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# Knowledge About the Nosocomial Infection, Their Control and Prevention Procedures Followed at Matrisadan Complex UPHC 04 Rajpur-Sonarpur Municipality, Kolkata, West Bengal

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***Abstract***

*In this research work, a detailed study about Nosocomial infection has been done. Different Nosocomial infections have been discussed and a detailed study about prevention of Nosocomial infection has been done in one of the government healthcare facilities, named as UPHC 4 Rathtola Matrisadan, Rajpur-Sonarpur Municipality, Kolkata-700150. The study aims to highlight effective prevention strategies and measures implemented at this facility to control the spread of infections within the healthcare environment. The findings underscore the importance of stringent infection control practices in reducing hospital-acquired infections. Method: The aforementioned healthcare facility was visited, and an interactive session was held with their staff regarding their methods for controlling nosocomial infections. During the visit, the facility's registers and patient inflow and outflow methods were observed, providing valuable insights into their infection control practices. Conclusion: After a vivid analysis, a clear idea about Nosocomial infection has been made, and it has been observed that this Nosocomial infection is mainly a Man Made Error for which the main sufferers are healthcare staffs and the patients who visit the healthcare facility. In order to control this, we have to maintain certain basic principle so that we can save not only the life of healthcare related people, but also the general patients.*

**Keywords:** Nosocomial infections, types of nosocomial infection, nosocomial pathogens, epidemiology, infection control team, surveillance, treatment

## INTRODUCTION

'Nosocomial' or 'healthcare associated infections' (HCAI) appear in a patient under medical care in the hospital or other health care facilities which was absent at the time of admission. These infections can occur during healthcare delivery for other diseases and even after the discharge of the patients. Additionally, they comprise occupational infections among the medical staff [1]. Invasive devices such as catheters and ventilators employed in modern health care are associated to these infections [2].

Of every 100 hospitalized patients, seven in developed and ten in developing countries can acquire one of the healthcare associated infections [3]. Populations at stake are patients in Intensive Care Units (ICUs), burn units, undergoing organ transplant and neonates. According to Extended Prevalence of Infection in Intensive Care (EPIC II) study, the proportion of infected patients within the

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ICU are often as high as 51% [4]. Based on extensive studies in USA and Europe show that HCAI incidence density ranged from 13.0 to 20.3 episodes per thousand patient-days [5].

With increasing infections, there is an increase in prolonged hospital stay, long term disability, increased antimicrobial resistance, increase in socio-economic disturbance, and increased mortality rate. Spare information exists on burden of nosocomial infections because of poorly developed surveillance systems and inexistent control methods. For instance, while getting care for other diseases many patients probably get respiratory infections and it becomes troublesome to spot the prevalence of any nosocomial infection in continuation of a primary care facility [5]. These infections get noticed only when they become epidemic, yet there is no institution or a country that may claim to have resolved this endemic problem [6].

Nosocomial infections are infections patients acquire while admitted to a health-care facility and generally develop 48 hours or later after admission. These infections can lead to serious problems like sepsis and even death. Most nosocomial infections are preventable, with prevention guidelines set by national public health institutes such as the Centres for Disease Control and Prevention (CDC). The risk of developing a nosocomial infection partially depends on how strictly health-care facilities follow infection control guidelines. Patients at increased risk of infection include those with comorbid conditions, increased age, recent treatment with antibiotics, and prolonged hospitalizations. The most common type of nosocomial infection involves invasive devices and procedures (urinary catheters, central lines, mechanical ventilation, or surgery).

Nosocomial infection prevention requires health-care facility-wide adaptation of stringent infection control programs with ongoing surveillance to identify and control outbreaks. Surgeons can limit nosocomial infections by implementing protocols that improve surgical technique, control operating room environment, limit organisms shed by the operating room staff, and decrease length of operation, as well as recognizing underlying patient factors that may increase the risk of a nosocomial infection.

## TYPES OF NOSOCOMIAL INFECTIONS

The most frequent types of infections include central line-associated bloodstream infections, catheter-associated urinary tract infections, surgical site infections and ventilator-associated pneumonia. A brief detail of these is given below:

### Central Line-Associated Bloodstream Infections (CLABSI)

CLABSIs are deadly nosocomial infections with the death incidence rate of 12–25% [7]. Catheters are placed in central line to provide fluid and medicines but prolonged use can cause serious bloodstream infections resulting in compromised health and increase in care cost [8]. Although there is a decrease of 46% in CLABSI from 2008 to 2013 in US hospitals yet an estimated 30,100 CLABSI still occur in ICU and acute facilities wards in US each year [9].

