RELATIONSHIP BETWEEN HOSPITAL ACQUIRED INFECTION AND INCREASE AVERAGE LENGTH OF STAY

Dissertation Submitted to

The IIHMR University, Jaipur

for the partial fulfillment for the award of the degree of

Master of Business Administration (MBA)

In

Hospital and Health Management

by

Alfa Khan

Under the Supervision and Guidance of

Dr. Mahender Kumar

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DECLARATION BY STUDENT

I hereby declare that this dissertation title Relationship between Hospital Acquired Infection and Increased Average Length of Stay is the bonafide record of my original research work. I declare that it is not been submitted to any other university or institution for the award of any degree or diploma. Information derived from the published or unpublished work of other has been duly acknowledged in the text.

Alfa Khan

Name of the Student

Date: 02-07-2021

CERTIFICATE

This is to certify that Alfa Khan in partial fulfillment of the requirements for the award of the degree of MBA (Hospital and Health Management) from the IIHMR University, Jaipur has successfully completed her internship at NH Rabindranath Tagore International Institute of Cardiac Sciences during March 22, 2021 to June 19, 2021.

Place: Preceptor/ Head of the Organization

Date: Name of the Organization

CERTIFICATE

This is to certify that dissertation titled Relationship between Hospital Acquired Infection and Increase Average Length of Stay is a record of the research work undertaken by Alfa Khan in partial fulfillment of the requirements for the award of the degree of MBA Hospital and Health Management from IIHMR University, Jaipur under my guidance and supervision and her approach to the research study has been sincere, scientific, and analytical.

Faculty Guide	School Dean
IIHMR University, Jaipur	IIHMR University, Jaipur
Date	Date

Abstract:

Background: The review is done to understand the relation between Hospital Acquired infection (HAI) and Increase Average Length of Stay. The HAI is leads the higher economic burden. It affect on the both cost, direct and indirect.

Hospital Acquired infection is also called as Nosocomial infection, healthcare-associated infection (HAI). This infection is occurred in 48 hours after the admission of the hospital.

Methods: Articles were searched in scientific databases like Google Scholar, PubMed, ResearchGate, and SciHub to identify the various studies that talks about the co-relation between the Hospital Acquired Infection and the extra Average Length of Stay. The database were searched by using the key words "HAI"," LoS", "CAUTI", "SSI", "CALBSI", "Nosocomial Infection", "HCAI", "VAP", "India", " worldwide". The article was selected within the time frame of 2011 to 2021.

Study Rationale: Nosocomial Infection slow down recovering, excess length of stay, and multiplication both hospital cost and risk of death. This article focus on to approximate the prolong hospital stay and mortality rate attributable to following HAIs: CLABSI, CAUTI, SSI, VAP. This study present a review of literature along with introduction, major outcomes and methods, result, discussion and followed by conclusion.

Conclusion: This review found the co-relation of HAI with extra LoS, morbidity, mortality; reduce the quality of life, anxiety. The LoS, mortality is relatable higher among the patients who are at least affected by one infection than Non HAI patients. HAI are generally increasing the substantial economic burden by increasing length of stay in hospital. Patients' morbidity and mortality rate also increase, this leads also functional disability, emotional stress, and many times the disability can reduce the quality of life. It also effect on economic cost for consumable items like increase drug use, additional diagnostic test, isolation.

Keyword: HAI, LoS, CAUTI, SSI, CALBSI, Nosocomial Infection, HCAI, VAP, India, worldwide.

Acknowledgement

It is always privilege for me to get a chance to successfully complete my Dissertation under IIHMR University, Jaipur.

First of all, I am thankful to my parents who support me unconditionally, without their support it might not be possible to complete.

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Third, I want to express my thanks to my entire faculty member, who make me able to understand this project.

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Abbreviations:

HAI	Hospital Acquired Infection
LOS	Length of Stay
CLABSI	Central Line-associated Bloodstream Infection
CAUTI	Catheter-associated Urinary Tract Infections
SSI	Surgical Site Infection
VAP	Ventilator -associated Pneumonia
HAP	Hospital Acquired Pneumonia
BSI	Blood Stream Infection
UTI	Urinary Tract Infection
SUIT	Symptomatic Urinary Tract Infection
ABUIT	Asymptometic Bacteremic Urinary Tract Infection
ICU	Intensive Care Unit
VDs	Ventilator Days
OR	Odd Ratio
WHO	World Health Organization
CDC	Center for Diseases Control and Prevention
IDSA	Infectious Diseases Society of America
ECDC	Europe Centre for Disease prevention and Control
INICC	International Nosocomial Infection Control Consortium
HCAP	Healthcare Acquired Pneumonia

Introduction:

Hospital Acquired infection also known as Nosocomial infection, healthcare-associated infection (HAI) (WHO, 2011). Nosocomial infection one of the major challenges in lower and middle income countries, which have limited healthcare resources (WHO, 2011). This infection is occurred in 48 hours after the admission of the hospital. This infection held both the developed and resource poor countries. Various studies show that between 5.9 to 13.5% patients are affected by Nosocomial Infection (CDC, CDC, 2018) (WHO, 2011) . This proportion is higher among the old age, underlying diseases, chemotherapy patients, immune-compromise patients (WHO/CDS/CSR/EPH/2002.12). According to WHO HAI is a invisible and sawing burden that no country can ascertain yet for solving this. It is a worldwide burden, in an article of national and multi-central studies (1995-2008), shows the general prevalence of HAI in developed countries are 5.9% to 11.6% (Robin Ohannessian, 2012). Where very less or insufficient data are available for middle to low income countries, hospital wide prevalence rate vary between 5%-19% but many studies showed its higher than 10% (D Pittet, 2011) (WHO, 2011). According to WHO definition "an infection acquiring in a patient in a hospital or other healthcare 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".

