

# An Integrative Study on Prevention of Nosocomial Infection-Meta Analysis

Dr. S. Valarmathi

MSc (N); MBA (H.M); PhD(N), Ave Maria college of Nursing, Professor Cum Vice Principal, Atoor, Thiruvattor, Kanyakumari District

**Abstract:** ***Background:** Nosocomial infections or hospital-acquired infections are infections that are acquired within the hospital environment. Transmission of such infections take place via several methods and interventional procedures. **Objective:** The objective of this study is to identify the various causes of nosocomial infections, assess the multiple impacts and implications of hospital-acquired infections on individuals and find the preventive methods necessary for controlling and mitigating nosocomial infections within the hospital setting. **Methods:** An integrative literature review methodology was selected for this study. Valuable and accurate secondary sources were chosen from multiple databases like Google Scholar, PubMed and CINAHL. Amongst all chosen articles, 16 were finally considered for this research. These sources were thoroughly reviewed to gather valid and reliable data. All recent studies were selected to ensure accuracy and quality of data. Moreover, several inclusion and exclusion criteria were considered to ensure gathered information is true and valid. **Results:** Nosocomial infections arise due to lack of hygiene and improper sanitization in the hospital, and lack of knowledge among nurses and physicians regarding proper sanitation, hygiene, waste management and disinfection. The various impacts of hospital-acquired infections include severe economic crisis and financial burden, patients' deteriorating health condition, increased morbidity and mortality, death, intense emotional stress and sepsis. Prevention techniques mainly include adoption of suitable and proper hygiene practices and disinfection. **Conclusion:** Nosocomial infections are very common in the hospital setting, which severely affects patients and their families. Inadequate hygiene and sanitation are the primary factor leading to hospital-acquired infections. The most essential preventive method is advancing hygiene and proper sanitation in the hospital.*

**Keywords:** nosocomial infection, hospital acquired infection, infection prevention, hand hygiene, healthcare safety

## 1. Introduction

### 1.1. Background of the study

Nosocomial infection refers to the contamination or disease that is spread from hospitals or health centres. It is a new kind of infection that spreads from the hospital environment. The infection is also known as Hospital-Acquired Infection or Health Care-Associated Infection (HAI, HCAI). It is defined as an infection acquired by an enduring during hospital care that was not present or developed at the time of admission.<sup>1</sup> It includes infections acquired in the hospital but appearing after discharge. It appears after 48 hours of getting discharged from the hospital.

Even some of the major affected nosocomial infections develops over urinary tract infections, pneumonia during respiratory, even there is infections over the surgical site wound.<sup>2</sup> With the surgical site involves bacteraemia, skin infections along with gastrointestinal infections.

However, this success was for a short span. Soon the situations changed. It was revealed that the infection arose in not only surgical or obstetric patients but also general medical patients. Besides, it was also evaluated that the infection is airborne.<sup>3</sup> It can transmit or spread through the air. People of that time did not have the idea of maintaining good and proper hygiene.<sup>4</sup> Even the doctors were not aware of washing hands and keeping them sanitised before treating patients. The infection thus spread numerously and took many lives. The hospital-acquired infection was primarily and mostly affected people during their treatment in the hospital. However, they did not admit to the hospital with the infection.<sup>5</sup> They did not wash their hands or clean their hands, took any measures like wearing a surgical mask or caps before an operation.<sup>6</sup> Thus, the infection has easily

appeared in the patients through the doctors, medical staff, workers, and other workers of the hospital.

The infection is hospital oriented, and it can appear to people who do not maintain hygiene or stay up to several hours in hospitals.<sup>7</sup> The infection also spreads through medical equipment or tools as in ancient times; there was no provision or concept of sterilising or disinfecting the medical equipment.

The prime causes of affecting with this infection are bacterial, viral and fungal pathogens. The most widespread and frequent kinds are bloodstream infection or also known BSI, Urinary tract infection or UTI, pneumonia such as ventilator related pneumonia or VAP, and surgical site infection or SSI.<sup>8</sup> Staphylococcal, Streptococcal, and Gram-negative became the main cause, and focus point of attention of healthcare-acquired infection or hospital-acquired infection.<sup>7</sup>

This hospital-acquired infection or healthcare-acquired infection is primarily caused by a toxin or contamination that exists in a particular position or location like health care centres or hospitals.<sup>9</sup>

In recent times, the infection can appear to a patient who is in the ventilation or staying in hospitals or health centres for a long time. As the infection is airborne, it is challenging to prevent the infection completely.

The prime cause of this effect can be assumed. As surgeries of that period were not protected with sanitisation, it affected the patients. Besides, the types of equipment that are used in the surgeries were also not sterilised and disinfected properly.<sup>13</sup> Besides, surgery patients always intend to affect with any infection instantly, even in the 21<sup>st</sup>

Volume 15 Issue 2, February 2026

Fully Refereed | Open Access | Double Blind Peer Reviewed Journal

[www.ijsr.net](http://www.ijsr.net)

century. Thus, it is inevitable for that time to prevent the infection from affecting the surgery patients.

It also infects the lower respiratory tract, infection at surgical sites, urinary tract and even over the other soft tissues. For the nosocomial infections, there are the use of a catheter and the ventilators.<sup>14</sup> It is even common procedures which are related to the infections. There is the development of multi-resistance organisms. It also gives pressure over the social level and even the economic level of the infected person.

As the consequences of the infections, it has diminished the life of the infected person and cannot get the proper treatment. With the lower tract of respiratory problems, the patients must carry the substantial HAI burden. It is quite hard to carry, and it also does not provide long-term mortality, which ultimately gives risks to the patients for losing their lives.<sup>16</sup> Without the availability of HAI, a person may die within 30 days. It is even risky for the uninfected person.

In the developed nation of UAE, the nosocomial infections represented a major attack over the patients. It is assumed that the attack rate is about 4.7 per cent and during the last 18 months, there were discharge of 6,544 patients and 379 has been affected with the infections.<sup>17</sup> There is always a frequent increase of 25 per cent with infected patients and thus there is the risks prevalence of 20 times higher.

Even with context to worldwide, the nation is facing severe challenging factors, as it is assumed that among the 10 percent of the developing nations, 7 percent has been infected with the nosocomial infections.<sup>18</sup> With the recent cases of infections, there is the increase of cases around urinary tract infections.<sup>19</sup> The direct contact with the pathogens makes the people faces with the infections.

Even to get the proper safeguard from the infections, it is important to maintain the hand hygiene process. Hence, environmental, or architectural factors are also considered, which is given importance.<sup>20</sup> Their preventions of the infections are divided into various subsets. It is even required to keep isolation with the use of antibiotic. During the transplantations, the room can be ventilated, with proper cleaning and decontaminations; it also includes protective cleaning of clothes with proper care about the food, which is the most special considerations.<sup>21</sup>

Many people are unable to get the proper treatment facilities; hence there is death or increasing number of cases around the world.<sup>23</sup>

The nation is building with seminars, which is supervised by different hospitals.<sup>24</sup> The Ministry of facilities discusses about the fundamental practices which can be taken down with the prevention of nosocomial infections. It is even helpful to control the transmission of virus and it wholly depends over the medical staff.<sup>25</sup>

Many doctors have given their views with the relative study and made them understand to the public over their health problems.<sup>26</sup> With the various federal facilities, various

measures are properly taken down which can help to understand with the high risks. The highest risks factors can be seen with in the intensive care units and even during the surgical site's infections.<sup>27</sup>

## 1.2 Need for the study

Nosocomial is a new type of infection, which is spread from the environment of hospitals and known as HAI (hospital-acquired infection). The Nosocomial infection arises due to surgical and obstetric patients along with general medical patients.<sup>1</sup> According to CDC, the common pathogens of Nosocomial infection include *Pseudomonas aeruginosa*, *Staphylococcus aureus* and *Escherichia coli*. This infection affects not only the respiratory tract but also skin, gastrointestinal and urinary tract, which have made this study, a vital aspect for determining root of Nosocomial infection.<sup>2</sup>

## 1.3 Statement of the problem

Nosocomial infection acquired from hospitals can have a significant impact on the rate on morbidity and mortality.<sup>2</sup> Nosocomial infection can be life-threatening for patients suffering from cardiovascular disease and infection in the urinary and gastrointestinal tract such as pancreatitis.<sup>4</sup> Therefore, it is essential to address the growing concern of Nosocomial infection in hospitals.

