hospital after discharge.[145] In another study in Portugal by Cardoso T et. al. on classification of healthcare-associated infection it was found health care associated infection was significantly higher among the patients who had been hospitalized in an acute care hospital for ≥2 days in the previous 90 days.[146] In the present study, though it was proved that there was significant relationship between prevalence of HAI and history of previous hospitalization within last three months but it could not be established whether the present hospitalization has been occurred due the effect of previous hospitalization or not.

4.2.2.2.11 Prevalence of HAI versus History of surgery within last 3 months

Regarding history of surgery (*Table-18*) only a small number (5.1%) of patients were found to under gone surgery within the last 3 months. But prevalence of HAI was found higher (20.4%) among them than their counterparts who had not undergone surgery within the said period among whom the prevalence was only 10.4%. The difference of prevalence among the two groups was statistically significant (*Table-59*). Centers for Disease Control and Prevention, Atlanta mentioned in its handbook for nurses that prevalence of nosocomial infections was found significantly higher among the patients who had undergone recent surgery.[130] In another study in Portugal it was found that prevalence of nosocomial infections was found significantly higher among the patients who had history of surgery in the last 180 days [146]

It was found in another study in Spain that recent surgery in chest and upper abdominal region significantly increased the nosocomial infections among both adult and pediatric patients.[147] By supporting the results of the present study, the previous studies are actually drawing our attention to safe surgery. Surgery should be taken in such a safe standard so that it would not facilitate the subsequent hospitalization.

4.2.2.3 Relationship with Treatment Factors

4.2.2.3.1 Major Specialty of Treatment versus prevalence of HAI- (Discussed under section **4.2.1.2**)

4.2.2.3.2 Prevalence of HAI versus Mode of decision for surgery -

Out of 371 surgical patients for nearly one third (32.9%) of the surgery was done on emergency basis (*Table-20*). And the prevalence of HAI was found significantly higher (20.5%) among the patients who had undergone emergency surgery than their counterpart (10.8%) who had undergone planned surgery (*Table-61*). Maksimović J, of Serbia identified contaminated or dirty wounds (which were mostly of emergency surgery) as the independent risk factors for hospital acquired surgical site infections by multivariate logistic regression analysis (OR, 12.09; 95% CI, 5.56-26.28).[148] In another study Al-Mulhim FA in Saudi Arabia commented that ‘emergency surgical procedures carried the greatest risk of nosocomial infection especially with *Staphylococcus* species’.[149] In another study in China it was found that HASSI was more in emergency surgery due to contamination. Multivariate analysis identified six independent parameters including mode of decision for surgery correlating with the occurrence of SSI. Univariate analysis also showed that HASSI was associated with the type of operation, mode of decision for operation and wound classification.[150] Actually the decision for emergency surgery mostly depends upon the arrival of the patients in hospital on emergency basis, the hospital authority or the surgeon has minimum scope to change the mode of decision for surgery in such a situation. To improve the quality of pre-procedural and intra-procedural stages of surgery is the only way to minimize the prevalence of HAI in such conditions.

4.2.2.3.3 Prevalence of HAI versus Types of operations -

It is revealed from the present study (*Table-21*) that highest number (11.3%) of patients undergone gastro-intestinal surgery and lowest number (2.0%) by multiple operation. Urogenital, neurological and soft tissue operations were conducted in 9.8%, 8.2% and 3.9% patients respectively. Highest prevalence (19.3%) was found among the patients who have under gone gastro intestinal operation. Significant difference was found between the types of operations done and the prevalence of HAI (*Table-62*). In a WHO study by Kollef MH, it was found that the prevalence of HAI and cost of care for laparoscopic surgery was much lower than open surgery for cholecystectomy, hysterectomy, and appendectomy.[151] In another study in USA the prevalence of nosocomial infections were found much higher in cardiac surgery (21.7%) patients than any other types of surgery.[152] The present and previous findings in this regards had drawn our attention for giving emphasis to the practice of non-invasive surgery with the view to minimize the proportion of hospital acquired infections.

4.2.2.3.4 Prevalence of HAI versus Therapeutic procedures -

Regarding application of therapeutic procedure it was evident from the present study (*Table-22*) that the highest (28.7%) and lowest (6.3%) number of patients were given nasogastric feeding and endoscopic examination respectively. Nasogastric Suction and Catheterization was done for 20.0% and 19.3% patients respectively. But highest prevalence of HAI (15.2%) was found among the patients with catheterization. Among the patients with nasogastric feeding and nasogastric suction the prevalence was 12.2% and 9.0% respectively. The lowest (7.3%) prevalence of HAI was found among the patients with other therapeutic procedures. The relationship of the therapeutic procedure with the prevalence of HAI was found statistically significant (*Table-63*). In a cross-sectional prevalence survey on pediatric patients in Australia, the presence of a urinary /vascular catheter or the presence of an endotracheal tube were found having significantly increased risk of HAI.[153] Cardoso T in Portugal proved by using multiple logistics regression analysis that the patients with intubation are at higher risk of HAI (Odds Ratio 3.32, 95% CI, 1.12-6.95).[142] Though the findings of the present study was supported by other studies in different countries, the remarkable limitation of the present study was that the duration of use of therapeutic procedures were not taken in to consideration which could be studied in further studies.

4.2.2.3.5 Prevalence of HAI versus immunosuppressive conditions and immunosuppressive therapy -

It was found from this study (*Table-23 & 24*) that 6.4% was suffering from underlying immunosuppressive condition and 5.6% pediatric patients had been treated by immunosuppressive therapy. And significantly higher prevalence of HAI was found among both the groups (*Table-64 & 65*) of suffering from underlying immunosuppressive condition (22.4%) and treated by immunosuppressive therapy (18.6%) than that of their counterparts, among whom the prevalence was 10.1% and 10.4% respectively. In a study in Denmark it was found that exposure to bladder catheter was associated with an increased risk of urinary tract infection, incidence rate ratio 4.9; (95% CI 1.8-11.5).[108] Significant association was found between the rate of UTI and LOS among 210 patients in a study in KSA. Three patients had UTI out of 37 catheterized patients (8%) at 10 days LOS, while 42 patients had UTI out of 49 catheterized patients (85.7%) at 18 days LOS. The longer the LOS, the higher the rate of UTI was found.[130] The presence of immunosuppression was found to be associated with a significantly increased risk of HAI in another study on pediatric patients in Australia.[145] Collins AS stated in his book that the higher likelihood of infection was reflected in vulnerable patients who were immune-compromised due to immunosuppressive medications.[154] The duration of immunosuppressive condition for which the patient was suffering and the length of time of immunosuppressive therapy by which the patients were being treated was not taken in to consideration in this study.

4.2.2.3.6 Prevalence of HAI versus Duration of operation -

Out of 371 surgical patients more than three fourth (76.3%) of the patient it took more than one hour and for less than one fourth (23.7%) patients needed less than one hour for completing their operation for (*Table-25*). In cross tab analysis significantly higher prevalence of HAI (15.9%) was found among those patients who needed more time (>1hour) for operation than that of their counterpart (8.0%) who needed less time (up to 1 hour) (*Table-66*). But in logistic regression analysis it was found that as duration of operation increases, likelihood of hospital acquired infection also increases though the odds ratio for none of the groups was statistically significant (*Table-80*). In a similar study in India operative time was classified as less than or up-to one hour, between 1 to 4 h and more than 4 h. An operative time more than 4 h was considered a risk factor for SSI (OR 5.67).[125] In another study in China among a total of 1,138 pediatric patients found that univariate analysis showed that SSI was associated with the type of operation, wound classification and duration of operation. And in a multivariate analysis they identified six independent variables including duration of operation for more than 120 minutes (OR 4.289; CI 1.773–10.378; *P*=0.001) correlating with the occurrence of SSI.[150] Bhattacharyya N et. al. conducted a study in USA and found multiple operations, and more time for doing surgery to be associated with increased hospital acquired infections.[155] Though alike the present study in all the previous studies there was relationship between prolonged operative time and higher prevalence of HAI but the cut off value between higher and lower time were not same, in the present study it was one hour and in the previous studies it was four hours. Lower compliance with the sterilization quality and the poor preventive measures against transmission of infections might the reasons for higher prevalence of HAI in the present study even in lesser duration of surgery (<4hours).

4.2.2.3.7 Prevalence of HAI versus Preoperative Waiting Period -

It was found from the present study (*Table-26*) that 43.1% of the surgical patients had to wait for 7 days or more for schedule of operation. Waiting period for up to 3 days and 4-6 days were for 31.3% and 25.6% patient respectively. In cross tab analysis highest (19.4%) prevalence of HAI was found among those patients who had to wait for longest time (7 days or more) for operation. In other two groups the prevalence was 11.6% and 8.6% respectively. The difference of prevalence of HAI among these three groups was found statistically significant (*Table-67*). But in logistic regression analysis it was found that respondents with more than 6 days waiting time had 1.4 times likelihood of hospital acquired infection though the odds ratios were not statistically significant (*Table-80*). In a study in Spain the effects of age and severity were studied by stratifying patients by duration of preoperative stay. Two multivariate regression models were used to confirm the results of the stratified analysis. The results suggest that lengthening the preoperative stay may increase the risk of nosocomial infection in surgical wounds and in other sites, and may simultaneously potentiate the effects of other risk factors such as age and severity of the patient's condition, whose influence on susceptibility to infection increases with the duration of preoperative stay. [156] In another study in India multivariate risk factor analysis revealed that preoperative hospital stay (odds ratio [OR] 1.22, 95% confidence interval (CI) 1.6-1.39, P = 0.004) along with some other variables were associated with the development of HAI. It was commented there that strategies should be taken to decrease preoperative hospital stay which will ultimately decrease morbidity and mortality of patients by decreasing the incidence of HAI.[157] Pereira HO in Brazil in a study on 432 patients identified the preoperative hospital stay greater than four days, as one of the important risk factors for developing HAI (OR = 3.3).[158] Alan R of University of Michigan hospital mentioned in answering the questions from the patients that sometimes prolongation of preoperative stay had to be done for the benefit of the patients, especially for the child patients to recover their airways, but it should not be lengthen for more than four weeks.[159] Experience says that the pre-operative waiting and break of operation schedule is the problem of developing countries like Bangladesh, it’s not the major managerial problem in developed countries, so they are not so much concern about pre-operative waiting for uncertain period or un predicted and irrational schedule break for operation.