From the infection site the Nosocomial Infection restricted source arise as SSI, UTI, CLABSI and VAP (Arockiasamy, 2018). The US Center for Diseases Control and Prevention (CDC) classified the HAI to the following types are Surgical Site Infection (SSI), Central Line-associated Bloodstream Infection (CLABSI), Catheter-associated Urinary Tract Infections (CAUTI), Ventilator -associated Pneumonia (VAP). A prevalence survey of WHO in 55hospital over 14 countries showed an average 8.7% admitted patients has suffered from HAI. ICU the high prevalence area of HAI. The responsible pathogen for HAI can be bacterial, viral and fungal microorganisms (WHO/CDS/CSR/EPH/2002.12).

Impact of HAI:

HAI are generally increasing the substantial economic burden by increasing hospital day. Patients' morbidity and risk of death also increase, this leads also functional disability, emotional stress, and many times the disability can reduce the quality of life (B.G.Mitchell, 2013) (Chen, 2016) (WHO/CDS/CSR/EPH/2002.12). It also effect on economic cost for consumable items like increase drug use, additional diagnostic test, isolation (D Pittet, 2011).

One study said the total increase of hospitalization period for surgical wound patients was 8.2days for gynecology 3 days, for general surgery and for orthopedic surgery patients 10 days and 19.8 days respectively (PokuaaFenny, 2020). Because of lost of work for the extend hospital stay, indirect cost is also affected to the patients and payers. (PokuaaFenny, 2020).

According to WHO estimation annual losses in Europe $6.9 billion, in USA around US$ 65 billion. Low to middle income countries HAI issue is relatable higher than high income countries (Chen, 2016). In Europe among the hospitalized patients the point prevalence rate was 6.1%, based on a point prevalence survey, 2011-2012. (WHO/CDS/CSR/EPH/2002.12). Based on a WHO report, (1995-2010), the HAI prevalence rate was 9.0% and 13.1% in Iran and Turkey respectively. India don't have any national surveillance system for monitoring HAI and there are no globally accepted guidelines on the usage of antibiotics after frequent infections. HAI and SSI were highly reported in India (S.B. Mishra, 2017).

HAI must occur:

- Up to 48 hours after admission in hospital
- All of 3 days after discharge
- All of 30 days of post surgery
- Initially patient admitted for different reason than the infection, in a healthcare facility.

The most common pathogens for the HAI:

CLABSI: Coagulative negative staphylococci are the most common pathogen and the other causative pathogens are Enterococcus, P. aeruginosa.

CAUTI- Most common pathogen is E. coli, other causative pathogens are klebisella, Enterococcus, P. mirabilis, P. aeruginosa.

VAP: the most common are S. aureus and P. aeruginosa. Other causatives pathogens are Enterobacteriaceae. H. influenza, S. Pneumonia, MRSA, Extended spectrum beta-lactamase (ESBL)- producing Enterobacteriaceae, A. baumannii.

SSI: most common pathogen is S. aureus, other causative pathogens are S.epidermis, Enterococcus, E.Coli, P. Aeruginosa.

1. Catheter Associated Urinary Tract Infection (CAUTI):

Urinary tract infection is most familiar infection. Around 80% of this infection cause by indwelling bladder catheter. Urinary tract infection leads less morbidity then other HAI but sometimes it can be cause of death. The accountable bacteria appear from gut flora, either normal (Escheichia coli) or acquired in health facilities (multiresistant klebsiella). Based on UTI definition norm about CAUTI, two type of UTIs are there: Symptomatic UTI (SUTI) and Asymptometic Bacteremic UTI (ABUIT).

As per the definition of Center for Disease Control and Prevention (CDC), CAUTI is explain by maintain the standard of SUTI and ABUTI (CDC, Urinary Tract Infection (Catheter-Associated Urinary Tract, 2021).

To confirm SUIT 1a or CAUTI the following criteria must be meet the patient**:**

1. “Patient had an indwelling urinary catheter that had been place for >2 days on the date of event (day of device placement = Day 1) and was either still present for any portion of the calendar day on the date of event or was removed the day before the date of the event.
2. Patients have at least one of the following sings of symptoms: fever (>38 degree C), suprapubic tenderness, costovertebral angle pain or tenderness, urinary urgency, urinary frequency, and dysuria.

3. Patients have a urinary culture with no more than two species of organisms, at least one of which is a bacterium of >_105CFU/ml."

ABUTI criteria are:

1. " The patient with or without an indwelling urinary catheter has no signs or symptoms of SUIT 1 or 2 according to age (Note : Patients >65 years of age with a non-catheter-associated ABUTI may have a fever and still meet the ABUTI criteria)
2. The patient has a urinary culture with no more than two species of organisms, at least one of which is a bacterium of >_105CFU/ml.
3. The patient has a positive blood culture with at least one matching bacterium to the urine culture or meets laboratory-confirmed bloodstream infection (LCBI) criterion 2 (without fever) and matching common commensal in the urine."

These all component must take place during the initial period in ABUTI.

2. Nosocomial Respiratory Infection/ Hospital Acquired Pneumonia:

Hospital acquired Pneumonia is a lower respiratory infection which occurred in hospital setting after two or more days of hospitalization (H Mythri, 2014). It occurs in several different groups of patients but in intensive care prevalence rate is higher than other. According to WHO report in ICU the Pneumonia rate is 3% per day (WHO, 2011). Nosocomial infection is consists of three categories: Non-intubated patients' pneumonia, ventilation-associated pneumonia (VAP) and Health care-associated pneumonia (HACP). High case fatality rate is associated with ventilation-associated pneumonia.