## 1.4 Research objectives

- 1) To analyse about the causes of nosocomial infection.
- 2) To understand about the different impact of nosocomial infections over patients.
- 3) To identify the prevention methods from the nosocomial infection.

## 1.5 Operational Definition

- 1) **Prevention:** The action of stopping or holding something before issue is happening or arising.
- 2) **Nosocomial:** Infection or something originated in health care settings.
- 3) **Infection:** It is the invasion of a pathogen in body tissues by disease-causing agents

## 1.6 Assumptions

Various methodological assumptions were made in this review as below:

- A thorough review of published literature will provide information that will facilitate a better understanding of causes of nosocomial infection, its effect on patient care, how to avoid nosocomial infection and healthy work environment characteristics
- Variables associated with nosocomial infections are positively associated with hand hygiene practices.
- Internal and external resources are associated negatively, and may serve as a defence against spreading of nosocomial infection

### 1.7 Delimitations

Different studies have shown that good hand hygiene practices among health professionals can prevent nosocomial infection. A thorough search was done on different data bases like PubMed, CINAHL, Medline, Google Scholar, published from 2000 to 2019 on causes of job stress on nurses, its impact on patient care and identified the strategies to overcome nosocomial infection. Further consideration was given to the results of this study in connection with its limitations. Identifying them would facilitate further recommendations and provide information on possible follow-up research in a wider perspective.

## 2. Literature Search Methods

### 2.1 Introduction

A literature review comprises various search methods. This helps the investigators to collect accurate data in order to conduct research. It can be pointed out that a literature search is an organized method to collect reliable and required information for the research to be conducted. On the other hand, with the help of the literature search method, the good quality of the article can be found to obtain related data for the research topic.

The literature search methods help in demonstrating the section criteria and exclusion criteria as well as the search terms and techniques used to collect information

### 2.2 Literature Search

Literature searches help in collecting accurate information for the topic discussed. In this study, the literature search approach helped collect information about the nosocomial infection. It can be pointed out that with the help of the literature search methods data from both experimental and non-experimental and scholarly journals were collected. This helped in understanding the concept of nosocomial infection and its impact on various sectors of the economy.

### 2.3 Selection Criteria

#### 2.3.1 Inclusion Criteria

Inclusion and exclusion are one of the primary criteria in a research method. The inclusion and exclusion criteria used in this literature method is discussed below.

- The inclusion criteria for search methods are that the articles, books and journals should be from the years 2000-2020. The articles should be in English.
- The information should be in the related to the topic.
- The research must be quantitative and qualitative or both.
- On the other, the articles and journals used in the research should have information about the impact and prevention of nosocomial infection on various economic fields.

#### 2.3.2. Exclusion Criteria

- In order to consider the exclusion criteria, articles which do not have the author's name and are published before the year 2000 will not be considered.
- Furthermore, Articles books and journals in languages other than English will not be considered.
- Articles books and journals, which do not have a systematic representation of the information on the discussed topic, will not be considered.

### 2.4 Search Techniques

Search techniques are also important in literature methods. The investigators must use a systematic search technique which will help them collect adequate information from the selected databases with the help of the search terms. The search terms are the keywords used in the literature methods to find articles, books or journals which have related and reliable information about the discussed topic. The investigator has both manual and automated internet-based search methods. This helped the investigator to collect qualitative information both from the online and offline sources. Although the researcher has implemented the online sources, mostly this is mainly because the offline sources contained unorganized information which was hard to analyse.

#### 2.4.1 Databases

Databases such as PubMed, google scholar, CINAHL, Medline is considered, where information is gathered from a published article from the year 2000-2020. On the other hand, with the help of the primary database the researcher was able to collect information from the various medical journals of BMC neurology, Canadian Journal of Infectious disease and medical microbiology, neonatology and perinatology journal and others. This helps the researcher to collect adequate and reliable information for conducting the research.

#### 2.4.2 Search Terms

In order to collect relevant information about the nosocomial infection the investigator has used accurate search terms. Here terms such as 'health care' 'infectious disease' 'nosocomial disease' 'hospital-acquired infection' 'personal hygiene' 'hospital hygiene' are used to collect appropriate information. On the other hand, search terms such as 'mortality rate' 'Fatal causes of nosocomial disease' and 'antibiotics used in the prevention of nosocomial diseases' are also used.

#### 2.4.3 Supplemental Search Methods

Collecting data with the help of a single database or method is time-consuming. As a result of this, the investors have used a supplementary method of collecting information about the discussed topic. The researcher has also visited universities libraries and manually collected information about the discussed topic. To consider the supplementary methods and intense web-based research have been conducted by the researcher. Here the information was collected from various websites. The information, although accurate, was not considered by the researcher because they did not meet certain criteria of the research. The primary

criteria for rejecting the collected information are that the information was published before the year 2000.

**2.5 Studies Meeting Inclusion Criteria**

This segment of the literature method the suitable journals are listed below. These journals are selected deepening on the selection criteria of the research. A total of 15 journals were selected, among which seven meet the criteria as mentioned above. The common factors that the rest of the journal which was not selected had that they were published before the years 2000. To state another criterion for the

rejection, certain journals had unorganized information. This made analysing the journals difficult for the investigator. On the other hand, it can be noted that certain journals have information in another language than English because of which they have not been used to collect information while conducting the research. Here the article selected as per the inclusion criteria are divided in three subgroups. Thus, helps in better understanding of the articles from which useful information is collected for the research. As a result of which the information collected and started is relevant and provides a in-depth knowledge of the topic discussed.

**Table 1:** Studied meeting inclusion criteria from google scholar

S. NO	Author	Location/Year	Purpose
1	Von Lengerke et al. (21)	German tertiary care hospital/ 2019	To manipulate and Mani facete and spread awareness of personal hygiene among patients and common people. To collect information about the importance of personal and hospital hygiene is spread in order to prevent nosocomial disease.
2	Sonmezer et al.(18)	Canadian Journal of Infectious disease and medical microbiology/ 2016	To understand the risk factors involved in various antibiotic resistance to patients' nosocomial infections.
3	Spatenkova et al.(19)	BMC neurology/2018	To understand the impact of multi drug use in preventing the nosocomial infection. This article was helped in collecting adequate information about the preventive measures applied by the doctors and clinical staff to stop the spread of nosocomial diseases.
4	Luong-Nguyen et al.(5)	Departments of digestive surgery. Journal of visceral surgery/ 2020	To understand the potential risk of the SARS – COV- 2 nosocomial infection and the necessary measures to prevent the same. The researcher of this article also focuses on steps to minimize the effect of nosocomial infection among people, by using safe surgical methods.
5	Yadollahi et al.	Chinese Journal of Traumatology. South of Iran	To assess mortality risk factors among nosocomial infected traumatic patients in Rajae trauma centre, Shiraz, Iran
6	Zhou et al.	Different hospitals in China	To determine risk factors that can help clinicians identify patients with high risk of nosocomial infection following influenza on admission
7	Biberaj	Germany, 2017	To develop measures to prevent infection and lessen antibiotic resistance based on nationwide studies on the prevalence of nosocomial infection (NI) and antibiotic use (AU)
8	Rosenthal	Medical University of Tirana	To ascertain the incidence of device-associated infections in the ICUs of developing countries

