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By: HAMANI Dounya

OUMICHE Khadidja

SOLTANI Aya

Titled

Prevalence of nosocomial infections in the surgery department of El-zahroui Hopital - M'sila

Jury:

Dr. LAIB Samira	University Mohamed Boudiaf M'sila	President
Dr. FATMI Ahlam	University Mohamed Boudiaf M'sila	Supervisor
Dr. FREIDJA Mohamedlamine	University Mohamed Boudiaf M'sila	Examiner

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Dedication

(وَآخِرُ دَعْوَاهُمْ أَنِ الْحَمْدُ لِلَّهِ رَبِّ الْعَالَمِين)

الحمد لله الذي هيأ البدء و يسر اليسر و طيب المنتهى

الحمد لله الذي أنعم و أكرم و أتم

و بكل حب أهدي ثمرة نجاحي و تخرجي :

إلى من دعمني بلا حدود و أعطاني بلا مقابل والدي الغالي

إلى من جعل الله الجنة تحت أقدامها إلى من كان دعائها سر نجاحي والدتي الغالية

إلى من شد الله بهم عضدي فكانوا خير معين اخوتي نسرين, شهرة, مداني, عيدة إلى لخضر ومنى

إلى من هم جزء من القلب و الفؤاد, أقماري وسيم اميرة و جنة

إلى رفقاء الروح الذين شاركوني خطوات هذا الطريق, شجعوني على المثابرة, رفقاء السنين شيماء, وداد, خديجة ,سميرة ,شهرزاد, سلسبيل.

إلى من ساعدنا على كتابة هذه المذكرة الأستاذة فاطمي أحلام

الحمد لله حبا و شكرا و امتنانا على البدء و الختام

دنيا

Dedication

أحمد الله عز وجل على عونه لإتمام هذا العمل

أهدي عملي المتواضع هذا:

إلى من أوصانا بهم الرحمن حين قال

"وَاخْفِضْ لَهُمَا جَنَاحَ الذُّلِّ مِنَ الرَّحْمَةِ وَقُل رَّبِّ ارْحَمْهُمَا كَمَا رَبَّيَانِي صَغِيرًا"

الى والدي...دوما.

الى والدتي...حبا وصونا.

أهدي لكم ثمرة جهودي وتعب سنين، اسأل الله أن يرزقكما الصحة والعافية حفظكما الرحمان.

أمي...أبي...، أشكركما الشكر الجزيل على

ما قدّمتماه لي طوال فترة دراستي، وإنجازي لهذا البحث شكرا على دعمكم اللامحدود.

إلى أخواتي.....رفعة وعونا.

أميرة... سلسبيل...زينب.... عبد الناصر صلاح...رفاق دربي أهدي لكم هذا الإنجاز، شكرًا لكم على دعمكم ومشاركتكم لي فرحة النجاح.

الى جدتي .... أطال الله في عمرها.

اليك دنيا حماني.... خلاصا ودعما.

شكرًا لك على وجودكِ طوال مسيرتي الجامعية ودعمكِ لي في الأوقات الصعبة أشهد أنك كنت نعمة الصديقة.

الى الاستاذة أحلام فاطمي..... التي ساهمت في اتمام هذا العمل

اتقدم لك بالشكر الجزيل على تفضلك بالإشراف على هذه المذكرة وكل المجهودات التي بذلتيها.

خديجة.

Dedication

From the bottom of my heart, I dedicate this work to all those who are dear to me:

To my **dear father**: For his encouragement, support and above all his sacrifices, nothing in this world is equal to the efforts you made day and night to educate and support me during my years of study.

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This work is the fruit of the sacrifices you made for my education and my training

To my brothers: **Issam** and **Kotaiba**, to my sisters: **Imane**, and **Baraa** who have been my source of strength all the time.

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Table of content

الملخص

المقدمة: عدوى المستشفيات هي كل عدوى تظهر بعد 48 ساعة من الإقامة في المؤسسات الصحية . تمثل مشكلة صحية عامة لعواقبها الوخيمة التي قد تؤدي الى الموت. الهدف الرئيسي من هذه الدراسة هو معرفة مدى انتشارها في مستشفى الزهراوي بالضبط في قسم الجراحة العامة وكذا معرفة الاخطار التي ترتبط بها.

الطريقة: دراستنا تتكون من جزأين رئيسيين. دراسة بأثر رجعي على أساس 48 مريضا بحسب ملفاتهم اصيبوا بالعدوى الاستشفائية لعام 2023 و2024 (جانفي الى افريل). قمنا بتحديد العمر، الجنس، مدة الاقامة طبيعة الجراحة، المسبب للعدوى ... وكل ما يفيدنا بهذا الصدد. اما الجزء الثاني فاعتمدنا على استبيان مباشر للطاقم الطبي لمعرفة دورهم في انتشار العدوى.

النتائج: اصيب 0.89% من المرضى في قسم الجراحة العامة بالعدوى الاستشفائية. نسبة النساء 52% منهم 19% بنات، بينما الرجال 48% و15% أولاد. ارتبط حدوث حالات العدوى في مستشفى الزهراوي بعدة عوامل: مثل العمر، وضعف الموارد في مرافق الرعاية الصحية، ووجود الجروح، وضعف إشراف الطاقم الطبي، بالإضافة إلى انتشار الكائنات الحية شديدة المقاومة مثل: (30%) *E,coli* ,*Klebsiella pneumonia* (5%), *S. aureus* (35%)

ومن خلال الاستبيان نلاحظ أن 40% من الطاقم الطبي أجابوا بأن نقص المناعة لدى المرضى هو عامل محتمل في الإصابة بالعدوى في المستشفيات. 46% لم يستخدموا القفازات أو يبدلوها بين المرضى. 80% من الطواقم الطبية لم يتلقوا أي تدريب على عدوى المستشفيات.

الخلاصة: يمكن التقليل من مشكلة العدوى الجراحية بإتباع الإجراءات الوقائية اللازمة سوآءا من طرف المرضى او الطاقم الطبي المسؤول.

Résumé

Introduction : Les infections nosocomiales sont toutes infections qui apparaissent 48 heures après un séjour dans un établissement de santé. Elle représente un problème de santé publique en raison de ses conséquences graves pouvant aller jusqu'à la mort. L'objectif principal de cette étude est de connaître l'étendue exacte de sa prévalence à l'hôpital Al-Zahraoui du service de chirurgie générale, ainsi que de connaître les risques qui y sont associés.

Méthode: Notre étude se compose de deux parties principales. Une étude rétrospective basée sur 48 patients selon leurs dossiers d'infection hospitaliers pour les années 2023 et 2024 (période de janvier à avril). Nous avons déterminé l'âge, le sexe, la durée du séjour, la nature de l'intervention chirurgicale, la cause de l'infection... et tout ce qui nous serait utile à cet égard. Quant à la deuxième partie, nous nous sommes appuyés sur un questionnaire direct auprès du personnel médical pour connaître son rôle dans la propagation de l'infection.

Résultats: 0.89% des patients du service de chirurgie générale ont développé des infections nosocomiales. Le pourcentage de femmes est de 52 %, dont 19 % de filles, 48 % d'hommes et 15 % de garçons.

La survenue d'infections à l'hôpital Al-Zahraoui était liée à plusieurs facteurs : tels que l'âge, les faibles moyens dans les structures de santé, la présence de blessures et la mauvaise supervision du personnel médical, en plus de la propagation d'organismes hautement résistants tels que *E. coli* (30%), *K. pneumonie* (5%), et *S.aureus* (35%),

A travers le questionnaire, on constate que 40 % du personnel médical a répondu « L'immunodéficience » chez les patients est un facteur potentiel d'infections hospitalières. 46% n'utilisent pas de gants et n'en changent pas entre les patients. 80% du personnel médical n'a reçu aucune formation sur les infections hospitalières.

Conclusion: Le problème des infections nosocomiales chirurgicales peut être réduit en suivant les mesures préventives nécessaires, que ce soit de la part des patients ou du personnel médical responsable.

Abstract

Introduction: Nosocomial infections are any infections that appear 48 hours after staying in health institutions. It represents a public health problem due to its serious consequences that may lead to death. The main goal of this study is to know the exact extent of its prevalence in Al-Zahraoui Hospital in the Department of General Surgery, as well as to know the risks that are associated with it.

Method: Our study consists of two main parts. A retrospective study based on 48 patients according to their hospital infection records for the years 2023 and 2024 (period from January to April). We determined the age, gender, length of stay, and nature of the surgery, the cause of the infection... and everything that would be useful to us in this regard. As for the second part, we relied on a direct questionnaire of the medical staff to find out their role in the spread of infection.

Results: 0.89% of patients in the general surgery department developed nosocomial infections. The percentage of women is 52%, of whom 19% are girls, while 48% are men and 15% are boys.

The occurrence of infections at Al-Zahraoui Hospital was linked to several factors: such as age, poor resources in healthcare facilities, the presence of wounds, and poor medical staff supervision, in addition to the spread of highly resistant organisms such as *E. coli* (30%), *K. pneumonia* (5%), and *S.aureus* (35%),

Through the questionnaire, we note that 40 % of the medical staff answered Immunodeficiency in patients is a potential factor in hospital infections. 46% did not use gloves or change them between patients. 80% of the medical staff have not received any training on hospital infections.

Conclusion: The problem of surgical nosocomial infection can be reduced by following the necessary preventive measures, whether by patients or the responsible medical staff.

Abreviations List

- **AIDS**: Acquired Immune Deficiency Syndrome
- **ASA**: American Society of Anesthesiologists.
- **ATBs**: Antibiotics.
- **CDC**: the Centers for Disease Control and Prevention
- **FISH:** Fluorescence in Situ Hybridization.
- **GNB**: Gram-negative bacilli.
- **ICUs**: intensive care units.
- **MDR**: multidrug-resistant.
- **MRSA**: Methicillin-resistant *Staphylococcus aureus.*
- **NI:** Nosocomial Infection.
- **PCR:** Polymerase Chain Reaction.
- **SSI**s: Surgical site infections.
- **WHO:** World Health Organization.
- **XDR:** Estensive drug resistance.
- **PDR:** Pan-drug resistance.
- **UTI:** urinary tract infection.

List of Figures

List of Tables

INTRODUCTION

Introduction

Nosocomial infections (NIs) or healthcare-associated infections regroup all type of infections developed during the process of getting health care, that occurs 48 hours after hospital admission without any evidence that the infection existed before the admission.

Despite all the progress that human medicine has made, and according to studies conducted in highly industrialized countries, nosocomial infections remain a major cause, or at least a non-negligible cause, of morbidity and even mortality.

Globally, nosocomial infections affect more than 100 million patients each year. In developed countries, the burden of NIs shows that more than four million patients are affected every year, it mostly affects high-risk admitted patients. According to studies, The World Health Organization (WHO) reported that the prevalence of nosocomial infections in hospital-admitted patients varied from 3.5 to 12% in developed countries [1].

In Algeria, like in all other countries around the world, these infections raise many concerns with the main causes being a lack of hygiene and non-compliance with basic preventive measures, nosocomial infections cause a significant financial burden. So, these infections represent a major public health issue due to their frequency and severity. Awareness of this problem should lead to establishing structures to study and prevent these infections [2].

The aim of this study was to:

- Investigate the frequency and types of nosocomial infections occurring in surgery departments.
- Identify risk factors contributing to the development of nosocomial infections in surgical settings.

BIBLIOGRAPHIC PART

CHAPTER I :

NOSOCOMIAL INFECTION

1. Nosocomial Infection Definition

Nosocomial Infection (from Greek: nosos: disease and komein: to take care of) is an infection contracted in a healthcare facility (Table 01), infections that are neither in incubation nor present at the patient's admission and appear after 48 hours of hospitalization. If the onset of the infection is less than 48 hours after admission, it is assumed that the infection was in the incubation period at the time of hospitalization, and therefore the infection was not picked up at the health care facility. However, it is important to keep in mind that this 48-hour timeframe is quite artificial and should not be applied without reflection. Indeed, it must be compared with the incubation period of the germ, which varies from one microorganism to another [3]. Moreover, NI can affect not only patients but also nurses, doctors, caregivers, visitors, merchants, delivery persons, guards, and anyone who has contact with the hospital [4].

Table 1. Definitions for Nosocomial infections and Surgical site infections[5].

Nosocomial Infections (NIs)	Infections occurring at least 48 hours after the patient's admission
Surgical site infections (SSI)	Infections occur within 30 days after an operative procedure if no implant is left in place or within one year if an implant is in place and the infection appears to be related to the operative procedure

2. Nosocomial Infection History

Nosocomial infections have existed since patients were geographically grouped to attempt to provide care for them. Until the 19th century, these infections were essentially the same as those observed in the community (cholera, smallpox, plague, typhoid, tuberculosis, puerperal fever...); at most, the proximity of many establishments made the acquisition of such affection even more likely. From the middle of the 19th century, great progress was made in limiting the development of hospital infections. Where Ignaz Philipp Semmelweis observed in 1846 that puerperal fevers were four times less frequent if deliveries were performed by midwives rather than doctors who also performed autopsies, by imposing hand disinfection before delivery, the mortality from puerperal fever dropped significantly [6].

Since the late 1950s, there has been the emergence of devastating epidemics of hospital infections caused by penicillin-resistant *Staphylococcus aureus* (*S. aureus*). This led to a renewed

interest in hospital infections. Indeed, while the strengthening of hygiene measures and the discovery of penicillinase-resistant penicillin helped to better control infections caused by *S. aureus* and other agents primarily Gram-negative bacilli (GNB), but also various bacteria or fungi previously considered non-pathogenic, took over and became the cause of hospital infections observed today. These infections are difficult to control because these agents often belong to the normal flora of the patient, and their resistance only widens alongside the development of new antibiotics (ATBs). This evolution in the epidemiology of hospital infections is due to progress made in recent years, now allowing the treatment of patients whose defense mechanisms are often compromised by their underlying condition(s) [7].

3. Epidemiology

3.1. In the world

Nosocomial infections affect a vast number of patients worldwide, leading to increased mortality rates and substantial financial losses. As per estimates from the WHO, around 15% of all hospitalized patients are affected by these infections. They account for between 4% and 56% of all causes of death in neonates, with an incidence rate as high as 75% in regions such as South-East Asia and Sub-Saharan Africa [8]. According to statistical analysis of microorganisms, *E. coli* is the most common microorganism in NI, with variations by WHO regions. *S. aureus*, *Pseudomonas aeroginosa*, and Klebsiella species are common in Africa and South America. Wound infection and transplant units have the highest prevalence rate. NI is linked also to the male sex, in addition, length of stay and age can affect the prevalence of NI.

A survey conducted in the United States in 2015 found that pneumonia is the most frequently occurring NI in acute hospital settings, followed by gastrointestinal infections, SSI, other systemic infections, bloodstream infections, and urinary tract infections. These findings differed from surveys conducted in 2011, which identified pneumonia (21.8%) and SSI (21.8%) as the most prevalent, followed by gastrointestinal (17.1%), urinary tract (12.9%), bloodstream (9.9%), and other infections. Interestingly, the same study revealed that non-ventilator-associated pneumonia (NV-HAP) is the predominant type of NI in acute healthcare settings, aligning with studies conducted in Europe [4].

3.2. In Africa

The prevalence of nosocomial infections in Africa is relatively high, but the available data are limited, where was estimated to be 12.2%.this high level of NI due to lack of personnel, lack of

awareness, poor water supply, poor laboratory backup, ineffective antibiotic policies with the emergence of multiple antibiotic-resistant microbes, inadequate funding, and non-adherence to safe practices by a health worker, Africa has a less effective infection control program [1].

A survey conducted in Ethiopia from 2016 to 2020 found that the most common types of nosocomial infection were hospital-acquired pneumonia (56.6%) and blood stream infection (24.53%). An estimated 13.21, 5.66, and 1.88% of the participants developed urinary tract infection, surgical site infection, and skin infection respectively [1].

3.3. In Algeria

An investigation was carried out at the University Hospital Center of Blida, over the period 2001 to 2005. This study shows a predominance of symptomatic urinary tract infections (30.8%), followed by surgical site infections (26.9%) and pneumonia (23.1%). In the period between 2002 to 2004 in the university hospital of Blida, surgical site infections predominated followed by symptomatic urinary tract infections. However, the report of 2005 noted that pneumonia were the most frequently infectious site (41.7%) [9].

3.4. Impact of nosocomial infections

Can be resumed it in principal's points below:

- Augment the risk of death.
- Increased length of hospital stay.
- In addition to high economic cost [10].

3.5. Pathogens

3.5.1. Bacteria

Particularly those naturally present in the patient's flora are the primary culprits behind nosocomial infections, typically causing illness in the patients immunocompromised. Acinetobacter, a genus of pathogenic bacteria, is notably responsible for infections within ICU settings, with a prevalence rate of 80%. *Bacteroides fragilis*, a commensal bacterium found in the intestines and colon, can lead to infections when in conjunction with other bacteria. *Clostridium difficile* induces colon inflammation, resulting in antibiotic-associated diarrhea and colitis, often due to the disruption of the balance between beneficial and pathogenic bacteria. Transmission of *C. difficile* occurs from infected patients to others via healthcare personnel with improperly

cleansed hands. Moreover, Enterobacteriaceae including Klebsiella species and *Escherichia coli*, typically found in the gut, can cause infections in other body parts, particularly when resistant to carbapenems, making them challenging to combat. In addition, Methicillin-resistant *Staphylococcus aureus* (MRSA) spreads through direct contact, open wounds, and contaminated hands, leading to conditions such as sepsis, pneumonia, and surgical site infections as it travels from organs or the bloodstream. MRSA exhibits high resistance to beta-lactam antibiotics [8].