Non-intubated patients are those who don't have the intubations but acquired the infection in hospital setting.

Ventilation acquired pneumonia (VAP) occur after 48 h of insertion of the endotracheal tube and it develop to the ventilator patients.

Surgical Site Infection (SSI):

Almost 5% of surgical patients are experience SSI (Mujagic, 2018) (PokuaaFenny, 2020)**.** It increase morbidity and mortality rate. SSI increase prolonged hospital length of stay, Hospital cost.

Magnitude of the Healthcare Associated Infections:

According to WHO, the problem of HAI, yet has not solved by any country. Low and middle income country has more burdens then the higher income countries (WHO, 2011).HAI leads a higher mortality every year, and around hundreds of million people are affected by HAI. According to a WHO, systematic literature review from 1998-2011, the entire prevalence rate of high income countries and low income countries reported between 5.1%-11.6%, and 5%-19% respectively. Based on a point prevalence survey (2011-2012) the HAI prevalence rate is 6.1% (CDC, CDC, 2018). According to a ECDC point prevalence survey (2011), directed in 23 European countries including 19888 patients in 67 acute care hospitals shows that overall 7.0% of patients has at the minimum one type of HAI, and the highest rate of HAI is found on ICU which is 28.1%. Based on 2013 ECDC point prevalence survey in Europe among long term care patients HAI crude prevalence rate was 3.4%. Prevalence rate of HAI in Iran and Turkey was 8.8% and 12.5% respectively shows by a systematic literature review by WHO from 1995-2011 (Robin Ohannessian, 2012).

HAI is the cause of the burden to the diseases also burden to the cost of the healthcare such as cost associated with length of stay, excess use of medicine, excess diagnostic treatment, it also can be part of long term disability of the patients due to infection and antimicrobials (B.G.Mitchell, 2013) (WHO/CDS/CSR/EPH/2002.12).

Situation in India:

According to WHO in 2021 India has 1.38billion population (statista, 2021), and according to Economic Survey India spend 1.8% of its GDP for healthcare purpose (The Financial Express, 2020). The overcrowding in hospital is a main problem in India and also affordability and accessibility are also a noticeable challenge which faces right now. Like the other country in India Intensive Care Unit (ICU) is the high prevalence place for HAI

(Nair Velu, 2017). Though the universal HAI rate is not reported in India but from the various article shows the estimated value, the overall rate of HAI is 4.5% and 9.1% HAI per 1000 ICU days (Nair Velu, 2017). Based on a INICC report of device associated nosocomial infection in Intensive Care Unit (ICU) from 7 cities in India, the HAI rates are: VAP was 28.61% of whole HAIs (11.0% per 1000 device days), CAUTI was 9.0% of entire HAIs (1.41 per 1000 device days) (S.B. Mishra, 2017). The extra mortality rate among CAUTI patients are 11.6%. 18.61% of VAP, and 4% of CLABSI. In addition to extra length of stay for CAUTI, VAP and CLABSI are 8 days, 11 days and 5 days respectively (S.B. Mishra, 2017) (Sharma, 2019). India's Nosocomial Infection rate 4.4% per 100 patients which is less than Thailand (23.1%) and with 8 developing countries (14.7%) according to the criterion of the regional as well as international standards (S.B. Mishra, 2017) (WHO, 2011). In 2015 the entire incidence rate of SSI in India was 2%-21%. In 2015-2017 study the most common type of HAI in India was UTI (71%), the CLABSI (19%), VAP (8%), and SSI (2%) and CLABSI was the most common reason of death shows by the mortality analysis (Chen, 2016).

According to the study of INICC, compared with regional and international standards of INICC and CDC-NHSN in India SSI rate is higher.

Hospital Infection Society India (HISI) and National Center for Disease Control (NCDC) are providing the services for preventing HAI.

Study Rationale: Nosocomial Infection slow down recovering, excess length of stay, and multiplication both hospital cost and risk of death. This article focus on to approximate the prolong hospital stay and mortality rate attributable to following HAIs: CLABSI, CAUTI, SSI, VAP. This study present a review of literature along with introduction, major outcomes and methods, result, discussion and followed by conclusion.

Review of Literature:

Out of all the articles reviewed for the study, 25 articles were found to match the inclusion criteria of the review. The articles had studies in mostly tertiary hospitals, teaching hospitals, private general hospitals, Govt. hospitals. All of these types of hospitals were from different countries.

HAI	Surgery	Country	Study	Cases no (sample no.)	Mean LOS days		Attributable Mortality Rate
					HAI	Non-HAI	
Bloodstream Infection **(CLABSI)**	-	India	S.B. Mishra et al.(2016)	46	35	25	56%
	-	Argentina	D. Tarara et al. (2015)	81	54	30	35%
	-	Canada	G.B.Gregson et al. (2018)	144	46.4	35.4	20%
	-	USA	Lena et al. (2020)	111	47	22	17%
	-	US	Wasim Quadir et al.(2017)	41	45	11	23%
	-	Argentina	Haifaa Hassan et al.(2017)	154	57.1	27	19.9%
(CAUTI)							
	-	Australia	B.G.Mitchell et al.(2016)	2821	33.3	8.7	3.1%
	-	Egypt	Mona Salona et al. (2016)	124	45.2	26.0	11.1%
	-	US	Jacob et al. (2017)	131	25.3	20	5%
	-	USA	Maria et al. (2017)	134	51.2	42	17.6%
	-	Morocco	Madani et al. (2015)	148	34.6	22	18.7%
Surgical Site Infection (SSI)							
	Colon	Spain	Evelyn Shaw et al. (2018)	343	15	9	77.3%
	Orthopedic	Switzerland	Edin Mujagic et al. (2018)	234	13	5	73.3%
	OLT	Thailand	Nongyao et al. (2017)	234	32.3	11.0	83.5%
	Cardiac	Africa	Ama Pokua Fenny et al. (2015)	40	9.2	4.6	40.0%
	CABG	USA	Hollenbeak et al. (2011)	140	26	18	21.4%
	Colorectal	France	Madani et al.(2016)	68	18	9	35.2%