**Table 2:** Studies meeting inclusion criteria from CINAHL

1	Meneguetti et al (6)	Latino-americana/2015	To collect information about the control measures implemented in hospitals to reduce the spread of the nosocomial infection. This article helps the researcher to understand the use of the indicators to understand the effectiveness of the control performance.
2	Sternal Franek & Pieńkus	Province of Silesia	Assess, quantitatively, nurses' knowledge about nosocomial infections and the procedures used most often in post-stroke patients

**Table 3:** Studies meeting inclusion criteria from PubMed

S. No	Author	Location/Year	Purpose
1	Chen	Journal of the Chinese Medical Association, Taiwan	To investigate the change of nosocomial infection rate in a NICU during a 4-year surveillance period.
2	Donaldson	California	To develop a 30-hour/one clinical academic unit VAD patient safety course with the aim of expediting clinician adoption of critical concepts related to VAD-related patient safety.
3	Behnke	Germany	To collect information about the prevalence of nosocomial infection (NI) and antibiotic use (AU). To gather information about the steps followed order to reduce the nosocomial infection in intensive care units.
4	Yepes	Ecuador	To collect information about nosocomial infection among patients in intensive care units in Ecuador. To collect information about the importance of hygiene in hospitals in order to reduce the spread of nosocomial diseases among patients. This article also sheds lights on the control measures and preventive guidelines applied by various hospitals in order to reduce the spread of nosocomial disease in intensive care units.

**Table 4:** Studies meeting inclusion criteria from Medline

S. No	Author	Location/Year	Purpose
1	Medeiros	Brazil	To find out information about Hand hygiene (HH) as the main tool for cross-infection prevention and focus on hand hygiene guidelines in limited-resource countries like Brazil
2	Al-Mousa	Kuwait	To collect information regarding the impact of the International Nosocomial Infection Control Consortium (INICC) multidimensional approach (IMA) on ventilator-associated pneumonia (VAP) rates in three intensive care units (ICUs) from two hospitals in Kuwait City from January 2014 to March 2015

This from the above discussion, it can be pointed out that the articles are divided into three subgroups depending on their inclusion criteria. It can be pointed out that with the help of the article chosen from Pub med and Medline, the researcher will get an in-depth knowledge of the discussed topic. Furthermore, it can be pointed out that with the help of the articles of the google scholar, the core information was collected. On the other hand, with the articles of the Medline, additional information about that hospital safety and precautionary measures were collected. In addition to this the articles in the PubMed helps the researcher to collected additional information about that the safety measures to be minted regarding operations and in case of cardiovascular patients are discussed. Accordingly, the information collected from the Medline, PubMed, google scholar, CINHALL were useful in collecting additional knowledge of the venous access devices, which helps in reducing the spread of the nosocomial infection among patients.

The article also shed knowledge on the information on the preventive measures implied by the clinical authorities to reduce the spread of nosocomial infection among infants. Here the additional information about the knowledge of clinical staffs in reducing the preventive measures can be understood with the help of the selected journals and articles for conducting the research. Thus, it can be noted that maintain a good inclusion and exclusion criteria in beneficial for the implementing adequate information tom the research.

### 3. Data Analysis Methods

#### 3.1 Introduction

This specific section of the entire study mainly defines the authorization and authenticity of used sources and information to complete the whole process of work. The researcher has done this research paper through effective research work and structural association actions. This part of the entire research vital enough as it can produce the ways of gathering information and also the quality of such relevant information about the review of Nosocomial infection.

#### 3.2 Evaluation of Data

Mainly, the opinions of the doctors are most valuable by which the researcher can produce an interesting research project with proper and effective information with valuable sites and methods.

Apart from all such features, secondary data collection method is also effective to complete the whole research process. It is an effective part as the researcher can gather information from several books, journals, and specific internet sources which have assisted the researcher through the information of the causes and negative effects of such infection. Along with all these actions, the researcher has also used descriptive research design as well as the deductive approach to complete this specific research paper.

#### 3.3 Quality Research elements

In this context, it has explored that the researcher uses all effective methods which are able to produce information through real-life experiences. The researcher can observe several books, with proper analytical features and the statement of famous authors can make the whole research paper significant the most.

#### 3.4 Data Reduction action

With the application of this specific action, the researcher can produce a large volume of accurate information with the aspect of effective decision-making features of work. It is also valid enough to maintain data stored action and mainly process the whole research with the contribution of relevant data about nosocomial infection.

#### 3.5 Data Display

It is a specific device with output action which can produce proper processing of data of the input action.<sup>1</sup> This action mainly presents the whole action of informative data analytical action with proper decision-making structure. The concept of data analytical action can produce a collective and individual display to proceed with the whole analytical action. In this context, the researcher has maintained the action of data display so that it can be possible to produce an automatic control which can maintain transmission system of the organization with effective design systems through the terminal feature with a special symbol. This action is appropriate with secondary data collection action.

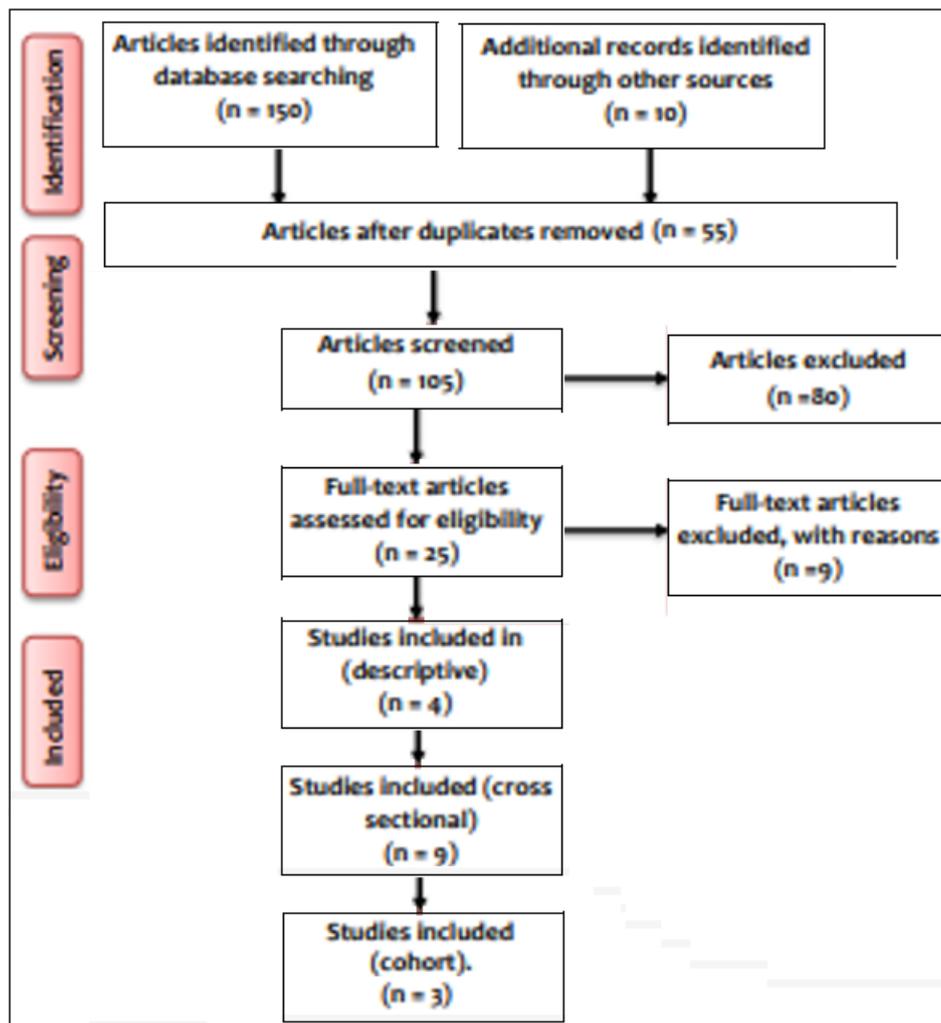


Figure 1: Research summary and screening process

Data collection is the most important and vital part to complete the entire research project through specific experimental features, design, documentation, and proper observation. Specific audio and visual display with video mainly assist the researcher to know more about the causes, effects, and treatment policy of such infection. Through the clarification of such data collection methods, it is possible for the researcher to make proper organisation, summarization, transformation, and simplification the data process. Such actions can develop research pattern as well as research sources. This above-mentioned chart is able to explore the whole research project easily with proper and effective patterns and themes.

