

Safety risk for patient due to nosocomial infection

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Abstract

The safety of both patients and healthcare workers has long been one of the most serious problem in healthcare worldwide. According to the World Health Organization (WHO), many patients suffer permanent damage to their health or death as a result of malpractice in the delivery of healthcare. The safe and quality delivery of health care is key to ensuring that errors and mistakes in patient care do not occur in the health sector. Lack of patient safety is a serious public health problem as well as a heavy burden on limited financial resources in the health sector. One of the most serious adverse events is the acquisition of a hospital-acquired infection during a patient's hospitalisation in a healthcare facility. Evidence of it points to malpractice by health care personnel in following the principles of barrier nursing care.

Key words: risk, patient, infection, safety.

Introduction

Nosocomial infections

Nosocomial or healthcare associated infections are infections that a patient has acquired in connection with his or her exposure to a healthcare facility. According to the WHO, a nosocomial infection is defined as an infection acquired in hospital by a patient who has been admitted for a reason other than that infection occurring in the patient's hospital or other health care facility where the infection was not present at the time of admission. The term also includes illness occurring after discharge, including both occupational infections in facility staff (WHO,2017). In terms of timing, these are infections that occurred more than 48-72 hours after admission to the facility, or within 48 hours of discharge, or the infection was present at the time of admission to the facility, but there is an epidemiological link to a previous hospitalization. Consequently, it is important to determine the site of transmission of infection, rather than the site where the infection was detected, to determine the definition of nosocomial infection.

Results

Infections acquired in healthcare settings are a major cause of death and increased morbidity among hospitalised patients. They are a significant burden to the patient, seriously complicating the course of the original illness. However, nosocomial infections are not only a medical problem, but also an economic one, as they prolong the hospital stay of the patient and thus the cost of treatment and delay the employment of the affected patient.

Responsible pathogens originate from a variety of different sources and are represented by different types of healthcare associated infections. The Centers for Disease Control and Prevention broadly categorizes the types of HAI as follows:

1. Central line-associated bloodstream infections
2. Catheter-associated urinary tract infections
3. Surgical site infections
4. Ventilator-associated pneumonia

Other types of HAI include non-ventilator-associated hospital-acquired pneumonia (NV-HAP), gastrointestinal infections (including *Clostridioides difficile*), other primary bloodstream infections – not associated with central catheter use, and other urinary tract infections—not associated with catheter use. HAI may also be grouped by affected systems such as ear, eye, nose and throat infections, lower respiratory tract infections (including bronchitis, tracheobronchitis, bronchiolitis, tracheitis, lung abscess or empyema without evidence of pneumonia), skin and soft-tissue infections, cardiovascular infection, bone and joint infections, central nervous systems infection, and reproductive tract infections. (Sikora,2023)

History of healthcare associated infections

The history of nosocomial infections is generally closely linked to the history of surgical interventions. The earliest evidence of surgical interventions dates back to around 4600 BC, when the most common method of keeping instruments clean was to heat them over a fire and stop bleeding from wounds by applying a hot iron (Duinova, 1997). In the 18th century, the field of surgery developed significantly. Hospitals at that time were filthy, rodent infested and unmaintained due to lack of information about the possibility of wound infection, the possibility of hospital infection. Patients were dying from trivial infections. Surgeries performed in hospitals were five times more likely to develop complications than surgeries performed in patients' private homes. From the 19th century onwards, active efforts began to take shape to minimize infections arising in medical facilities. One of the most historically important personalities "fathered" the prevention of nosocomial infections was Ignaz F. Semmelweis. It was he who had the theory that infections are transmitted by the doctors themselves when they pass between the autopsy room, between patients and other wards without washing their hands in the meantime. He achieved a drastic reduction in the incidence of infections by introducing compulsory handwashing of medical staff with choler lime (Nield,2020). Louis Pasteur later proposed three methods to combat pathogens: filtration, high temperature sterilisation or destruction by chemicals. A very important milestone in the history of nosocomial infections was undoubtedly the discovery of antibiotics, which brought completely new possibilities for treatment and prevention of possible complications. In 1941, the antibiotic penicillin was used for the first time. With the discovery of penicillin, most experts believed that the problem of hospital-acquired infections had been solved. However, the modern history of medicine has seen struggles with the problem of inappropriate and excessive use of antibiotics and thus the emergence of the dreaded microorganisms resistant to almost all antibiotics i.e. multidrug resistant microorganisms. They pose a life threatening risk to the patient, their treatment may not be successful and in the most serious cases may cause death of the patient. Thus, the risk of nosocomial infections is not reduced but increased (Cavaillon,2019).

Incidence of hospital-acquired infections

Nosocomial infections occur worldwide and affect patients in both developed and poor countries of the world. A WHO-sponsored survey of their prevalence in 55 hospitals from 14 countries showed that an average of 8.7% of hospital patients had nosocomial infections, and that at any one time more than 1.4 million people worldwide suffer from nosocomial infectious complications. Hospital-acquired infections are subject to mandatory reporting from every healthcare facility in the European Union. An international network of European national surveillance systems, EARSS, has been established. Its main task is to collect comparable and valid data on the occurrence of hospital-acquired infections, serious resistant micro-organisms and thus rapidly detect the emergence of new resistances.