### Catheter Associated Urinary Tract Infections (CAUTI)

CAUTI is the most usual type of nosocomial infection globally [10]. According to acute care hospital stats in 2011, UTIs account for more than 12% of reported infections [11]. CAUTIs are caused by endogenous native microflora of the patients. Catheters placed inside serve as a conduit for entry of bacteria, whereas the imperfect drainage from catheter retains some volume of urine in the bladder providing stability to bacterial residence [10]. CAUTI can develop to complications such as, orchitis, epididymitis and prostatitis in males, and pyelonephritis, cystitis and meningitis in all patients [11].

### Surgical Site Infections (SSI)

SSIs are nosocomial infections be fall in 2–5% of patients subjected to surgery. These are the second most common type of nosocomial infections mainly caused by *Staphylococcus aureus* resulting in prolonged hospitalization and risk of death [12]. The pathogens causing SSI arise from endogenous

 

microflora of the patient. The incidence may be as high as 20% depending upon procedure and surveillance criteria used [13].

### Ventilator associated pneumonia (VAP)

VAP is nosocomial pneumonia found in 9–27% of patients on mechanically assisted ventilator. It usually occurs within 48 h after tracheal incubation [14]. 86% of nosocomial pneumonia is associated with ventilation [15]. Fever, leucopoenia, and bronchial sounds are common symptoms of VAP [16].

## NOSOCOMIAL PATHOGENS

Pathogens responsible for nosocomial infections are bacteria, viruses and fungal parasites. These microorganisms vary depending upon different patient populations, medical facilities and even difference in the environment in which the care is given.

### Bacteria

Bacteria are the most common pathogens responsible for nosocomial infections. Some belong to natural flora of the patient and cause infection only when the immune system of the patient becomes prone to infections. Acinetobacter is the genre of pathogenic bacteria responsible for infections occurring in ICUs. It is embedded in soil and water and accounts for 80% of reported infections [17]. *Bacteroides fragilis* is a commensal bacteria found in intestinal tract and colon. It causes infections when combined with other bacteria [18]. *Clostridium difficile* cause inflammation of colon leading to antibiotic-associated diarrhoea and colitis, mainly due to elimination of beneficial bacteria with that of pathogenic. *C. difficile* is transmitted from an infected patient to others through healthcare staff via improper cleansed hands [18]. *Enterobacteriaceae* (carbapenem-resistance) cause infections if travel to other body parts from gut; where it is usually found. *Enterobacteriaceae* constitute Klebsiella species and *Escherichia coli*. Their high resistance towards carbapenem causes the defence against them more difficult [19]. Methicillin-resistant *S. aureus* (MRSA) transmit through direct contact, open wounds and contaminated hands. It causes sepsis, pneumonia and SSI by travelling from organs or bloodstream. It is highly resistant towards antibiotics called beta-lactams [19].

### Viruses

Besides bacteria, viruses are also an important cause of nosocomial infection. Usual monitoring revealed that 5% of all the nosocomial infections are because of viruses [20]. They can be transmitted through hand-mouth, respiratory route and faecal-oral route [21]. Hepatitis is the chronic disease caused by viruses. Healthcare delivery can transmit hepatitis viruses to both patients and workers. Hepatitis B and C are commonly transmitted through unsafe injection practices [19]. Other viruses include influenza, HIV, rotavirus, and herpes-simplex virus [21].

### Fungal Parasites

Fungal parasites act as opportunistic pathogens causing nosocomial infections in immune-compromised individuals. *Aspergillus* spp. can cause infections through environmental contamination. *Candida albicans*, and *Cryptococcus neoformans* are also responsible for infection during hospital stay [21]. Candida infections arise from patient's endogenous microflora while Aspergillus infections are caused by inhalation of fungal spores from contaminated air during construction or renovation of health care facility [22].

## EPIDEMIOLOGY OF NOSOCOMIAL INFECTIONS

Nosocomial infection affects huge number of patients globally, elevating mortality rate and financial losses significantly. According to estimate report of WHO, approximately 15% of all hospitalized patients suffer from these infections [22]. These infections are responsible for 4–56% of all death causes in neonates, with incidence rate of 75% in South-East Asia and Sub-Saharan Africa [1]. The incidence is high enough in high income countries, i.e., between 3.5 and 12%, whereas it varies between 5.7 and 19.1% in middle and low income countries. The frequency of overall infections in low income countries

 

is three times higher than in high income countries, whereas this incidence is 3–20 times higher in neonates [23].