4.2.2.4. Hospital related factors versus prevalence of HAI-

4.2.2.4.1 Type of hospitals versus prevalence of HAI- (Discussed under section **4.2.1.1**)

4.2.2.4.2 Prevalence of HAI versus Hand washing practice of the doctors -

It is evident from the study (*Table-28*) that more than half (54.1%) of the patients was found treated by inadequately practicing hand washing. And it was found that the prevalence of HAI was significantly higher (14.2%) among those patients who were served by doctors by inadequate hand washing practice than their counterparts (7.0%) who were served after adequate hand washing (*Table-69*). A long-term hospital wide study by University of Geneva Hospitals, demonstrated that an effectively implemented hand washing policy reduced hospital acquired infection by half and saving precious resources. Hospital-acquired infection prevalence fell from 17% in 1994 to 10% in 1998 new cases of MRSA fell by half. The hand washing programme saved 900 infections.[160] Another study in Switzerland concluded that hand hygiene is the leading measure for preventing the spread of antimicrobial resistance and reducing healthcare-associated infections (HCAIs).[161]McLaws ML opined that hand hygiene compliance contributed to the prevention of health care-associated infections, he also commented that high hand hygiene alone cannot impact formidable risk factors, such as older age, immunosuppression, admission to the intensive care unit, longer length of stay, and indwelling devices. When hand hygiene interventions are concurrently undertaken with other routine or special preventive strategies, there is a potential for these concurrent strategies to confound the effect of the hand hygiene program.[162] In a study in Kuwait it was found that the overall rate of HH compliance by all the HCWs increased from 42.9% pre-intervention to 61.4% post-intervention, $P < 0.001$. There were significant reductions in the following: the rate of overall health care-associated infections/1000 patient-days, which fell from 37.2 pre-intervention to 15.1 post-intervention (*P* < 0.001); the rate of bloodstream infections, which fell from 18.6 to 3.4/1000 central-line-days (*P* < 0.001); and the rate of lower respiratory tract infections, which fell from 17.6 to 5.2/1000 ventilator-days (*P* < 0.001).[163] In the present study the impact of hand washing practice of the doctors on HAI as a whole was estimated, the impact of hand washing practice on different types of HAI was not taken into consideration. It needs further interventional study to reveal the impact of different aspects (i.e. methods and duration of hand washing, types of reagent used, hand washing by only doctors or by both doctors and nurses) of hand washing on the prevalence of different types of HAI.

4.2.2.4.3 Prevalence of HAI versus Face mask using and Gown wearing Practice of the doctors -

Regarding face mask using and gown wearing practice of the doctors (*Table-29 & 30*) it was found that 41.9% pediatric patients was given treatment by the doctors without using facemask and 38 % patients was given treatment without wearing gown properly. Prevalence of HAI was significantly higher (16.1%) among those patients who were served by the doctors without using face mask than that of their counterparts (7.2%) who were served by the doctors after using face mask. Similarly it was also found that the prevalence of HAI was significantly higher (14.2%) among those patients who were served by the doctors without wearing gown than that of their counterparts (8.9%) who were served by the doctors after wearing gown properly (*Table-70 & 71*). A study in Jamaica reported rates of compliance were high for hand-washing (100%), use of gloves (98%), use of gowns (83%) and facemasks (87%); but low for use of eye protection mask (56%), not re-sheathing needles (46%) and changing clothes when exiting and re-entering the OD (55%).[164] In a study in Baltimore, USA regarding intervention with face mask on pediatric ICUs patients it was found decrease in the primary outcome of MRSA or VRE from 21.35 acquisitions per 1000 patient-days (95% CI, 17.57 to 25.94) in the baseline period to 16.91 acquisitions per 1000 patient-days (95% CI, 14.09 to

20.28) in the study period.[165] Another study, published on Oct. 4 in JAMA, found that wearing disposable gowns and gloves might help fight against MRSA's spread. The study looked at 20 medical and surgical ICUs, where the researchers took 92,000 cultures from more than 26,000 patients from January to October 2012. MRSA infection was 40 percent less likely in hospitals where all health care workers were found to use disposable gowns and gloves in the ICU, compared to establishments where they were found to wear only protective clothing during a standard isolation routine.[166] Harris A, at the University of Maryland School of medicine found that effective universal gowning and gloving would be in lowering the number of new cases of disease in ICUs. Physical barriers are the most effective way to block invisible intruders like the bacteria responsible for methicillin-resistant Staphylococcus aureus (MRSA) and vancomycin-resistant Enterococcus (VRE) infections, which are among the most common hospital-acquired pathogens.[167] Though it could be proved from above study that the proper use of apron, gloves and face mask can decrease the prevalence of hospital acquired infections but still some of the researchers of this field thought that standard sterile hospital garb can't efficiently prevent infections. It's hardly been clear that requiring all health care workers to put on gowns and gloves before visiting each patient, then discarding and re-robing before visiting the next patient, would help to reduce the spread of such infections in ICUs. It is also thought that the use of apron is protective for several patients, who are being treated at the beginning of the duty of a doctor, as the time is passing the probability of protection is decreasing and ultimately at the end of the duty hour the doctor's apron becomes harmful for the patients. The Centers for Disease Control currently recommended that workers suit up with gowns and gloves before caring only for patients with known MRSA or VRE infections.

4.2.2.4.4 Prevalence of HAI-versus Cleanliness status of Pillow cover and Bed sheet

In the present study (*Table-31 & 32*) regarding cleanliness status, pillow cover of the 33.7% pediatric patients was found dirty and that of 14.5% was found very dirty. And cleanliness status of the bed sheet of 32.1% patients was found dirty and that of 14.0% was found very dirty. Regarding prevalence of HAI highest (16.3%) prevalence was found among those patients whose pillow covers were very dirty and the lowest (7.5%) prevalence was found among those patients whose pillow covers were very clean. Similarly highest (16.2%) prevalence was found among those patients whose bed sheets were very dirty and the lowest (8.8%) prevalence was found among those patients whose bed sheets were very clean. Relationship of the cleanliness status of both the pillow cover and the bed sheet with the prevalence of HAI was found statistically significant (*Table-72 & 73*). Brunton WA, concluded that correct laundering procedures of hospital textiles are an important measure for preventing health-acquired infections especially when other more common sources of infections have been ruled out.[168] Otero RB, in USA on the basis of his two studies recommended that it is necessary to implement infection control practices including proper handling of dirty linen by laundry workers in order to prevent possible health-acquired infections.[169,170] Creamer M, also claimed bed linens and pillow covers as source for MRSA, VRE, Pseudomonas and other pathogens.[171] But a different finding was revealed in Pyrek KM's study. He opined that although soiled linen may contain large numbers of pathogenic microorganisms, the risk of actual disease transmission is very low if the soiled and non-soiled linen are processed, cleaned and storage separately with hygienic care.[172] In the present study only the differences of prevalence of HAI with the level of cleanliness or dirtiness of the linen was assessed, but it was not contrasted whether the dirtiness was the cause or consequences of HAI due to long hospital stay and being soiled from infection sites. Furthermore the cleanliness and dirtiness were assessed in this study on the basis of visual indicators, the microbiological analysis to determine the presence of micro-organisms was not carried out. To rule out the actual role of dirtiness for causing HAI, further microbiological study could be conducted.

4.2.3 Impact of HAI on Treatment Cost and outcomes of Hospital Management

4.2.3.1 Impact of HAI on Treatment Cost

4.2.3.1.1 Cost of Treatment versus Prevalence of HAI

It is evident from *Table-36* that the highest number (68.7%) of HAI patients had to spend Tk. 20,001/- - Tk.30,000/- but highest number (44.7%) of non-HAI patients had to spend Tk. 10,001/- - Tk.20,000/- for their treatment. In the present study as per the non-parametric Mann-Whitney U test (*Table-77*) the treatment cost was found having significant impact on the prevalence of hospital acquired infection (HAI). Khan MH also found significant difference of treatment cost in his study among the HAI patients than that of their non-HAI counterpart.[26] Sharif MSH conducted a study on adult patients and found significant relationship between HAI cost of treatment.[88] A study in the University of Geneva Hospitals found that a case of hospital acquired infection on an average increases the extra cost by £3150 for each HAI.[173] In a study in UK complete in-patient data sets were obtained for 3980 patients. Of these, 309 patients (7.8%; 95% CI; 7.0, 8.6) presented with one or more hospital-acquired infections during the in-patient period. Infected patients, on average, incurred hospital costs 2.9 (regression model estimate: 2.8; 95% CI; 2.6, 3.0) times higher than uninfected patients, equivalent to an additional pound 3154 (regression model estimate pound 2917). Both the incidence and the economic impact varied with site of infection and with admission specialty.[174] Chavda A, in her academic study found that patients who acquired infections of the lower respiratory tract, skin, surgical wound or ‘other’ sites experienced similar patterns of increase in costs. Costs were, on average, two to 2.5 times greater than those incurred by uninfected patients.[175] It was found in another in Sweden that the excess LOS comprised 11.4% of the total costs (95% CI, 10.2-12.7) for the patients affected by HAL.[176] As the prime aim of this study was to find out the relationship between HAI and increased cost of treatment, so the two important dimensions regarding cost calculation could not be considered properly. One: though all the opportunity costs and private costs had been calculated but the cost due to wages lost could not be taken in to consideration in this study. Two: how much part of the extra cost had to be spent due to occurrence of HAI could not be estimated. Further study could be conducted in future to explore these two important issues by adopting appropriate formula of health economics.

4.2.3.1.2 Cost of Treatment versus Types of HAI

To determine the variation of treatment cost with the differences of types of HAI Kruskal Walis test was done (*Table-79*) because, as per normality test the data were found non-normally distributed. And the result of Kruskal Walis test revealed that the treatment cost was found significantly associated with the types of HAI. In the above mentioned study in Sweden it was found that surgical wound infection incurred the significantly higher cost of treatment than that of other sites of infections.[176] Kurutkan MN in Turkey found that Surgical Site Infection's (SSI) costs vary according to the surgery types and infecting pathogen types.[177] In another study Larson E found that Study-adjusted cost differences were greater for bloodstream infections vs. any other infections by sites.[178] In a study in USA it was found that Pneumonia was associated with 43.8% increases in total hospital cost (P < 0.0001 for both), compared to the total hospital costs for other types of infections (BSIs, SSIs, and others).[179] It can be noted on the basis of the findings of the previous studies that, though the cost of treatment was found to vary with the difference of sites of infections but the specific sites responsible for highest cost is not similar in different studies. Several factors (i.e. resistance pattern of the organisms, patient's susceptibility and factors related with hospital and treatment) may be responsible for these sorts of dissimilarity.