### 3.6 Data Comparison

It is an extremely difficult action which mainly processes the resource incentive actions with proper and effective data analytical action.<sup>2</sup> In this context, the researcher has kept this specific comparison step which can produce the whole database through a proper comparison record to make a comparison of gathered data sources with others. In this principle, there are specific sources such as only within the source, equal feature, only within the target, and proper differentiation. With the application of all these actions, the researcher compared the whole process of data collection

and synchronized the whole process of the working structure.

### 3.7 Theme Identification

Nosocomial Infection is an action which can produce losses in various economic fields. In this principle, it has been gathered that this infection has a direct impact on the economic field of specific places such as health care sectors. It is a specific action which can be occurred after admitting in the hospital. Mainly, this infection does not affect an outer person; rather, it infects the patients who admit in the hospitals. It is an action which is consisted of bacterial formation, and thus, it creates economic losses in the hospitals. The concept of Nosocomial infection rises due to obstetric and surgical patients with the information of general patients in medical department

### 3.8 Conclusion

From the above discussion of the review of nosocomial infection, it can be revealed that the researcher has completed this research paper with relevant data. The most effective part is that the researcher has made the entire structure more effective and as a unique piece with the application of positivism philosophy, deductive approach, descriptive design, and with the application of both primary

and secondary data collection methods. All these actions are valid enough to produce the all-detail description of this action. In conclusion, the researcher is able to maintain the proper quality of this research on the review of nosocomial infection on society.

## 4. Presentation of Findings

### 4.1 Introduction

The main aim of this research was to identify the causes of nosocomial infection, understand its direct and indirect impacts on patients and recognise major preventive methods. Relevant and appropriate secondary sources discussing nosocomial infection, its prevalence today, causal factors, health implications and effective preventive methods were chosen from multiple databases. These articles, journals and research papers were selected based on the inclusion/exclusion criteria discussed in chapter 2. Different types of sources, including both qualitative and quantitative studies, were considered in this paper to collect a large body of information and most accurate data. These sources were arranged according to themes and analysed based on similarities and differences in the previous chapter. Following such analyses, a summary of findings is drawn in this chapter to gather intricate and vital research inferences. The quality of all sixteen secondary sources is also scored in this section to gather a better idea about the relevance, validity and credibility of data collected from these sources.

### 4.2 Summary of literature

According to information and data gathered from 16 secondary sources, it is evident that nosocomial infections, also known as hospital-acquired infections, are of several types. The most common types include gastrointestinal infections, genitourinary infections, respiratory infections, and surgical wound infections. Nosocomial infections have several causal factors, such as non-sterile and unclean environmental surfaces, breaches in infection control procedures, inadequate sanitization and disinfection, and lack of experience. Selected secondary sources show that with increasing treatment and care performed in hospitals, the litigation generating from nosocomial infections is also augmenting each year. While patients of all age groups are equally susceptible to nosocomial infections, its impact on health is more severe in case of children and older patients due to differences in immunity. These infections may be transmitted in various ways, such as through direct contact, aerosol droplets, water and food provided by the hospital, inadequately sterilized instruments, etc.

Secondary sources reveal that the most common pathogens causing nosocomial infections include *E. coli*,

*Pseudomonas aeruginosa* and *Staphylococcus aureus*. Several types of fungi and viruses also cause such infections. Different risk factors for nosocomial infections were identified from different sources selected and reviewed in this research. Some common risk factors mentioned in more than one sources are patient's immune status, infection control facilities, prevalence of pathogens in the community, older age, underlying comorbidities, stay in intensive care unit (ICU) and recent invasive procedures. According to estimations derived from chosen sources, nosocomial infections occur in approximately 5-10% of patients or around 2 million individuals around the world annually. This infection contributes largely to the death rate and costs incurred by the health care system in most developed and developing countries. It also affects patients' health severely, prolongs hospital stay, generates several dysfunctions in the body and acutely raises hospital mortality. Evidence gathered from secondary sources reveal that the prevalence of nosocomial infections is highest in case of patients undergoing some form of surgery and those receiving treatment for childbirth. According to most scholars, the common preventive methods for nosocomial infections are washing hands frequently, using alcoholic hand spray, cleaning all treatment equipment regularly, wearing gloves, providing suitable vaccinations, constantly screening and cohering patients and maintaining environmental hygiene.

### 4.3 Quality of literature

Validating and ensuring the quality of selected secondary sources is vital for gathering accurate and reliable inferences and maintaining desired quality standards. Assessing the quality of existing literature involves evaluating the title, problem area and abstract of the journals or articles, as well as appraising the overall writing style, research methods, discussion, and analysis of data. Setting and following specific inclusion and exclusion criteria is particularly important in this context. Such criteria were maintained diligently while selecting secondary sources for this research. In addition, a quality checking tool or Qual Syst was adopted to maintain uniformity while checking and validating the quality of all secondary sources. The fourteen elements or basic quality aspects addressed through this tool are shown in the appendix.

Results gathered from this quality tool reveals that all secondary sources chosen for this study are of high quality, and therefore proves valuable for this research. The lowest quality score recorded in this context is 22/28, and the highest score is 27/28. Maximum secondary sources have a quality score above 25, thereby indicating that most studies considered in this research provide fully accurate and valid information. The quality scores for all individual sources are given in the below table.

Table 1: Quality scores of included studies

No.	Study title	Quality score
1	Impact of psychologically tailored hand hygiene interventions on nosocomial infections with multidrug-resistant organisms: results of the cluster-randomized controlled trial PSYGIENE (Psychological optimized hand hygiene promotion)	25/28
2	Evaluation of risk factors for antibiotic resistance in patients with nosocomial infections caused by <i>Pseudomonas aeruginosa</i> .	26/28
3	Low incidence of multidrug-resistant bacteria and nosocomial infection due to a preventive multimodal nosocomial infection control: a 10-year single Centre prospective cohort study in neurocritical care.	27/28
4	Nosocomial infection with SARS-Cov-2 within departments of digestive surgery.	26/28
5	Risk factors of mortality in nosocomial infected traumatic patients in a trauma referral center in south of Iran.	25/28
6	Risk factors for nosocomial infection among hospitalized severe influenza A (H1N1) patients.	25/28
7	Knowledge and source of information among health care students on nosocomial infections.	26/28
8	Device-associated nosocomial infections in 55 intensive care units of 8 developing countries.	26/28
9	Evaluation of nosocomial infection control programs in health services.	25/28
10	Nurses knowledge on the prevention of nosocomial infections in patients after stroke.	24/28
11	Reduced nosocomial infection rate in a neonatal intensive care unit during a 4-year surveillance period.	26/28
12	Expediting Clinician Adoption of Safety Practices: The UCSF Venous Access Patient Safety Interdisciplinary Education Project	22/28
13	The Prevalence of Nosocomial Infection and Antibiotic Use in German Hospitals	24/28
14	Device-associated infection rates, mortality, length of stay and bacterial resistance in intensive care units in Ecuador: International Nosocomial Infection Control Consortium's findings	27/28
15	Impact of the International Nosocomial Infection Control Consortium (INICC) multidimensional hand hygiene approach in 3 cities in Brazil	26/28
16	Impact of the International Nosocomial Infection Control Consortium (INICC) multidimensional approach on rates of ventilator-associated pneumonia in intensive care units of two hospitals in Kuwait	25/28

4.4 Themes

Detailed data reduction and data comparison of selected secondary sources reveal that different factors affect or influence the prevalence of nosocomial infection. Owing to inefficient immunity and comparatively longer stay at hospitals, elderly patients and neonates are most vulnerable to nosocomial infection. Some basic risk factors promoting or contributing to this infection include acute physiology, admission to ICU, surgical history, underlying diseases, chronic health evaluation, cause of admission, etc. Since different patients experience varied health issues and respond to treatments and medicines in different ways, a particular strategy, recovery method or treatment plan may not prove fruitful in mitigating nosocomial infections in multiple cases. Healthcare professionals should realize and acknowledge the diversity of causes, impacts and

preventive methods in this case, to treat all cases of nosocomial infection efficiently.