3.5.2. Viruses

According to standard surveillance, approximately 5% of all nosocomial infections are attributable to viruses. These viruses can spread through various routes, including hand-to-mouth contact, respiratory droplets, and the fecal-oral route. Viral hepatitis is a chronic disease caused by viruses, with healthcare settings being potential sources of transmission for both patients and healthcare workers, especially through unsafe injection practices leading to transmission of Hepatitis B and C. Other notable viruses include influenza, HIV, rotavirus, and herpes simplex virus [8].

3.5.3. Fungal pathogens

Fungal pathogens typically cause opportunistic infections in individuals with weakened immune systems and those with medical devices like central lines or urinary catheters. Candida species, including *C. albicans*, *C. parapsilosis*, and *C. glabrata*, are the most frequently encountered fungi associated with healthcare-associated infections. *Candida auris* presents a significant challenge as it is a globally emerging multidrug-resistant organism with substantial morbidity and mortality rates due to difficulties in diagnosis and high treatment failure rates. Candida species are collectively rank as the fourth most common pathogens in all types of HAIs. *Aspergillus fumigatus* can be acquired through airborne contamination in healthcare construction areas, but infected hospitalized patients may also serve as a primary source [4].

4. Reservoir

4.1. Endogenous route

4.1.1. Permanent or temporary flora of the patient

The patient's saprophytic flora undergoes qualitative changes during hospitalization. These changes are due to the hospital environment and certain treatments such as antibiotics, and immunosuppressant, in this case, the bacteria transmitted to other sites than their natural habitat

(Figure 1)**.** For example, the gram-negative bacteria present in the digestive tract are frequently the cause of surgical site infections following abdominal surgery or urinary tract infections in catheterized patients [11].

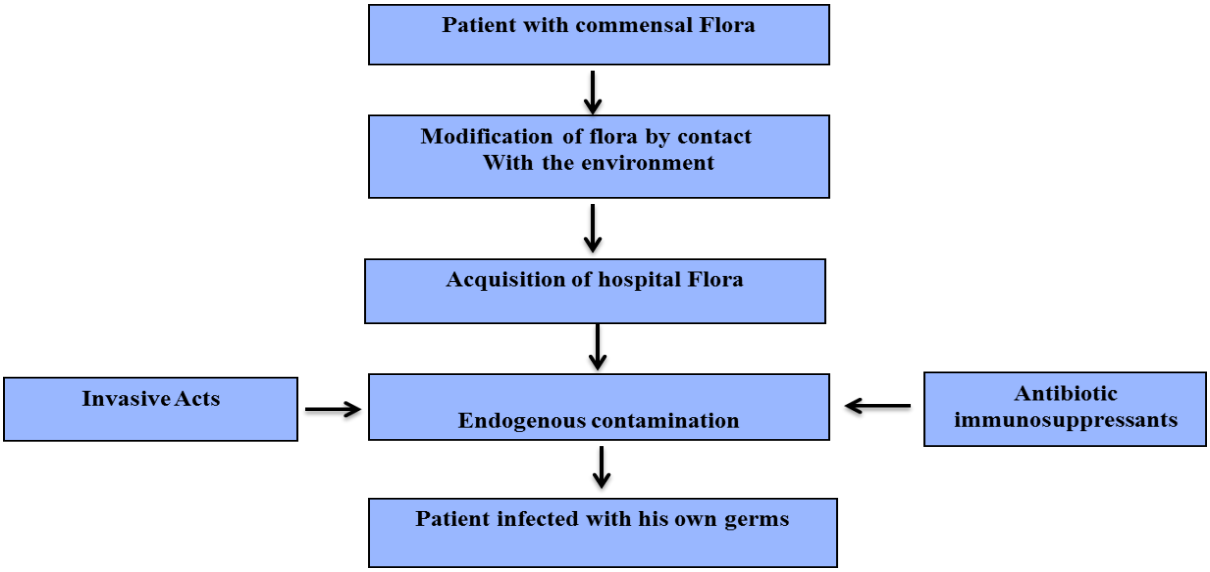

Figure 1. Modality of Endogenous transmission [12].

4.2. Exogenous route

4.2.1. Flora from another patient or staff member

Bacteria can be transmitted from one patient to another in several ways: by direct contact between patients via hands, droplets of saliva or other biological fluids…. etc., or through the air such as droplets or dust contaminated by a patient's bacteria. Moreover, can be caused by staff contaminated during patient care via their hands, clothing, nose, throat, who become temporary or permanent carriers and then transmit the bacteria to other patients by direct contact during care, in addition to objects contaminated by the patient including medical equipment, visitors, or other environmental sources such as water, other fluids, food [13].

4.2.2. Flora present in the healthcare environment: Endemic or epidemic exogenous environmental infections

Most of the microorganisms can survive in the hospital environment:

- In water, damp environments, and sometimes in sterile products or disinfectants (Pseudomonas, Acinetobacter, and Mycobacterium)
- In items such as linen, medical equipment, and supplies used during care.
- Appropriate cleaning of establishment normally limits the risk of survival of bacteria, as most require a warm or humid environment and nutrients to survive
- In foods
- In fine dust and the nuclei of droplets emitted when coughing or talking.

(bacteria less than 10 µm in diameter remain suspended in the air for several hours and can be inhaled in the same way as fine dust) [13]. The figure 2 below resume the direct and indirect mode of spread of nosocomial infections

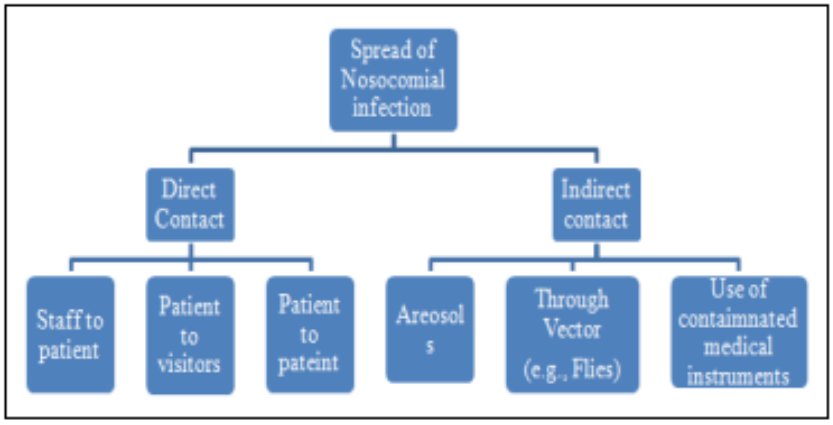

Figure 2. Spread of nosocomial infection [14].

5. Risk factors for nosocomial infection

The factors contributing to healthcare-associated infections are numerous and interrelated. They can be grouped under the following headings: patient-related factors, and care-related exposure to infectious risk/healthcare factors [15].

5.1. Patient risk factors

Certain characteristics in patients increase their risk of acquiring a healthcare-associated infection, these include:

A. **Chronic diseases:** such as diabetes, and immunodepression, leukopenia, cancer, AIDS (Acquired Immune Deficiency Syndrome).

B. Disturbed nutritional status: (malnutrition, obesity)

- Disturbed nutritional status: undernutrition is a major factor in all infection sites.
- Obesity favors post-operative parietal abscesses.

C. Age: In neonates, infants, and aging patients the risk of infection is always greater, without forgotting the patient's individual risk.

D. Certain acute pathologies requiring hospitalization: including polytrauma, burns, and acute visceral failure [15].

5.2. Infectious Risks in Healthcare

- The nature and quality of care influence the risk of acquiring a healthcare-associated infection.
- The risk of surgical site infection varies according to the type of procedure performed.
- Invasive procedures and devices (endoscopy, dialysis, catheterization, intubation/ventilation, drainage, perfusion, parenteral nutrition, punctures, etc.)
- Treatments that reduce resistance to infection (prolonged corticosteroid therapy, radiotherapy, cancer chemotherapy) [15].

6. Type of nosocomial infection

6.1. Nosocomial urinary tract infections

The most frequent NI is hospital-acquired urinary tract infections (UTI), which account for 40% of all hospital-acquired infections. In 80% of cases, they occur in patients with indwelling catheters (bladder catheterization). The risk of nosocomial UTI is relatively stable in the first four days, and then increases significantly by 5% per day of catheterization [16].

To be considered nosocomial, the criteria differ depending on whether the bacteriuria is asymptomatic or symptomatic.

A. Asymptomatic bacteriuria

- Case 1: A positive quantitative uroculture ($\geq 10^5$ microorganisms mL^{-1}), if the patient has been catheterized in the week before sampling.
- Case 2: In the absence of catheterization, two consecutive positive quantitative urocultures ($\geq 10^5$ microorganism's mL^{-1}) with the same microorganism(s), with no more than 2 microorganisms isolated [17].

B. **Symptomatic bacteriuria (in a patient with or without catheterization)**

- Fever (> 38°C) with no other infectious site and/or urge to urinate and/or dysuria and/or pollakiuria and/or suborbital tension.
- With bladder catheterization or other approach to the urinary tract, in progress or within seven days. Previous: a positive urocultures ($\geq 10^5$ microorganisms/ mL), and with no more than two microbial species isolated.
- Without bladder catheterization or other approach to the urinary tract: a leukocyturia ($\geq 10^4$ leukocytes/mL) and positive urocultures ($\geq 10^3$ microorganisms/mL), and no more than two different microorganisms [17].

6.1.2. Germs responsible:

In descending order, they are dominated by *Escherichia coli*, which is largely resistant to amino penicillins and increasingly to beta-lactamase inhibitors, Enterococci, *Pseudomonas aeruginosa*, Klebsiella spp, Serratia spp, Candida spp [18].

6.2. Pneumonia nosocomial

Pneumonia nosocomial is a lung infection that develops in people who are hospitalized, usually after two or more days in hospital. Generally, it is more severe than community-acquired pneumonia, this is due to the adaptation of microorganisms which are more aggressive in the hospital environment and also less likely to respond to antibiotics and are therefore more difficult to treat [19].

Symptoms may include cough, expectoration, and a rise in body temperature, chest pain, or dyspnea. Signs include fever, tachypnea, consolidations, or crackles [20].

6.2.1. Germs responsible:

The main micro-organisms responsible are *Streptococcus pneumonia*, *S. aureus*, Gram-negative bacilli (GNB) such as *Pseudomonas aeruginosa* and *Haemophilus influenza*, Acinetobacter spp, Enterobacteriaceae as Klebsiella, Enterobacter, and Serratia groups.in addition to fungal agents are Aspergillus sp [19].

6.3. Surgical site infections

Surgical site infections are defined as the presence of pus from one of the following locations:

- Superficial part of the surgical incision (skin and subcutaneous tissue).
- Deep part of the surgical incision (deep soft tissue below the fascia) [21].

6.3.1. The germs responsible

Principally *S. aureus* and enterococci, *Escherichia coli, coagulase-negative staphylococci, Candida spp Klebsiella spp*, *Pseudomonas aeruginosa*, and *Enterobacter spp* [22].

6.3.2. Surgery-related factors

The three factors most strongly associated with infectious risk are Altemeyer contamination class, ASA class, and duration of surgery:

Altemeyer's contamination class

The extent of contamination rates and the resulting levels of prevention depends mainly on the type of surgery performed. Surgical procedures can be divided into 4 stages according to the Altemeyer classification**:**

A. **Class I: "clean surgery":** no opening of hollow organs, no trauma, no breach of asepsis, no inflammation.
B. **Class II: "clean-contaminated surgery":** minimal organ opening, trauma or breach of asepsis.
C. **Class III: "contaminated surgery":** wound < 4 h, frank breach of asepsis, infected genitourinary, or biliary surgery.
D. **Class IV: "dirty surgery":** fecal contamination, visceral opening, bacterial infection with or without pus present at the time of surgery, traumatic wound > 4 h.

- **ASA classification (American Society of Anesthesiologists):**

This is a good indicator of overall perioperative mortality. It classifies patients into five categories:

A. **ASA 1**: Patient with no condition other than that requiring the surgical procedure.

B. **ASA 2**: Patient with moderate disturbance of a major function, e.g. mild hypertension, anemia, mild chronic bronchitis.
C. **ASA 3**: Patient with a serious disturbance of a major function not leading to incapacity, for example: moderate angina pectoris, diabetes, severe hypertension, incipient cardiac decompensation.
D. **ASA 4:** Patient with pathology presenting imminent vital risk, e.g. angina pectoris at rest, pronounced systemic insufficiency (pulmonary, renal, hepatic, cardiac...).
E. **ASA 5:** Moribund patient with a life expectancy not exceeding 24 hours, with or without surgical intervention.

- **Duration of surgery:**

The longer the procedure lasts, the higher the risk of infection. If the procedure lasts longer than sixty minutes, the risk of infection increases and the rate of infectious complications is much higher [11].

6.4. Catheter-related infections

The morbidity associated with catheter-related infections is high in ICU. Despite advances in prevention methods, their management remains a daily concern for many clinicians. Recent advances in diagnostic techniques have made it possible to define more effective treatment strategies based on differences in the growth times of blood cultures taken from the catheter and its surrounding area.

All infected catheters must be removed, although in rare cases they can be preserved with an antibiotic lock. Guided replacement of suspected infected catheters is supported only by circumstantial evidence and treatment [23].

6.5. Septicemia

Nosocomial bacteremia is defined as a positive blood culture after 48 hours in the hospital, in the presence of clinical signs of septic shock such as hyperthermia > 38°C, shivering or shock, hypothermia. The various medical devices used in hospitals are the cause of the majority of recorded septicemia, whether intra-vascular central or peripheral, with a percentage of 10.1% for septicemia linked to the introduction of catheters [24].

Nosocomial Bacteremia accounts for only a small proportion of nosocomial infections (around 5%), but has a high case-fatality rate - over 50% for certain micro-organisms such as multi-resistant coagulase-negative Staphylococcus and Candida spp. The main risk factors are the duration of catheterization, the level of asepsis during insertion, and ongoing care once the catheter is in place [13].

There are other types of nosocomial infections, such as:

Osteoarticular infections, digestive tract infections, cardiovascular infections, ENT (ear, nose, and throat) infections, skin and mucous membrane infections, neuro-meningeal infections, and other miscellaneous infections [25].

7. Antibiotic Resistant

7.1. Antibiotic Use

The prudent utilization of antibiotics is crucial. Administering antibiotics at correct doses and durations is essential, with guidance from local formularies and microbiologists. Collaborative ICU rounds with microbiologists can optimize antibiotic selection tailored to individual patients, mitigating risks associated with antibiotic-resistant bacteria, which can prolong hospital stays and increase mortality rates. While empirical antibiotic usage is often necessary due to delayed laboratory results, proper specimen collection is vital. Monitoring parameters such as temperature, leukocyte count, CRP levels, and along with procalcitonin for bacterial infections guide treatment response assessment. Strategies like de-escalation therapy and antibiotic stewardship programs are pivotal in curbing antibiotic misuse, reducing resistance, and enhancing patient care while minimizing costs. However, further research is needed to validate the efficacy of such antibiotic management approaches [26].

7.2. Antimicrobial resistance

Nosocomial infections play a significant role in the rise and transmission of multidrug-resistant (MDR) bacteria. Commonly used broad-spectrum antibiotics like vancomycin, third-generation cephalosporins, and carbapenems are frequently employed as initial treatment for infected patients, inadvertently promoting the persistence of MDR pathogens. Defined terms are utilized to categorize the resistance level, MDR organisms being resistant to at least one agent in three or more antimicrobial categories. Extensive drug resistance (XDR) refers to resistance to all but two or fewer antimicrobial categories, while pan-drug resistance (PDR) denotes resistance to all agents

in every antimicrobial category. Major culprits of nosocomial MDR infections include MRSA, vancomycin-resistant enterococci (VRE), and MDR Gram-negative bacteria such as *Escherichia coli* and Klebsiella species. The rise of carbapenem resistance in Gram-negative bacteria, driven by various carbapenemase genes, is amplifying the prevalence of infections caused by XDR and PDR pathogens, posing a threat to safe healthcare delivery in numerous countries. Additionally, nosocomial infections caused by resistant fungi are increasingly being documented. The escalating resistance crisis is exacerbated by the scarcity of new antibiotic classes being introduced into clinical practice [25].

7.3. Surveillance of nosocomial infection

While the primary goal of the infection prevention and control program is to eliminate hospital-acquired infections, it remains essential to conduct epidemiological surveillance to demonstrate performance improvement. Effective surveillance involves gathering data from various sources by trained personnel, including administrative records, demographic information, patient histories, diagnostic tests, and data validation. Once collected, this information should undergo analysis, which involves identifying factors influencing infections, understanding their distribution, and comparing incidence rates. Infection control committees, management, and laboratories should share feedback and reports resulting from this analysis while maintaining confidentiality. Evaluating the credibility of surveillance systems is necessary for successful intervention implementation and continuity. Regular data collection intervals are crucial for maintaining the efficiency of surveillance systems [8]. Figure 03 provides a structured methodology for implementing an appropriate surveillance approach.

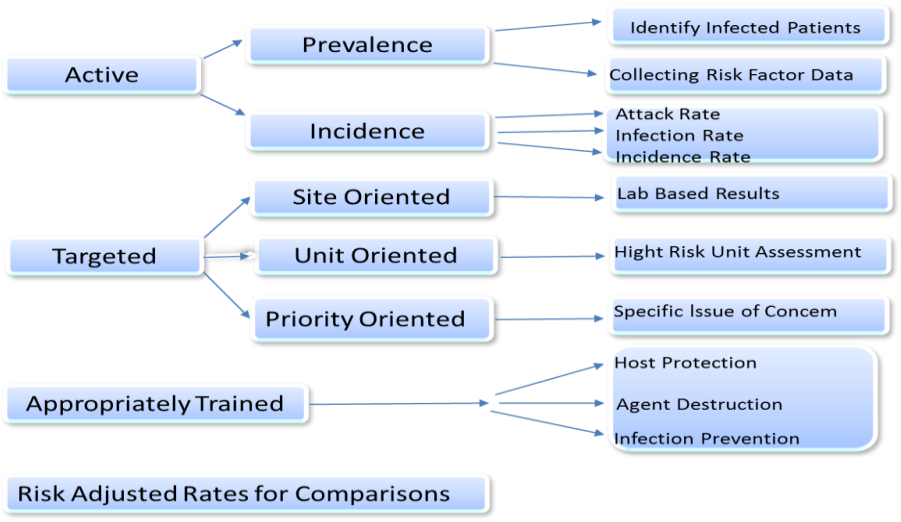

Figure 3. Organization for efficient surveillance [8].