4.2.3.2 Impact of HAI on some indicators of Hospital Management

4.2.3.2.1 Satisfaction of the Respondents versus Prevalence of HAI

In this study (*Table-38 & 74*) satisfaction level of the respondents was found significantly different with the differences of prevalence of hospital acquired infections. Among the non-HAI patient's 30.0% respondents were found highly satisfied whereas among the HAI patients highly satisfied respondents were only 10.4%. Reversely, among the non-HAI patient's only 2.0% respondents were found highly dissatisfied whereas among the HAI patients highly dissatisfied respondents were 40.0%. Prakash B, of India concluded in his study that patient satisfaction is an important and commonly used indicator for measuring the quality in health care especially in connection with hospital acquired infections.[180] Barton M, opined that nosocomial infections also decrease patient satisfaction and increase the risk of a financial penalty for hospitals that have higher rates of infection than peer health systems under the government hospital-acquired conditions (HAC) reduction program.[181] As per fundamentals of US health care, increased rate of nosocomial infections not only decrease patient's satisfaction but also decrease patient's compliance simultaneously increases patient's stay and cost of treatment.[182] In the present study only the overall satisfaction of the respondents was assessed, the satisfaction of the respondents on different components of services were not taken in to consideration. If it would be possible to assess the satisfaction level of the respondents on different aspects of services provided to them and would be analyzed following any standard measuring scale, more refined scenario regarding satisfaction level could be possible to rule out.

4.2.3.2.2 Outcome of Treatment in terms of Mortality versus Prevalence of HAI-

In the present study higher mortality (10.4%) was found among the patients who had been affected by HAI and among the Non-HAI patients the mortality was only 2.9%. Mortality among the HAI and Non-HAI patients was found significantly significant (*Table-37 & 75*). Gaynes R, found in his study that the 1-year overall mortality rate for patients with HAI in comparison to all other patients was 1.75 (95% CI, 1.45-2.11), the difference was statistically significant ($P < .001$).[176] A study in US showed that the patients who developed hospital-acquired infections had a twofold increased risk of death, compared to uninfected patients. The increased risk of death persisted even after adjustment for several confounding factors, and was particularly high in younger patients with less severe disease.[183]A study conducted on 255 pairs of matched surgical patients with and without surgical site infection in North Carolina, USA, indicated that infected patients had a 2.2-fold increased risk of dying, a 60% increased risk of being admitted to an intensive care unit, and a twofold increased hospital length of stay, compared to uninfected patients.[184] A study conducted by Dinkel RH in Germany showed that even after controlling for possible confounders, patients who developed a hospital-acquired infection had a two-fold increased risk of death, compared to patients without this complication. The risk of death increased by three-folds in patients hospitalized for trauma who developed a hospital-acquired infection.[185]In another study in USA, it was found that the mortality rate of patients acquiring a nosocomial infection (11.5%) was significantly greater than the mortality rate of patients without a nosocomial infection (3.2%) (odds ratio [OR]=4.0; 95% confidence interval [CI]=2.7 to 5.8; p<0.001).[186] In another study in Philippine General Hospital it was found that the development of HAP increased the mortality of critically-ill patients from 12.3% among non-HAP patients to 42.4% among those who developed HAP (p 0.001).[187] It is true that as per the methodology of the present and previous studies the HAI was found to be related with increased mortality but none of the studies claimed particularly HAI as the only cause of mortality, there might be several causes for which the patients died.

4.2.3.2.3 Average length of Hospital Stay versus Prevalence of HAI-

Table-35 reveals that the highest number (46.9%) of HAI patients had to stay at hospital for 21-25 days and the lowest number (2.6%) of HAI patients had to stay at hospital for up to 5 days. But among the non-HAI patients highest (50.5%) and lowest (0.9%) number had to stay at hospital for 6-10 days and 26-30 days respectively. As per normality test the data were not normally distributed the non-parametric Mann-Whitney U test was done (*Table-76*) instead of t-test and hospital acquired infection (HAI) was found significantly associated with length of hospital stay. On the other hand it was found in regression analysis (*Table-80*) that length of hospital stay more than 5 days significantly increased the likelihood that someone will have hospital acquired infection by 3.5 times as hospital stay more up to 5 days. In a study published in American Journal of Infection Control commented that out of total bed days, 9.3% was considered to be excess days attributed to the group of patients with an HAI.[176] Kollef MH in USA found in his study that among hospital survivors, patients acquiring a nosocomial infection had longer hospital lengths of stay compared to patients without a nosocomial infection (20.1±13.0 days vs 9.7±4.5 days; $p<0.001$).[186] A study in North Carolina, USA, conducted on 255 pairs of matched surgical patients with and without surgical site infection, indicated that infected patients had a twofold increased hospital length of stay, compared to uninfected patients.[184] Alejandria M in Philippine found in her study that the development of HAP markedly increased prolonged hospitalization from 15.1 +/- 12.5 days to 29.7 +/- 23.9 days (p 0.001).[145] A study in the University of Geneva hospitals found that on an average a case of hospital acquired infection increases 14 extra bed-days.[188]Angelis GD, found in her study that patients who acquired an infection remained in hospital on average 2.5 times longer than uninfected patients, an average equivalent to 11 extra days.[173] The Danish medical bulletin explored a different findings that, prevalence of HAI increased with the duration of admittance ($p < 0.001$) by approximately 0.6% per day.[189] In a previous study in our country by Bhuiyan MU found that the risk of developing hospital-acquired infection increased for each additional day of hospitalization beyond 72 hours.[106] Considering the findings of the present and previous studies it is really difficult to comment, whether the HAI is the cause or effect to increased length of hospital stay.

4.2.3.2.4 Average length of Hospital Stay versus Types of HAI

As the data were not normally distributed as per normality test, the non-parametric Kruskal Walis test (*Table-78*) was done in this study as the corresponding test for ANOVA test. And the result revealed that the length of hospital stay was significantly associated with the types of hospital acquired infection (HAI). In a study in sweden by Rahmqvist M found that surgical wound infection was responsible for significantly longer LOS than that of any other types of nosocomial infections (95% CI, 10.2-12.7).[176] In another study in USA it was found that pneumonia was associated with 38.2% increases in LOS ($P < 0.0001$ for both), compared to the LOSs for other types of infections (BSIs, SSIs, and others).[179] In another study on 'length of hospital stay related to health care-acquired infections' the relationship of adjusted LOS with types of infection was found significant.[190] Gardner in Australia A in a point prevalence study found that UTI was occupying more than 30% of all the health care associated infection and the neurological patients among all HAI had to stay in hospitals for significantly longer period ($p<0.001$).[191] Role for increasing the length of stay at hospitals was found different on the part of the sites of infections. LOS was found to vary with the difference of sites of infections. Several factors (i.e. resistance pattern of the organisms, patient's susceptibility and factors related with hospital and treatment) might be responsible for these sorts of dissimilarity.

5.0 Conclusion and Recommendation

5.1 Conclusion

It was found from this study that highest number of fathers and mothers of the pediatric patient had educational qualification below SSC. More than quarter of fathers was found as regular smoker. Nearly one quarter of the pediatric patients were found as severely anemic. Slight decrease of prevalence and incidence of HAI was evident comparing with the findings of the previous studies in our country. Prevalence of HAI was found higher in surgery ward than that of medicine wards. Surgical Wound Infection was found to occupy the top of the list among all types of HAI. Prevalence of HAI among the pediatric patients was found significantly different with the differences of education levels of both fathers and mothers but the relation of HAI with the occupation of the parents was not found significant. Prevalence of HAI was also found significantly different among the children of smoker parents than those of among their non-smoker counterpart. No evidence of significant difference of HAI was found with the geographical difference of residence. Children from bigger size families (>5 members) were found to have higher prevalence of HAI than those of smaller (1-5 members) families. Significantly higher prevalence of HAI was found among those pediatric patients who had been born by CS operation. Significantly higher prevalence of HAI was also found among those patients who had been given care by the attendants other than the mothers. Prevalence of HAI was found significantly related with both the immunosuppressive conditions and the immunosuppressive therapy. Prevalence of HAI was also found significantly related with cleanliness status of pillow cover and bed sheets of the patients, face mask using, gown wearing and hand washing practice of the doctors and personal hygienic status of the attendants. It was found that likelihood of HAI among the lower age group was higher than that of higher age group and if the income decreased, the likelihood of HAI increased. Decreased Hb level was found to increase the likelihood of HAI. It was also found that if the duration of operation increased, likelihood of hospital acquired infection also increased. Patients with more waiting time were found to increase the likelihood of hospital acquired infection. Mortality of the HAI patients was found significantly higher than that of non-HAI patients. Satisfaction level of the respondents was found significantly different among the parents of HAI and non-HAI patients. Length of hospital stay and treatment cost was found significantly different among the HAI and non-HAI patients. However, since the study hospitals were mostly similar to other tertiary hospitals in terms of treatment facility and management status so, it would be reasonable to assume that the findings of the present study would be generalizable for all the tertiary level hospitals of Dhaka city.

5.2 Recommendations

On the basis of the findings of the present study the following recommendations are put forward for readers, hospital managers, planners and policy makers:

- Practice of safe surgery should be established especially by minimizing the duration of operation and by decreasing the period of pre-operative delay to reduce the surgical wound infection among the post-operative cases.
- Hospital authority should ensure the WHO standard in supplying patient's linen, special attention should be given to maintain cleanliness status of pillow cover and bed sheets of the patients.
- Practice of using face mask and wearing of gown by the doctors should be strictly maintained because this physical barrier can enormously reduce the incidence of hospital acquired infections.
- Numbers of visitors and attendants (personal care givers) should be brought within WHO recognized levels.
- Hygienic status of the attendants should be regularly monitored, effective hospital based health education program is expected to play role in increasing the awareness of the attendants in this regard.
- Much awareness building campaign should be undertaken regarding harmful effect of second hand smoking, which is expected to restrain the parents to smoke in front of their kids.
- Number of CS operations should be brought within WHO approved limit not only to minimize the prevalence of HAI but also to minimize maternal morbidity mortality.
- Special cautions and attentions should be taken to handle the pediatric patients suffering from immunosuppressive conditions and being treated with immunosuppressive therapy.

- Peoples should be motivated to complete at least secondary level education so that they will develop awareness regarding the consequences of HAI and ultimately they will be more capable to play role in preventing the transmission of causative organisms.
- Parents should be trained regarding child's nutrition, especially about iron rich food which will contribute to increase the hemoglobin levels of their babies. Considering the economic status of the country low cost and culturally acceptable food should be encouraged.
- Rational use of antibiotics should be ensured which will ultimately reduce the cultivation of resistant bacteria.
- Duration of therapeutic procedure (i.e. catheterization, intubation, drainage etc.) should be minimized.
- As the govt. hospitals are in challenging situation with private sectors especially regarding higher rate of infections, so it would be the opportunity for the administrators of the govt. hospitals to overcome the challenge by minimizing the rate of infections.
- Patients with HAI have to stay at hospital for a longer period than uninfected patients due to several factors other than those had been included in this study. It is therefore recommended that further study should be under taken to explore the complex relationship between length of stay (LOS) and HAI especially to estimate more precisely, what part of the LOS and associated cost had been occurred absolutely due to HAI.