For identifying and developing suitable research themes, all 16 secondary sources are categorized based on the location of the research, particular research design adopted to gather data, targeted population and chosen sample size. Individual tables are designed for explicitly reviewing all chosen sources according to the four criteria.

4.5 Research findings based on theme

4.5.1 Location

Location based segregation of sources will enable the researcher to identify countries lacking adequate healthcare facilities and those providing optimum healthcare to all patients.

Table 2: Presentation of selected literature based on study location

No.	Study title	Location
1	Impact of psychologically tailored hand hygiene interventions on nosocomial infections with multidrug-resistant organisms: results of the cluster-randomized controlled trial (Psychological optimized hand hygiene promotion)	Germany
2	Evaluation of risk factors for antibiotic resistance in patients with nosocomial infections caused by <i>Pseudomonas aeruginosa</i> .	Turkey
3	Low incidence of multidrug-resistant bacteria and nosocomial infection due to a preventive multimodal nosocomial infection control: a 10-year single Centre prospective cohort study in neurocritical care.	Czech Republic
4	Nosocomial infection with SARS-Cov-2 within departments of digestive surgery.	France
5	Risk factors of mortality in nosocomial infected traumatic patients in a trauma referral center in south of Iran.	Shiraz, Iran
6	Risk factors for nosocomial infection among hospitalized severe influenza A (H1N1) patients.	China
7	Knowledge and source of information among health care students on nosocomial infections.	Tirana, Republic of Albania
8	Device-associated nosocomial infections in 55 intensive care units of 8 developing countries.	Turkey, Peru, Morocco, Mexico, India, Colombia,

		Brazil, Argentina. Members of the International Nosocomial Infection Control Consortium (INICC)
9	Evaluation of nosocomial infection control programs in health services.	São Paulo, Brazil
10	Knowledge of Nurses on Prevention of Nosocomial Infections in post-stroke Patients.	Province of Silesia, Germany
11	Reduced nosocomial infection rate in a neonatal intensive care unit during a 4-year surveillance period.	Taiwan
12	Expediting Clinician Adoption of Safety Practices: The UCSF Venous Access Patient Safety Interdisciplinary Education Project	California
13	The Prevalence of Nosocomial Infection and Antibiotic Use in German Hospitals	Germany
14	Device-associated infection rates, mortality, length of stay and bacterial resistance in intensive care units in Ecuador: International Nosocomial Infection Control Consortium's findings	Ecuador
15	Impact of the International Nosocomial Infection Control Consortium (INICC) multidimensional hand hygiene approach in 3 cities in Brazil	Brazil
16	Impact of the International Nosocomial Infection Control Consortium (INICC) multidimensional approach on rates of ventilator-associated pneumonia in intensive care units of two hospitals in Kuwait	Kuwait

**4.5.2 Study design**

The second criterion considered in this research to distinguish and categorize selected secondary sources is type of study design. Three major types were selected, which are descriptive, cohort and cross-sectional. Accordingly, the table below indicates that maximum previous studies conducted in this field or 7 out of 16 selected sources are descriptive studies, where researchers

conduct detailed investigations to find out the rate of nosocomial infections among patients in a particular country, hospital or setting. Five selected sources were cohort studies, where nosocomial infections and their occurrence among different patients were investigated by undertaking elaborate researches, and another four sources were cross-sectional studies, which involved considering a specific period.

**Table 3:** Presentation of selected literature based on study design

Study design	Study title
Descriptive study	<ol style="list-style-type: none"> <li>1) Impact of psychologically tailored hand hygiene interventions on nosocomial infections with multidrug-resistant organisms: results of the cluster-randomized controlled trial PSYGIENE (Psychological optimized hand hygiene promotion)</li> <li>2) Evaluation of risk factors for antibiotic resistance in patients with nosocomial infections caused by Pseudomonas aeruginosa.</li> <li>3) Risk factors for nosocomial infection among hospitalized severe influenza A (H1N1) patients.</li> <li>4) Knowledge and source of information among health care students on nosocomial infections.</li> <li>5) Evaluation of nosocomial infection control programs in health services.</li> <li>6) Knowledge of Nurses on Prevention of Nosocomial Infections in post-stroke Patients.</li> <li>7) The Prevalence of Nosocomial Infection and Antibiotic Use in German Hospitals.</li> </ol>
Cross sectional study	<ol style="list-style-type: none"> <li>1) Nosocomial infection with SARS-Cov-2 within departments of digestive surgery.</li> <li>2) Reduced nosocomial infection rate in a neonatal intensive care unit during a 4-year surveillance period.</li> <li>3) Impact of the International Nosocomial Infection Control Consortium (INICC) multidimensional approach on rates of ventilator-associated pneumonia in intensive care units of two hospitals in Kuwait.</li> <li>4) Impact of the International Nosocomial Infection Control Consortium (INICC) multidimensional hand hygiene approach in 3 cities in Brazil.</li> </ol>
Cohort study	<ol style="list-style-type: none"> <li>1) Low incidence of multidrug-resistant bacteria and nosocomial infection due to a preventive multimodal nosocomial infection control: a 10-year single Centre prospective cohort study in neurocritical care.</li> <li>2) Risk factors of mortality in nosocomial infected traumatic patients in a trauma referral center in south of Iran.</li> <li>3) Device-associated nosocomial infections in 55 intensive care units of 8 developing countries.</li> <li>4) Expediting Clinician Adoption of Safety Practices: The UCSF Venous Access Patient Safety Interdisciplinary Education Project.</li> <li>5) 5. Device-associated infection rates, mortality, length of stay and bacterial resistance in intensive care units in Ecuador: International Nosocomial Infection Control Consortium's findings.</li> </ol>

**4.5.3 Study populations**

The third important criterion followed while categorizing selected secondary sources is the population chosen for the research. Different hospital settings, medical schools and universities, care units and medical training centres considered in the chosen studies are identified in the table below, to offer a brief overview of the scenario or setting adopted in the study. This categorization is valuable for this

research since it helps in identifying the prevalence of nosocomial infections in different environmental conditions or settings. Since surrounding factors majorly influence the occurrence of nosocomial infections, identifying the research setting will also aid in explicating the specific scenarios in which, the prevalence of nosocomial infections is highest and lowest.