7.4. Nosocomial Microorganisms

There are many germs responsible for nosocomial infections. As an example, we mention, without exhaustive enumeration, a list of the most common germs in this issue.

1- *Klebsiella pneumoniae*:

It is a facultative anaerobic Gram-negative bacillus, belonging to the *Enterobacteriaceae* family. *Klebsiella pneumoniae* has certain plasmids that originate multidrug resistance. These antibiotic resistances concern aminoglycosides (since the 1970s), third-generation cephalosporins (since the 1980s), and more recently carbapenems. *Klebsiella pneumoniae* is primarily responsible for nosocomial infections (bronchopulmonary infections, urinary infections, bacteremias, post-traumatic or post-surgical meningitis) [27].

2- *Enterobacter*:

Several species include *E. sakazakii*, *E. cloacae*, *E. aerogenes*, and the latter two being are most commonly found in nosocomial infection surveillance and are opportunistic pathogens. Species of the genus Enterobacter are often encountered in intensive care units and account for 8.6% of nosocomial infections, according to the Centers for Disease Control and Prevention (CDC) in the United States [27].

Enterobacter infections include bacteremias, lower respiratory tract infections, skin and soft tissue infections, urinary tract infections, and intra-abdominal infections [27].

3- *Escherichia coli:*

Aerobic Gram-negative bacilli also known as colibacillus. It constitutes the majority of the aerobic intestinal flora and can be found on the mucous membranes of humans and animals. Epidemiologically, it is the most isolated germ in urinary tract infections.

Extended-spectrum beta-lactamase-producing Enterobacteriaceae, or extended-spectrum beta-lactamase-producing Enterobacteriaceae, are increasingly encountered multidrug-resistant bacteria in routine practice [27].

4- *Pseudomonas aeruginosa*:

The pyocyanic bacillus is a bacterium found in the environment but can also be a commensal of the digestive tract. It is a major opportunist, particularly formidable in immunocompromised individuals due to the expression of its pathogenicity factors, namely endotoxins, exotoxins, and proteolytic enzymes that promote its spread in the body.

In the hospital environment, this bacterium can be found in humid areas such as sinks, faucets, drains, nebulizers, and humidifiers, in addition can sometimes contaminate antiseptic solutions, hospital equipment induced pneumonia. Moreover, Pseudomonas aeruginosa isolates from catheterized patients indicate that 77% of the isolated strains were biofilm producers. Most isolated germs were multidrug-resistant (69%), and biofilm production correlated with resistance to gentamicin.

According to the CDC:

- The pyocyanic bacillus is the second leading cause of nosocomial pneumonia worldwide (17%).
- It is the third leading cause of urinary tract infections (7%).
- It is the fourth leading cause of surgical site infections (8%).
- It is the seventh pathogen isolated in blood cultures (2%) [27].

5- Staphylococci:

Predominantly *S. aureus*, also known as golden staph, which inhabits the nasal passages and hands of healthy individuals. This genus is responsible for skin and mucous membrane infections, as well as septicemia. It is one of the most isolated germs in neonatal septicemia (opsonization of *Staphylococcus aureus* is very low in newborns).

To a lesser extent, coagulase-negative staphylococci (CNS) such as Staphylococcus epidermidis are generally found in catheter-related bacteremias.

Methicillin-resistant Staphylococcus aureus (MRSA), or antibiotic-resistant golden staph, are regularly monitored and are among the multidrug-resistant bacteria that increasingly concern the scientific community [27].

6- *Clostridium difficile*:

It is a Gram-positive anaerobic bacillus whose pathogenic strains can produce two toxins (tdcA and tdcB). It is responsible for nearly 10% of nosocomial diarrheas. There are between 1 and 3% of asymptomatic carriers worldwide [27].

8. Diagnosis of Nosocomial Infection

Diagnosing nosocomial infections relies on clinical, radiological, biological, and microbiological indicators, where the first three often lack precision in sensitivity or specificity. Microbiological analysis aids in identifying pathogens causing infections and assessing their

antibiotic sensitivity, facilitating tailored treatment selection for each patient. With the rise of multi-resistant strains, it's crucial to monitor and promptly diagnose these pathogens [28].

8.1. Clinical sings

Classic clinical signs of an infection (redness, pain, swelling, edema, secretion) are not always straightforward. It is often only during the infection's progression that we can recognize it, through increasingly severe pain, secondary wound dehiscence, or persistent or new secretion [22]. However, Ambanna *et al* resumed clinical sings in the table below (table 02).

Table 2. Diagnostic criteria for nosocomial infection [29].

Nosocomial infection	**clinical features**	**lab features**
Urinary Tract Infection	Fever, lower abdominal pain, change in urine parameters	Leukocytosis, positive urine culture (10^5 CFU per ml of urine)
Lower respiratory infection	Fever, cough/sputum decreased breath sounds, crept	Leukocytosis, sputum for Gram stain, changes in fresh x-ray
Catheter related infections	un explained fever/chills, pain tenderness at site of insertion of Central Venous Pressure Intravenous lines	Leukocytosis, positive blood culture, positive catheter culture
Skin & soft tissue infections	pain, swelling, tenderness of skin, fever, purulent drainage	Leukocytosis, positive swab culture
Pneumonia	Fever, chest pain, decreased breath sounds intensity, rales	Leukocytosis, sputum for gram stain, positive sputum culture, positive X-ray

8.2. Laboratory examination

8.2.1. Rapid Bacteriological Diagnostic Techniques

The urgent need to detect the pathogen early prompts interest. Traditional methods, lacking sensitivity and relying on slow pathogen amplification, hinder rapid identification. However,

molecular biology techniques like real-time PCR and FISH Fluorescence *In Situ* Hybridization, offer swift identification, potentially allowing routine analysis within 24 hours [28].

8.2.1.1 Polymerase Chain Reaction (PCR)

Nucleic-acid-based amplification technologies represent advanced tools utilized for swift and precise identification of pathogen-specific nucleic acids. PCR, initially introduced by Mullis in 1985, marked the inception of DNA amplification methods, enabling the replication of millions of copies of a DNA template from just a few molecules. PCR operates through thermal cycling, involving repetitive cycles of heating and cooling to synthesize DNA. Utilizing short DNA segments known as primers, which match the target region, PCR achieves exponential amplification of a specific sequence. Recognizing pathogens and understanding their resistance mechanisms swiftly is crucial in combating the further spread of antibiotic resistance. Therefore, since its inception, numerous variations of endpoint PCR have emerged to efficiently address these objectives [30].

8.2.1.2. Other deductions

Pre-culture step: All samples other than blood may potentially contain enough bacteria for direct examination to detect them. The bacterial load depends on the timing of infection at the time of sampling, the quality of the sample, and the time and conditions of transportation to the clinical microbiology laboratory. Direct examination, after Gram staining, allows the use of FISH techniques and MALDI-TOF analysis if the sample is monomicrobial;(PCR-based techniques can be performed directly on positive blood cultures. positive blood cultures, while direct examination with Gram staining must be performed prior to FISH and MALDI-TOF mass spectrometry tests. In the former case, this examination is used to determine the FISH kit to be used, whereas for mass spectrometry, it is used to that the sample is monomicrobial) [28]. PCR analysis can also be performed directly on clinical samples, and the result will greatly depend on the nucleic acid extraction step, which varies in performance depending on the sample type and bacteria. Techniques for Insoluble Detection and Recognition techniques can be used to detect soluble antigens in urine or stool [28].

A. **MALDI-TOF:**

For the identification of bacteria by MALDI-TOF, ribosomal proteins are the main targets, as they are present in large quantities. The mass spectrum obtained is compared with a database to establish a match based on the number of peaks, their intensity and the m/z ratio. Two main instruments are used: the MALDI Biotyper, which compares a

large number of peaks with the database, and the Vitek MS, which focuses on around 15 peaks known as super-spectra. Identification can be made at species or genus level, with a similarity score validating the match. In the event of a strict non-match, a phylogenetic tree is drawn to estimate the proximity of the strain tested to the species in the database.

Mass spectrometers consist of three components:

- an ion source, which ionizes and fractionates the targets to be analyzed
- an ion separator, which discriminates analytes according to the ratio of their mass
- their mass to their electrical charge (m/z ratio)
- a detector [28].

B. **FISH:**

PNA-FISH probes have an overall sensitivity and specificity in excess of 98%, with rapid detection in 2.5 hours from positive blood cultures. They enable rapid identification of infections, such as SCN, which are often detected in the event of contamination, helping to avoid inappropriate treatment. This technique can be used directly on various types of clinical specimen, providing same-day results for urine or BAL samples. Despite the rapid identification of pathogens, bacterial culture is still required for antibiotic susceptibility testing. Specific resistance detection is limited to certain chromosomal mutations conferring resistance to macrolides, lincosanides and streptogramins [28].

C. **Culture of clinical samples:** Agar plates are inoculated with samples. A microscopic examination after Gram staining is performed on positive cultures (1 to 3 days of incubation), and rapid and/or conventional diagnostic tests as well as an antibiogram are performed from isolated colonies. In the case of polymicrobial samples, the procedure is the same as for blood cultures. The clinical relevance of microbiological examination is highest when identification is available to the clinician within the first 24 hours following sampling. Early implementation of appropriate antibiotic therapy greatly reduces the morbidity, mortality, and hospital costs associated with nosocomial infections [28]. Table 3 mentions the Primary traditional and molecular techniques.

Table 3. Main conventional and molecular methods [31].

anatomical site	**Conventional methods**	**Molecular methods**
	Ex mic; Cult; ID ATB of sputum, bronchial aspiration, BAL, protected telescopic brush, blindly performed distal sampling	Specific PCR amplification of mandatory pathogenic organisms (*Mycobacterium tuberculosis*) or atypical pneumonia agents (*Legionella pneumophila, Mycoplasma pneumoniae, Chlamydophila pneumoniae*).

Lower respiratory infections	Detection of antigens of *Streptococcus pneumoniae,* *Legionella pneumophila* group 1 in urine, in BAL.	Quantitative PCR of *S. pneumoniae* (not validated).
Infections of the central nervous system	Ex mic; Cult; Id ATB of cerebrospinal fluid Blood cultures (automatic detection system)	Specific PCR amplification (*S. pneumoniae, Neisseria meningitidis, Haemophiles influenzae, Listeria monocytogenes*): detection of one or more germs simultaneously (multiplex PCR)
Systémic infections (bacteremias)	Blood cultures (automatic detection system)	Identification by hybridization from positive blood cultures Broad-spectrum PCR from native blood (not validated)
Infections of intravascular catheters	Semi-quantitative culture of rolled Maki-catheter on nutrient agar Quantitative culture of catheter tip Difference in time to positivity of catheter and peripheral venous blood cultures Bacterial detection by fluorescence microscopy of catheterized native blood	Quantitative PCR on native blood from catheter tip (not validated)
Endocarditis	Blood cultures, vials with resin if prior antibiotic therapy Serology if endocarditis with negative blood cultures (*Coxiella burnetti*, Brucella spp., Bartonella spp., Chlamydia spp., Mycoplasma spp., Legionella spp.) Ex mic; Cult; Id ATB of excised valves.	Broad-spectrum PCR of excised valves (amplification of one or more genes).

urinary tract infections	Ex mic; Cult; Id ATB of urine. Urine strips-Leukocyte esterase, nitrites Detection of significant pyuria and bacteriuria by flow cytometry	
Skin, soft tissue, and musculoskeletal infections	Ex mic; Cult; Id ATB of invasive samples Blood cultures (automatic detection system)	PCR amplification of *Streptococcus pyogenes* toxin (necrotizing fasciitis) [not validated] PCR identification of MRSA-C from clinical isolates Broad-spectrum PCR from invasive material (joint fluid)
Multidrug-resistant germs	Automated determination of antibiotic susceptibility (use of an expert interpretation system) Detection of MRSA and VRE by culture on selective media	MRSA detection by PCR from surveillance smears Identification of VRE and MRSA by PCR from positive cultures

Ex mic: microscopic examination of samples; Cult: culture on solid and liquid media; Id ATB: identification and antibiogram determination of potentially pathogenic germs (manual or automated method); BAL: bronchoalveolar lavage, PCR: polymerase chain reaction; MRSA-C: community methicillin-resistant Staphylococcus aureus, VRE: vancomycin-resistant enterococci.

8.2.1.3. CHROMagar

Discovered initially in 1979, chromogenic agar presents a culture-based rapid method that demands less effort and fewer resources. It proves to be a cost-efficient alternative to standard conventional media and API 20E/20NE, typically employed for uropathogen identification. However, a drawback of CHROMagar is its inability to distinguish between Klebsiella, Enterobacter, and Citrobacter, as they all produce colonies of the same metallic blue color [32].

8.2.1.4. Bactech Machine

One of the most effective techniques, which has become standard in investigating bacterial cultures of M. tuberculosis over the past two decades, is the BACTEC MGIT 960 system. This system, while it indirectly measures growth, shows a relationship between the indicated growth units and the actual bacterial population. Here's how it works: The Mycobacteria Growth Indicator Tube (MGIT) contains a growth-supporting medium and a silicon rubber impregnated with a fluorescent quenching oxygen sensor. As bacteria grow, they consume oxygen and replace it with

carbon dioxide, reducing the inhibition of the fluorescent sensor. The BACTEC MGIT 960 automates this process hourly, detecting fluorescence under ultraviolet light. However, its conventional use is binary, determining if fluorescence surpasses a set boundary, indicating growth, or not. Yet, it has potential for deeper analysis, especially in studying M. tuberculosis growth dynamics, including synchronous cell division [33].

8.3. Radiological Examination

A chest x-ray should not be mandatory unless pulmonary signs are present [34]. Some authors recommend a Tele thorax as a minimum radiological work-up for febrile neutropenia (NF), while others require it if pulmonary signs are present. It may reveal images suggestive of pneumonia or other radiological signs. Chest CT may even be considered if there are any telltale signs especially COVID-19. Abdominopelvic ultrasound is also useful in the event of digestive signs, as is CAT or MRI to look for foci of infection. These examinations should not delay therapeutic management [35].

9. Prevention and treatment

9.1. Principles of treatment of infectious diseases

- **Types of Antimicrobial Programs**

Three basic types of antimicrobial treatment programs are available:

1- Empiric treatment

Empirical treatment is commonly employed as the first-line approach to address severe infections. The primary focus is on selecting a medication that can effectively combat the anticipated microbial agents. Often, a broad-spectrum treatment is favored initially to swiftly gain control and mitigate the risk of mortality or complications. These empirical treatment plans are frequently maintained due to positive clinical outcomes and lingering uncertainty regarding the specific causative microbe. However, if there's a lack of clinical improvement, adjustments or expansions to the empirical therapy are often made, even in scenarios where infection may not be definitively diagnosed [36].

2- Definitive treatment program

Once a particular pathogen is identified, clinicians typically prescribe a preferred drug based on factors such as past experiences, expert opinions, sensitivity tests, and cost considerations. However, alternative medications with similar efficacy are also available and commonly used,

especially if the patient has a history of allergic reactions, toxicity, or intolerance to the preferred drug. Alternatively, the definitive treatment may be determined by the specific sensitivity of the microorganism as demonstrated *in vitro* in the microbiology laboratory (Table 4).

The objective of definitive therapy is to achieve maximum curative effects using a narrow-spectrum, cost-effective, and safe medication. In cases of polymicrobial infections, the definitive therapy may involve a broader spectrum agent or a combination of two or more antimicrobial agents administered concurrently. Additionally, in certain instances, two drugs may be required in combination to enhance bactericidal activity against the microorganism or to prevent the development of resistance [36].

3- Prophylaxis or suppression program:

Certain infections can be prevented by targeting a single specific organism that consistently responds to the chosen treatment. For instance, penicillin is often utilized to prevent rheumatic fever, while trimethoprim-sulfamethoxazole is employed for prophylaxis against Pneumocystis carinii pneumonia or recurrent urinary tract infections caused by *E. coli*. Prophylaxis aimed at multiple potential pathogens is typically effective only in the short term, such as in the case of surgical wound prophylaxis. Prolonged prophylaxis, although it may delay infection, also runs the risk of promoting the emergence of resistant organisms.

In situations where infections cannot be entirely cured, long-term administration of antibiotics can sometimes suppress the infection for a certain period. This strategy is occasionally used to maintain the function of infected prosthetic devices and serves as the foundation of therapy for AIDS patients to prevent recurrence of previously treated opportunistic infections [36].

Table 4. Mention Therapeutic strategies for documented nosocomial infections [37].