6.0 References

1. WHO - Guidelines on prevention and Control of Hospital Associated Infections. Regional Office for SE - Asia. New Delhi. January 2002: 1-3.
2. G. Ducel, et al. Prevention of Hospital - Acquired Infections - A practical Guide, 2nd ed. WHO; 2000: 1-7.
3. Wenzel RP. Prevention and Control of Nosocomial Infections. 3rd Ed. Williams & Wilkins. Baltimore; 1997: 5-7.
4. Theodore C. Eickhoff. Airborne Nosocomial Infection: A Contemporary Perspective. JO Society for Health Care Epidemiology. Oct 1994; 15(10): 663-673.
5. Langmuir AD. Changing concepts of airborne infection of acute contagious diseases: a re-consideration of classic epidemiologic theories. Anny NY Acad Sci. 198; 353: 35-44.
6. Hall CB. Nosocomial viral respiratory infections: Perennial weeds in paediatric wards. In: Dixon RE, ed. Nosocomial Infections. York Medical Books; New York; 1981: 227-233.
7. Hoffman PC, Dixon RE. Control of infection in hospital. Ann Intern Med 1977; 87: 725-728.
8. National Research Council. Postoperative wound infections: The influence of UV irradiation in the operating room. Ann Surg 1964; 160: 1-192.
9. Ayliffe GA. Role of the environment of the operating suite in surgical wound infection. Rev infect. Dis 1991; 13 (Suupl.): 800-804.
10. James M. Hughes. Nosocomial Infection Surveillance in the United States: Historical Perspective. 1987; 8(11): 451, 452.
11. Bennett V.J, Brachman Philips. Hospital Infections. 4th ed. Lippincott-Raven Pub. New York; 1998; 472-476.
12. Sax, -H; Huguenot-S; Harbarth,-S; Herald-P; Pithier-D. Variation in nosocomial infection prevalence according to patient care setting; a hospital-wide survey. MEDLINE®on CD 2001; 07. J-Hosp. Infec. Switzerland; May 2001; 48(1): 27-32.

13. Garner J, Bennet J, Sheckler W, et al: Surveillance of nosocomial infections, in Brachman PS, Eickhoff TC (eds): Proceedings of the International Conference on Nosocomial Infections, American Hospital Association, Chicago; 1971: 277-281.
14. Schifman RB, Palmer RA: Surveillance of nosocomial infections by computer analysis of positive culture rates. J Clin Microbial 1985; 21(4): 493-495.
15. Loss SL, Goodloe S Jr: Follow-up on nosocomial infections on nursing units. *QRB* 1986; 12(7): 243-247.
16. Mcguckin M, Abrutyn E: A surveillance method for early detection of nosocomial outbreaks. *Am J Infect Control* 1979; 7: 18-21.
17. Ayliffe GAJ, Collins BJ, Taylor LJ. Hospital-Acquired Infection. John Wright & Sons Ltd; 1983: 39.
18. Donald E. Craven. Nosocomial Pneumonia: New Concepts on an old Disease, Infection Control and Hospital Epidemiology. 8(2); 1998: 57.
19. Hadi SA. A comparative Study on Factors Determining Post-operative Stay Due to Infection in a Selected Government Hospital and a Private Hospital. Dhaka; 1993: 37, 59, 68.
20. Zaman M, Ahmed N, Chow ZU, Ahmed KU. Surveillance Study of Hospital Acquired Infection. JO-BCPS. Jan 1992; 10: 9-13.
21. Das AM, Rahman M. Health care Quality Assurance: Concept, Strategy and Issues. JOPSOM; 1993; 12(4): 92-97.
22. Bhuiyan MSA. Nosocomial infection in combined Military Hospital. 1999: iv-v
23. Gulandaz HA. Pattern of Surgical Wound Infection in a Selected Tertiary Level Hospital. Dhaka; 1999-2000: 48.
24. Hussain T, Fazal A, Ahmed A, Hussain A. Nosocomial Infection- A Cross-Sectional Study In the Surgical Wards of DMCH.JOPSOM 1991;10(2):70-73.
25. Kawsar NM, Karim N, Rahman M, Eunus M. A study on Nosocomial Infection and the Antibiotic Resistance Pattern of the Isolates in ICU Patients. Bangladesh Armed Forces Med J Dec 2002; XXX (2): 9-15.

26. Khan M.H. Hospital Acquired Infections: It's out come on Quality hospital care in a selected tertiary level Public Hospital. Dhaka; 2003: v-vi.
27. Freeman J, McGowan JE Jr. Risk factors for nosocomial infection. *J infect Dis* 1978; 138: 811.
28. Wolfgang K. et al. Normal Flora and opportunistic infections, Zinsser Microbiology. 20th ed. Appleton & Lange; California: 111, 399-400.
29. Coleman Rotstein, et al. Nosocomial Infection Rates at an Oncology Centre. Infection Control and Hospital Epidemiology. January 1988; 9(1): 13-19.
30. Pannutics, Grinbaum RS. An Overview of Nosocomial Infection Control in Brazil, Infection Control and Hospital Epidemiology. March 1995; 16(3): 152-175.
31. McDermott W. Conference on air borne infections, Bacteriol Rev 25: 173; 1961.
32. Skinner FA, Carr JG. The Normal Microbial Flora of Man. New York, Academic Press, 1974.
33. Evaldson G, et al. The normal human anaerobic microflora. Scand J Infect Dis (supple) 35(9); 1982.
34. Platt R, et al: Risk factors for nosocomial urinary tract infection. Am J Epidemiol 124: 977; 1986.
35. Sen P, et al: Superinfection: Another look. Am J Med 73:707; 1982.
36. WHO. Prevention of Hospital Acquired Infections: A Practical Guide. CDS/CSR/EPH/2002; 12:4-8.
37. Mayon-White R, et al. An international survey of the prevalence of hospital-acquired infection. *J Hosp Infect*, 1988; 11(supple A): 43-48.
38. Gastmeier P, et al. Prevalence of nosocomial infections in representative German hospitals. *J Hosp Infect,* 1998; 38: 37-49.
39. Pittet D, et al. Prevalence and risk factors for nosocomial infections in four university hospitals in Switzerland.*Infect Control HospEpidemiol*,1999;20: 37-42.
40. Scheel O, Stormark M. National prevalence surveys in hospital infections in Norway. *J Hosp Infect,* 1999; 41: 331-335.

41. Ofelia C, Tablan, et al. Guideline for Prevention of Nosocomial Pneumonia, Infection Control and Hospital Epidemiology Sep. 1994; 15(9): 587-589.
42. Tikhomirov E. WHO Programs for the Control of Hospital Infections. Chemiolherapia, 1987; 3:148-151.
43. Pittet D, Tarrara D, Wenzel RP. Nosocomial blood stream infections in critically ill patients. Excess length of stay, extra costs, and attributable mortality. JAMA. 1994; 271: 1598-1601.
44. Nicholas Graves. The cost of Hospital Acquired Infections, Unit Costs of Health and Social Care.School of Hygiene & Tropical Med; London; 2001:25-29.
45. Grayson ML, Steven L Wesselingh. Hospital acquired infections, Medi JO Australia, March 2002; 176(6): 286-291. www.mja.com.au.
46. DH/PHLS. *Hospital Infection Control: Guidance on the Control of Infections in Hospital*. Department of Health, London; 1998.
47. Girard R, Fabry J, Meynet R, Lambert DC, Sepetjan M. Costs of nosocomial infection in a neonatal unit, *Journal of Hospital Infection*, 4; 1983: 361-366.
48. Green J, Wenzel RP. Postoperative wound infection: A controlled study of the increased duration of hospital stays and direct costs of hospitalisation, *Annals of Surgery*. 1977; 185(3): 264-268.
49. Haley RW. Measuring the costs of nosocomial infections: Methods for estimating economic burden on the hospital, *American Journal of Medicine;* 1991 (Suppl-3): 32-38.
50. Liu-yi L, Shu-qun W. Economic effects of nosocomial infections in cardiac surgery, *Journal of Hospital Infection.* 1990; 16: 330-341.
51. Haley RW, et al. how frequent is outbreaks of nosocomial infection in community hospitals? *Infect Control* 1985; 6: 233.
52. Kislak JW, Eickhoff TC, Finland M. Hospital-acquired infections and antibiotic usage in the Boston City Hospital. *N Engl J Med* 1964; 271: 834.
53. Eickhoff TC, Brachman PS, Bennett JV, Brown JF. Surveillance of nosocomial infections in community hospitals: I, surveillance methods, effectiveness, and initial results, *J Infect Dis* 1969; 120: 305.

54. Magnussen MH, Robb SS. Nosocomial infections in a long-term care facility. *Am J Infect Control* 1980; 2: 12.
55. Cruse PJE, Ford R. The epidemiology of wound infection: a 10-year prospective study of 62939 wounds. *Surg Clin North Am* 1980; 60:27.
56. Wenzel RP.The economics of nosocomial infections. *J Hosp Infect.* 1995; 31:79-87.
57. Coella R, et al. The cost of infection in surgical patients: a case study. *J Hosp Infect,* 1993, 25: 239-250.
58. Wenzel RP, Edmond MB. Emerging Infectious Diseases: The impact of Hospital-Acquired Bloodstream infection. 2001; 7(No. 2): 174-177.
59. F Shah, M Gandhi, V Mehta, D Udani, M Mundra, N Swadia. Nosocomial Infections in Surgical Wards. The Internet Journal of Surgery.2011; 24(No.1): 52-57.
60. Pittet D, Tarara D, Wenzel RP. Nosocomial blood stream infection in critically ill patients. JAMA 2012;271:598-601.
61. UMIS. DGHS. Health and Population Statistical Report 2001-2002: 1.
62. Coello R, Glenister, H, Fereres J, Bartlett C, Leigh D, Sedgwick J. Cooke E. The cost of infection in surgical patients: A case control study. Journal of Hospital Infection. 2013;25:239-250.
63. Klevens, Edwards, Richards, et al. Burden of Healthcare-Associated Infections in the United States Pub Health Rep 2014;122:160-6.
64. National Nosocomial Infections Surveillance (NNIS) System, USA 2012.
65. Pollack, Andrew. “Rising Threat of Infections Unfazed by Antibiotics” New York Times, Feb. 27, 2010.
66. Quenon JL, Gottot S, Duneton P, Lariven S, Carlet J, Régnier B, Brücker G. Enquêtenationale de prévalence des infections nosocomiales en France : HôpitalPropre; 2010.
67. Liziolia A, Privitera G, Alliata E, AntoniettaBanfi EM, Boselli L, Panceri ML, Perna MC, Porretta AD, Santini MG, Carreri V. Prevalence of nosocomial infections in Italy: result from the Lombardy survey in 2000. J Hosp Infect 2003;54:141-8.
68. Aodhán S Breathnacha, Nosocomial infections, Medicine, 2005: 33, 22-26.

69. Sax H, Pittet D pour le comité de rédaction de Swiss-NOSO et le réseau Swiss-NOSO Surveillance. Résultats de l'enquêtenationale de prévalence des infections nosocomiales de 2004 (snip04). Swiss-NOSO 2005;12(1):1-4.