**Main Problems in The Field of Infection Control and Its Prevention**

The first part of this review focuses on problems not yet solved, such as:

1. Surveillance systems, which should be active and extremely flexible;
2. Infection outbreaks in hospitals and strategies to avoid them;
3. Hand washing and alternatives such as rapid hand antisepsis;
4. Water and food in the hospital as potential reservoirs of nosocomial pathogens;
5. Upgrading of infection control programs to turn them into systems to improve the quality of care;
6. Fatal Gram-negative bacteria in hospitals from developing countries, which can be avoided with better standards of care;
7. The elemental role of the microbiology laboratory in the prevention and control of infections.
8. The unprecedented crisis due to the emergence of specific multi-resistant pathogens;
9. The risks for healthcare workers, such as tuberculosis, hepatitis, HIV, SARS, and Haemorrhagic fevers;
10. The need for the consistent application of guidelines.

**Figure 1.** Matrisadan Complex UPHC 04 Rajpur-Sonarpur municipality.

**Observation**

The scope of study was limited to the Matrisadan Complex UPHC 04 Rajpur-Sonarpur Municipality, Kolkata, West Bengal (Figure 1). This is a health and wellness centre under Rajpur-Sonarpur Municipality. Till now there are 08 such health and wellness centres under Rajpur-Sonarpur Municipality. Matrisadan Complex UPHC 04 looks after a population of 1,11,986 heads which covers 10 wards i.e. ward numbers: 14, 16, 17, 18, 20, 22, 23, 24, 25 and 26. The study focuses on the following areas:

**Current Infection Control and Prevention Practices**

On the day of the visit, it was observed that Matrisadan has some unique and a very good infection control policies. They undergo some systems such as are follows:

 

They have made an infection control team comprising of:

- 1 FTMO In charge.
- 1 Staff Nurse.
- 1 Pharmacist.
- 1 Laboratory Technician.
- 1 Clerical Assistant.
- 1 Office Assistant.

These groups of members call for a meeting every year to set the goals which they would be going to follow in the current year. Along with this they also discuss about the drawbacks and the backlogs of the previous year which they plan to complete in the current year. Everything which has been discussed in the meeting is summarized, noted and gets authorised by FTMO, which is to be strictly followed.

They have made a separate waiting room for the patient who usually comes with any communicable disease. This distinction of the disease whether they are communicable or non-communicable is specially done by the group of Staff Nurses after examining the patient. As the patient enters Matrisadan UPHC 04 for any sort of illness, they are first registered at the reception (Figure 2).

From there they are sent to the Nursing Station (Figure 3).

where the patients are examined for their BP, weight, whether their disease is communicable or not. Other parameters are also checked like CBG, MPDA and etc. as per the requirement of the patient.

Once the patient is discriminated as per their communicable nature, they are sent to the separated waiting room dedicated for communicable disease. There they maintain a record containing the patient's name, age, phone number, and sort of problem they are having. They deploy a separate staff in that room to do these activities.

They have a unique system that if such patient comes with communicable disease, they are first sent to the doctor, irrespective of the other patients who attended the OPD for some non-communicable diseases. As per their rules, this system attending the patient has been deployed so that the communicable diseases do not spread and become a nosocomial disease for others.

**Figure 2.** Reception of Matrisadan Complex UPHC.

 

**Figure 3.** Nursing station of Matrisadan complex UPHC.

During visit it has been observed that all the staff uses personal protective substances such as gloves, mask, and head caps. They use hand sanitiser at regular intervals.

It has been observed that they have hand washing techniques attached in front of each sink along with elbow taps. When the staff were interviewed, it seems they know about the hand washing techniques and about the 5 moments of hand washing.

To avoid the spread of nosocomial disease, the staff of Matrisadan UPHC 4 strictly follows the biomedical waste patterns, for which a separate register also seems to be maintained. To prevent the nosocomial diseases, the mentioned institution also trains the house keeping staffs. They are used to clean all the foot stepping part of the institution with 0.5% Hypochlorite solution thrice per day to maintain hygienic and clean environment. These records are also checked [24].