Etiology of hospital-acquired infections

The causative infectious agent is introduced into the hospital by the patients themselves, by visitors as well as by the attending staff. Infections can be caused by a microorganism acquired from another person in the hospital (cross-infection, exogenous infection) or can be caused by the patient's

own flora (endogenous infection). Some organisms may be acquired from an inanimate object or substances recently contaminated from another human source (environmental infection) (Gulasova)

Transmission of the infectious agent from the source of infection to the patient may be direct or indirect. Direct transmission occurs by contact such as touch, kiss, sexual intercourse, droplet infection when sniffing, coughing, talking. Indirect transmission is characterized by the absence of a source of infection when the infectious agent is transmitted to a susceptible organism. The possibility of this transmission depends on the ability of the microorganism to survive for a sufficiently long period of time outside the host body and on the existence of a suitable means (vehicle) with the help of which transmission to a susceptible individual takes place (Hungary,2020).

Indirect transmission can be mediated:

- contaminated objects and diagnostic treatment devices, contaminated biological products and drugs,

- contaminated linen

- contaminated air, either in the form of droplets or dust particles,

- contaminated food, water

- biological vectors such as flies, mosquitoes, ants (Schwartz, 1994).

An individual's level of susceptibility is influenced by a number of factors; not every patient who is exposed to an infectious agent will necessarily become ill. Risk factors include virulence, toxicity, and gateway of infection. Internal and external factors also contribute to an individual's susceptibility. Internal factors include age (under 3 years, over 65 years), lifestyle, hormonal disorders, immunodeficiency, nutritional status, circulatory disorders, polytrauma, burns, malignancy, and others. External factors include treatment and diagnostic methods, immunosuppression, length of hospitalization, transfusions, implementation of surgery and others (Šrámová, 2013).

Most common pathogens responsible for nosocomial infections (Sikora 2023)

Gram-positive organisms	coagulase-negative <i>Staphylococci</i> , <i>Staphylococcus aureus</i> , <i>Streptococcus</i> species, and <i>Enterococcus</i> species (e.g. <i>faecalis</i> , <i>faecium</i>), <i>C.difficile</i>
Gram-negative organisms	<i>Enterobacteriaceae</i> family, including <i>Klebsiella pneumoniae</i> and <i>Klebsiella oxytoca</i> , <i>Escherichia coli</i> , <i>Proteus mirabilis</i> , and <i>Enterobacter</i> species; <i>Pseudomonas aeruginosa</i> , <i>Acinetobacter baumannii</i> , <i>Burkholderia cepacia</i>
Multidrug-resistant bacteria	<i>Staphylococcus aureus</i> (MRSA), Vancomycin-intermediate <i>Staphylococcus aureus</i> (VISA) and Vancomycin-resistant <i>Staphylococcus aureus</i> (VRSA), <i>Enterobacteriaceae</i> with extended-spectrum cephalosporin resistance consistent with extended-spectrum beta-lactamase (ESBL) production, vancomycin-resistant <i>Enterococcus</i> (VRE), carbapenem-resistant <i>Enterobacteriaceae</i> and <i>Acinetobacter</i> species, multi-drug resistant <i>Pseudomonas aeruginosa</i>
viruses	hepatitis B, hepatitis C, human deficiency virus (HIV) rhinovirus, cytomegalovirus, herpes simplex virus, rotavirus, influenza.

Prevention of hospital-acquired infection

Barrier nursing care is most important in preventing the spread of nosocomial infections The essential elements of barrier nursing include barrier isolation and barrier technique (Kilikova,2020). A barrier isolation regimen is a material, technical and isolation provision to prevent the spread of

nosocomial infection. The aim is to prevent the spread of infection among other patients and staff. It includes marking the site of infection, isolation of the patient from others, minimizing access to the room, prohibition of patient movement outside the room, , restriction or prohibition of visits, use of protective disposable equipment and its disposal, use of adequate disinfectants, hand disinfection, etc. Barrier technique is a complex of diagnostic, therapeutic and nursing aseptic procedures that are carried out in the process of patient care and prevent the process of transmission of micro-organisms from the infected patient to the environment. An essential part of the barrier nursing technique is the observance of aseptic procedures during dressings, insertion and treatment of venous cannulas and urinary catheters, administration of infusion therapy, care of decubitus and open wounds (Šrámová,2013). The basis of barrier nursing technique is hand hygiene and disinfection, use of disposable gloves or other personal protective equipment.