70. Lyytikainen O, Kanerva M, Agthe N, Mottonen T. Prevalence Survey Study Group. National Prevalence Survey on Nosocomial Infections in Finnish Acute Care Hospitals, 2005. 10th Epiet Scientific Seminar. Mahon, Menorca, Spain, 13-15 October 2005.

71. Jain SK, Persaud D, Perl TM. (July 2005). Nosocomial malaria and saline flush. Emerging Infect;2011:**11** (7): 1097–9.

72. Brittney NV, Derek J R, Helen LR, Andreas H K, Kevin B L. Incidence prevalence and occurrence rate of infection among adults hospitalized patients: a systematic Review 2013, 2:68.

73. Haley RW. Preliminary cost-benefit analysis of hospital infection control programs (The SENIC Project). In: Daschner F, editor. Proven and unproven methods in hospital infection control. Stuttgart: Gustav, Fisher and Verlag; 2010:93–6.

74. Prevention of hospital-acquired infections: A practical guide. 2nd edition. WHO/ CDS/CSR/EPH/2002.12.

75. Nalini SN, Bruce S, Kantilal P, Murray P, Risk factors for nosocomial infection in critically ill children: A prospective cohort study. Pediatric Critical Care;May 2006:24(5)875-878.

76. Olivier G, Ulrich D, Vladimir T, Carlos R, Nuran S, Zsofia M, Carlo G, Emmanuel G. Nosocomial Rotavirus Infection in European Countries: A Review of the Epidemiology, Severity and Economic Burden of Hospital-Acquired Infections. Pediatric Infectious Disease Journal 2013;25(1):12-21.

77. Haley RW, Culver DH, White JW, Morgan WM, Emori TG. The Nationwide Nosocomial Infection Rate A New Need For Vital Statistics. American Journal of Epidemiology. 2014;121(2): 159-167.

78. Richards MJ, Edwards JR, Culver DH, Gaynes RP. Nosocomial Infections in Pediatric Intensive Care Units in the United States. National Nosocomial Infections Surveillance System.2012;133:39.

79. Jones ELF, Mindorff CM, Langley JM, Allen U, Patrick ML,Milner R, Gold R. Epidemiologic study of Hospital-acquired Infections in Pediatric Patients. Division of Infectious Diseases, Hospital for Sick Children, Toronto, Ontario, Canada.2010;51-57.
80. Haas JP. Measurement of infection control department performance: state of the science. Am J Infect Control. 2012;34:545-9.
81. Haas JP. Measurement of infection control department performance: state of the science. Am J Infect Control 2011;34:545-9.
82. Haley RW. Brachman P, Bennett J. Cost-benefit analysis of infection control activities. Hospital Infections. Philadelphia: Lippincott-Raven; 2009:249-67.
83. Currie E, Maynard A. The economics of hospital acquired infection. 1st ed. York, UK: University of York; 1989.
84. Stone PW, Braccia D, Larson E. Systematic review of economic analyses of health care-associated infections. Am J Infect Control 2011;33:501-509.
85. Finkler SA. The distinction between cost and charges. Ann Intern Med 1982;96: 102-109.
86. Nathwani D, Raman G, Sulham K, Gavaghan M, Menon V. Clinical and economic consequences of hospital-acquired resistant and multidrug-resistant Pseudomonas aeruginosa infections: a systematic review and meta-analysis. Antimicrob Resist Infect Control. 2014; 3: 32.
87. Januel JM, Harbarth S, Allard R, Voirin N, Lepape A, Allaouchiche B, Guerin C. Estimating attributable mortality due to nosocomial infections acquired in intensive care units. Infect Control Hosp Epidemiol. 2014 Apr;31(4):388-94.
88. Sharif MSH. Hospital Acquired Infections and the proportion of Methicillin resistant Staphylococcus Aureus Strain in a selected Hospital. M phil thesis. NIPSOM;2005.
89. Sax H, Hugonner S, Harbarth S, Herrault P, Pitter D. Variation in nosocomial infection prevalence according to patient care setting:a hospital-wide survey.J Hosp Infect. 2001 May;48(1):27-32.

90. Petersen MH, Holm MO, Pedersen SS, Lassen AT, Pedersen C. Incidence and prevalence of hospital-acquired infections in a cohort of patients admitted to medical departments. Dan Med Bul 2014;57(11):210.
91. Rotstein C, Cummings KM, Nicolaou AL, Lucey J, Fitzpatrick J. Nosocomial infection rates at an oncology center. Infect Control. 2011 Jan;9(1):13-9.
92. Klevens RM, Edwards JR, Richards CL, Horan T, Gaynes R, Pollock D, Cardo D. Estimating healthcare-associated infections in U.K. hospitals, 2002. Public Health Rep. 2012;122:160-166.
93. McLaws ML, Gold J, King K, Irwing LM, Berry G.T. The prevalence of nosocomial and community-acquired infections in Australian hospitals. Med J Aust. 2014 Dec 5-19;149(11-12):582-90.
94. Ecdc Surveillance Report On Point Prevalence Survey Of Healthcare-Associated Infections And Antimicrobial Use In European Acute Care Hospitals 2013–2014.
95. Oli AN, Okoli KC, Ujam NT, Adje DU, Ezeobi I. Health professionals' knowledge about relative prevalence of hospital-acquired infections in Delta State of Nigeria. Pan Afr Med J.2016;24:148.
96. Jones EL, Mindorff, Langley JM, Allen U, Patric ML,Milner R, Gold R. Epidemiologic study of 4684 hospital-acquired infections in pediatric patients. Pediatric Infectious Disease Journal. 2014;8(10):668-75.
97. Rahmqvist M, Samuelsson A, Bastami S, Rutberg H. Direct health care costs and length of hospital stay related to health care-acquired infections in adult patients based on point prevalence measurements. American Journal of Infection Control. May 2016;44(5):500–506.
98. Richards MJ, Edwards JR, Culver DH, Gaynes RP. Nosocomial infections in pediatric intensive care units in the United States.National Nosocomial Infections Surveillance System. Journal of Pediatrics 2015;103(4):39.
99. Sydnor ERM, Perl TM. Hospital Epidemiology and Infection Control in Acute-Care Settings. Clin Microbiol Rev. 2014; 24(1): 141–173.
100. News and Announcement of US Onco-therapy on Hospital Acquired Infections. Clin Infect Dis. 2003 Mar 15;36(6):724-30.

101. WHO Health care-associated infections FACT SHEET 2012.

102. Khan HA, Ahmad A, Mehboob R. Nosocomial infections and their control strategies. Asian Pacific Journal of Tropical Biomedicine.2015;5(7): 509-514.

103. Mulu W, Kibru G, Beyene G, Damtie M. Postoperative Nosocomial Infections and Antimicrobial Resistance Pattern of Bacteria Isolates among Patients Admitted at Felege Hiwot Referral Hospital, Bahirdar, Ethiopia. Ethiop J Health Sci. 2012; 22(1):7-18.

104. Mylotte JM, Graham R, KahlerL, Young L, Goodnough S. Epidemiology of Nosocomial Infection and Resistant Organisms in Patients Admitted for the First Time to an Acute Rehabilitation Unit. JIDSA. 2012;30(3):425-432.

105. Razine R, Azzouzi A, Barkat A, Khoudri I, Hassouni F, Almontacer Charif Chefchaouni, Abouqal R. Prevalence of hospital acquired infections in the university medical center of Rabat, Morocco. International Archives of Medicine.2012; 5:26.

106. Bhuiyan MU, Stephen PL, Zaman RU, Rahman W, Sharker MAU, Hossain MJ, et al. Incidence of and Risk Factors for Hospital-Acquired Diarrhea in Three Tertiary Care Public Hospitals in Bangladesh. Am J Trop Med Hyg.2014 Jul 2; 91(1): 165-172.

107. Miah KA, Ali M. Mowla G. Secondhand Tobacco-smoke and Respiratory problems among the Infants of Smoker and non-Smoker Parents. JBCCP.2015;10(2):17-21.

108. Petersen MH, Holm MO, Pedersen SS, Lassen AT, Pedersen C. Incidence and prevalence of hospital-acquired infections in a cohort of patients admitted to medical departments. Dan Med J. 2014;57(11):42.

109. Allegranzi B, Pittet D. Role of hand hygiene in healthcare-associated infection prevention. Journal of Hospital Infection. 2009;73:305-315.

110. Bahador Z, Dehghani SM, Bahador A, Nikeghbalian S, Hafezi N, Bahador M, Malek-Hosseini SA. Parents' Education Level and Mortality and Morbidity of Children after Liver Transplantation. Int J Organ Transplant Med. 2015; 6(1): 25-30.

111. Gentile A, Rivas N, Cochran SRL, Momesso T, Iriart EM, Lopez E, Beck-Sague CM, Jarvis WR. Nosocomial infections in a children's hospital in Argentina: impact of a unique infection control intervention program. Infect Control Hosp Epidemiol. 2013 Dec;22(12):762-6.

112. Ahmed AEA, Khalek EMA, Marzok AHK. Prevalence and Determinants of Chest-Related Symptoms of Acute Respiratory Tract Infections among Children below 5 Years in Upper Egypt. Journal of Pulmonary & Respiratory Medicine. 2016;6(4):1-5.

113. Bagaitkar J, Demuth DR, Scott DA. Tobacco use increases susceptibility to bacterial infection. PMCJ. Tob Induc Dis. 2008; 4(1): 12. Published online 2008 Dec 18. doi: 10.1186/1617-9625-4-12. PMCID: PMC2628337.

114. Huttunen R, Heikkinen T, Syrjanen J. Smoking and the outcome of infection. J Intern Med2014;269:258–269.

115. Hwang SH, Hwang JH, Moon JS, Lee DH. Environmental Tobacco Smoke and Children's Health. Korean J Pediatr. 2012 Feb; 55(2): 35–41.

116. WHO Bulletin on “The burden of health care-associated infection worldwide”2017.

117. Ravishankar A, Singh S, Rai S, Sharma N, Gupta S, Thawani R. Socio-economic profile of patients with community-acquired skin and soft tissue infections in Delhi. Pathog Glob Health. 2014 Sep;108(6):279-282.

118. Sarah S, Long Charles G, Marc Fischer P. Principles and Practice of Pediatric Infectious Diseses.ELSEVIER. Philadelphia.2012;206.

119. Strachan DP. Family size, infection and atopy. Thorax. 2012;55(Suppl 1):S2-S10.

120. Ujunwa FA, Ezeonu CT. Risk Factors for Acute Respiratory Tract Infections in Under-five Children in Enugu Southeast Nigeria. Annals of Medical and Health Sciences Research. 2014;4(1):13-17.

121. Yadav S, Khinchi Y, Pan A, Gupta SK, Shah GS, Baral DD, Poudel P. Risk Factors for Acute Respiratory Infections in Hospitalized Under Five Children in Central Nepal. J Nepal Paediatr Soc.2013;5(2):23-29.