**Surveillance of Infection Control and Prevention**

One Scottish study suggested that because the surveillance system in Scotland was not so well-organized, the time taken to first recognize nosocomial infections was longer than the gold standard [25]. This study also found that the time at which nosocomial infections are recognized can be reduced either by "increasing the number of hospitals participating in surveillance or by optimally selecting which hospitals to include in a surveillance system" [25]. Two other Scottish studies echoed this, reporting that a better surveillance system could have prevented a considerable number of *Staphylococcus aureus* bacteria (SAB) episodes [26, 27]. One recent Indian observational prospective study noted a low incidence of nosocomial infections due to the strict practice of active surveillance in a neurosurgery unit [28]. In Germany, the Krankenhaus Infections Surveillance System (KISS) was found to decrease nosocomial infections more efficiently in comparison to other protocols [29]. This system is like that described by the CDC and is structured like the National Nosocomial Surveillance system of the USA [30, 31]. However, another German study reported that the KISS surveillance system tended to miscalculate the rates of nosocomial infections [32]. Later, yet another German study reported that around 35% of ICUs in Germany have never isolated patients with MRSA as individuals or cohorts [33]. Isolation of MDRs infected patients is one of the top priority issues in preventing or controlling a nosocomial infection epidemic [34–37]. The timely recognition of the unique variants of nosocomial infections, especially of MDRs pathogenic microorganisms, is vital, although surveillance strategies are frequently restricted because of financial and practical limitations. Therefore, although surveillance is extensively acknowledged as playing an active part in preventing and controlling nosocomial infections, there is not enough evidence on how well-organized individual healthcare centred surveillance structures work and how lessons can be applied in low resource settings [35].

 

As there are 10 wards of Rajpur-Sonarpur Municipality under the supervision of Matrisadan UPHC 04, it is seemed and checked as per documentation that this facility performs an Outreach Camp as per their previously scheduled date. In this Outreach Camp their main role is to council that patient who goes for OPD service on regular basis. They generally check for whether the patients have any nosocomial infection or not. Beside this they also look for any sort of disease outbreak in the community. There are 30 ASHA workers working under this UPHC. They visit house to house and act as data collector. As per their data, feedback and reports analysis is being carried out by infection control committees and the treatments are done as per the guideline. The healthcare facility keeps confidentiality of individuals. Finally they undertake the data at regular intervals for maintenance of efficiency of surveillance systems [21].

**Promotion of the Infection Control and Prevention Among the Patient and Localities**

Matrisadan UPHC 04 of Rajpur-Sonarpur Municipality undergoes different types of community programmes to spread awareness of different type of infectious disease. They perform this programme either in open air, ward to ward, or within the UPHC premises as well. They do so by some sort of rallies or open air show or by any song in colloquial language or by some magic shows.

**Roles of the Unit During Outbreak of the Disease or Infection in the Surrounding Area**

- They follow all the standard protocols as per west Bengal Govt. health dept.
- They undergo house to house survey of their 10 wards. This house to house survey is generally done by the Asha workers or popularly known as Health workers.
- They spread awareness all throughout their area by miking and by audio/visual shows.
- They extend their working hours, so that none of the patient leaves the UPHC bare handed.
- Along with all other activities they also maintain their medicine stock along with the buffer stock [38–40].

**Treatment of Nosocomial Infection as per Antibiotic policy of Govt. of India titled 'National Treatment Guidelines for Antimicrobial Use in Infectious Diseases' [40]**

Since individual antibiotic policy preparation for UPHCs is under consideration, till date the guidelines issued by National Centre for Disease Control under DGHS, MoHFW, Govt. of India titled 'National Treatment Guidelines for Antimicrobial Use in Infectious Diseases' will be followed as antibiotic policy. The copy of the module and guidelines are enclosed herewith for guidance and compliance. However certain points are to be taken into consideration in this context:

1. Send for the appropriate investigations in all these infections as recommended. These are the minimum required for diagnosis, prognosis and follow up of these infections.
2. All antibiotic initiations would be done after sending appropriate cultures.
3. Change in antibiotic would be done after sending fresh cultures.
4. Follow the UPHC policy when choosing antimicrobial therapy whenever possible. If alternatives as chosen, document the reason in the case records.
5. Check for factors which will affect drug choice and dose, e.g., renal function, interactions, and allergy.
6. Check that the appropriate dose is prescribed. If uncertain, contact Infectious disease physician, Pharmacy, or check in the formulary.
7. The need for antimicrobial therapy should be reviewed on a daily basis. For most infections 5–7 days of antimicrobial therapy is sufficient (simple UTIs can be adequately treated with 3 days of antibiotic).
8. All IV antibiotics may only be given for 48–72 h without review and consideration of oral alternatives. New microbiological or other information (e.g. fever defervescence for at least 24 h, marked clinical improvement; low CRP) should at this stage often permit a switch to oral antibiotic(s), or switch to an IV narrow spectrum alternative, or cessation of antibiotics (no infection present).