Ventilator - associated Pneumonia (VAP)							
	-	Germany	Arthur Allignol et al.(2018)	397	27.8	12.8	28.46%
	-	Thailand	Estuardo salgado et al. (2017)	343	20.2	15.4	14.5%
	-	France	Bercault et al. (2015)	310	20	13	27%
	-	Kuwait	Abeer aly et al. (2017)	149	40.2	18.0	30.9%
HAI		India	Dictor Daniel et.al (2021)	863	50.4	11.3	8.36%
		France	Robin Ohamessian et al.(2015)	5176	54.3	14.4	34%
		Belgium	Vrijens et al. (2012)	4281	42.3	35.0	2.8%
	-	India	Kothari et al. (2011)	5162	33.9	11	54%
	-						
All		India	Shilpee Kumar et al. (2018)	69	43.2	30.2	11.8%
	-	USA	Robert et al. (2011)	3120	32.8	25	6.1%

Table 1: Location, HAI type, Mean extra Length of Stay (LOS), Extra Mortality Rate.
Source: Review Papers (cited in tables)

Methodology:

Research Question:

Relationship between Hospital Acquired Infection and increase Average Length of Stay.

Objectives:

- To understand the prevalence rate of HAI in India and Worldwide.
- To ascertain the prolonged hospital length by patients due to HAI compare with patients without HAI.

Search Technique:

This study is conducted in 2021. Articles were searched in scientific databases like Google Scholar, PubMed, ResearchGate, and SciHub to identify the various studies that talks about the co-relation between the Hospital Acquired Infection and the extra Average Length of Stay. The database were searched by using the key words HAI, LoS, CAUTI, SSI, CLABSI, Nosocomial Infection, HCAI, VAP, India, worldwide. The article was selected within the time frame of 2011 to 2021.

Study selection:

Title and abstracts of all the articles were check through to recognize those original studies that access the relation between Hospital Acquired Infection with extra Average Length of Stay.

i. Inclusion Criteria: Original Research, provide the co-relation between HAI with extra LoS, done in Intensive Care Unit, adult patients age above 18 years. Patients up to 48 hours after admission in hospital.
ii. Exclusion Criteria: Bellow 18 years of age group, who are not ICU patients, before 48 hours of hospitalized patients.

Out of 96 abstracts studied, around 45 relevant articles were identified that had the study about the relation between the Hospital Acquired Infection and the extra Average Length of Stay. Out of it, 18 were excluded as they were not shown the relation between HAI and length of stay or within the time frame, and 8 were also excluded because they were only explaining the concept of HAI. This study is based on only 27 studies.

Sample Size: 24864 ICU Hospital Acquired Infection patients, above 18 years.

Data Analysis: Data were analyzed by using MS Excel.

Result:

The purpose of this article is to evaluate the extra LOS which related to HAI in ICU in an eleven year time interval. Extra length of stay measures by subtracting the Mean LOS of Non-HAI patients from HAI patients. At least one HAI affected patients LOS will increase than the Non-HAI patients. And the excess length of stay increase the direct cost and indirect cost, it leads a high financial burden, morbidity and mortality rate (B.G.Mitchell, 2013).

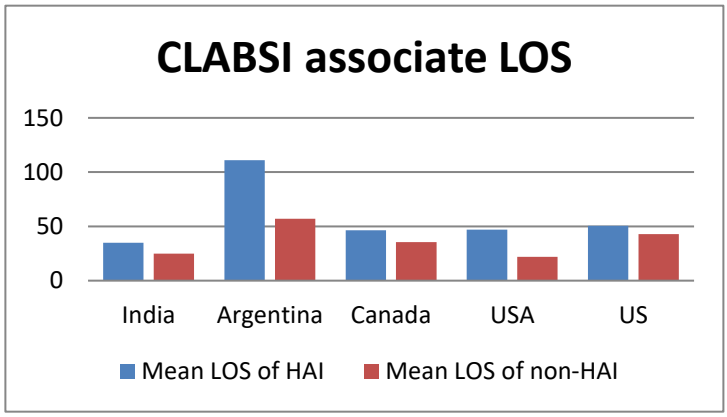
The usable HAI patient sample was 24864 and Non-HAI patient sample was 230015. The Mean LOS of each study was given in the article itself is maintain in Table.1 above.

The review of this article helps us to understand how the HAI addition to the extra length of stay, hospital cost, productivity cost, morbidity and attributable mortality among the patients.