122. Chmielarczyk A, Wójkowska-Mach J, Romaniszyn D, Adamski P, Helwich E, Lauterbach R. et.al. Mode of delivery and other risk factors for

Escherichia coli infections in very low birth weight infants. BMC Pediatrics.2014;14:274.

123. Rutayisire E, Huang K, Liu Y, Tao F. The mode of delivery affects the diversity and colonization pattern of the gut microbiota during the first year of infants life: a systematic review. BMC Gastroenterol. 2016;16:86.

124. Muñoz M, Ramírez SG, Campos A, Ruiz J, Giancarlo M. Liumbruno GM. Pre-operative anaemia: prevalence, consequences and approaches to management**.** J Blood Transfus. 2015 Jul; 13(3): 370-379.

125. Pathak A, Mahadik K, Swami MB, Roy PK, Sharma M, Mahadik VK, Lundborg CS. Incidence and risk factors for surgical site infections in obstetric and gynecological surgeries from a teaching hospital in rural India. Antimicrobial Resistance & Infection Control.2017;6(66):3-59.

126. Hussain SQ, Ashraf M, Wani JG, Ahmed J. Low Hemoglobin Level a Risk Factor for Acute Lower Respiratory Tract Infections (ALRTI) in Children. J Clin Diagn Res. 2014 Apr; 8(4): 1-3.

127. Orlando G, Gubertini G, Negri C, Coen M, Ricci E, Galli M, Rizzardini G. Trends in hospital admissions at a Department for Infectious Diseases in Italy, implications for health policies. BMC Public Health. 2014; 14: 980.

128. Boehme AK, Kumar AD, Dorsey AM, Siegler JE, Aswani MS, MSPH, Lyerly MJ, Monlezun DJ, George AJ, Albright KC, DO, Timothy M. Beasley TM, Martin S. Infections Present on Admission Compared with Hospital-Acquired Infections in Acute Ischemic Stroke Patients. J Stroke Cerebrovasc Dis.2013; 22(8):582-589.

129. Kritsotakis E, Kontopidou F, Astrinaki E, Roumbelaki M, Gourgoulis GM, Ioannidou E, Bolikas E, Gikas A. Burden and impact of hospital-acquired infections in patients with chronic lung disease. European Respiratory Journal 2016;48(6):60-65.

130. Collins AS. Patient Safety and Quality: An Evidence-Based Handbook for Nurses. Centers for Disease Control and Prevention. Atlanta, Georgia;2008 Apr.

131. Prevention of hospital-acquired infections, A practical guide, 2nd Edition.WHO/CDS/CSR/EPH/2002.12 p-7.

132. Banach DB, Bearman GM, Morgan DJ, Munoz-PriceLS. Infection control precautions for visitors to healthcare facilities. J Expert Review of Anti-infective Therapy.2015;13(9):28-31.

133. Cohen B, Hyman S, Rosenberg L, Larson E. Frequency of Patient Contact with Health Care Personnel and Visitors: Implications for Infection Prevention**.** Jt Comm J Qual Patient Saf. 2012 Dec;38(12): 560-565.

134. Sultana R, Islam S, Rimi N, Stephen P, Emily S. Role of Patients' Attendants in Transmission and Prevention of Nosocomial Infections in Bangladeshi Public Hospitals. Conference Paper, 13th International Congress on Infectious Diseases. December 2008.

135. Bhuiyan MU, Luby SP, Zaman RU, Rahman MW, Sharker MAY, Choudhury MJH, Rasul H, Ekram ARMS, Rahman M, Ramirez KS, Baumgartner EA, Gurley ES. Incidence of and Risk Factors for Hospital-Acquired Diarrhea in Three Tertiary Care Public Hospitals in Bangladesh. Am J Trop Med Hyg. 2014; 91(1): 165–172.

136. Islam MS, Luby SP, Sultana R, Rimi NA, Zaman RU, Uddin M, Nahar N, Rahman M, Hossain MJ, Gurley ES. Family caregivers in public tertiary care hospitals in Bangladesh: risks and opportunities for infection control. Am J Infect Control. 2014;42(3):305-10.

137. Lacey S, Smith JB, Cox K. Patient Safety and Quality: An Evidence-Based Handbook for Nurses. Rockville USA; Apr 2008: Chapter 15.

138. Barron IK, Hayden TA. Essentials of infection prevention in the pediatric population. International Journal of Pediatrics and Adolescent Medicine. 2016; 3(4): 143-152.

139. Raza S. Healthcare Associated Infections. SPICe Briefing; 16 November 2011.

140. The Chief Public Health Officer's Report on the State of Public Health in Canada 2013 – Healthcare-associated infections – Due diligence.

141. Tofayel SAM. Electrically active materials for medical devices. Joanna Bauer. Imperial College Press; Wroclaw University of technology Poland:319.

142. Bantar C, Alcazar G, Franco D, Vesco E, Salamone F, Izaguirre M, Oliva ME. Impact of antibiotic treatment on bacterial resistance rates from patients with hospital-acquired infection. J Chemother. 2007 Dec;19(6):673-6.

143. Cardoso T, Ribeiro O, Aragão I, Costa-Pereira A, Sarmento A. The Impact of Healthcare-Associated Infection on Mortality: Failure in Clinical Recognition Is Related with Inadequate Antibiotic Therapy. PLOS. 2013; 8(3): e58418. MCID: PMC3592830. Published online 2013 Mar 8. doi: 10.1371/ journal. pone.0058418.

144. Alejandria M. et.al. Incidence, risk factors and outcome of hospital-acquired pneumonia in critically-ill patients at the Philippine General Hospital. The Philippine Journal of Microbiology and Infectious Diseases.2015;28(2):29-38.

145. Darouiche R. Surgical site infections. Hospital Infection Control. 2016;9(3):12-15.

146. Cardoso T, Almeida M, Friedman ND, Aragão I, Costa-Pereira A, Sarmento AE, Azevedo L. Classification of healthcare-associated infection: a systematic review 10 years after the first proposal. BMC Med.2014; 12: 40.

147. Celis R, Torres A, Gatell JM, Almela M, Rodríguez-Roisin R, Agustí-Vidal A. Nosocomial Pneumonia: A Multivariate Analysis of Risk and Prognosis. ELSEVIER.2008;93(2):318-324.

148. Maksimović J, Marković-Denić L, Bumbaširević M, Marinković J, Vlajinac H. Surgical Site Infections in Orthopedic Patients: Prospective Cohort Study. Croat Med J. 2008 Feb; 49(1): 58–65.

149. Al-Mulhim FA, Baragbah MA, Ali MS, Alomran AS, Azam MQ. Prevalence of Surgical Site Infection in Orthopedic Surgery: A 5-year Analysis. Int Surg. 2014 May-Jun; 99(3): 264–268.

150. Cheng K, Li J, Kong Q, Wang C, Ye N, Xia G. Risk factors for surgical site infection in a teaching hospital: a prospective study of 1,138 patients. Patient Prefer Adherence. 2015; 9: 1171–1177.

151. Gunnarsson C, Rizzo JA, Hochheiser L. The Effects of Laparoscopic Surgery and Nosocomial Infections on the Cost of Care: Evidence from Three Common Surgical Procedures. Value in Health J. 2013;12(1):52.

152. Kollef MH, Sharpless L, Vlasnik J, Pasque C, Murphy D, Fraser VJ. The impact of nosocomial infections on patient outcomes following cardiac surgery. Chest J. 2014Sep;112(3):666-75.

153. Burgner D, Dalton D, Hanlon M, Wong M, Kakakios A, Isaacs D. Repeated prevalence surveys of paediatric hospital-acquired infection. J Hosp Infect. 1996 Nov;34(3):163-70.

154. Al-Hazmi H. Role of duration of catheterization and length of hospital stay on the rate of catheter-related hospital-acquired urinary tract infections. Res Rep Urol. 2015; 7: 41–47.

155. BhattacharyyaN, Ann M. Kosloske AM, Macarthur C. Nosocomial infection in pediatric surgical patients: A study of 608 infants and children. Journal of Pediatric Surgery. 2013;28(3):338–344.

156. Cavanillas AB, Contreras R R, Rodriguez M D, Abril OM, Gigosos RL, Solvas JG, Vargas RG. Preoperative stay as a risk factor for nosocomial infection. Eur J Epidemiol. 2011 Nov;7(6):670-6.

157. Sahu MK, Siddharth CB, Devagouru V, Talwar S, Singh SP, Chaudhary S, Airan B. Hospital-acquired Infection: Prevalence and Outcome in Infants Undergoing Open Heart Surgery in the Present Era. Indian J Crit Care Med. 2017 May;21(5):281-286.

158. Pereira HO, Rezende EM, Couto BRGM. Length of preoperative hospital stay: a risk factor for reducing surgical infection in femoral fracture cases. Revista Brasileira de Ortopedia. 2015;50(6):638-646.

159. Alan R. Frequently Asked Questions Anesthesia While a Child has a Common Cold: My child's surgery was cancelled because of a cold. How long should I wait to reschedule surgery? University of Michigan Hospitals and Health Center. 2017.

160. Bandolier. Washing hands reduces hospital-acquired infection. Evidence based thinking about health care.2013;1-10.

161. Allegranzi B, Pittet D. Role of hand hygiene in healthcare-associated infection prevention. J Hosp Infect. 2014 Dec;73(4):305-15.

162. McLaws ML. The relationship between hand hygiene and health care-associated infection: it’s complicated. Infect Drug Resist. 2015; 8: 7–18.

163. Salama MF, Jamal WY, Haifa Al Mousa HA, Ghani KA. Rotimi VO. The effect of hand hygiene compliance on hospital-acquired infections in an ICU setting in a Kuwaiti teaching hospital. Journal of Infection and Public Health. 2013;6(1) 27-34.

164. McGaw CD, Tennant I, Harding HE,, Cawich SO, Crandon IW, Walters CA. Healthcare workers' attitudes to and compliance with infection control guidelines in the operating department at the University Hospital of the West Indies, Jamaica. International Journal of Infection Control. 2013;8(3):2-9.

165. D. Harris AD, Pineles L, Belton B. Universal Glove and Gown Use and Acquisition of Antibiotic-Resistant Bacteria in the ICUA Randomized Trial. JAMA. 2013;310(15):1571-1580.

166. Castillo M. Wearing gloves and gown in ICU may protect against MRSA superbug, but not VRE. CBS News; October 7, 2013.

167. Harris AD, Samore MH, Lipsitch M, Kaye KS, Perencevich E, Carmeli Y. Control-Group Selection Importance in Studies of Antimicrobial Resistance: Examples Applied to Pseudomonas aeruginosa, Enterococci, and Escherichia coli. J Clinical Infectious Diseases.2015; 34(12): 1558–1563.