 

9. Once culture reports are available, the physician shall step down to the narrowest spectrum, most efficacious and most cost effective option. If there is no step down availed, the reason shall be documented and is subjected to clinical audit.
10. Empiric Therapy: Where delay in initiating therapy to await microbiological results would be life threatening or risk serious morbidity, antimicrobial therapy based on a clinically defined infection is justified. Where empiric therapy is used, the accuracy of diagnosis should be reviewed regularly and treatment altered/stopped when microbiological results become available.
11. Microbiological samples must always be sent prior to initiating antimicrobial therapy. Rapid tests, such as Gram smears, can help determine therapeutic choices when empiric therapy is required.
12. Prescribing antibiotics just in case an infection is present is rarely justified. Where patients are in hospital, close observation is usually a better option.
13. All patients should be asked about drug allergies. This is the responsibility of the doctor examining the patient. If a patient reports a drug allergy, clarify whether this is an allergy or drug intolerance. In some cases, there will be an overlap between drug allergy and drug intolerance.
14. *Clinical features suggestive of drug allergy:* One or more symptoms developed during or following drug administration including difficulty in breathing, swelling, itching, rash, anaphylaxis, swelling of the lips, loss of consciousness, seizures or congestion involving mucous membranes of eyes, nose and mouth.
15. *Clinical features suggestive of drug intolerance*: One or more symptoms developed during or following drug administration including gastrointestinal symptoms e.g. nausea, vomiting, diarrhoea, abdominal pain and giddiness.
16. If patients are unable to give an allergy history, the doctor clerking in the patient should take reasonable steps to contact someone who can provide a reliable allergy history. It is the prime responsibility of the prescribing doctor to ensure that:
    - The allergy box on the patients' drug chart is completed when a new prescription chart is written or transcribed. If no allergy, specify "No known allergy or NKA". The box should be signed and dated. If allergy history cannot be obtained, then specify "history not available". Under no circumstances should the allergy box be left blank. A pharmacist or nurse may complete the allergy box if the allergy status is documented in the clerking in notes.
    - The allergy box is completed before prescribing a new drug, except in exceptional circumstances. If patients have a suspected drug allergy, then the drug and suspected reaction should be documented in the clerking-in notes and the drug chart.

## LIMITATIONS OF THE STUDY

- The study was limited to only Matrisadan Complex UPHC 04 Rajpur-Sonarpur Municipality, Kolkata, West Bengal.
- The study was about only the infection control and its prevention in the above mentioned site, and not about the quality of service they provide.
- Through this research we would come to know about the nosocomial infection, its control and prevention for the patients who attend the OPD for health related issues.

## CONCLUSION

This project provides a detail about the nosocomial infection control and prevention procedures of Matrisadan Complex UPHC 04 Rajpur-Sonarpur Municipality, Kolkata, West Bengal. This research study will also help to find the loop holes if there is any in their procedures. This study can be also used as a reference by other any kind of hospitals (govt. and private) in West Bengal to set up an infection control and prevention procedures. Nosocomial infections are an increasingly important and severe public health issue about which concerns have been expressed among all stakeholders involved in healthcare, including doctors, nurses, allied health professionals, patients, and the public. As there is a considerable rise of multidrug-resistant pathogenic microorganisms, the prevention and control of Nosocomial infections is one of the burning issues around the earth among all healthcare facilities. This research study found overwhelmingly that proper hand washing, perfect patient inflow technique and

 

environmental hygiene with antibiotic stewardship are the principal measures that minimize nosocomial infections and improve treatment outcomes.