	Monotherapy	**Conventional combinations**	**Alternatives**	**Comments**
Gram negative organisms				
Escherichia coli	Ceftazidime or aztreonan or cefpirome/cefepime: amoxicillin-clavulanic acid:	Cefotaxime + amikacin: piperacillin + tazobactam: cefoxitin or	Imipenem alone: imipenem + aminoglycoside: imipenem + fluoroquinolone	Increasing rates of ESBL production in *E. coli* (≈5.4%):

	fluoroquinolone (in UTI)	aztreonam + aminoglycoside		fluoroquinolone resistance 28%
Klebsiella spp: ESBL	Ceftazidime or cefoperazone or cefepime/cefpirome: amoxicillin-clavulanic acid	Piperacillin + tazobactam: ticarcillin + clavulanic acid: cefotaxime + aminoglycoside	Imipenem alone: imipenem + aminoglycoside: imipenem + fluoroquinolone	1.5 to 3.6% ceftazidime R: 1 to 58% ESBL (outbreaks), fluoroquinolone R (≈8-80%): importance of susceptibility testing
ESBL+	Imipenem or cefepime: fluoroquinolone (in UTI)	mipenem + aminoglycoside : piperacillin + tazobactam + amikacin	Imipenem + ciprofloxacin	Detection of ESBL production
Enterobacter spp.	Imipenem or meropenem: cefpirome/cefepime: piperacillin + tazobactam	Third generation cephalosporin + aminoglycoside : aztreonam + amikacin	Imipenem + fluoroquinolone: aminoglycoside + ciprofloxacin	Importance of detection of Bush group 1 cephalosporinase (14-56%): detection of imipenem-R: cefepime inhibits 97% of ceftazidime-R strains
Pseudomonas aeruginosa	Penicillins (ticarcillin, piperacillin, azlocillin). Cephalosporins	Ticarcillin, aztreonam or ceftazidime + sulbactam + tobramycin or	Antipseudomonal penicillin + fluoroquinolone: aztreonam + amikacin:	Ceftazidime-R: stable (≈10%), higher for cefotaxime (35-70%): outbreaks

	(ceftazidime, cefpirome/cefepime), imipenem, meropenem	amikacin: imipenem + amikacin: ceftazidime + fluoroquinolone	aminoglycoside + ciprofloxacin: fosfomycin + ciprofloxacin	of imipenem-R strains: increasing R to quinolones (>18%)
Gram-positive organisms				
***Staphylococcus aureus* : MSSA (methicillin–susceptible)**	Penicillins, cloxacillin: cefazoline, cefalothin: second generation cephalosporin: cefotaxime: aminoglycosides	Penicillin + aminoglycoside (oxacillin + gentamicin): tetracycline + aminoglycoside: amoxicillin-clavulanic acid: ampicillin + sulbactam	Fluoroquinolone + fusidic acid: fosfomycin + β-lactam: synergistins (streptogamins): oxacillin: fusidic acid + cloxacillin	High risk of emergence of R mutants by using: rifampicin (rifampin), fosfomycin, fusidic acid, fluoroquinolones in monotherapy
MRSA (methicillin–resistant)	Vancomycin: imipenem-cilastatin: meropenem: fusidic acid	Rifampicin + vancomycin: fusidic acid + glycopeptide: fosofomycin + aminoglycoside: vancomycin + fluoroquinolone	Imipenem + vancomycin: fusidic acid + fosfomycin: fusidic acid + glycopeptide: fusidic acid + rifampicin: synergistins	Choice of combination as a function of infection site: careful susceptibility testing of combinations for each strain
Coagulase-negative staphylococci	Same indications as for MRSA, with higher resistance rates to: quinolones, aminioglycosides,		Imipenem + fosfomycin: aminoglycoside or synergistins	Difficult to treat infections

	clindamycin, cotrimoxazole			
Enterococcus spp.	Ampicillin: imipenem: piperacillin: glycopeptide (in nosocomial UTI only): synergistin	Ampicillin + gentamicin: vancomycin + aminoglycoside	Teicoplanin + penicillin: imipenem + glycopeptides: piperacillin + teicoplanin	*E. faecium* : increasing resistance to β-lactams, imipenem, vancomycin

ESBL = extended spectrum β-lactamase; R = resistant; UTI = urinary tract infection

9.2. Prevention

Nosocomial infections can be avoided by reducing the transmission of harmful agents, isolating patients with infectious diseases, and upholding proper sanitation standards in medical facilities. There are five key areas where preventive measures can be focused.

- Maintenance of hygiene.
- Avoid surgical site infection.
- An isolation unit for a patient infected by an infectious disease.
- Sterilization of medical equipment.
- Validation and cleaning of the hospital environment [14].

9.2.1. Maintain Hand Hygiene:

Maintaining clean hands is paramount in controlling infections and preventing nosocomial infections. Regular hand hygiene effectively eliminates harmful microorganisms temporarily present on healthcare workers, minimizing the likelihood of transmission to patients. Additionally, it prevents both infection and the spread of contaminants in the healthcare worker and their surroundings. The World Health Organization outlines five key instances when hand hygiene should be consistently observed:

- Before coming into contact with a patient
- Before any clean or sterile procedure
- Following exposure to bodily fluids
- After interacting with a patient
- After handling patient-related surfaces [38].

Inadequate hand washing fails to eliminate germs, and increasing the risk of infection. Contributing factors include insufficient education, poor hygiene habits, perceived insignificance, time constraints, dry or irritated skin, absence of appropriate cleansing agents, and incomplete hand washing. Researchers have documented the transmission of antibiotic-resistant MRSA strains through hand contact. Adhering to proper hand hygiene, which entails 11 specific steps of hand washing, can significantly decrease the spread of infectious agents through hands in the figure 4 [14].

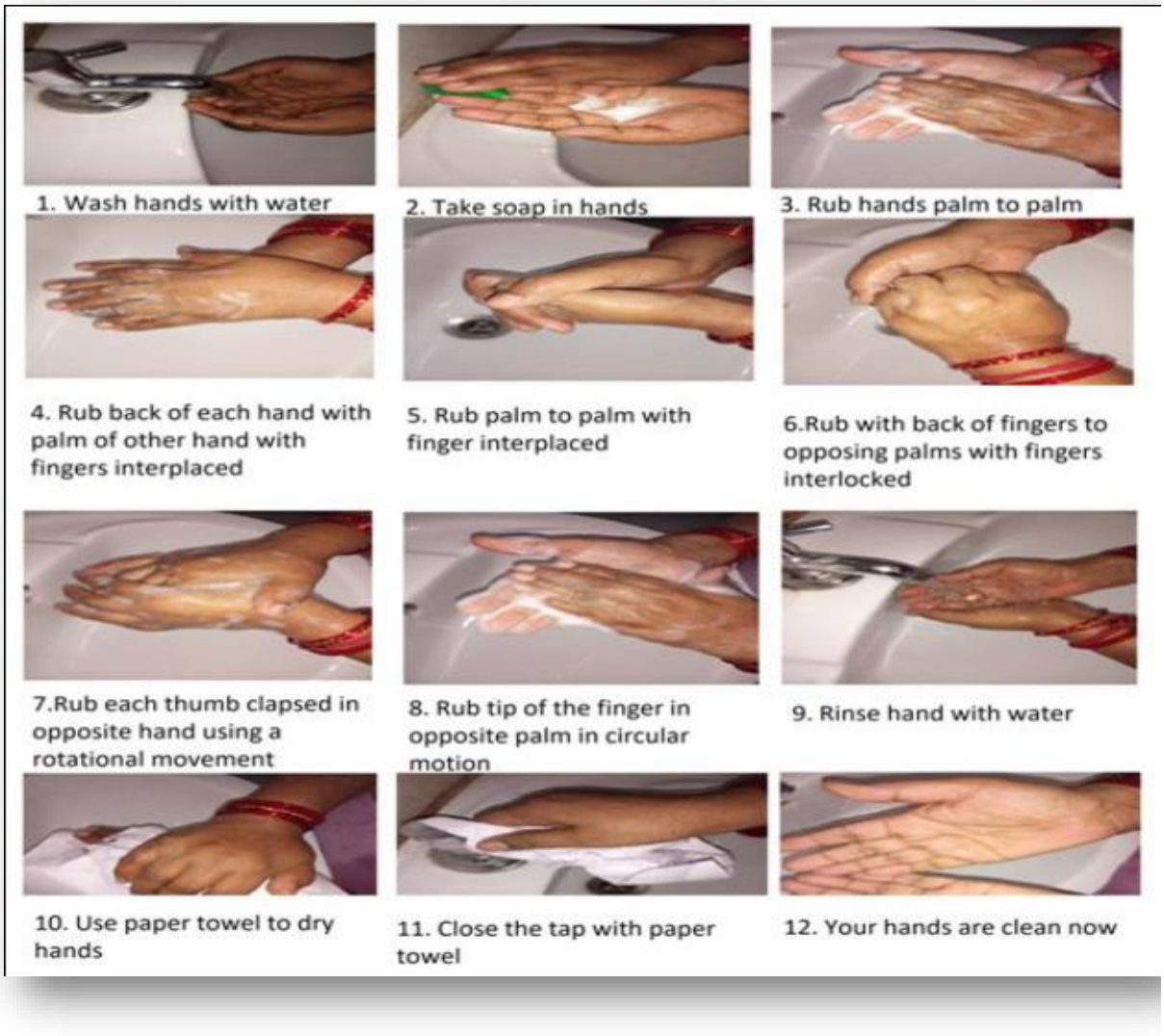

Figure 4. Source represents steps of hand washing recommended by WHO [14].

PRACTICAL PART

10. Study Methodology

Our research is a retrospective study based on collecting data from files of patients who have NI, and the use of a survey as a quantitative research method to collect the data from medical staff.

10.1. Study Population

Of the 5396 patients during 16 months to the surgery Department of EPH EL ZAHRAOUI of M'sila located in the middle of Algeria, 48 were admitted to the department and after 48 hours of hospitalization developed NI with clinical features of sepsis (e.g., fever, infected wound, respiratory distress ... etc.). The exclusion criteria;(Exclusion criteria for patients in the study or analysis of hospital-acquired infections vary according to the specific objectives of the research and local conditions. However, below are some common exclusion criteria in our study: Patients hospitalized for less than 48 hours, and patients with community-acquired infections). included those patients not declared by the clinicians and their files that had not any changes in biologic balance, clinical manifestation, or antibiotherapy.

10.2. Survey of medical staff

The survey was distributed and collected to all medical personnel (General Practitioners, Surgeons) and paramedical personnel (Nurses, Nursing Assistants ...). More than 70 surveys were distributed but only 30 surveys were collected. The survey was conducted during our final internships from 07/04/2024 to 06/05/2024 at the EPH in M’sila.

10.3. Data analysis

This study aims to evaluate the prevalence of NI in the surgery department in addition to assessing the medical staff’s knowledge, attitude, and practice on preventing nosocomial infections in patients. To this end, we used Excel 2013 to input data and analyze them. The basic findings are described by percent.

11.The results

11.1. Investigation Area

- **Description and Composition of the Surgery Department**

Among the services at the public hospital:

- The Child surgery department is located on the first floor.
- The Women's and Men's surgery departments is located on the 2nd floor.
- Upon entering the department, on the right is the general practitioner's office, and on the left is the head of department's office.
- The duty room.
- A service pharmacy.
- Storage room.

Then, we found two main corridors divided as follows:

Patient rooms, where there are:

- Two (02) small rooms, each with (02) beds.
- Six (06) medium-sized rooms, each with (03) beds.
- In addition, in the last room, there is a large room with (06) beds.
- A toilet for patients

A. Material Resources

- A dressing trolley.
- A manual sphygmomanometer.
- 02 wheelchairs.
- Two carts. (Care and emergency)

B. Human Resources :

- **Medical Staff :**

- Two general practitioners.
- 11 General Surgeons.
- 2 Orthopedists.
- 4 Pediatric Surgeons.

Paramedical Staff :

- 11 Nurses.
- 2 Nursery Assistants.
- 01 Dietitian.
- 01 Physiotherapist.

11.2. Description of the population in the surgery department

Between January 2023 and April 2024, the general surgery department (Men, Women, and children) received 5396 patients, among whom 1520 (28%) were women, 2042 (38%) were children, and 1834 (34%) were men. The average age of the patients was 32 to 69 years. In figure 5 the description of this population according to age, 2042 (38%) patients were under 16 years old, and 3354 (62%) were over 17 years old.

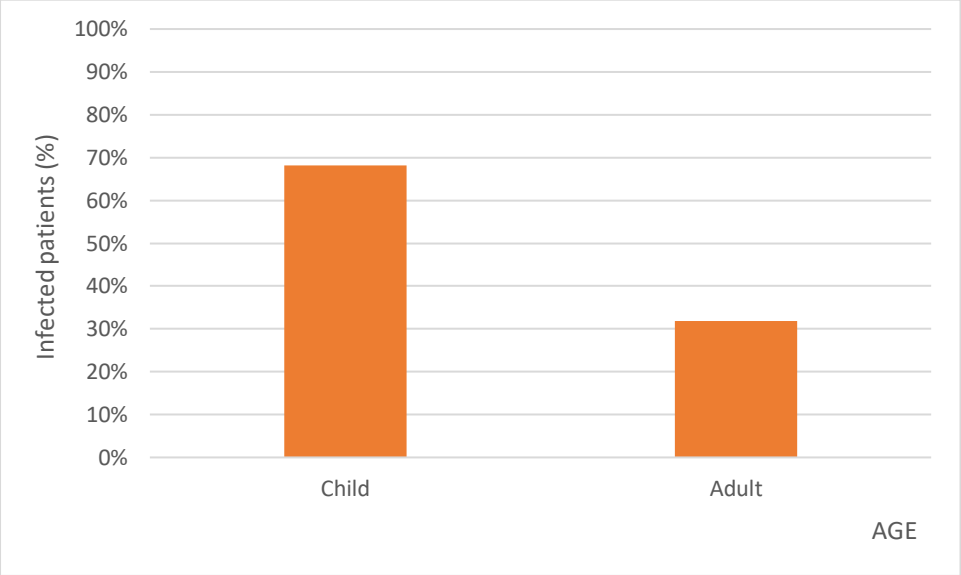

Figure 5. Distribution of patients according to age groups.

11.3. Distribution of population according to NI cases

Our study was carried out on a population of patients with a high risk of developing NI. To study the distribution of patients according to the number of NI cases, patients are grouped into two groups, where among the 5,396 hospitalized patients, 48 developed an infection, representing a nosocomial infection rate of 3%, and the uninfected patients represent (97%) (Figure 6). in addition, in the figure (Figure 7) the distribution of patients according to age groups.

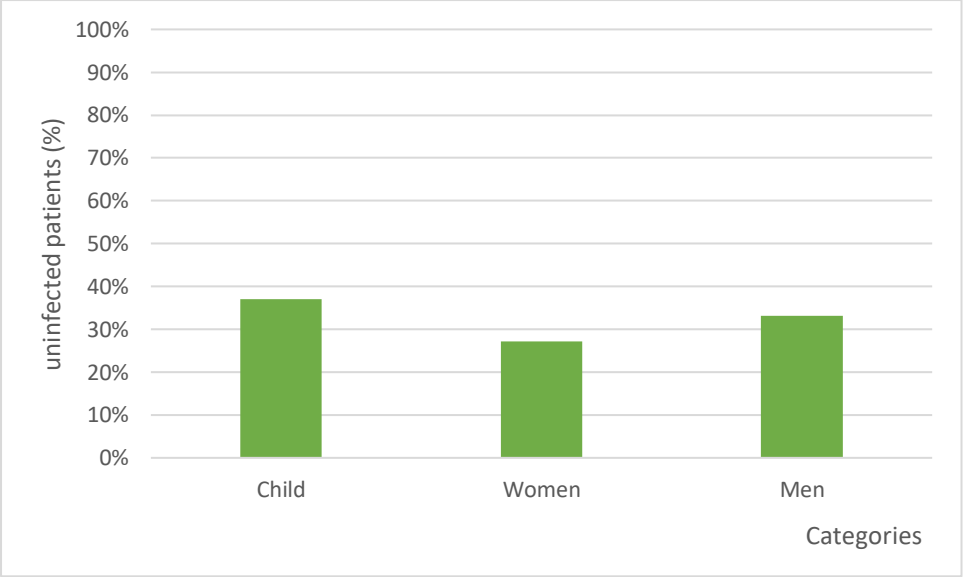

Figure 6. Distribution of data according to uninfected patients.

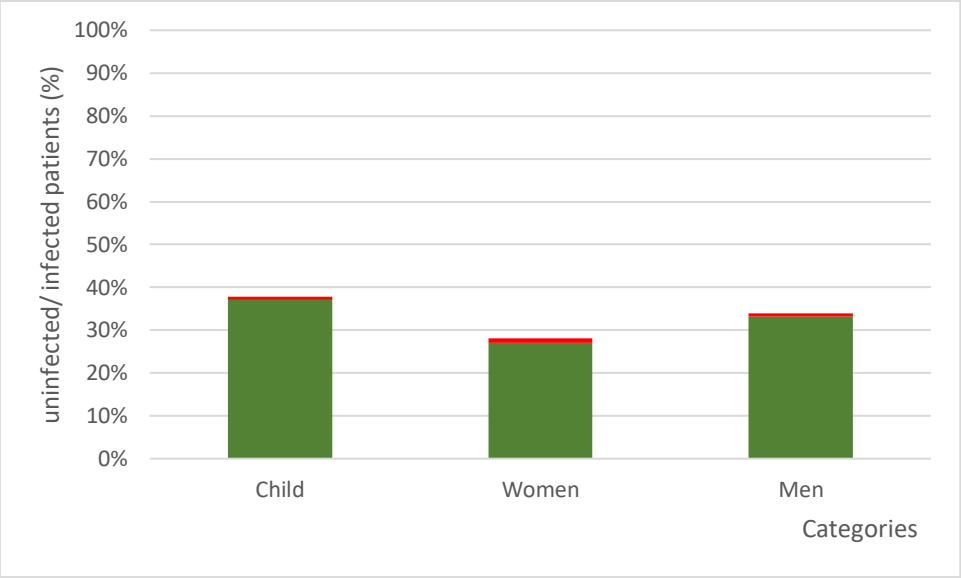

Figure 7. Distribution of data according to uninfected patients.