168. Brunton WA. Infection and hospital laundry. Lancet. 2o12;345:1574–1575. doi: 10.1016/S0140-6736(95)91124-3.

169. Otero RB. Soiled hospital linens-Are they a threat? Laund. News. 2011;12:17. doi: 10.1364/ON.12.12.000017. [PubMed] [Cross Ref].

170. Otero RB. American Society for Healthcare Environmental Services of the American Hospital Association; Chicago, IL, USA: 2010. Healthcare Textile Services: Infection Control; pp. 1–13.

171. Creamer M. The Contribution of Beds to Healthcare-Associated Infection: The Importance of Adequate Decontamination. Journal of Hospital Infection.2010;69: 8-23.

172. Pyrek KM. Lessons in Linen. Following Aseptic Technique in the Laundry Department. 2011. [(accessed on 10 September 2012)]. Available online: http://www.infectioncontroltoday.com/articles/2003/02/lessons-in-linen.aspx.

173. Angelis GD, Murthy A, Beyersmann J, Harbarth NS. Estimating the impact of healthcare-associated infections on length of stay and costs. Clinical Microbiology and Infection.2010;16(12): 1729-1735.

174. Plowman R, Graves N, Griffin MA, Roberts JA, Swan AV, Taylor L. The rate and cost of hospital-acquired infections occurring in patients admitted to selected specialties of a district general hospital in England and the national burden imposed. J Hosp Infect. 2011 Mar;47(3):198-209.

175. Chavda A. Effectiveness of structural teaching programme on prevention and control of methicillin resistant staphylococcus aureus. M Phil Thesis. Rajiv Gandhi University Of Health Sciences, Bangalore, Karnataka,India. 2012.

176. Rahmqvist M, Samuelsson A, Bastami S, Rutberg H. Direct health care costs and length of hospital stay related to health care-acquired infections in adult patients based on point prevalence measurements**.** American Journal of Infection Control. 2016 May;44(1): 500-506.

177. Kurutkan MN, Kara O, Eraslan IH. An implementation on the social cost of hospital acquired infections. Int J Clin Exp Med. 2015; 8(3): 433-445.

178. Larson E. Factors associated with variation in estimates of the cost of resistant infections. Med Care. 2014;48(9):767-775.

179. Mauldin PD, Salgado CD, Hansen, Durup DT, Bosso JA. Attributable Hospital Cost and Length of Stay Associated with Health Care-Associated Infections Caused by Antibiotic-Resistant Gram-Negative Bacteria.J American Society for Microbiology. 2010;54(1):109-115.

180. Prakash B. Patient Satisfaction. J Cutan Aesthet Surg. 2014; 3(3): 151–155.

181. Barton M. 3 Ways to Decrease Nosocomial Infections in Hospitals. Explore Health Catalyst Insights: Readiness Assessment.2015.

182. Yesalis CE, Holt HD, Politzer RM. Fundamentals of US Health Care: Principles and Perspectives. Delmar Cengage Learning.USA;2013:316.

183. Bueno-Cavanillas A, et al. Influence of nosocomial infection on mortality rate in an intensive care unit. Crit Care Med 20144 Jan;22(1):55-60.

184. Kirkland KB, Briggs JP, Trivette SL, Wilkinson WE, Sexton DJ. The impact of surgical-site infections: attributable mortality, excess length of

hospitalization, and extra costs. Infect Control Hosp Epid 2012;20(11):725-30.

185. Dinkel RH, Lebok U. A survey of nosocomial infections and their influence on hospital mortality rates. J Hosp Infect 2010 Dec;28(4):297-304.

186. Kollef MH, Sharpless L, Vlasnik J, Pasque C, Murphy D, Fraser VJ. The impact of nosocomial infections on patient outcomes following cardiac surgery. J Chest. 2011 Sep;112(3):666-75.

187. Alejandria M, Rosaros J, Mendoza M, Chavez J, Cordero C, Berba R. Incidence, risk factors and outcome of hospital-acquired pneumonia in critically-ill patients at the Philippine General Hospital. The Philippine Journal of Microbiology and Infectious Diseases. 2011;28(2):29-38.

188. D Pittet et al. Effectiveness of a hospital-wide programme to improve compliance with hand hygiene. Lancet 2010; 356: 1307-1312.

189. Petersen MH, Holm MO, Pedersen SS, Annmarie Touborg Lassen AT, Pedersen C. Incidence and prevalence of hospital-acquired infections in a cohort of patients admitted to medical departments. November 2010; Dan Med Bul 57/11:1-5.

190. Gaynes R, Edwards J R. Overview of healthcare associated infections caused by gram-negative bacilli. Clin Infect Dis. 2015;41:848-854.

191. Gardner A, Mitchell B, Beckingham W, Fasugba O. A point prevalence cross- sectional study of healthcare-associated urinary tract infections in six Australian hospitals. BMJ. Published online 2014 Jul 29. doi: 10.1136/bmjopen-2014-005099.

Annexure:

Informed consent

Title of the Project:

Hospital Acquired Infections among the Paediatric Patients in Tertiary Level Hospitals of Dhaka City: Extent, Determinants and, Impact on Cost and Hospital Management.

Respect Respondents, Assalamualaikum / Good morning.

I myself Dr./Mr--Father's name--------------------
-------------------------- Mother's name--------------------------------------Vill /Rd------
---------------------------PO---------------------UZ/PS--------------------------- Dist------
-----have come to you as an interviewer of the above mentioned project.

The purposes of this study is to determine the factors involved in the occurrence of hospital acquired infections and to find out the impact of HAI on cost of treatment and on hospital management.

Your participation in this study is completely on voluntary basis by giving the answers of some questions regarding your disease and by showing the affected parts of your body. The interview and observation session with you will take approximately 30 minutes. The findings of the study will help the policy maker to formulate realistic strategy in eliminating child marriage from the country. No drugs or placebos will be used in this study. No blood, fluids or any other items will be collected from your body.

Usually there is no possibility of potential risks to you in this study, even though if any such situation would arise the researcher will provide all sorts of risk coverage to you.

All sorts of confidentiality will be ensured in connection with this study.

You have the full right to be withdrawn from the interview session at any time.

You will have one copy of this informed consent form after being signed by all concern.

Name of the Witness Signature/ Thumb impression of the Witness	Name of the Respondent Signature/ Thumb-impression of the Respondent	Name of the Researcher Signature of the Researcher

জ্ঞাত m¤§wZcÎ

M‡elbvi wk‡ivbvgt

Hospital Acquired Infections among the Paediatric Patients in Tertiary Level Hospitals of Dhaka City: Extent, Determinants and, Impact on Cost and Hospital Management.

সম্মানিত তথ্য প্রদানকারী,

আস্‌সালামু আলাইকুম/সুপ্রভাত

আমি -------------------------------------পিতাঃ--মাতাঃ-------- --------------------গ্রাম/সড়কঃ--------------------------------ডাক ঘরঃ-------------------------------- উপজেলা/থানাঃ-------------------------জেলাঃ -----------------------------------উপরে বর্নিত বিষয়ক একটি গবেষনা কাজের উপাত্ত সংগ্রহের উদ্দেশ্যে আপনার নিকট এসেছি।

এই গবেষনাটিতে ডাঃ খোরশেদ আলী মিয়া, সহকারী অধ্যাপক, জনস্বাস্থ্য ও হাসপাতাল প্রশাসন বিভাগ, জাতীয় প্রতিষেধক ও সামাজিক চিকিৎসা প্রতিষ্ঠান (নিপসম), মহাখালী, ঢাকা, প্রধান গবেষক হিসাবে আছেন।

আপনাকে শুধূ কিছু প্রশ্নের উত্তর প্রদান করতে হবে । আপনার সাক্ষাৎকার গ্রহন করতে আনুমানিক ১৫ মিনিট সময় লাগবে।

এ গবেষণাটি সঠিক তথ্য সরবরবহের মাধ্যমে সঠিক কর্মপরিকল্পণা নির্ধারনে নীতি নির্ধারক গনের জন্য সহায়ক হবে।

এ গবেষনায় আপনাকে কোন ধরনের ঔষধ বা ঔষধ-সদৃশ বস্ড়ু খাওয়ানো বা প্রয়োগ করা হবে না। আপনার শরীর থেকে রক্ত বা অন্য কোন উপাদান সংগ্রহ করা হবে না।

এই গবেষনায় আপনার কোন রকম ঝুকির সম্ভাবনা নেই। তারপরও যদি এমন কোন অবস্থা সৃষ্টি হয় তাহলে এ সংক্রান্ড় সব ধরনের ঝুকি ও চিকিৎসা খরচ গবেষক নিজে বহন করবেন।

এ গবেষনা সম্পর্কীত সকল ধরনের গপোনীয়তা অত্যান্ড় নিষ্ঠার সাথে রক্ষা করা হবে।

যে কোন তথ্য প্রদান করা বা না করার ব্যাপারে আপনি সম্পূর্ন স্বাধীন।

সংশিণ্টষ্ট সকলের স্বাক্ষরের পরে আপনাকে এই জ্ঞাত সম্মতিপত্রের একটি কপি প্রদান করা হবে।

¯v¶xi bvg ¯v¶xi ¯v¶i/wUcmwn	Z_¨ c'vbKvixi bvg Z_¨ c'vbKvixi ¯v¶i/wUcmwn	M‡el‡Ki bvg M‡el‡Ki ¯v¶i

Research under PhD Programme

Faculty of Post-graduate Medicine and Research,
Dhaka University.

Through National Institute of Preventive and Social Medicine (NIPSOM), Mohakhali, Dhaka.

Title: Hospital Acquired Infections among the Paediatric Patients in Tertiary Level Hospitals of Dhaka City: Extent, Determinants and, Impact on Cost and Hospital Management.

Questionnaires for Parents or Caregivers of Patients.

(For both HAI and non-HAI patient)

Name of Hospital: ☐

[Declaration to the respondents: This research programme is the compulsory part of PhD course under Faculty of Post-graduate Medicine and Research of Dhaka University. As a researcher I am in urgent need to have some information from you regarding your patient to carry out this research programme. You are highly appreciated to pass your opinion without any bias. Not only that you have the full right even not to response at all. It is for your kind information that full confidentiality will be maintained in this concern. I would again like to express my thanks and gratitude to you for your great contribution.]