Table No. 4: Presentation of selected literature based on populations

No.	Study title	Hospital
1	Impact of psychologically tailored hand hygiene interventions on nosocomial infections with multidrug-resistant organisms: results of the cluster-randomized controlled trial PSYGIENE (Psychological optimized hand hygiene promotion)	Hannover Medical School, German tertiary care hospital
2	Evaluation of risk factors for antibiotic resistance in patients with nosocomial infections caused by <i>Pseudomonas aeruginosa</i> .	Ankara Training and Research Hospital
3	Low incidence of multidrug-resistant bacteria and nosocomial infection due to a preventive multimodal nosocomial infection control: a 10-year single Centre prospective cohort study in neurocritical care.	Liberec Regional Hospital
4	Nosocomial infection with SARS-Cov-2 within departments of digestive surgery.	Digestive surgery departments of three university hospitals in Ile-de-France
5	Risk factors of mortality in nosocomial infected traumatic patients in a trauma referral center in south of Iran.	Rajae hospital in Shiraz, Iran
6	Risk factors for nosocomial infection among hospitalized severe influenza A (H1N1) pdm09 patients.	Hospitals acquired from Chinese national network. China
7	Knowledge and source of information among health care students on nosocomial infections.	Medical University of Tirana
8	Device-associated nosocomial infections in 55 intensive care units of 8 developing countries.	46 hospitals in Turkey, Peru, Morocco, Mexico, India, Columbia, Brazil and Argentina
9	Evaluation of nosocomial infection control programs in health services.	Local hospitals in the city of Ribeirão Preto, Brazil.
10	Knowledge of Nurses on Prevention of Nosocomial Infections in post-stroke Patients.	Local hospitals in the Province of Silesia
11	Reduced nosocomial infection rate in a neonatal intensive care unit during a 4-year surveillance period.	Taichung Veterans General Hospital (TCVGH)
12	Expediting Clinician Adoption of Safety Practices: The UCSF Venous Access Patient Safety Interdisciplinary Education Project	Academic medical centres in California
13	The Prevalence of Nosocomial Infection and Antibiotic Use in German Hospitals	Acute-care hospitals in Germany
14	Device-associated infection rates, mortality, length of stay and bacterial resistance in intensive care units in Ecuador: International Nosocomial Infection Control Consortium's findings	1 private and 1 public hospital in Quito, Ecuador
15	Impact of the International Nosocomial Infection Control Consortium (INICC) multidimensional hand hygiene approach in 3 cities in Brazil	2 INICC member hospitals in Kuwait City
16	Impact of the International Nosocomial Infection Control Consortium (INICC) multidimensional approach on rates of ventilator-associated pneumonia in intensive care units of two hospitals in Kuwait	4 INICC member hospitals from Brazil

4.5.4 Sample size

The last criterion selected in this research to categorize and segregate chosen secondary sources is the sample size considered in the studies. Both target and sample populations chosen in different sources are mentioned in the table below. This information is very vital for this research as it reveals the rate of occurrence of nosocomial infections among patients belonging to different age groups, undergoing different

treatments and surgeries, and experiencing different health implications. The data presented in the below table also assists in evaluating how the presence of physicians, nurses and specialty units affect the rate and treatment of nosocomial infections. Sample sizes considered in the selected sources varied from 80 nurses to 572 nurses and from 120 patients to 3463 patients. Evidently, studies considering both small and large sample sizes were chosen for this research to gather relevant and accurate inferences.

Table 5: Presentation of selected literature based on populations

No.	Study title	Population	Sample size
1	Impact of psychologically tailored hand hygiene interventions on nosocomial infections with multidrug-resistant organisms: results of the cluster-randomized controlled trial PSYGIENE.	Physicians and nurses in intensive care units and hematopoietic stem cell transplantation units	515 physicians and 572 nurses
2	Evaluation of risk factors for antibiotic resistance in patients with nosocomial infections caused by <i>Pseudomonas aeruginosa</i> .	Patients resistant to imipenem, meropenem, piperacillin-tazobactam, ciprofloxacin, amikacin, and ceftazidime	120 patients in neurosurgery ICU, Neurology ICU and anaesthesia-reanimation ICU
3	Low incidence of multidrug-resistant bacteria and nosocomial infection due to a preventive multimodal nosocomial infection control: a 10-year single Centre prospective cohort study in neurocritical care.	Primary acute neurocritical care patients	3464 acute brain disease patients
4	Nosocomial infection with SARS-Cov-2 within departments of digestive surgery.	Patients admitted to digestive surgery departments	305 patients
5	Risk factors of mortality in nosocomial infected traumatic patients in a trauma referral center in south of Iran.	All patients in Rajae hospital	All patients in Rajae hospital
6	Risk factors for nosocomial infection among hospitalized severe influenza A (H1N1) pdm09 patients.	Patients admitted in different hospitals in China for influenza	2146 patients

7	Knowledge and source of information among health care students on nosocomial infections.	Medical and nursing students enrolled in Medical University of Tirana	251 students
8	Device-associated nosocomial infections in 55 intensive care units of 8 developing countries.	ICUs of 46 hospitals in eight developing countries	55 ICUs
9	Evaluation of nosocomial infection control programs in health services.	16 Nosocomial Infection Control Programs in the city of Ribeirão Preto	13 Nosocomial Infection Control Programs
10	Knowledge of Nurses on Prevention of Nosocomial Infections in post-stroke Patients.	Nurses working at stroke and neurological wards in local hospitals in the Province of Silesia	80 nurses
11	Reduced nosocomial infection rate in a neonatal intensive care unit during a 4-year surveillance period.	Neonates admitted to the NICU in Taichung Veterans General Hospital	512 neonates
12	Expediting Clinician Adoption of Safety Practices: The UCSF Venous Access Patient Safety Interdisciplinary Education Project	Academic medical centres in California	Two Academic medical centres
13	The Prevalence of Nosocomial Infection and Antibiotic Use in German Hospitals	218 hospitals, 64 412 patients	Representative group- 49 hospitals, and the core group-46 hospitals
14	Device-associated infection rates, mortality, length of stay and bacterial resistance in intensive care units in Ecuador: International Nosocomial Infection Control Consortium's findings	Private and public hospitals in Ecuador	2 adult medical/surgical ICUs from 1 private and 1 public hospital
15	Impact of the International Nosocomial Infection Control Consortium (INICC) multidimensional hand hygiene approach in 3 cities in Brazil	NICC member hospitals in Kuwait	Three adult ICUs of two INICC member hospitals
16	Impact of the International Nosocomial Infection Control Consortium (INICC) multidimensional approach on rates of ventilator-associated pneumonia in intensive care units of two hospitals in Kuwait	INICC member hospitals from Brazil	4 adult ICUs in 4 INICC member hospitals

#### 4.6 Conclusion

Based on preliminary information gathered through such detailed segregation of secondary sources, valuable and relevant research inferences will be derived in the next chapter, which in turn will help in addressing all research objectives and answering all research questions. Clearly, the tables presented above prove valuable for this research paper.

### 5. Results and Discussion

These results and findings are derived from the detailed literature review analysis conducted in previous chapters and the interview of doctors. Both primary and secondary information are gathered and considered in this chapter to answer all research questions. The major findings derived in this case are stated and discussed in detail to provide a clear and adequate conception on nosocomial infections and its preventive methods.

#### 5.1 Major findings

##### Causes of nosocomial infections

- Inadequate hand hygiene is a universal problem and challenge in patient care, which leads to nosocomial infections.
- In many hospitals, clinical managers, nurses, and physicians do not follow WHO's standards of hand disinfection, which is a vital factor accelerating the rate and chances of nosocomial infections.
- The rate or degree of nosocomial infections and the harmful impact of related pathogens depend on the various types of ICU and risk structures prevalent for patients.
- Long-term hospitalization, poor conditions of treatment and care facilities, several invasive procedures, and

continuous antibiotic pressures lead to nosocomial infections.

##### Impact of nosocomial infections

- Patients suffering from nosocomial infections related to *P. aeruginosa* face severe health problems and high mortality and morbidity, since this gram-negative bacterium is resistant to several antibiotics.
- Nosocomial infections are a very serious threat for neurodevelopment and survival of infants in neonatal intensive care.
- The occurrence of such infections increases the cost of care manifold.

##### Preventive methods for nosocomial infections

- Limiting antibiotic use is therefore a vital preventive method for treating such deadly infections
- Adopting suitable preventive multimodal nosocomial infection control management is vital for decreasing the rate of such infections among patients
- Common infection control programs necessary for preventing nosocomial infections include antibiotic stewardship, hand-hygiene campaigns, and other multifaceted and elementary practices.
- To control nosocomial infections in different healthcare settings, professionals must conduct detailed internal studies to identify the prevalent sources, build negative-pressure quarantine ICU wards and follow all operational instructions, procedures and standards established by international health organizations.