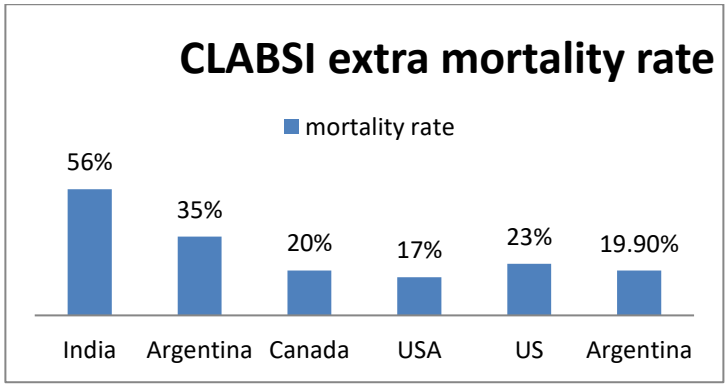
Table 2: The social Cost of Healthcare Associated Infections

Costs Categories	
1. Direct Hospital Costs	• Excess hospital stay • Extra medication • Added health professional time
2. Indirect costs	• Decrease productivity on the job • Increase morbidity • Increased death risk • Family/friends opportunity-cost visiting and assisting.
3. Intangible cost	• Economic anxiety • Physical pain and suffering • Social stigmatization

Source: Haddix et al. (1996)



Graph 1. Length of Stay (LOS) of CLABSI Patients VS Non-CLABSI Patients



Graph2. CLABSI mortality rate.

The graph 1 and graph 2 clearly shows the extra Length of Stay (LOS) and extra mortality rate respectively among the patients who are acquired at least one infection and the patients without infection. Most of the time patients who are terminally ill required central venous access for the admission of fluid, medicines, blood product and for that they are highly susceptible to evolve bloodstream infection.

In the study by S.B. Mishra et al.(2016), the respondent were selected the adult ICU patients in tertiary hospital. It was a prospective study of 153 patients. Total CLABSI patients was 46and among them 35% (16) was female, and 107 patients were Non-CLABSI. Extra mortality rate was 56% and mean extra LOS was 10 days. In this survey the severity of ill and co-morbidities were considerable higher and it increase considerable risk of infection ,increase hospital stay, added cost and increase attributable mortality.

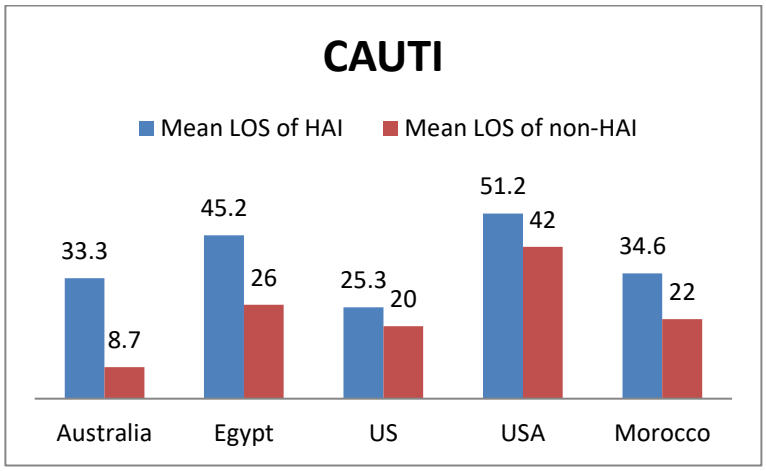
The study of D. Tarara et al. (2015), is a case-control study, here include 81 cases and 81 controls of adult ICU patients. In this survey 50% case are died and 15% control are died, the extra mortality rate is 35%. And mean Length of stay of cases and control are 54days and 30days respectively. The LOS and attributable mortality rate in nosocomial blood stream infection is high in critically ill patients. And the infection is doubling SICU patients. Each HAI patients also paid an extra $40000 then the non-HAI patients.

The study of G.B.Gregson et al. (2018) is a cohort study with 144 CLABSI patients and 144 non-CLABSI patients. It shows that at least one infection leads extra LOS and extra mortality rate. In this study the ICU patients with CLABSI excess there mean LOS around 11 days and mortality rate increase 20% and patients with CLABSI paid extra $85137. This study shows hospital infection excess the direct and as well as the indirect cost.

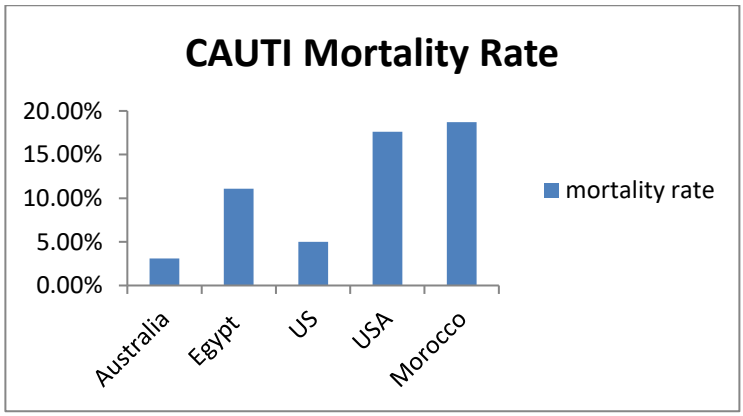
In Lena et al. (2020), a retrospective study takes 111 cases and 499 controls. In this study the mortality rates of the patients with CLABSI is high 17%, and mean extra LOS is 25 days than the non-CLABSI patients. In this survey the hospital acquired infection leads a high morbidity and mortality and high economic burden to the infected patients. The extra cost paid by the HAI patient $59741 then a non-HAI patients.

The study of Wasim Quadir et al.(2017) is a prospective study of 1132 patients. Among them cases were 41 patients and control were 1091 patients. Patients with associated bloodstream infection are significantly longer ICU and hospital LOS, here the extra mean

LOS was 34 days and extra mortality was 23%. Also hospital cost of catheter associated blood stream infection was approximately $11971.