## REFERENCES

1. WHO. (2010). The burden of health care-associated infection worldwide. [Online] Available from: https://www.who.int/news-room/feature-stories/detail/the-burden-of-health-care-associated-infection-worldwide [Accessed on 10th April, 2024]
2. Horan TC, Andrus M, Dudeck MA. CDC/NHSN surveillance definition of health care–associated infection and criteria for specific types of infections in the acute care setting. Am J Infect Control. 2008 Jun; 36(5): 309–32. [Online] https://www.ajicjournal.org/article/S0196-6553(08)00167-3/abstract
3. Raja Danasekaran GM, Annadurai K. Prevention of healthcare-associated infections: protecting patients, saving lives. Int J Community Med Public Health. 2014; 1(1): 67–68.
4. Vincent JL, Marshall J, Silva E, Anzueto A, Martin CD, Moreno R, *et al.* International study of the prevalence and outcomes of infection in intensive care units. JAMA. 2009; 302(21): 2323–2329.
5. Allegranzi B. Report on the burden of endemic health care-associated infection worldwide. Geneva: WHO; 2011.
6. Gupta A, Singh DK, Krutarth B, Maria N, Srinivas R. Prevalence of health care associated infections in a tertiary care hospital in Dakshina Kannada, Karnataka: a hospital based cross sectional study. Int J Med Res Health Sci. 2015; 4(2): 317–321.
7. Centers for Disease Control and Prevention (CDC). Vital signs: Central line–associated blood stream infections – United States, 2001, 2008, and 2009. Morb Mortal Wkly Rep. 2011; 60(08): 243–248.
8. WHO. Proposed members of the WHO global guidelines for the prevention of bloodstream infections and other infections associated with the use of intravascular catheters. 2023.
9. CDC. Bloodstream infection event (central line-associated bloodstream infection and non-central line-associated bloodstream infection). Atlanta, Georgia: CDC; 2015.
10. Warren JW. Catheter-associated urinary tract infections. Int J Antimicrob Agents. 2001; 17(4): 299–303.
11. CDC. Urinary tract infection (catheter-associated urinary tract infection [CAUTI] and non-catheter associated urinary tract infection [UTI]) and other urinary system infection [USI]) events. Atlanta, Georgia: CDC; 2016.
12. Anderson DJ. Surgical site infections. Infect Dis Clin North Am. 2011; 25(1): 135–153.
13. Owens CD. Surgical site infections: epidemiology, microbiology and prevention. J Hosp Infect. 2008; 70(Suppl 2): 3–10.
14. Hunter JD. Ventilator associated pneumonia. BMJ. 2012; 344: 40–44.
15. Steven M, Koenig JDT. Ventilator-associated pneumonia: diagnosis, treatment, and prevention. Clin Microbiol Rev. 2006; 19(4): 637–657.
16. Hjalmarson DEC. Ventilator-associated tracheobronchitis and pneumonia: thinking outside the box. Clin Infect Dis. 2010; 51(Suppl 1): S59–S66.
17. Suresh G, Joshi GML. *Acinetobacter baumannii*: an emerging pathogenic threat to public health. World J Clin Infect Dis. 2013; 3(3): 25–36.
18. Jayanthi A. Most common healthcare-associated infections: 25 bacteria, viruses causing HAIs. Becker's Hospital Review. 2014.
19. CDC. Diseases and organisms in healthcare settings. Healthcare-associated infections (HAIs). Atlanta, Georgia: CDC; 2016.
20. Aitken CJD. Nosocomial spread of viral disease. Clin Microbiol Rev. 2001; 14(3): 528–546.
21. Ducel JF, Nicolle L. Prevention of hospital-acquired infections. Geneva: WHO; 2002.
22. Emily RM, Sydnor TMP. Hospital epidemiology and infection control in acute-care settings. Clin Microbiol Rev. 2011; 24(1): 141–173.
23. Nejad SB, Syed SB, Ellis B, Pittet D. Health-care-associated infection in Africa: a systematic review. Bull World Health Org. 2011; 89: 757–765.

 