11.4. Distribution of the sample according to sex

The analysis of the results obtained from the files revealed the abundance of NI in women which represents 52% of patients among them 19% were under 16 years of age (girls). In comparison, 48% of cases were in men, and among them 15% were boys (Figure 8).

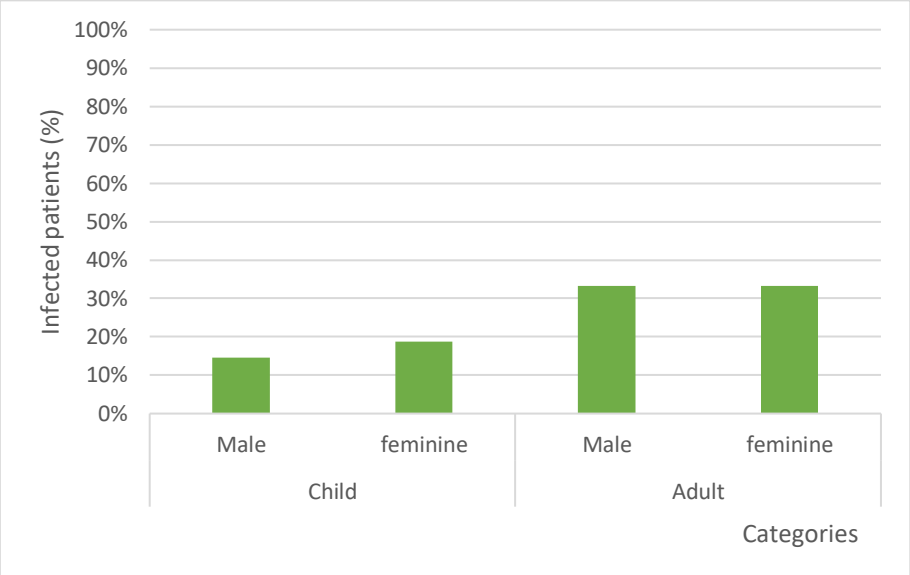

Figure 8. Distribution of sample according to sex.

11.5. distribution of data according to length of hospitalization

The length of hospitalization represents one of the biggest risk factors for developing NI. based on it we show in figure 9 that in our population the length contributes also to the acquisition of NI, where Patients whose preoperative hospitalization duration was between 2 and 15 days had the highest infection rate 54%, compared to 4% for those whose preoperative hospitalization duration was between 0 and 1 day.

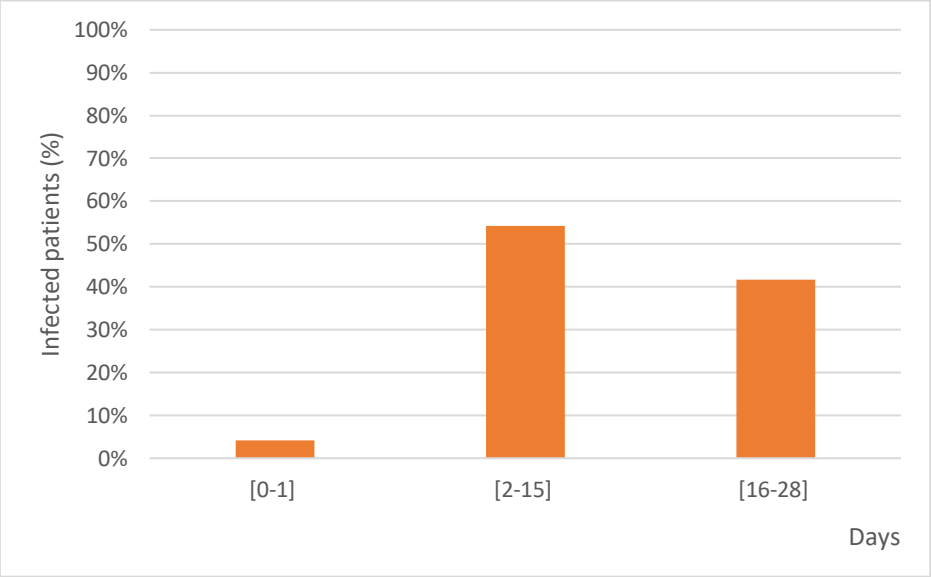

Figure 9. Distribution of data according to length of hospitalization.

11.6. Distribution of cases according to Mode of contamination

According to Figure 10, it was found that of all infected hospitalized patients, 74% sustained surgical intervention, 22% sustained peripheral catheter, and 4% Drain.

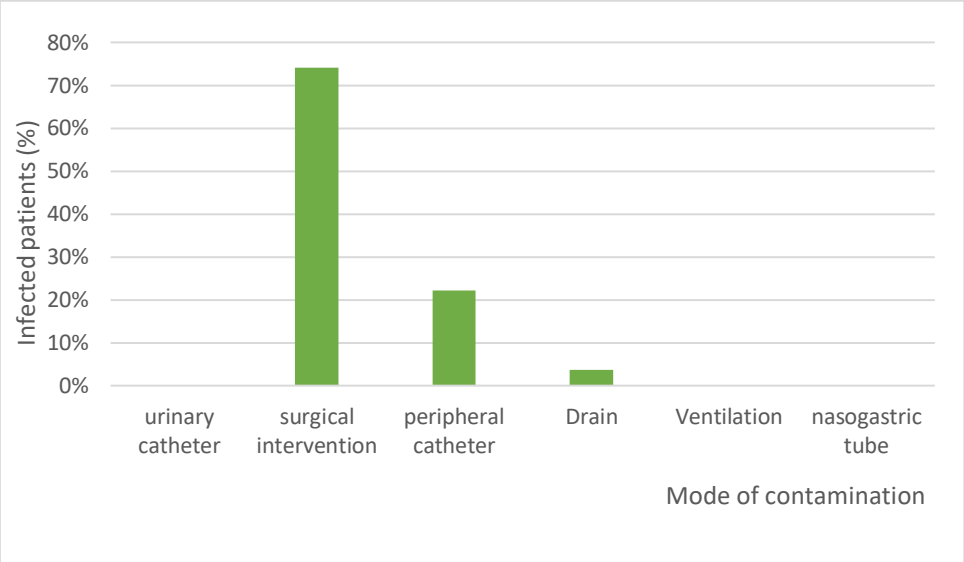

Figure 10. Distribution of cases according to Mode of contamination.

11.7. Distribution of data according to type of surgical

When we tried to know the frequency of NI according to the type of surgical intervention or hospitalization reasons. We categorized (Figure 11) the majority of patients had acute appendicitis 41%, acute pancreatitis 9% followed by acute arthritis, Burn, and peritonitis with equal percentages 6%. While the rest of the reasons as hydrocephalus, intestinal obstruction, brain cancer, and pertrochanteric fracture... had the same rate of 3%.

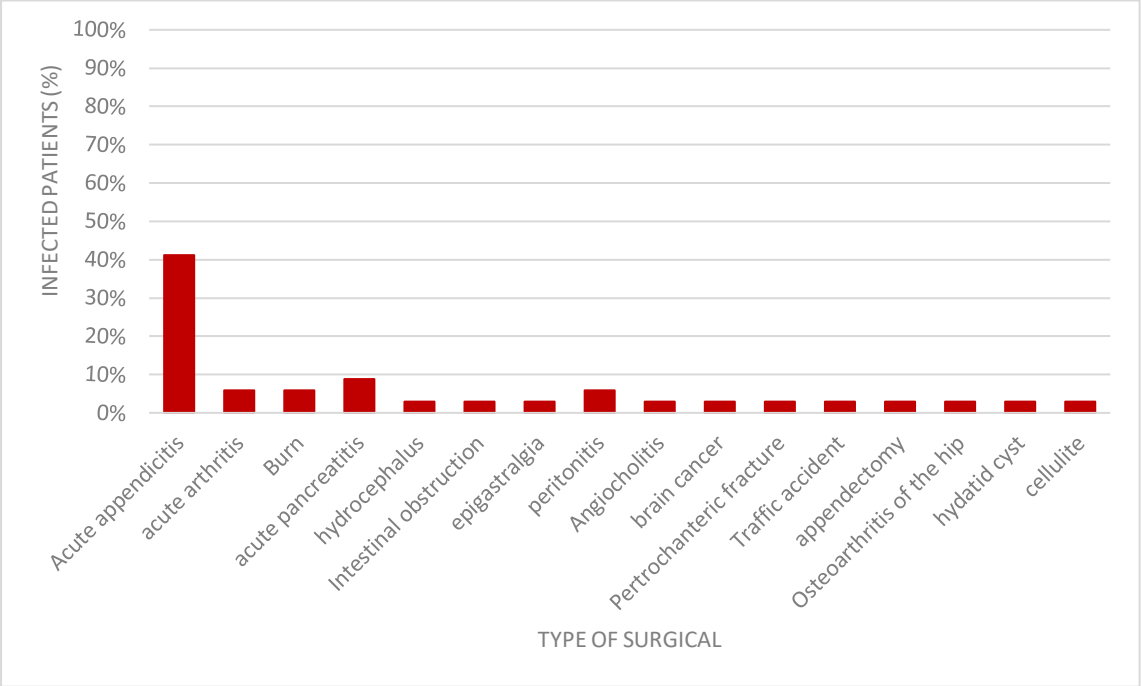

Figure 11. Distribution of data according to type of surgical.

11.8. The frequency clinical signs in NI patients

Figure 12 shows that the majority of patients' present infected wounds 21% followed by Fever, dyspnea, weakness, and cough with equal percentages 16%, pain 11%, and serosity wound with rate 5%.

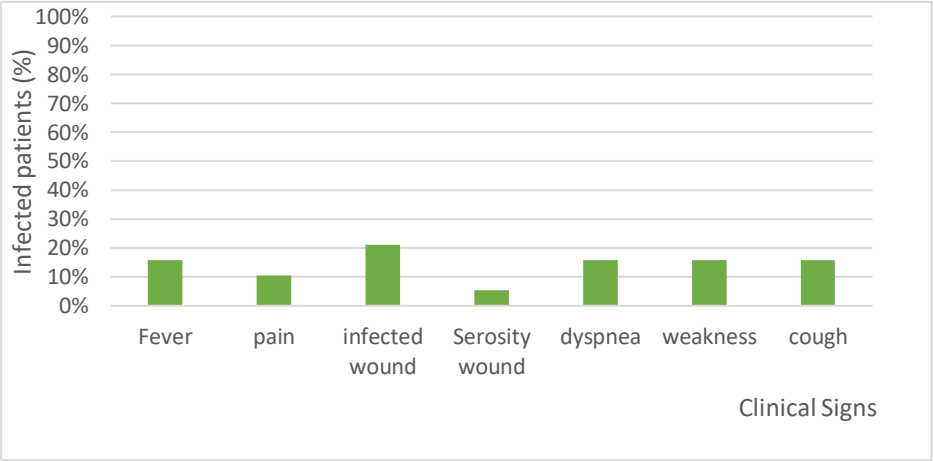

Figure 12. Distribution of data according to the frequency clinical signs in NI patients.

11.9. The frequency of microorganisms isolated in NI:

Bacteriological examination of pus is the most used test in NI patients in our patients. Figure 13 presents the microorganisms that have been the cause of NI, *E. coli* 30%, *Pseudomonas aeruginosa* 15%, Enterobacter 10%, *Acinetobacter baumannii*, and *K. pneumoniae* 5%. In addition, the highest level to *S. aureus* 35%.

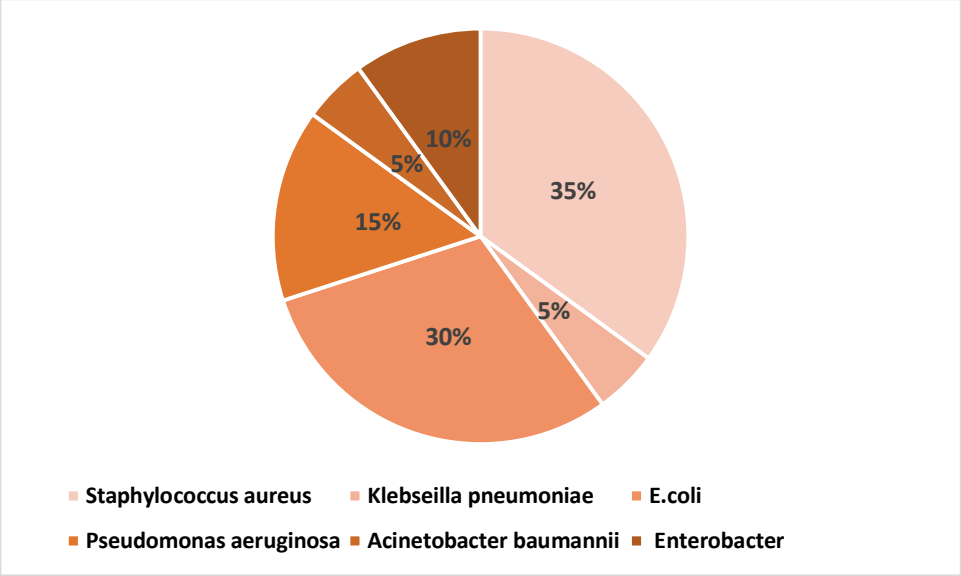

Figure 13. Distribution of data according to the frequency of microorganisms isolated in NI.

11.10. The resistance of microorganisms isolated from NI patient

Table 5. Distribution of germs responsible for nosocomial infections according to their sensitivity to the antibiotics tested.

Antibiotic/ Germs	Colistine	Ciprofloxacine	Ofloxacine	Gentamycine	Levoflaxacine	Amikacine	Vancomycine	Céfotaxime	Ceftazidime	Amoxicilline	Augmentin	Fosfomycine	Tetracyclin
Staphylococcus aureus	0/7	3/7	2/7	2/7	2/7	1/7	5/7	2/7	0/7	0/7	0/7	1/7	2/7
Klebseilla pneumoniae	0/1	0,25	0/1	0/1	0/1	1/1	1/1	0/1	0/1	0/1	0/1	1/1	1/1
E.coli	1/6	0/6	1/6	2/6	0/6	2/6	1/6	0/6	0/6	0/6	1/6	0,5	1/6
Pseudomonas aeruginosa	1/3	0/3	0/3	2/3	1/3	0/3	0/3	0/3	1/3	0/3	0/3	0/3	0/3
Acinetobacter baumannii	1/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1
Enterobacter	1/2	0/2	0/2	1/2	0/2	1/2	1/2	0/2	0/2	0/2	0/2	1/2	1/2
Total	0,2	0,2	0,15	0,35	0,15	0,25	0,4	0,1	0,05	0	0,05	0,3	0,25
Percentage (%)	8,16	8,16	6,12	14,29	6,12	10,20	16,33	4,08	2,04	0,00	2,04	12,24	10,2

Antimicrobial Resistance occurs when bacteria, viruses, fungi and parasites no longer respond to antimicrobial medicines. Among Gram-positive, the most prevalent *S. aureus* was highly resistant to Colistine, Ceftazidime, Amoxicilline (0% sensitive strain), and was intensely sensitive to Vancomycine (25% Sensitive strain) And Ciprofloxacin (15%). For Gram-negative, the most prevalent *E. Coli* was resistant to Ciprofloxacine, Levoflaxacine, Céfotaxime, Ceftazidime, Amoxicilline (0% sensitive strain), And was extremely Sensitive to Gentamycine, Amikacine (20%).

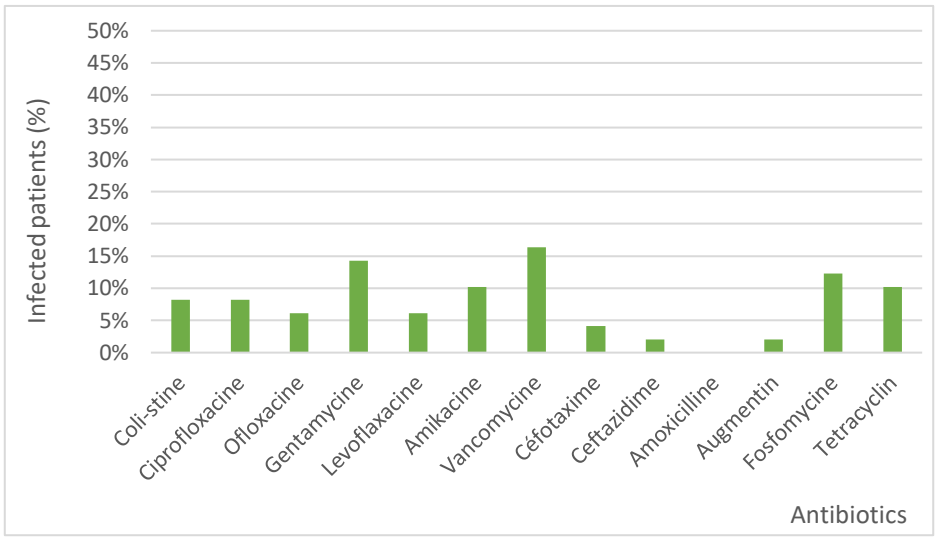

Figure 14. Distribution of germs responsible for nosocomial infections according to their sensitivity to the antibiotics tested.

11.11. Treatment of NI patients

According to Figure 15, the most common treatment used in NI cases is Antibiotic 86%, which can be associated with analgesics 10%, vitamins, proteins, and anti-inflammatories 3%.