1. Name of the patient:

2. Ward No............... Reg.No................. Bed No..................

3. Name of the respondent:

4. Relation of the patient with respondent: ☐

   1) Mother 3) Grand mother

   2) Father 4) Others (Caretaker)

5. Age of the patient: ....Months

6. Sex of the patient: 1) Male 2) Female ☐

7. Religion of the patient

1) Muslim
2) Hindu
3) Christian
4) Buddhist
5) Others (specify):

8. Occupation of patient's father

1) Agriculture.
2) Business.
3) Service.
4) Industry worker
5) Daily laborer
6) Others (Specify):

9. Occupation of patient's mother

1) House wife.
2) Service.
3) Factory worker
4) Others (Specify):

10. Educational level of patient's father:

1) Class One.
2) Class Two.
3) Class Three
4) Class Four
5) Class Five.
6) Class Six.
7) Class Seven.
8) Class Eight.
9) Class Nine
10) Class Ten
11) SSC
12) HSC
13) Graduation
14) Masters
15) No Education

11. Educational level of patient's mother:

1) Class One.
2) Class Two.
3) Class Three
4) Class Four
5) Class Five.
6) Class Six.
7) Class Seven.
8) Class Eight.
9) Class Nine
10) Class Ten
11) SSC
12) HSC
13) Graduation
14) Masters
15) No Education

12. Monthly family income (in thousand taka): ..../=

13. What is about the smoking habit of the patient's father?

1) Non smoker . 3) Regular smoker
2) Irregular smoker . 4) Chain smoker

14. What is about the smoking habit of the patient's mother?

1) Non smoker. 3) Regular smoker
2) Irregular smoker . 4) Chain smoker

15. Was the patient being hospitalised within three months back?

1) Yes. 2) No.

16. Had the patient undergone any surgical operation within three months back?

1) Yes. 2) No.

17. How may attendants on an average stay with the patient? (In number):

18. How many visitors (average) are coming daily? (In number):

19. Have you seen any rodents and pests in the hospital?

1) Seen several times in a day. 3) Infrequently seen
2) Frequently seen. 4) Never seen

20. How frequently the linen is changed?

1) Every day 4) Three days interval
2) One day interval 5) Four days interval
3) Two daysinterval. 5) Four days interval

21. How frequently the pillow cover is changed?

1) Every day 4) Three days interval
2) One day interval 5) Four days interval
3) Two days interval 6) Five days interval

22. What is your comment regarding the overall services provided by this hospital?

1) Highly satisfied 4) Dissatisfied
2) Satisfied. 5) Highly dissatisfied
3) No comment /average

Research under PhD Programme

Faculty of Post-graduate Medicine and Research,
Dhaka University.

Through National Institute of Preventive and Social Medicine (NIPSOM), Mohakhali, Dhaka.

Title: Hospital Acquired Infections among the Paediatric Patients in Tertiary Level Hospitals of Dhaka City: Extent, Determinants and, Impact on Cost and Hospital Management.

Observation Check-List For Patients

(For both HAI and non-HAI Patient)

Name of Hospital**:** ☐

1. Patient's Name**:**

2. Bed No. Ward No. Registration No.

3. Name of the basic disease for which the patient had got admitted:

4. Has the patient presented with features of infection at the time of admission?

1) Yes 2) No ☐

If no then

5. Has the patient developed infection withing 48 hours after admission?

1) Yes 2) No ☐

If no then

6. Has the patient passed 48 hours after admission?

1) Yes 2) No ☐

If yes then

7. Has the patient developed infections at any time in hospital after passing 48 hours from admission?

1) Yes 2) No ☐

<u>If yes then</u>

8. Has the patient been clinically diagnosed as HAI? ☐

1) Yes 2) No

<u>If yes then</u>

9. Has the patient undergone thorough clinical and laboratory investigations? ☐

1) Yes 2) No

<u>If yes then</u>

10. Whether the case has been finally diagnosed as HAI or non- HAI patient: ☐

1) HAI 2) Non-HAI

<u>If diagnosed as HAI then</u>

11. Please mention the type of HAI- (On the basis of site of infection) ☐

(Please put the number of the appropriate option in the box)

1) Surgical wound infection
2) Urinary Tract Infection (UTI)
3) Respiratory Tract infection
4) Vascular catheter infection
5) Septicaemia/Bacteraemia
6) Skin and soft tissue infection
7) Others (Specify):

12. Causative organisms involved in the occurrence of HAI: ☐

(Please put the number of the appropriate option in the box)

1) Staphylococcus Aurius
2) Pseudomonas aerogenosa
3) E. Coli
4) Staphylococcus viridens
5) Pneumococcus
6) Gonococcus
7) Streptococcus
8) Others (Specify):

13. In culture and sensitivity test (of the required specimen) resistance was found against which of the following antimicrobial agents? ☐
(Please put the number of the appropriate option in the box)

1) Amoxycillin
2) Cephalexin
3) Cefradine
4) Ciprofloxacin
5) Livofloxacin
6) Ceftriaxone
7) Others (Specify):
8) None

14. Had the patient undergone any of the following therapeutic interventions?
(Please put the number of the appropriate option in the box) ☐

1) Biopsies
2) Endoscopic examination
3) Catheterization
4) Intubation/Ventilation
5) Naso-gastric Suction
6) Naso-gastric Feeding
7) Surgical procedure
8) Others (Specify):
9) None

15. Duration of use of specific intervention: ....days

16. Had the patient taken any of the following Immunosuppressive therapy?
(Within three months back) ☐

1) Cytotoxic drug
2) Irradiation
3) Steroid therapy
4) None

17. Had the patient suffered from any of the following Immunosuppressive condition?
(Within three months back) ☐

1) Leukaemia
2) Other malignant disease:
3) Uraemia
4) Injury to skin or mucous membrane
5) Renal failure
6) Liver failure

18. Had the patient been treated with antibiotic during present hospital days?

1) Yes 2) No

<u>If yes then</u>

19. Which of the following antibiotic was given?

1) Amoxicillin
2) Erythromycin
3) Cephalexin
4) Cefradine
5) Ceftriaxone
6) Azithromycine
7) Cefixime
8) Others:

20.For how many days the antibiotic was used?: ....days

21.Patient's haemoglobin level at the time of admission: ……..Gm%

22.Patient's BMI at the time of admission:

23.Patient's blood group:

1) A +ve
2) A –ve
3) B +ve
4) B –ve
5) AB+ve
6) AB -ve
7) O + ve
8) O - ve

24. Name of operation done for basic disease for which the patient has got admitted**:**

25. How many days the patient had to wait for operation after confirmation of diagnosis (preoperative delay)?**:** …… days

26. Name of operation done for HAI or complication of HAI (when and where applicable)**:**

Specify ....

27. What was the ultimate outcome of the patient? ☐

1) Cure 3) Morbidity

2) Death 4) Referral

28. Date of admission: ☐☐☐

29. Date of development of HAI ☐☐☐

(I.e.HAI developed on ....th day after admission)

30. Date of discharge / death /referral: ☐☐☐

31. Average length of stay (ALS) at hospital for non-HAI patient:

....

……days

32. Total days of stay at hospital for this patient (SL. 27 – SL.25):

................................……days

33. Extra days of stay at hospital for this patient (SL. 29 – SL. 28):

....days

34**. Calculation of extra private cost: (in Taka)**

ITEMS	**Perday cost (a)**	**Extra days (b)**	**Total cost(aòb)**
a) Cost of extra medicine			
b) Cost of extra investigation			
c) Extra food expenses for patient			
d) Extra food for attendants			
e) Extra travel cost of attendants			
f) Income loss of the parents			
g) Unseen expenses			
Grand Total			

35. **Calculation of extra opportunity cost: (in Taka)**

ITEMS	**Per day cost**	**Extra days**	**Total cost**
a) Bed charge (including diet) for extra days			
b) Extra Investigation			
c) Operation charge (for HAI)			
d) MSR used for extra days			
e) Extra services rendered by doctors			
f) Extra services rendered by nurses			
g) Extra services rendered by other staffs			
Grand Total			

Research under PhD Programme

Faculty of Post-graduate Medicine and Research,
Dhaka University.

Through National Institute of Preventive and Social Medicine (NIPSOM),

Mohakhali, Dhaka.

Title: Hospital Acquired Infections among the Paediatric Patients In Tertiary Level Hospitals Of Dhaka City: Extent, Determinants And, Impact on Cost and Hospital Management.

Observation Check-List For Hospital Facilities

Name of Hospital:

1. Total number of paediatric patients had been admitted during study period in this hospital **:**

2. Total number of HAI among the paediatric patients during study period in this hospital **:**

3. Total number of non-HAI paediatric patients brought under study in this hospital **:**

4. Total number of paediatric beds in this hospital **:**

5. Total number of death of paediatric patients **:**
   (Excluding the death occurred within 48 hours of admission)

6. Length of data collection period in this hospital **:** ....days.

7. Total bed-days utilized by all non-HAI paediatric patients during study period in this hospital **:** . ...days.
8. Total bed-days utilized by all paediatric HAI patients during study period in this hospital **:** ....days.

9. Sum of bed-days utilized by all admitted patients
   (including HAI and non-HAI) during study period in this hospital **:** ....days.

10. Total number of doctors working in the study area of the hospital **:**

11. Total number of nurses working in the study area of the hospital **:**

12. Total number of staffs working in the study area of the hospital **:**

13. Space between two beds (on an average) **:** ....feet

<u>Hygienic practice of the Attendants</u>

14. Practice of using facemask at the time of caring the patient:
    (Give the <u>number</u> of personnel found using or not using the facemask)

(Pedi. Medi. /Pedi.Surgery) Ward No..........Date of visit: / /		
Personnel	Using	Not using
Doctor:		

15. Practice of using facemask at the time of caring the patient:
    (Give the <u>number</u> of personnel found using or not using the cap)

(Pedi. Medi. /Pedi.Surgery) Ward No..........Date of visit: / /		
Personnel	Using	Not using
Doctor:		

16. Practice of using facemask at the time of caring the patient:
    (Give the <u>number</u> of personnel found using or not using the gown)

(Pedi. Medi. /Pedi.Surgery) Ward No..........Date of visit: / /		
Personnel	Using	Not using
Doctor:		

17. Practice of hand washing before and after caring the patient:

(Give the number of personnel practicing or not practicing hand washing)

(Pedi. Medi. /Pedi.Surgery) Ward No..........Date of visit: / /		
Personnel	Practiced	Not Practiced
Doctor:		

Condition of linen:

18.Cleanliness status of bed sheet:

(SL.No.of appropriate option should be put in the box)

(Pedi. Medi./Pedi.Surgery) Ward No....Date of visit:
1) Clean
2) Dirty

19**. Cleanliness status of pillow cover:**

(SL.No.of appropriate option should be put in the box)

(Pedi. Medi./Pedi.Surgery) Ward No....Date of visit:
1) Clean
2) Dirty

20. Is there any infection control committee in this hospital?

1) Yes 2) No

21. Do the infection control committee work regularly?

1) Yes 2) No

22. Has the hospital separate budget for controlling infection?

1) Yes 2) No

23. Is there any provision for special care for HAI patients?

1) Yes 2) No

Flow Chart of the Schedule of the Study:

Activities	Months											
	4	4	4	4	4	4	4	4	4	4	4	4
Review of literature												
Development of Research Instruments												
Pre-testing												
Finalization of Research Instrument												
Training of interviewers												
Data collection												
Data processing and analysis												
Report writing												