24. Tomar SL. Public health perspectives on surveillance for periodontal diseases. *J Periodontol*. 2007; 78(Suppl 7S): 1380–1386. doi: 10.1902/jop.2007.060340 [PubMed] [CrossRef] [Google Scholar]
25. Morris AK, Russell CD. Enhanced surveillance of *Staphylococcus aureus* bacteremia to identify targets for infection prevention. *J Hosp Infect*. 2016; 93(2): 169–174. doi: 10.1016/j.jhin.2016.03.003 [PubMed] [CrossRef] [Google Scholar]
26. Murdoch F, Danial J, Morris AK, *et al*. The Scottish enhanced Staphylococcus aureus bacteremia surveillance program: the first 18 months of data in adults. *J Hosp Infect*. 2017; 97(2): 133–139. doi: 10.1016/j.jhin.2017.06.008 [PubMed] [CrossRef] [Google Scholar]
27. Agarwal R, Mohapatra S, Rath GP, Kapil A. Active surveillance of health care-associated infections in neurosurgical patients. *J Clin Diagn Res*. 2017; 11(7): DC01–DC04. [PMC free article] [PubMed] [Google Scholar]
28. Zuschneid I, Rücker G, Schoop R, *et al*. Representativeness of the surveillance data in the intensive care unit component of the German nosocomial infections surveillance system. *Infect Control Hosp Epidemiol*. 2010; 31(9): 934–938. doi: 10.1086/655462 [PubMed] [CrossRef] [Google Scholar]
29. Garner JS, Emori WR, Horan TC, Hughes JM, Hughes JM. CDC definitions for nosocomial infections. *Am J Infect Control*. 1988; 16(3): 128–140. doi: 10.1016/0196-6553(88)90053-3 [PubMed] [CrossRef] [Google Scholar]
30. Emori TG, Culver DH, Horan TC, *et al*. National nosocomial infection surveillance system (NNIS): description of surveillance methods. *Am J Infect Control*. 1991; 19(1): 19–35. doi: 10.1016/0196-6553(91)90157-8 [PubMed] [CrossRef] [Google Scholar]
31. Rücker G, Schoop R, Beyersmann J, Schumacher M, Zuschneid I. Are KISS data representative of German intensive care units? Statistical issues. *Methods Inf Med*. 2006; 45(4): 424–429. doi: 10.1055/s-0038-1634099 [PubMed] [CrossRef] [Google Scholar]
32. Gastmeier P, Schwab F, Geffers C, Rüden H. To isolate or not to isolate? Analysis of data from the German Nosocomial Infection Surveillance System regarding the placement of patients with methicillin-resistant Staphylococcus aureus in private rooms in intensive care units. *Infect Control Hosp Epidemiol*. 2004; 25(2): 109–113. doi: 10.1086/502359 [PubMed] [CrossRef] [Google Scholar]
33. Mehta Y, Gupta A, Todi S, *et al*. Guidelines for prevention of hospital-acquired infections. *Indian J Crit Care Med*. 2014; 18(3): 149–163. [PMC free article] [PubMed] [Google Scholar]
34. Alp E, Damani N. Healthcare-associated infections in intensive care units: epidemiology and infection control in low-to-middle income countries. *J Infect Dev Ctries*. 2015; 9(10): 1040–1045. doi: 10.3855/jidc.6832 [PubMed] [CrossRef] [Google Scholar]
35. Ciccolini M, Donker T, Grundmann H, Bonten MJ, Woolhouse ME. Efficient surveillance for healthcare-associated infections spreading between hospitals. *Proc Natl Acad Sci USA*. 2014; 111(6): 2271–2276. doi: 10.1073/pnas.1308062111 [PMC free article] [PubMed] [CrossRef] [Google Scholar]
36. Sydnor ER, Perl TM. Hospital epidemiology and infection control in acute-care settings. *Clin Microbiol Rev*. 2011; 24(1): 141–173. doi: 10.1128/CMR.00027-10 [PMC free article] [PubMed] [CrossRef] [Google Scholar]
37. European Centre for Disease Prevention and Control. An agency of the European Union. Antimicrobial resistance and healthcare-associated infections programme. [Online]. Available from: https://ecdc.europa.eu/en/about-uswho-we-aredisease-programmes/antimicrobial-resistance-and-healthcare-associated-infections. Accessed February12, 2019.
38. Revelas A. Healthcare-associated infections: a public health problem. *Niger Med J*. 2012; 53(2): 59–64. doi: 10.4103/0300-1652.103543 [PMC free article] [PubMed] [CrossRef] [Google Scholar]
39. Kanerva M, Ollgren J, Hakanen AJ, Lyytikäinen O. Estimating the burden of healthcare-associated infections caused by selected multidrug-resistant bacteria Finland, 2010. *Antimicrob Resist Infect Control*. 2012; 1(1): 33. doi: 10.1186/2047-2994-1-33 [PMC free article] [PubMed] [CrossRef] [Google Scholar]
40. National Treatment Guidelines for Antimicrobial Use in Infectious Diseases. Directorate General of Health Services, Ministry of Health & Family Welfare, Government of India; 2016.

 