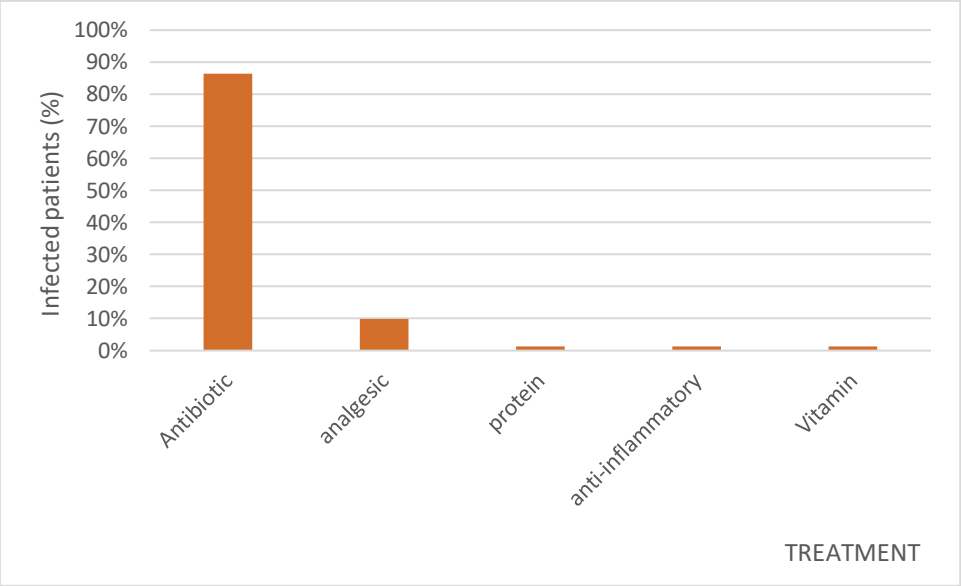

Figure 15. Distribution of data according to Frequency treatment in patients who have acquired IN.

12. Analysis of survey data

12.1. Professional category:

To understand the role that healthcare professionals play, from raising awareness to disseminating NI. After the distribution of more than 70 units, we only had 30 questionnaires with responses. We show in figure 16, that 67% of answers came to caregivers, while the rest 33% were from doctors.

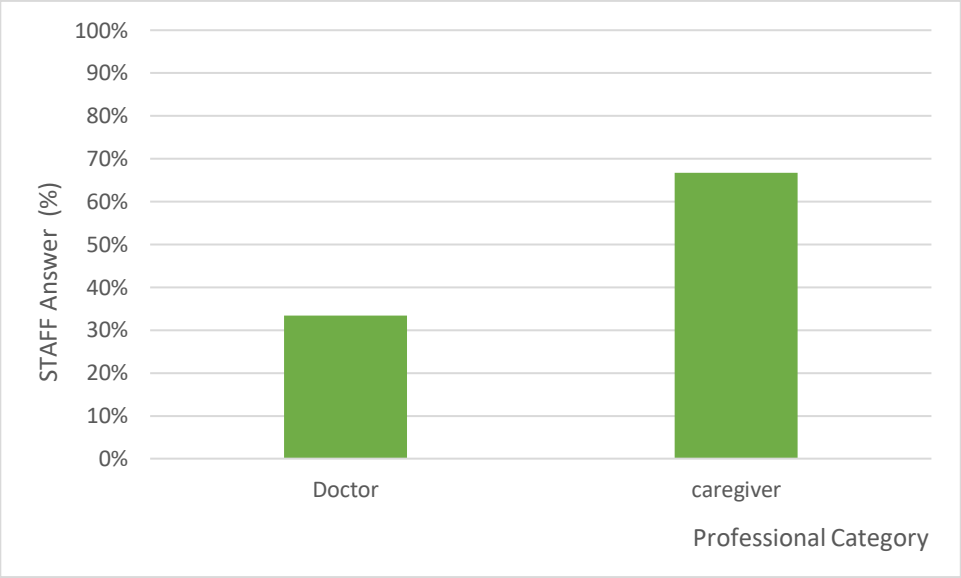

Figure 16. Distribution Represent the professional category interviewed.

12.2. Distribution of the medical staff according to years of service

According to Figure 17, we noticed that 17% of the medical staff are young with less than one year of experience. The category with 1 to 5 years of experience represents 33%, which is the highest percentage. While 23% have 5 to 10 years of experience, 27% have more than 10 years of experience.

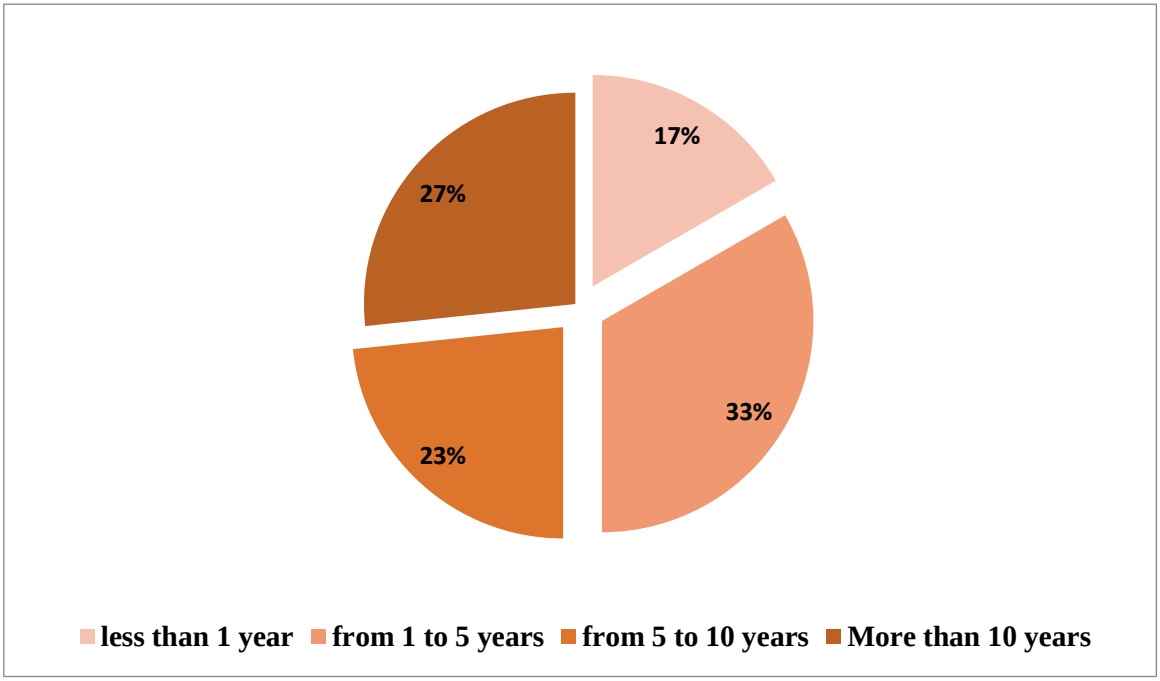

Figure 17. Distribution of the medical staff according to years of service.

12.3. The common types of nosocomial infections prevalent according to medical staff

According to figure 18, we can see that all (100%) of professional staff are familiar with the common types of Nosocomial infections prevalent in healthcare facilities.

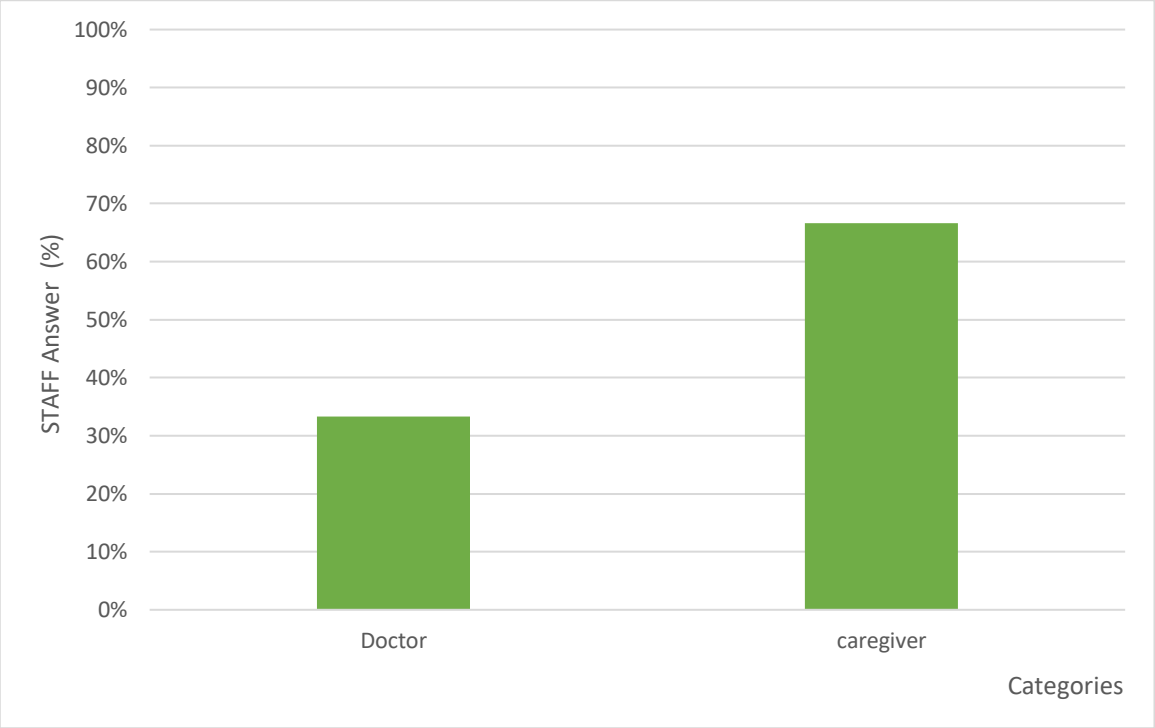

Figure 18. Distribution of data according to the common types of nosocomial infections prevalent according to medical staff.

12.4. Severity type of nosocomial infection according to medical staff

Figure 19 shows that all categories of medical staff know that NI has different degree of severity. So not all infection nosocomial have the same risk.

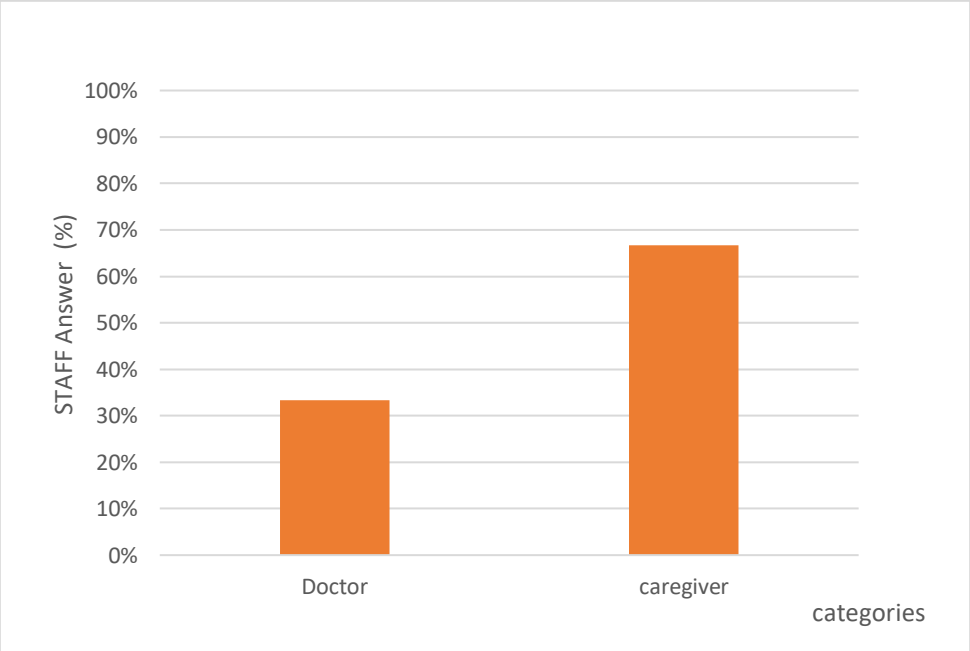

Figure 19. Distribution of Percentage of Severity type of nosocomial infection.

12.5. Main signs and symptoms of nosocomial infections according to medical staff

The symptoms and signs of NI are many and varied. They depend on the type of infection, its course, and the cause. However, the responses from medical staff were limited to a few and in varying proportions. Figure 20 shows that 29% of the symptoms of hospital infections affecting the patient are fever, 11% sweating, 14% tachycardia, 24% pus from the wound, and 11% diarrhea and shudder.

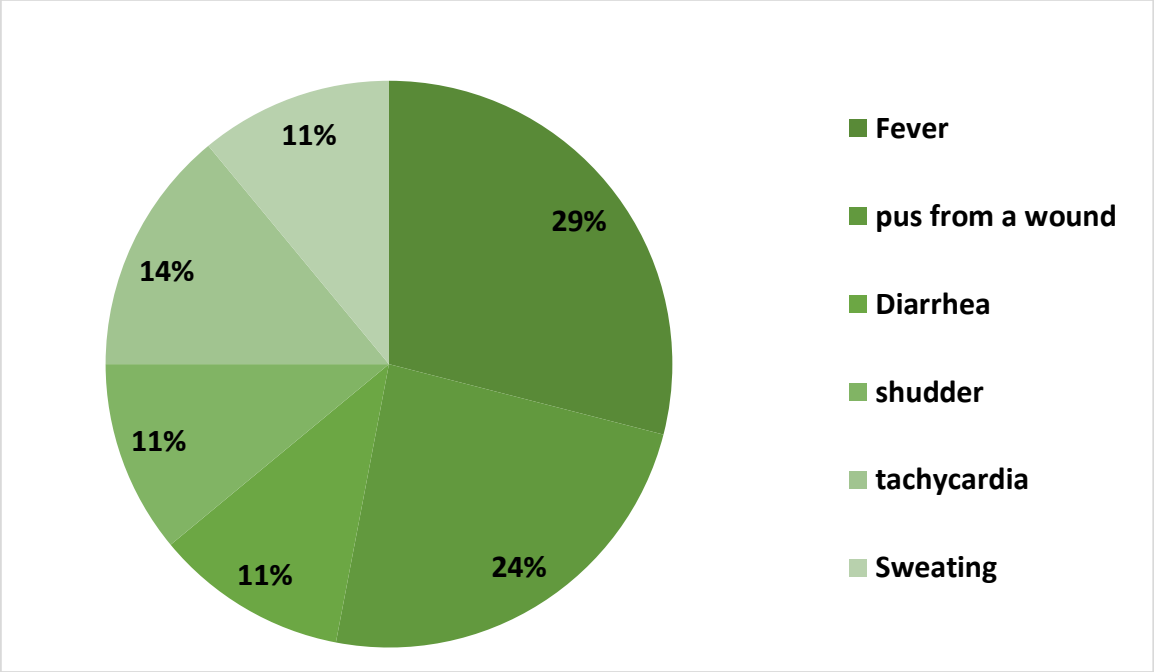

Figure 20. Distribution of Percentage of the main signs and symptoms of nosocomial infections.

12.6. The ability to identify potential sources of nosocomial infections in a hospital setting according to medical staff:

If you cannot determine the source, you cannot be avoided. Figure 21 shows that 50% from professional categories said No, they could not determine the source of nosocomial infection, while 17% said yes, and 33% Answered by Maybe we can.

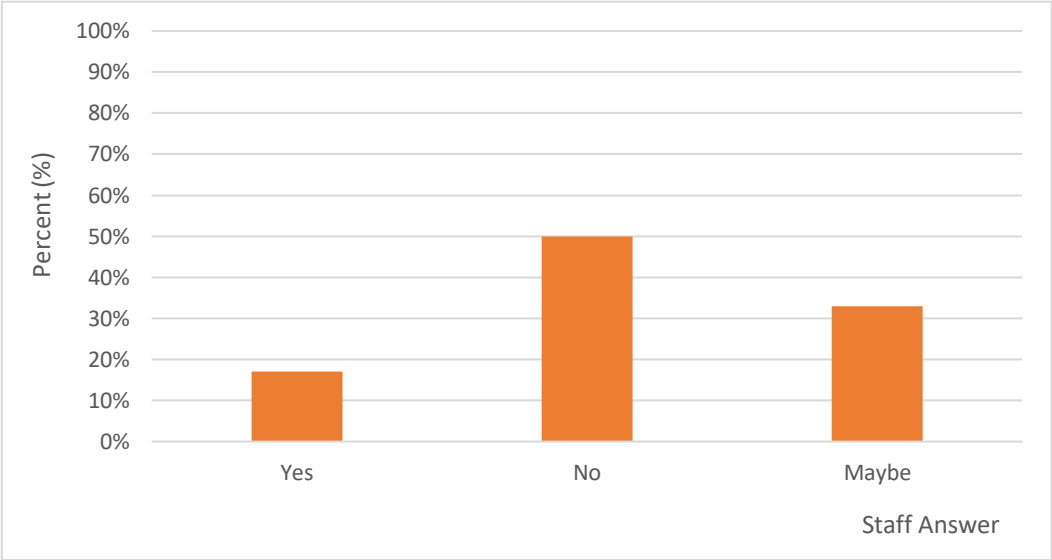

Figure 21. Distribution represents the ability to identify potential sources of nosocomial infections in a hospital setting.

12.7. The electronic portal for reporting serious health events:

Not all medical staff use any of the electronic portals for reporting serious health events, so there is a lack of hospital data.