## 5.2 Discussion

### Objective 1: To analyse the causes of nosocomial infections

Different secondary sources considered in this research discussed different types of factors causing nosocomial infections. However, in most cases, researchers identified that admission to intensive care units, staying for long durations in the hospital, advanced age and improper hygiene conditions are the most prevalent and usual factors leading to various types of hospital-acquired infections. Amongst these, inadequate hand hygiene or hand sanitization before and after interaction with patients is the leading cause for the transmission of bacteria responsible for nosocomial infections.<sup>1</sup>

### Objective 2: To understand the different impacts of nosocomial infections on patients

The most direct impacts of nosocomial infections on patients are deteriorated health condition, increased suffering, prolonged stay at hospitals, increased mortality and morbidity, and major economic burden. It is also true that nosocomial infections add to patients' functional disability as well as emotional stress.<sup>6</sup> In extreme cases, such infections lead to severe and permanent disabling conditions, which majorly disrupts individual's quality of life. Nosocomial infection is the leading cause of sepsis, which in turn is a leading cause of death today.

### Objective 3: To identify preventive methods for nosocomial infections

Since nosocomial infections cause severe illness and death, preventing it by identifying its major sources is vital for controlling its spread. The most important and vital method for restricting transmission in this case is by identifying and improving unhygienic conditions and environments within the hospital. Nosocomial infections spread mostly through healthcare delivery.

Nosocomial infections are also transmitted from healthcare staff. All nurses, physicians, doctors and other care providers working in hospitals must therefore focus on infection control and personal hygiene.<sup>10</sup> The most important preventive method for avoiding nosocomial infections is to maintain appropriate hand hygiene.<sup>11</sup> Wearing gloves, masks, proper uniform, and head covers is also vital for efficient and risk-free healthcare delivery. These practices are not only imperative for the safety of patients but is also necessary for the safety of care providers in a hospital setting.

Addressing hospital waste management adequately is another major preventive method for avoiding nosocomial infections. Studies show that around 10-25% of waste generated from hospitals is hazardous and contains contaminated blood, sputum and other disposable items.

Implementing proper infection control mechanism in the hospital setting and improving healthcare education and training opportunities for all staff are important ways of preventing hospital-acquired infections.<sup>14</sup> Lastly and most importantly, improving hospital facilities by building isolated quarantine wards and proper ICU wards, implementing all

operational instructions and adopting new technologies and advanced quality checking equipment are important strategies and methods for mitigating the chances of hospital-acquired infections. Apart from such developments, hospital authorities should also stress on adequate sterilization of all surfaces within the hospital premises and follow specific nursing interventions to prevent common hospital-acquired infections like lymphocytopenia, ventilator acquired pneumonia, Staphylococcus aureus infection, catheter-associated urinary tract infections and CVC-related bloodstream infections.

## 5.3 Summary

The main objective of this integrative review was to study nosocomial infections in detail and identify its various causal factors, impacts on patients and necessary preventive methods. Sixteen secondary sources were chosen from multiple databases like Google Scholar, CINAHL and PubMed, and were considered in this study to gather elaborate information

## 5.4 Conclusion

Based on results gathered in this research, it may be concluded that nosocomial infections are deadly and life-threatening contagions that harm patients in several ways and may even cause permanent disability or lead to death. The most important finding collected from secondary sources show that nosocomial infections arise due to lack of hygiene and proper sanitization in the hospital. Improper hand hygiene is the leading cause of hospital-acquired infections.

## References

- [1] Alkendi, F., Chandrasekhar Nair, S., & Hashmey, R. (2019). Descriptive epidemiology, clinical characteristics, and outcomes for Middle East respiratory syndrome coronavirus (MERS-CoV) infected patients in Al Ain–Abu Dhabi Emirate. *J Infect Pub Health*, 12, 109-151.
- [2] Al-Mousa HH, Omar AA, Rosenthal VD, Salama MF, Aly NY, El-Dossoky Noweir M, Rebello FM, Narciso DM, Sayed AF, Kurian A, George SM. Impact of the International Nosocomial Infection Control Consortium (INICC) multidimensional approach on rates of ventilator-associated pneumonia in intensive care units of two hospitals in Kuwait. *Journal of infection prevention*. 2018 Jul;19(4):168-76.
- [3] Barreto MF, Dellaroza MS, Kerbauy G, Grion CM. Sepsis in a university hospital: a prospective study for the cost analysis of patients' hospitalization. *Rev Esc Enferm USP*. 2016 Apr;50(2):302-8. English, Portuguese. Doi: 10.1590/S0080-623420160000200017. PMID: 27384211.
- [4] Behnke M, Aghdassi SJ, Hansen S, Pen A. The prevalence of nosocomial infection and antibiotic use in German hospitals. *Deutsches Ärzteblatt International*. 2017 Dec;114(50):851.
- [5] Biberaj P, Gega M, Bimi I. Knowledge and source of information among health care students on nosocomial infections. *Proceedings of the in Proceedings of the*