Cleanliness of hands

The level of microbial hand cleanliness is a collective issue in a healthcare facility and all members of the work team should be concerned with maintaining and improving the quality of hand cleanliness. Good hand hygiene is one of the easiest ways to prevent nosocomial infections. In healthcare facilities, compliance with hand hygiene and disinfection is poor. Hence, it was necessary to develop a global initiative for adherence to hand hygiene and disinfection principles by health care workers to reduce the incidence of nosocomial infections. The 'Save Lives: Clean Your Hands' campaign aims to educate healthcare workers on how to properly wash and disinfect their hands using alcohol-based hand sanitizers

The World Health Organization has identified five moments in which hand hygiene should always be practiced:

1. Before touching a patient
2. Before any clean or aseptic procedure
3. After exposure to body fluid
4. After touching a patient
5. After touching patient surroundings

Protective personal equipment

Protective personal equipment such as disposable gloves, gowns and disposable gowns must be used when treating infected patients. The protective gown must cover the entire torso from the neck to the knees, around the back, and the hands must be covered up to the wrists. The protective jacket is an essential aid in all isolation measures. Particularly in patients with contact-transmitted infection, the gown must be worn during all interactions with the patient and whenever the worker is in contact with the patient's environment.

Protective gloves are made from a variety of materials, latex, vinyl and nitrile. The gloves must fit the size of the hands and cover the wrists so that they extend over the sleeve portion of the gown. Due to frequent allergic reactions to latex, vinyl and nitrile are alternatives. Vinyl is suitable for short-term patient care, while nitrile provides better barrier protection for long-term care

Masks and respirators can provide different levels of protection depending on the type of mask and how it is used. Loosely woven cloth products provide the least protection, layered finely woven products provide more protection, well-fitting disposable surgical masks provide even more protection, and well-fitting approved respirators provide the highest level of protection.

Disposable masks are commonly available. They are sometimes referred to as surgical masks or medical masks. A surgical mask is a loose-fitting, disposable device that creates a physical barrier between the wearer's mouth and nose and potential contaminants in the immediate environment It works on the principle of blocking droplets of large particles that may contain germs (viruses and bacteria) and preventing them from reaching the wearer as well as the patient. It traps by means of a filter layer the coughed or sneezed infectious "microdroplets" so that they are not passed on to the surroundings, the drape mainly protects the surroundings from the sick person, but this protection

works only to a certain extent in reverse as well. Surgical masks are not designed for more than one use. a common problem with drapes is that they do not seal well on the face and air from the surroundings easily gets through the resulting gaps directly into the airways.

A respirator filters the air we breathe in and effectively traps harmful substances (dust, smoke, aerosol) from entering our respiratory system. All respirators sold in the EU must comply with EN 149:2001 + A1:2009, which guarantees their filtering capacity. This is expressed as FFP1, FFP2 or FFP3, with FFP3 providing the highest protection.

Conclusions

Modern healthcare facilities not only provide the patient with quality medical treatment, but also ensure a safe environment so that the patient is not inadvertently exposed to the risk of harm to health and life. The greatest threat is infection with a hospital-acquired infection, which is usually resistant to conventional treatment. Therefore, hospitals as organisations, but also individual healthcare professionals, should make every effort to prevent the spread of these infections.

References

- Cavaillon, J. M., Chretien, F. 2019. From septicemia to sepsis 3.0—from Ignaz Semmelweis to Louis Pasteur. *Microbes and Infection*, 21(5-6), 213-221.
- Duinová, N., Sutgliffová, J. 1997. *Historie medicíny od pravěku do roku 2020*. 1. Vydání. Praha: Slovart, 1997. ISBN 80-85871-04-1.
- Gulášová, I., Breza, J., Riedl, I., bačíková, Z.: *Najčastejšie príčiny nozokomiálnych nákaz v zdravotníckych zariadeniach*. Available from : <https://www.pulib.sk/web/kniznica/elpub/dokument/Istonova2/subor/gulasova3.pdf>
- Kilíková, M. et al. 2020. *Bezpečnosť pacienta – ukazovateľ kvality zdravotnej starostlivosti*. Příbram: Ústav sv. Jana Nepomuka Neumanna Příbram ,2020. 159s. ISBN 978-80-88206-18-7
- Maďar, R., Štefkovičová, Moscow. 2004. *Nemocničné infekcie*. Bratislava: Agentúra DUMAS, 2004. 158 s. ISBN 80-968999-1-0.
- Nield, H. 2020. A short history of infection control in dentistry. *Bdj Team*, 7(8), 12-15.
- Sikora A, Zahra F. 2023. Nosocomial Infections. In: *StatPearls* [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 Jan. Available from : <https://www.ncbi.nlm.nih.gov/books/NBK559312/>
- Swartz, M. N. Hospital-acquired infections: diseases with increasingly limited therapies. *Proceedings of the National Academy of Sciences*, 1994, 91.7: 2420-2427.
- Šrámová, H. et al. 2013. *Nozokomiální nákazy*. Praha : Maxdorf s.r.o., 2013. 400 s. ISBN 978-80-7345-286-5
- World Health Organization. 2017. Patient safety: making health care safer. World Health Organization. Available from : <https://apps.who.int/iris/handle/10665/255507>