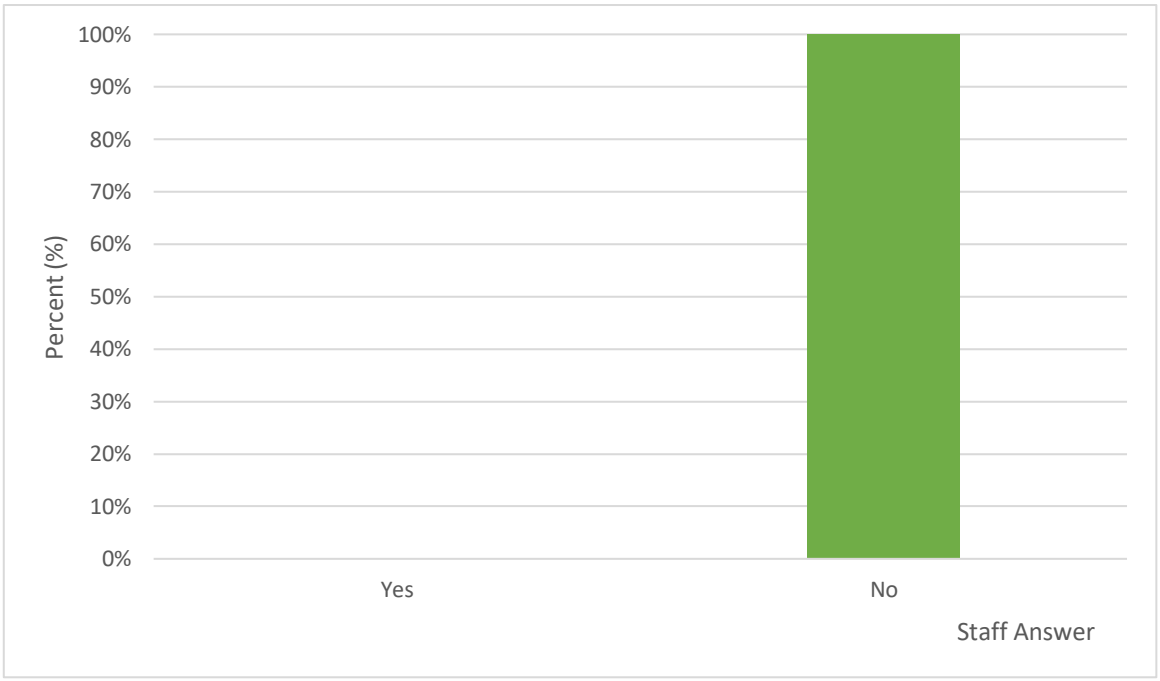

Figure 22. Distribution of Percentage of responses regarding the electronic portal for reporting serious health events.

12.8. The process for reporting suspected cases of Nosocomial infections to the competent authorities:

The data shown in figure 23 indicated that 80% of professional categories have proven that they know the mechanism for reporting suspected cases of infection to the competent authorities. While a small group does not know about the mechanism, it represents 20%.

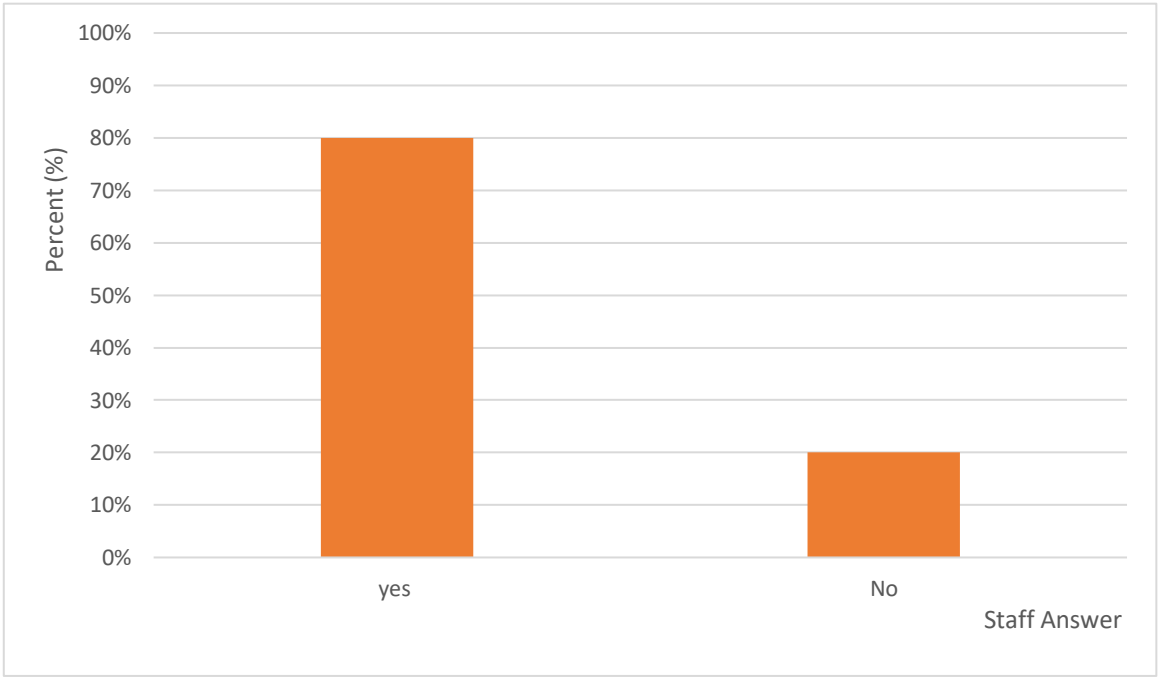

Figure 23. Distribution of percentage for the process for reporting suspected cases of Nosocomial infections to the competent authorities.

12.9. The need to improve detection and prevention of hospital infections:

77% of professional staff show the importance of improving nosocomial infection detection and prevention in our health organizations (Figure 24).

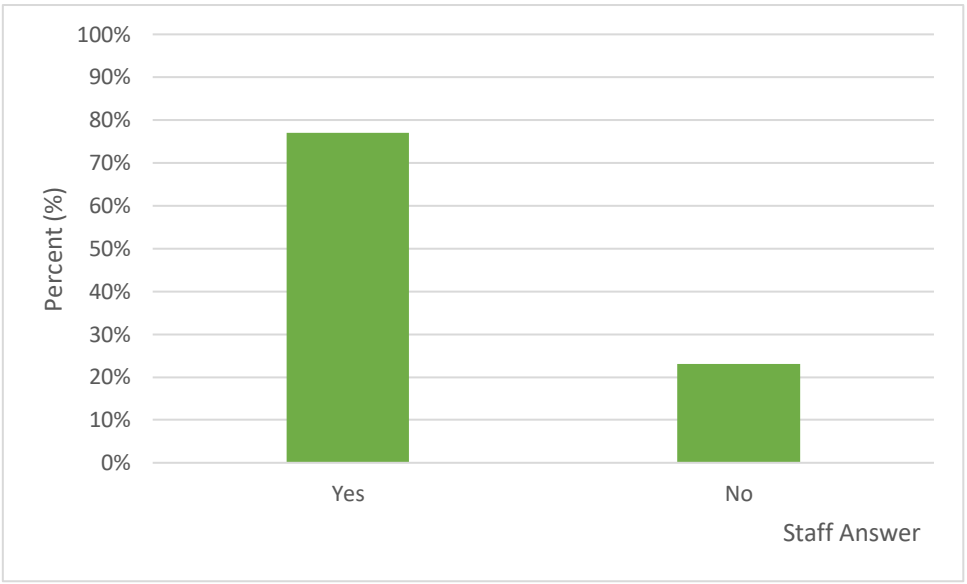

Figure 24. Distribution for Percentage of answers to the question of improvements that need to be made improve detection and prevention of hospital infections.

12.10. Potential risk factors for hospital infections when treating patients according to medical staff:

According to Figure 25, 40% of the professional groups believe that the main factor that increases the rate of hospital infections when treating patients is a weak immune system, 20% indicated surgical intervention, 20% the contaminated hospital environment, 8% the percentage of intravenous catheterization while 12% talking about urinary catheterization.

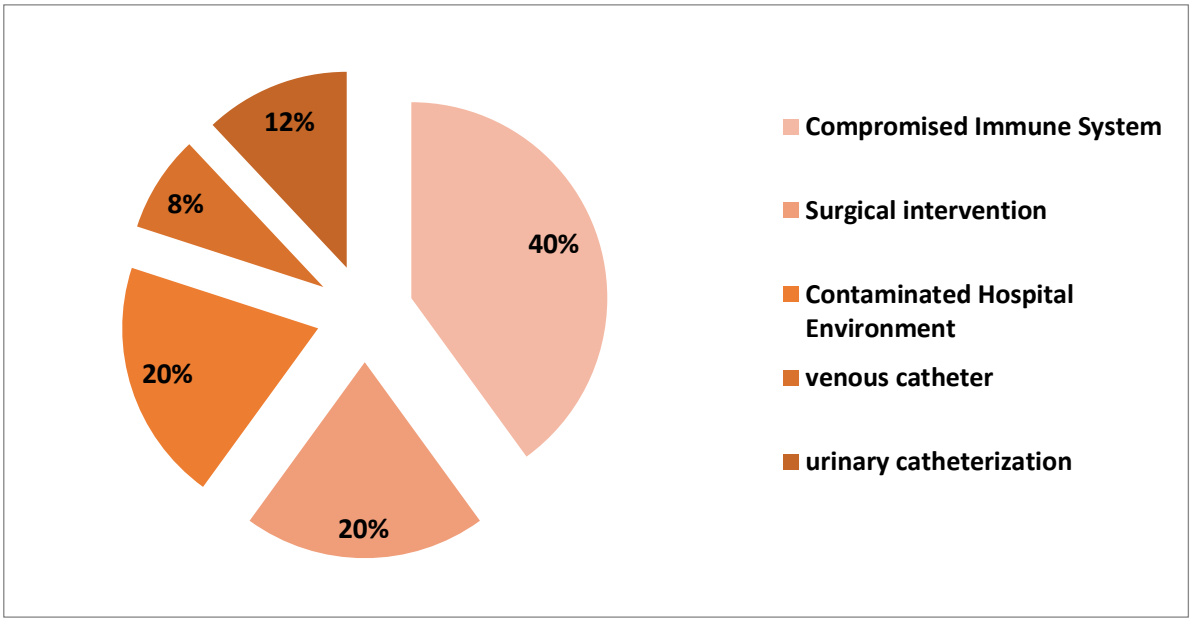

Figure 25. Distribution for Percentage of the potential risk factors for nosocomial infections when treating patients.

12.11. Received formal training on the identification and management of different types of nosocomial infections:

Training courses allow for improving performance in addition to updating information. However, through surveys we found that only 20% of professional category has received formal training on the identification and management of different types of nosocomial infections (Figure 26).

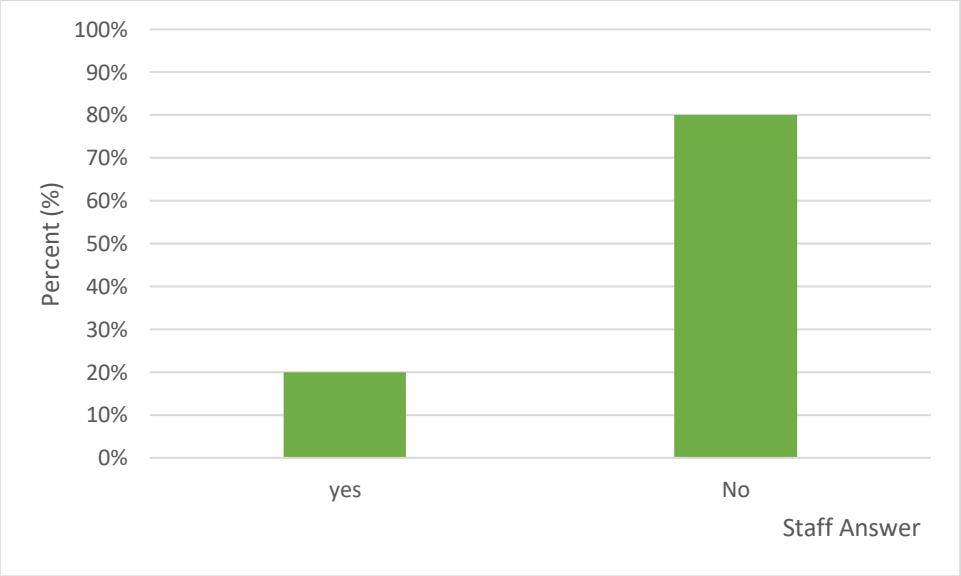

Figure 26. Distribution for Percentage for answered about received formal training on the identification and management of different types of nosocomial infections.

12.12. Medical staff following infection prevention guidelines.

Figure 27 shows that 53% of professional category do not follow infection prevention guidelines; on other hand 47% says yes, they follow infection prevention guidelines.

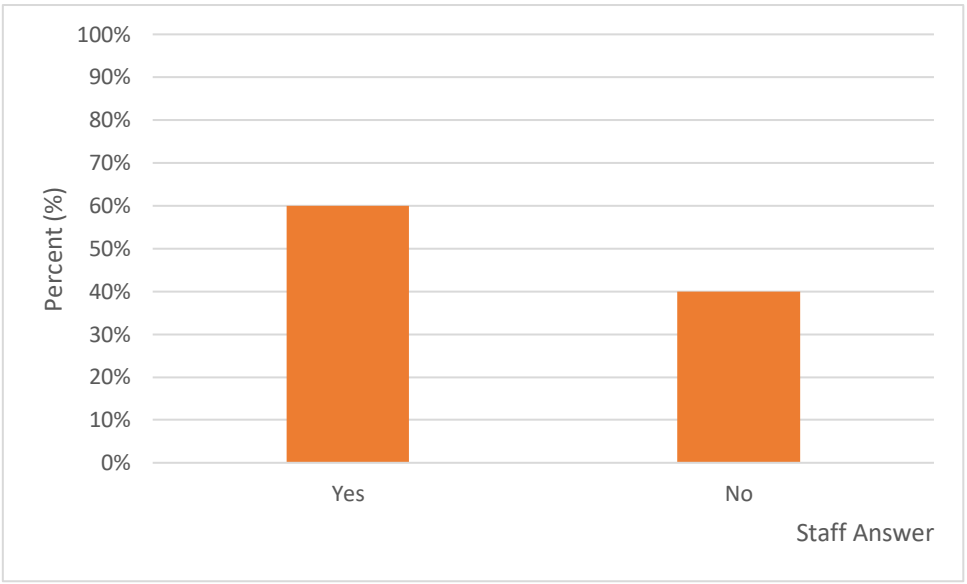

Figure 27. Distribution Represent Percentage of following infection prevention guidelines.

12.13. Wear gloves while performing medical tasks for patients

According to OMS, wearing gloves during therapeutic practices is one of the conditional prevention methods. However, 46% of the professional group do not wear gloves while working (Figure 28).

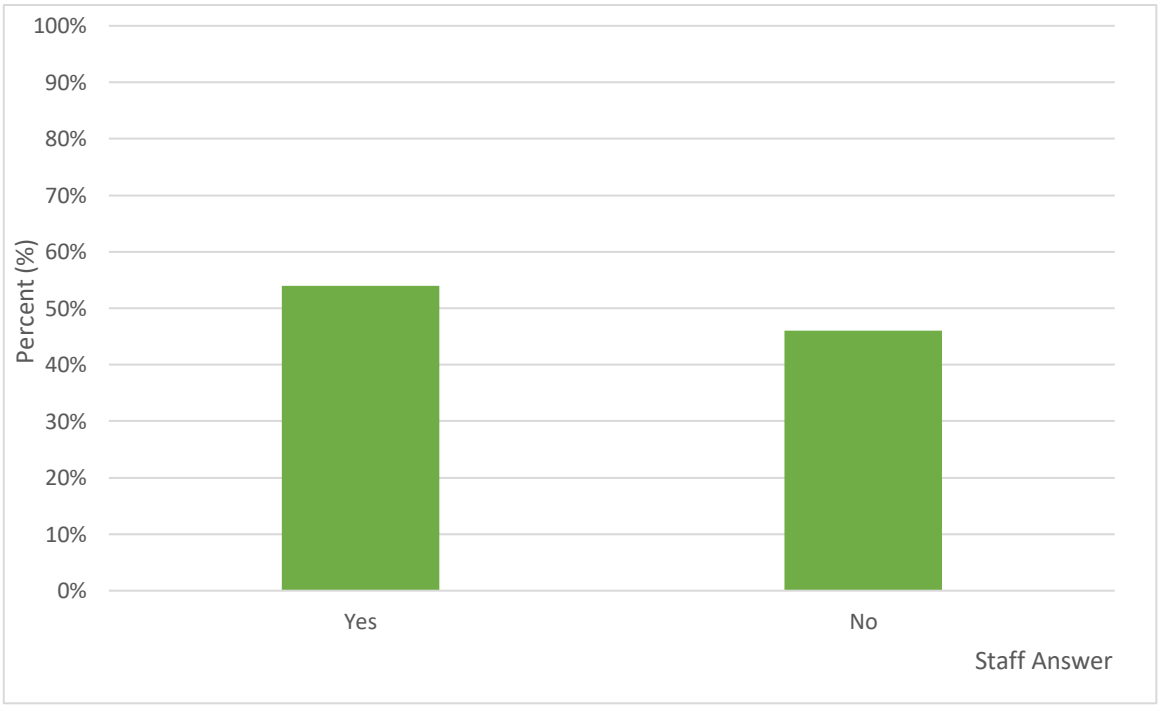

Figure 28. Distribution of Percentage of Wearing gloves during treatment.

12.14. Changing gloves between two patients

Of the 54 who wear gloves during their activity, 33% change their gloves when finishing a patient and moving on to another patient (Figure 29). However, the remaining 67% stated that they do not change gloves.