- International Journal of Humanities Social Sciences and Education (IJHSSE). 2014 Jul; 1:46-51
- [6] Chen YC, Lin CF, Rehn YF, Chen JC, Chen PY, Chen CH, Wang TM, Huang FL. Reduced nosocomial infection rate in a neonatal intensive care unit during a 4-year surveillance period. *J Chin Med Assoc.* 2017 Jul;80(7):427-431. doi: 10.1016/j.jcma.2017.02.006. Epub 2017 May 3. PMID: 28479017.
- [7] Denstaedt SJ, Singer BH, Standiford TJ. Sepsis and Nosocomial Infection: Patient Characteristics, Mechanisms, and Modulation. *Front Immunol.* 2018 Oct 23; 9:2446. doi: 10.3389/fimmu.2018.02446. PMID: 30459764; PMCID: PMC6232897.
- [8] Donaldson N, Plank R, Williamson A, Pearl J, Kellogg J, Ryder M. Expediting Clinician Adoption of Safety Practices: The UCSF Venous Access Patient Safety Interdisciplinary Education Project [Internet]. *Vsearch.nlm.nih.gov.* 2020 [cited 5 November 2020].
- [9] Egu O, Bonnel P. Can we estimate accurately fare evasion without a survey? Results from a data comparison approach in Lyon using fare collection data, fare inspection data and counting data. *Public Transport.* 2020 Mar;12(1):1-
- [10] Eric J. Topol, MD; Abraham Verghese, MD; 2019, 4<sup>th</sup> October.
- [11] Ferreira VHS, Teixeira VM, Giacomini MA, Alves LR, Gleriano JS, Chaves LDP. Contributions and challenges of hospital nursing management: scientific evidence. *Rev GauchaEnferm.* 2019 Aug 5;40: e20180291. Portuguese, English. Doi: 10.1590/1983-1447.2019.20180291. PMID: 31389476.
- [12] Fu C, Wang S. Nosocomial infection control in healthcare settings: Protection against emerging infectious diseases. *Infect Dis Poverty.* 2016 Apr 12; 5:30. doi: 10.1186/s40249-016-0118-9. PMID: 27068809; PMCID: PMC4828876.
- [13] Grewal A, Kataria H, Dhawan I. Literature search for research planning and identification of research problem. *Indian journal of anaesthesia.* 2016 Sep;60(9):635.
- [14] Hayes. Prevention of cross infection [Internet]. *Vsearch.nlm.nih.gov.* 2020 [cited 5 November 2020].
- [15] Jiang WL, Hu XP, Hu ZP, Tang Z, Wu HB, Chen LH, Wang ZW, Jiang YA. Morbidity and Mortality of Nosocomial Infection after Cardiovascular Surgery: A Report of 1606 Cases. *Curr Med Sci.* 2018 Apr;38(2):329-335. doi: 10.1007/s11596-018-1883-4. Epub 2018 Apr 30. PMID: 30074193.
- [16] Kaur, S., Bherwani, H., Gulia, S., Vijay, R., & Kumar, R. (2020). Understanding COVID-19 transmission, health impacts and mitigation: timely social distancing is the key. *Environment, Development and Sustainability*, 1-17.
- [17] Kim EM, Nabors Oláh L, Peters S. A Learning Progression for Constructing and Interpreting Data Display. *ETS Research Report Series.* 2020 Feb.
- [18] Kluytmans JA, Wertheim HF. Nasal carriage of *Staphylococcus aureus* and prevention of nosocomial infections. *Infection.* 2005 Feb;33(1):3-8.
- [19] Lacey S, Smith J, Cox K. Paediatric Safety and Quality [Internet]. *Vsearch.nlm.nih.gov.* 2020 [cited 5 November 2020].
- [20] Li Y, Gong Z, Lu Y, Hu G, Cai R, Chen Z. Impact of nosocomial infections surveillance on nosocomial infection rates: A systematic review. *Int J Surg.* 2017 Jun;42:164-169. Doi: 10.1016/j.ijsu.2017.04.065. Epub 2017 May 3. PMID: 28476543
- [21] Liu P, Capitano B, Stein A, El-Solh AA. Clinical outcomes of linezolid and vancomycin in patients with nosocomial pneumonia caused by methicillin-resistant *Staphylococcus aureus* stratified by baseline renal function: a retrospective, cohort analysis. *BMC Nephrol.* 2017 May 22;18(1):168. Doi: 10.1186/s12882-017-0581-y. PMID: 28532398; PMCID: PMC5440938.
- [22] Luong-Nguyen M, Hermand H, Abdalla S, Cabrit N, Hobeika C, Brouquet A, Goéré D, Sauvanet A. Nosocomial infection with SARS-Cov-2 within departments of digestive surgery. *Journal of visceral surgery.* 2020 Jun 1;157(3): S13-8.
- [23] McIlwaine. Health Economics [Internet]. *Vsearch.nlm.nih.gov.* 2020 [cited 5 November 2020].
- [24] Medeiros EA, Grinberg G, Rosenthal VD, Angelieri DB, Ferreira IB, Cechinel RB, Zanandrea BB, Rohnkohl C, Regalin M, Spessatto JL, Pasini RS. Impact of the International Nosocomial Infection Control Consortium (INICC) multidimensional hand hygiene approach in 3 cities in Brazil. *American journal of infection control.* 2015 Jan 1;43(1):10-5.
- [25] Meneguetti MG, Canini SR, Bellissimo-Rodrigues F, Laus AM. Evaluation of nosocomial infection control programs in health services. *Revista latino-americana de enfermagem.* 2015 Feb;23(1):98-105.
- [26] Michael Klompas, MD, MPH Mo Y, Low I, Tambyah SK, Tambyah PA. The socio-economic impact of multidrug-resistant nosocomial infections: a qualitative study. *J Hosp Infect.* 2019 Aug;102(4):454-460. Doi: 10.1016/j.jhin.2018.08.013. Epub 2018 Aug 29. PMID: 30171886.
- [27] Rafael Zaragoza; Pablo Vidal-Cortés; Gerardo Aguilar; Marcio Borges; Emili Diaz; Ricard Ferrer; Emilio Maseda; Mercedes Nieto; Francisco Xavier Nuvials; Paula Ramirez; Alejandro Rodriguez; Cruz Soriano; Javier Veganzones; Ignacio Martín-Loeches
- [28] Ramasethu J. Prevention and treatment of neonatal nosocomial infections. *Maternal health, neonatology and perinatology.* 2017 Dec 1;3(1):5.
- [29] Rosenthal VD, Maki DG, Salomao R, Moreno CA, Mehta Y, Higuera F, Cuellar LE, Arkan ÖA, Abouqal R, Leblebicioglu H. Device-associated nosocomial infections in 55 intensive care units of 8 developing countries. *Annals of internal medicine.* 2006 Oct 17;145(8):582-91.
- [30] Shehnaz, S. I., Agarwal, A. K., &Taher, Y. M. (2020). Usage Pattern of Antimicrobial Agents in Surgical Patients of a Tertiary Care Teaching Hospital in Ajman, United Arab Emirates. *International Journal of Research in Pharmaceutical Sciences*, 11(SPL2), 54-63.
- [31] Sonmezer MC, Ertem G, Erdinc FS, Kaya Kilic E, Tulek N, Adiloglu A, Hatipoglu C. Evaluation of risk factors for antibiotic resistance in patients with nosocomial infections caused by *Pseudomonas aeruginosa*. *Canadian Journal of Infectious Diseases and Medical Microbiology.* 2016 Oct;2016.

- [32] Spatenkova V, Bradac O, Fackova D, Bohunova Z, Suchomel P. Low incidence of multidrug-resistant bacteria and nosocomial infection due to a preventive multimodal nosocomial infection control: a 10-year single centre prospective cohort study in neurocritical care. *BMC Neurol.* 2018 Mar 7;18(1):23. Doi: 10.1186/s12883-018-1031-6. PMID: 29514600; PMCID: PMC5842527
- [33] Standaert, B., Strens, D., Li, X., Schecroun, N., & Raes, M. (2016). The sustained rotavirus vaccination impact on nosocomial infection, duration of hospital stays, and age: the RotaBIS study (2005–2012). *Infectious diseases and therapy*, 5(4), 509-524.
- [34] Sternal D, Franek G, Pieńkus D. Knowledge of nurses on prevention of nosocomial infections in post-stroke patients. *The journal of neurological and neurosurgical nursing.* 2014;3(2).
- [35] Trifi A, Abdellatif S, Oueslati M, Zribi M, Daly F, Nasri R, Mannai R, Fandri C, Ben Lakhel S. Nosocomial infections: current situation in a resuscitation-unit. *Tunis Med.* 2017 Mar;95(3):179-184. PMID: 29446811.
- [36] Ulger F, Dilek A, Esen S, Sunbul M, Leblebicioglu H. Are healthcare workers' mobile phones a potential source of nosocomial infections? Review of the literature. *J Infect Dev Ctries.* 2015 Oct 29;9(10):1046-53. doi: 10.3855/jidc.6104. PMID: 26517478.
- [37] Vásquez V, Ampuero D, Padilla B. Urinary tract infections in inpatients: that challenge. *Rev Esp Quimioter.* 2017 Sep;30 Suppl 1:39-41. PMID: 28882014.
- [38] von Lengerke T, Ebadi E, Schock B, Krauth C, Lange K, Stahmeyer JT, Chaberny IF. Impact of psychologically tailored hand hygiene interventions on nosocomial infections with multidrug-resistant organisms: results of the cluster-randomized controlled trial PSYGIENE. *Antimicrobial Resistance & Infection Control.* 2019 Dec 1;8(1):56. Will Boggs MD, January 22, 2020,
- [39] Yadollahi M, Kashkooe A, Feyzi M, Bornapour S. Risk factors of mortality in nosocomial infected traumatic patients in a trauma referral center in south of Iran. *Chinese Journal of Traumatology.* 2018 Oct 1;21(5):267-72.
- [40] Yang YM, Hsu CY, Lai CC, Yen MF, Wikramaratna PS, Chen HH, Wang TH. Impact of comorbidity on fatality rate of patients with Middle East respiratory syndrome. *Scientific reports.* 2017 Sep 12;7(1):1-9. s
- [41] Yopez ES, Bovera MM, Rosenthal VD, Flores HA, Pazmiño L, Valencia F, Alquinga N, Ramirez V, Jara E, Lascano M, Delgado V. Device-associated infection rates, mortality, length of stay and bacterial resistance in intensive care units in Ecuador: International Nosocomial Infection Control Consortium's findings. *World journal of biological chemistry.* 2017 Feb 26;8(1):95
- [42] Zhou F, Li H, Gu L, Liu M, Xue CX, Cao B, Wang C. Risk factors for nosocomial infection among hospitalised severe influenza A (H1N1) pdm09 patients. *Respiratory medicine.* 2018 Jan 1; 134:86-91.