Graph 3. Mean extra Length of Stay (LOS) of CAUTI Patients



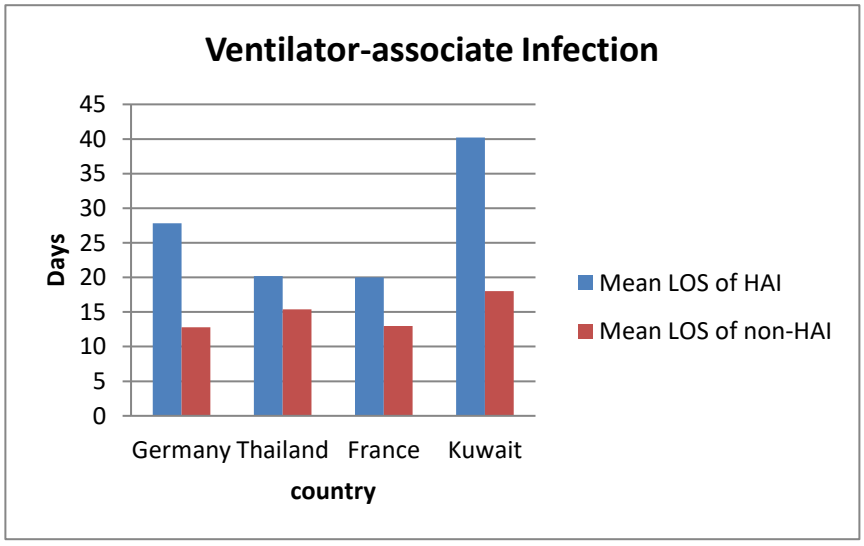
Graph 4. Extra mortality rate of CAUTI patients

Graph 3 and graph 4 clearly shows the extra Length of Stay (LOS) and extra mortality rate respectively among the patients who are acquired at least one infection and the patients without infection. The most familiar nosocomial infection is urinary tract infection. In all 1.7% patients who were hospitalized more than two days acquired CAUTI. Female and elderly patients were greater risk of acquiring a CAUTI.

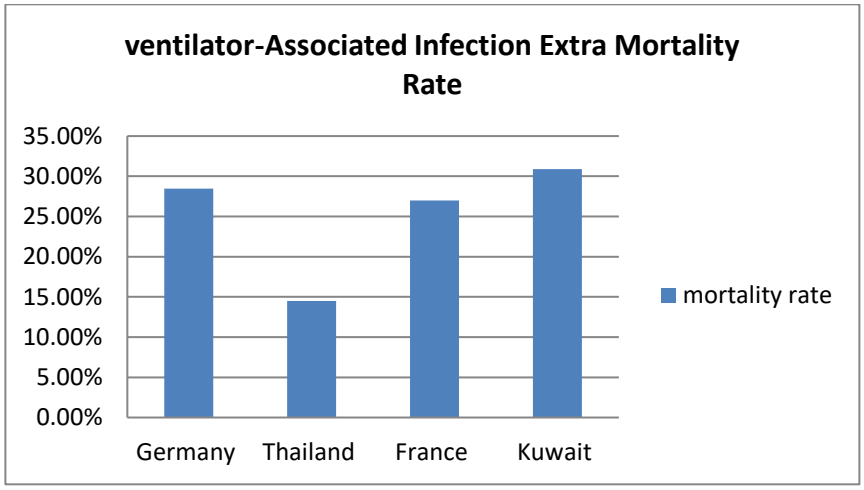
The study B.G.Mitchell et al. (2016), a cohort study of 162503 patients, among them CAUTI patients were total 2821 and Non-CAUTI patients were 159682. In this study approximate every CAUTI spend average 4 days extra in hospital. Here for the CAUTI the mean extra LoS were 24.6, and extra mortality rate was 3.1%. The increase of CAUTI, in addition to the extra length of stay, suggested the CAUTI place a significant burden of healthcare service.

In the study of Mona Salona et al. (2016), took 124 cases and 124 controls. Here the mean extra LOS is higher among the patients with CAUTI than the Non-CAUTI patients, it is 19.2days. In this study the shows that the mortality rate also higher among the patients with CAUTI than the Non-CAUTI patients. The extra mortality rate is 11.1% among the infected patients.

Jacob et al. (2017) study takes 131 cases of CAUTI and 231 Nom-CAUTI. It shows the most of the patients in ICU use the catheter but the CAUTI is more among the female and elderly patients. In this study for the hospital acquired infection the mean extra length is 9.2 days higher among the CAUTI patients than the NON-CAUTI. And the higher LoS is also leads the high mortality and here the extra mortality rate was17.6% among cases.



Graph 5: Mean extra LOS for Ventilator-associated infection patients (VAP)



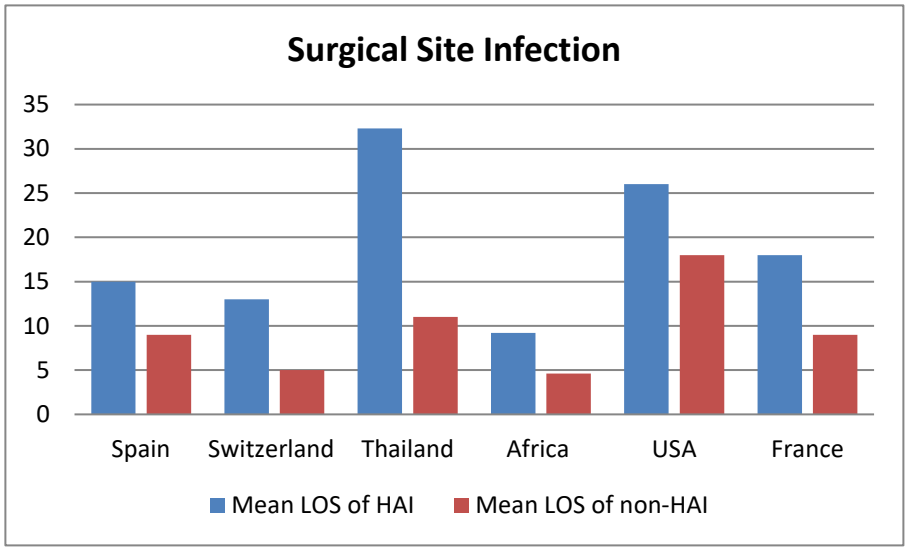
Graph 6.Extra mortality rate of VAP patients.