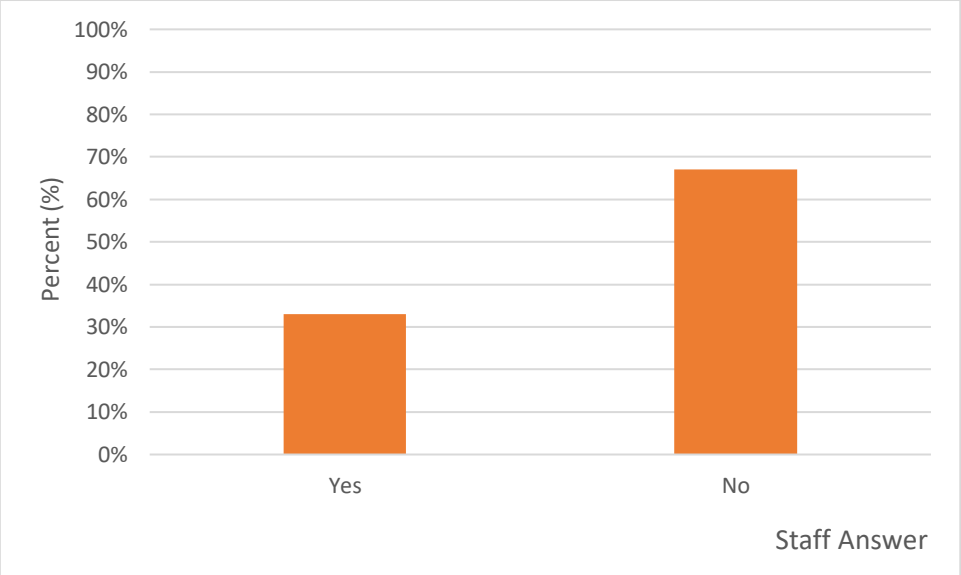

Figure 29. Distribution Percentage of changing gloves between two patients.

12.15. The importance for surveillance systems to detect and control nosocomial infections

According to Figure 30, all staff agreed on the importance of surveillance systems to detect and control nosocomial infections within our health institutions.

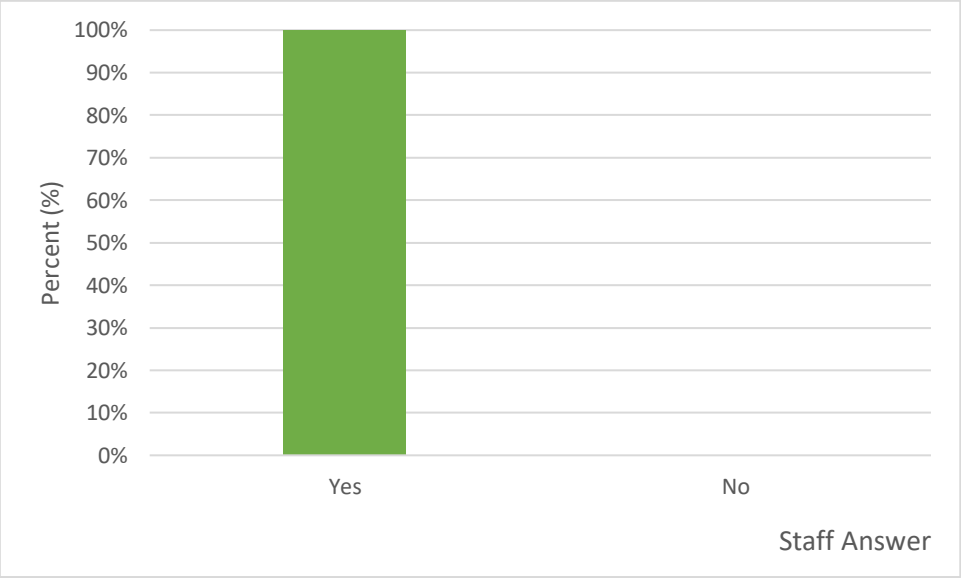

Figure 30. Distribution of Percentage of The Importance for surveillance systems to detect and control nosocomial infections.

12.16. Difficulties in following infection control protocols and guidelines:

All medical staff responded that there are major difficulties that limit their adherence to hospital infection control guidelines (Figure 31).

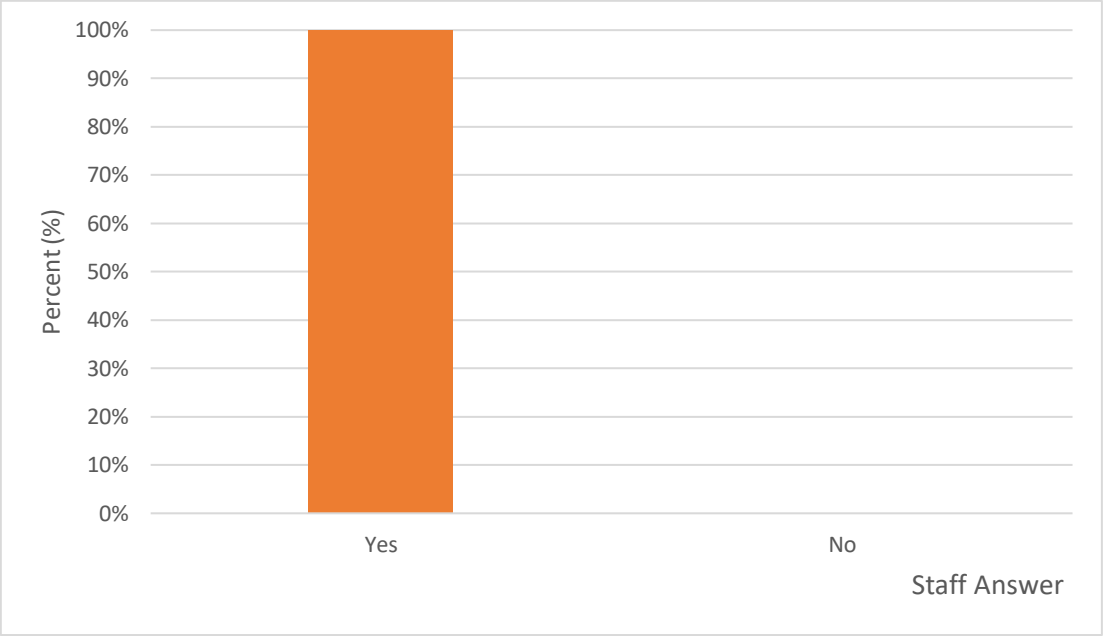

Figure 31. Distribution of percentage challenges or difficulties in following infection control protocols and guidelines.

DISCUSSION

Discussion

Postoperative wound infection or surgical site infection is the major complication following a surgical procedure, especially in hospital environments. Our study was conducted to assess the prevalence of nosocomial infections in hospitalized patients in the surgery department of EZAHRAOUI Hospital in M'sila. To achieve this objective, a retrospective descriptive study was conducted in the aforementioned department from January 2023 to April 2024, on based to patient's files. After that, with a survey (prospective study), we evaluated the role of medical staff in the NI episodes in this hospital.

The files of patients did not mention the duration of the operation and the subsequent evolution of the patients, as well as the unavailability of all anamnestic, clinical, and paraclinical elements in the records of certain patients, making it complex to establish data for statistically powerful correlations or to study risk factors.

Out of all hospitalized patients (5396) from January 2023 to April 2024 in the general surgery department of EZAHRAOUI, 46 patients had been hospitalized for more than 48 hours. During data collection, we noted that elderly individuals were most affected by nosocomial infection. Several factors may contribute to this predisposition where the leading cause is the aging process to physiological changes that can weaken the immune system [39].

Additionally, elderly individuals have comorbidities such as diabetes, high blood pressure, or heart diseases, which can also weaken their immune system and increase the risk of postoperative infections [40]. Moreover, underlying medical conditions may require more complex surgical interventions, increasing the infection risk. Elderly individuals have decreased muscle mass, weight loss, and prolonged recovery can lead to extended immobilization. It is important to emphasize that adequate preventive measures can reduce the risk of postoperative infections in elderly individuals [41].

Data analysis reveals a Men trend regarding the sex of individuals most affected by these infections [42]**.** This is dissimilar to our results; it was found that women were more likely to be infected than men during this period.

The analysis of data collected on patients who contracted an infection during this period reveals that acute appendicitis interventions are most often associated with postoperative infections, according to data from Taiwan's National Health Insurance Research Database; sepsis risk was considerably higher in patients who had an appendectomy. However, it has recently been recognized that the appendix plays a crucial role in the growth and maintenance of the gut immune

system, rather than just being a vestige of the digestive system [43]. This observation highlights the importance of monitoring and preventing these complications in these specific types of surgical interventions. Postoperative infections are a common concern. Appropriate preventive measures, such as the use of prophylactic antibiotics, strict surgical hygiene, and proper management of drains and catheters, should be implemented to minimize the risk of infection [44].

Our data shows that the patients who had hospitalization duration between 2 and 15 days had the highest NI rate. Still, Cavanillas mentioned that 45 infections per 100 patients who underwent surgery at the University Hospital of Granada had a length stay of 32.3 days [45]. Thus, the long hospitalization is a predisposing factor for NI. Moreover, some studies mentioned that cutaneous microbial flora changes as early as the 3rd and 4th days of hospitalization. So the risk of NI increases from 0.5% to 3% for all patients in surgery deportment, this risk is associated with lengthier hospital stay [46].

We were observed that the majority of pus samples were positive due to the infected surgical wounds. The predominant bacteria in our study are *S. aureus* (35 %) and *E. coli* (30 %), in 65% of the samples taken. However, the literature describes a predominance of Gram-positive bacteria, notably *S. aureus* [47], followed by *P. aeruginosa*, and Enterobacter (25%). *Acinetobacter baumannii* and *Klebsiella pneumoniae* are in the third position with low proportions. These microorganisms mentioned in a clinical microbiology review as the most frequently isolated pathogens in NI [48].

Prophylactic antibiotics ought to be effective against the most likely pathogen and have appropriate tissue penetration. Antibiotics can be administered enterally, systemically, or topically. They should be involved in the selection of pathogenic organisms and exhibit low toxicity and allergy incidence [49]. So Prophylactic antibiotics were present in all hospitalized patients. This result is almost equal to that found in the study conducted by Dali Ali at the Hospital and University Establishment of Oran EHUO, where it was equal to 97.7% [50].

Vitamins and proteins were used in 3% of patients. Regardless of the vitamin's form, the study found no statistically significant correlation between sepsis risk and vitamins [51]. Proteins like Albumin, a crucial plasma protein, is effective in managing fluid imbalance, circulatory dysfunction, and inflammation-related complications. However, its use in sepsis presents contrasting effects and remains controversial [52].

The first line of defense for implementing routine infection control procedures to stop infections and the spread of pathogens to other patients is clinical care personnel and other healthcare professionals. They are also in charge of controlling and preventing nosocomial infections [53]. Through the questionnaire, we note that 40 % of the medical staff answered

Immunodeficiency in patients is potential factor of hospital infections, Many hospitalized patients are immune compromised and therefore at high risk of infection, even by microorganisms with low pathogenicity [54]. 20% said surgical intervention while others showed that 20% contaminated the hospital environment, and forgot their role.

Wearing gloves and changing gloves, it is necessary during any contact with a biological fluid (blood, urine… etc.) to prevent the risk of infection and to protect healthcare personnel. They must be changed between each patient and between each treatment [55]. However, more than 45 % did not use it or change it between patients.

80% of the medical staff have not received training on hospital infections, which affects the quality of health care and leads to a lack of knowledge among the medical staff. while training courses for medical staff are needed, as they are very useful and effective to improve infection control in hospitals [56]. Among the problems observed in the study were few training opportunities among the hospital staff, shortage of infection control staff, shortage of doctors and nurses and their overload in daily medical practice, shortage of fundamental equipment including PPE, and low awareness regarding nosocomial infection control [57].

Finally, through the questionnaire that we submitted to the medical staff and the results obtained, we noticed that the majority do not apply the protection rules to combat hospital infections and do not give importance to this infection.

CONCLUSION

&

PERSPECTIVES

Conclusion

Nosocomial Infections are a real public health problem and have a high rate of mortality and morbidity. Despite the lack of information and lack of disclosure on hospital infections, finding that the prevalence rate between January 2023 and April 2024 in the surgical department alone was 3% is considered serious. These results call for quick and effective measures.

The occurrence of nosocomial infections in Al-Zahraoui Hospital was linked to several factors: such as the age, weak hospital capabilities, the presence of wounds, poor medical staff supervision, in addition to the spread of highly resistant organisms such as *E. coli*, *K. pneumonia*, and *S.aureus.*

Diagnosing these infections relies on clinical, radiological, biological, and microbiological factors. However, the first three factors are not very sensitive or specific, and microbiological testing is both time-consuming and demanding. Pinpointing the pathogen causing the infection typically requires more than 2 to 5 days, with defining the antibiotic resistance profile taking even longer.

Infection control in hospitals is critical in providing high-quality medical care. Therefore, to control infections, several solutions and improvements must be followed:

- Rationalizing the consumption of antibiotics, especially in hospitals, to prevent the emergence of more resistant bacteria, as well as trying to find alternatives to them
- More efforts should be focused on training medical staff
- Good writing of patient information is very useful, whether in following up on the patient's condition or in statistical studies to develop useful preventive plans
- Increase the number of medical staff, in addition to awareness of patients.
- Sterilization of medical equipment, and respect standard hygiene precautions.
- Wearing and changing gloves from patient to patient, and good practice in patients care.

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ANNEXES

Annexes

Annexes 01: Questionnaire form used in data collection

REPUBLIQUE ALGERIENNE DEMOCRATIQUE ET POPULAIRE

MINISTERE DE L'ENSEIGNEMENT SUPERIEUR ET DE LA RECHERCHE SCIENTIFIQUE

UNIVERSITE MOHAMED BOUDIAF - M'SILA

FACULTE DES SCIENCES

DEPARTEMENT DE MICROBIOLOGIE & BIOCHIMIE

Objectif :

Ces questions visent à évaluer les connaissances, la sensibilisation et les pratiques du personnel médical concernant les infections nosocomiales, fournissant des informations précieuses pour améliorer les mesures de contrôle des infections

Questionnaire destiné au personnel médical

1- A quelle catégorie professionnelle appartenez-vous :

- Médecin ☐
- Soignant ☐

2- Quelle est votre ancienneté :

- Dans votre profession :

Moins de 1 an ☐ De 1à 5 ans ☐ De 5 à 10 ans ☐ plus de 10 ans ☐

- Dans le service :

Moins de 1 an ☐ De 1à 5 ans ☐ De 5 à 10 ans ☐ plus de 10 ans ☐

3- Connaissez-vous les types courants d'infections nosocomiales répandues dans notre établissement de santé ?

Oui ☐ Non ☐

4- Selon-vous tous les infections nosocomiales ont-elles la même gravité ?

Oui ☐ Non ☐

5- Pouvez-vous identifier les principaux signes et symptômes des infections nosocomiales chez les patients ?

Oui ☐ Non ☐

Lesquelles ?.....

6- Avez-vous confiance en votre capacité à reconnaître les sources potentielles d'infections nosocomiales en milieu hospitalier ?

Oui ☐ Non ☐ peut être ☐

7- Avez-vous reçu une formation adéquate sur les protocoles et procédures de contrôle les infections nosocomiales?

Oui ☐ Non ☐

8- Connaissez-vous sur internet le portail de déclaration des évènements sanitaires indésirables graves (dont les infections associées aux soins)?

Oui ☐ Non ☐

Lesquelles ?.....

9- Connaissez-vous le processus de déclaration des cas suspects d'infections nosocomiales aux autorités compétentes ?

Oui ☐ Non ☐

10- Selon vous, ya-t-il des améliorations à apporter pour améliorer la détection et la prévention des infections nosocomiales dans nos établissements de santé ?

Oui ☐ Non ☐

11- Quels sont les facteurs de risque potentiels d'infections nosocomiales lors de la prise en charge des patients ?

.....

12- Avez-vous reçu une formation formelle sur l'identification et la prise en charge des différents types d'infections nosocomiales ?

Oui ☐ Non ☐

13- Respectez-vous les directives de prévention des infections, telles que le port d'un équipement de protection individuelle (EPI) ?

Oui ☐ Non ☐

14- portez –vous des gants lors des soins ?

Oui ☐ Non ☐

15- Changez-vous de gants entre deux patients ?

Oui ☐ Non ☐

16- Selon votre expérience si il'ya une importance des systèmes de surveillance pour détecter et contrôler les infections nosocomiales au sein de nos établissements de santé ?

Oui ☐ Non ☐

17- Avez-vous rencontré des défis ou les difficultés pour respecter les protocoles et les directives de contrôle des infections ?

Oui ☐ Non ☐

Lesquelles ?.....

……

18- Dans les traitements empiriques des IN comment vous distinguer entre les infections causes par bactéries gram négatives ou positives pour choisir l'antibiotique ?

(Question pour les médecins)

……

Annexes 02: Questionnaire form used in data collection

REPUBLIQUE ALGERIENNE DEMOCRATIQUE ET POPULAIRE

MINISTERE DE L'ENSEIGNEMENT SUPERIEUR ET DE LA RECHERCHE SCIENTIFIQUE

UNIVERSITE MOHAMED BOUDIAF - M'SILA

FACULTE DES SCIENCES

DEPARTEMENT DE MICROBIOLOGIE & BIOCHIMIE

Fiche d'enquête **Profil épidémiologique des infections nosocomiales**		
Sexe	Femme ☐ Homme ☐ Enfant ☐	
Age		
Service d'hospitalisation		
Date d'hospitalisation		
Date de sortie		
Type d'infection nosocomial		
Mode de contamination	Sonde urinaire ☐ intervention churigical ☐ Cathéter périphérique ☐ Central ☐ Drain ☐ Sonde nasogastrique ☐ ventilation ☐	
Motif d'hospitalisation		
Type de Bactérie	Positive ☐ Négative ☐	
Type de prélévement	Hémoculture ☐ ECBU ☐ Ecouvillonnage ☐	

Bilan biologique	CRP				
	VS				
	FNS				

Le patient a-t-il subi des radiographies pendant le période d'hospitalisation ? Oui ☐ Non ☐

Les signes d'infection nosocomial	Avant 48h			
	Après 48h			
Site 1	**Type**	**Date**	**Culture**	**Microorganisme En Cause**
Prélevements				
Méthodes pour identification la bactérie	☐ Méthode classique : ☐ Méthode moderne :			
Antibiogramme				
	Avant 48h		**Après 48h**	

Traitement **De patient**		
Evolution	Transfert ☐ guérison ☐ Décès ☐	