Graph 5 and graph 6 clearly shows the long hospital Stay (LOS) and death rate respectively among the patients who are acquired at least one infection (ventilator acquired infection) and the patients without infection. Ventilator-associated pneumonias (VAPs) are a universal issue that make patient morbidity, death, and hospital days or LOS remarkably high.

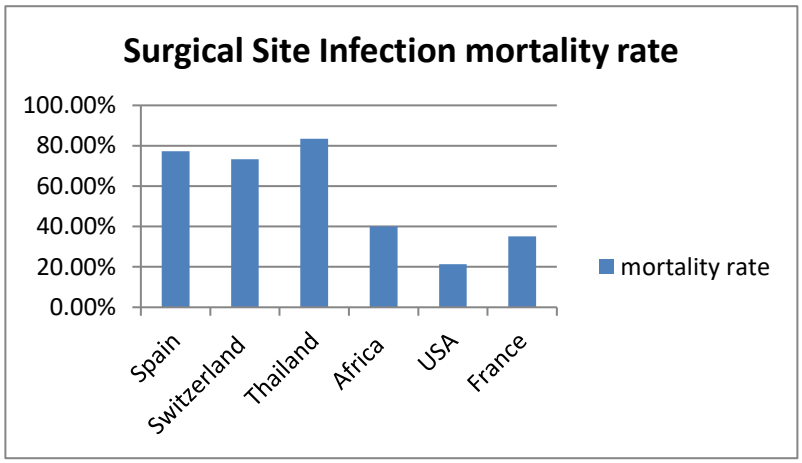
Article of Arthur Allignol et al. (2018) provided a theoretical structure about how the expected excess hospital stay related with VAP in ICU. This article includes total 6416 inpatients; among them 397 were VAP patients and 6019 were Non-VAP patients in ICU. The LOS is related highly with the VAP patients, and the extra LOS was 14.8 days than Non-VAP patients and it leads an extra high mortality rate which is 28.46%.

Estuardo salgado et al. (2017), conducted estimate extra LoS and mortality in intensive care unit due to VAP in a cohort study of 776 Inpatients; among them VAP patients were 343 and Non-VAP patients were 433. The mortality rates of ventilator patients are relatively high but the infected patients' mortality rate is higher than the non infected ventilator

patients. The extra mean LoS of VAP patients are 4.8 days higher than the Non-VAP patients, and the mortality rate is higher 14.5% then the Non-VAP patients to the VAP patients.



Graph 7: Mean extra LOS for Surgical Site Infection (SSI)



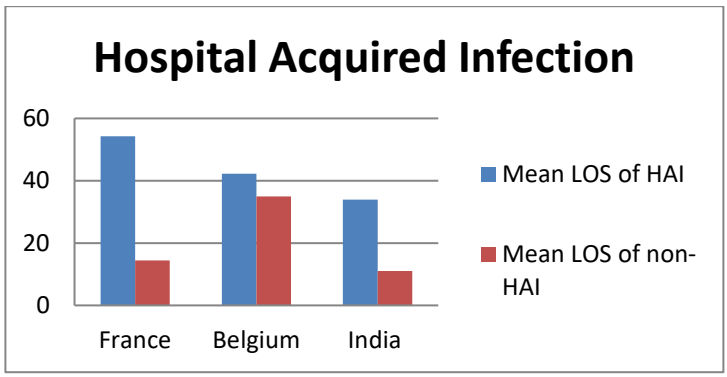
Graph 8: extra mortality rate of Surgical Site Infection patients.

Graph 7 and graph 8 clearly shows the extra Length of Stay (LOS) and extra mortality rate respectively among the patients who are acquired at least one hospital infection (surgical site infection) and the patients without infection. Surgical Site Infection is the common threat of surgical patients. 5% of all patients who undergo surgery will experience the SSI.

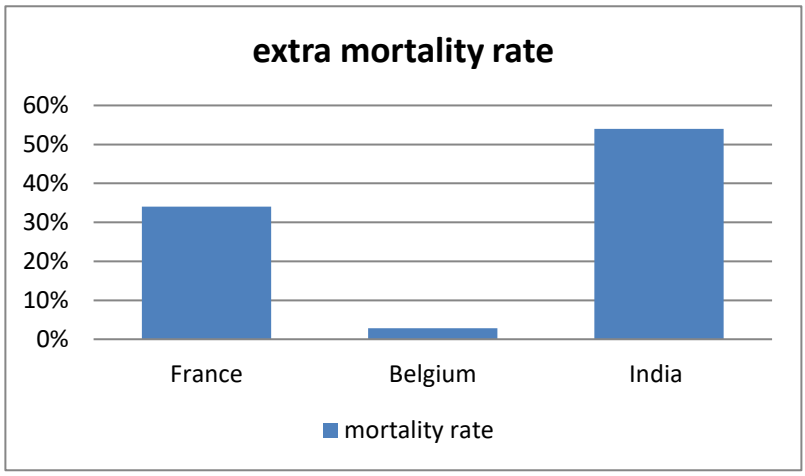
In the article of Evelyn Shaw et al.(2018) take 343 SSI patients and 2435 Non-SSI patients. In this article the extra mortality rate was 77.3%. And extra LoS of the SSI patients is higher 7 days than the Non SSI patients. The burden of Morbidity, mortality and for the extra cost took place to the SSI patients.

The study of Edin Mujagic et al. (2018) include total 4596 Inpatients in which cases are 234 and the control are 4362. Here clearly shows at least one infection leads the extra hospital days, also HAI is co-related with extra LoS, morbidity, mortality and economic burden, direct cost and also the indirect cost, and sometime the indirect costs are much higher than the direct cost. On average hernia surgery patients paid around US$ 393 excess than control, and the thyroid surgery patients paid more US$ 43. The result shows that all surgical procedures, SSI patients report excess hospitalization day. The extra day for limb amputation, and rectal surgery,2 days to 17 days respectively.

Article of Ama Pokua Fenny et al. (2015), a case-control study. Here takes 40 cases and 40 controls. All the case and control gone through with same surgery, but it clearly shows that the SSI patients stay long in hospital than Non-SSI patients. The extra length of stay for SSI patients is 4.6 days and extra cost of SSI patients than the Non-SSI patients are $1985. And also a higher mortality rate leads by SSI patents that are 40% than Non-SSI patients.



Graph 9: Gap of mean extra LoS of at least one Hospital Acquired Infection.



Graph 10: Extra mortality rate of at least by one Hospital Acquired Infection.

Graph 9 and graph 10 shows clearly shows the extra Length of Stay (LOS) and extra mortality rate respectively among the patients who are acquired at least one hospital infection and the patients without infection. The expected excess LOS is a traditional theory to evaluate the health and economic effect of nosocomial infection.

The study was conducted by Robin Ohamessian et al. (2015) shows an excess hospital stay attributable of HAI in the ICU was estimated using multistate model in a prospective surveillance study in France. 33449 patients were included and hospital-acquired infection attack of 5176 (15.5%) patients. The infected site number is directly affect the extra LOS and with the alive discharged patients from ICU.

Discussion:

Based on article HAI is a worldwide issue and still no country can be ascertain for solving this issue, this article include 15 countries. 7 developing country and 8 developed country, and among these 10 high income countries and 5 middle income countries, from that its clear HAI is a global issue not a particular country issue. Based on WHO report 5.9% - 13.5% patients are affected by HAI. In developed country prevalence rate 5.9%-11.6% but the accurate report of HAI for developing country is not available but approximately 5%-19% of HAI prevalence is present, but according to various study it's the result is 10% higher.

This study mainly finds the relation between HAI and the excess LOS in hospital among the ICU patients. Depend on the result of various articles HAI is directly affect the LOS and also it increase the cost of treatment because of extra hospitalization, extra use of diagnostic and therapeutic treatment. This article shows the difference of excess LOS between patients of HAI and Non HAI patients in table 1, and graph 1, 3, 5, 7 and graph 9.

The excess LOS is co-relate with cost, in table 2 shows HAI affect both the direct and indirect cost of patients.

In study D.Tarara (2015) in tertiary hospital in Argentina per HAI patients paid extra $40000. In Canada tertiary hospital G.B. Gregson (2018) HAI patients paid extra $8513. Study done on USA Teaching hospital (Lena, 2020) (extra $59741), another study by Wasim Quadir, 2017 (extra $11971). Evelyn Shaw (2018) study done on Spain HAI patients paid extra US$392, Edin Mujagic (2018) on Switzerland, HAI patients paid extra US$142. Not only direct cost patients also lost the productivity cost, increase mental anxiety, morbidity and mortality. And also some time reduce the quality of life.

As the author taken various methods to prove the co-relation between HAI and excess LOS and even done in various hospitals setting in different countries, it is not possible to compare it with another but still it can seen that universally hospital face that issue of HAI which affect the LOS. The healthcare provider and medical specialist need to give attention on it.

Conclusion:

As per the article review an excess LOS approximated 5 days credited to Nosocomial infection in the ICU. An extend hospital stay of HAI patients in ICU in dependent on the diversity according to disease severity, patients age, time period, number and type of infections. The result was quite consistent and found a moderate extension in the hospital stay because of infection. The economic burden also increases 2-4 times to the patients with HAI.

The avoidance of HAI needs to be a global attitude. Have to follow the specific strategies for HAI control programs. The developing countries, Intensive Care Units should refine and enhance the implementation of evidence based strategies with the aim of prevention CAUTI, CLABSI, SSI, VAP because they are directly related with excess length of stay and mortality rate.

Recommendation:

Prevention of HAI needs as broad perspective; Infection Control Program can be the only way to fight that issue. But these programs will execute only by following two specific strategies:

I. Strict Guidelines and
II. Educate the healthcare worker

Strict guidelines will be prior median for implementing those infection control programs. These strict guideline must be involve the proper hand hygiene, proper utilization of antibiotic and also other precautions at the time of operation or procedure and in the ICU.

And the second strategy to educate the healthcare worker, that will educate the health care worker with support of guideline and acceptance of the guideline, then only those infection control program can be success.

Government of all countries should take the important role to make the guidelines mandatory. The regulations come to progress by WHO, Center for Diseases Control and Prevention (CDC), Infectious Diseases Society of America (IDSA), Europe Centre for Disease prevention and Control (ECDC), International Nosocomial Infection Control Consortium (INICC, and they took control of implementing and be accountable for impose

the guidelines by making good Infection control team for all healthcare facilities worldwide.

The follow-up measure will start after two years of implementation of these programs, because the strategies will effective only by evaluating the nosocomial infection rate. And if the rate is reduce then the intervention strategy will be effective and suggested to continue that to achieve the standard goal.

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