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REVIEW ARTICLE

Review on Nosocomial Infections

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ABSTRACT

When a patient enters hospital, the hospital acquired infections are neither current nor incubating. About 9% of in-patients have a hospital acquired infection at any one time corresponding to at least 100,000 infections a year. The special effects can vary from discomfort for the patient to long-lasting or undeviating disability. A small quantity of patient deaths each year is mostly attributable to hospital acquired infections. The costs of treating hospital acquired infection, counting extended duration of stay, are difficult to measure with certainty, but may be as much as £1,000 million each year. Not all hospital acquired infection is escapable, since the very old, the very young, those undergoing persistent procedures and those with undeveloped immune systems are particularly susceptible. However, in 1995 the Hospital Infection Working Group of the Department of Health (Department) and Public Health Laboratory Service believed that about 30 per cent of hospital acquired infections could be avoided by better application of existing knowledge and realistic infection control practices.

KEYWORDS

Hospitals, Infections, Clinical Pharmacist, Management, Environment, Immunity, Microorganisms, Diagnostic criteria, Treatment, Antibiotics, Prophylaxis, Transmission, Prevention, Hygienic, Complications

INTRODUCTION

A nosocomial infection-also called "hospital acquired infection" can be defined as: An infection acquired in hospital by a patient who was admitted for a reason other than that infection.[1] An infection occurring in a patient in a hospital or other healthcare facility in whom the infection was not present or incubating at the time of admission. This includes infections acquired in the hospital but appearing after discharge, and also occupational infections among staff of the facility.[2]

Patient care is provided by highly capable clinics and scientifically developed hospitals along with other basic services.

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Even with development in health care system, even with progress in public health and hospital care, infections continue to develop in hospitalized patients, and may also affect hospital staff.

Many factors promote infection among hospitalized patients: decreased immunity among patients; the increasing variety of medical dealings and invasive techniques creating potential routes of infection; and the transmission of drug resistant bacteria among crowded hospital populations, where poor infection control practices may assist transmission.

The most common nosocomial infections are infections of surgical wounds, urinary tract infections and lower respiratory tract infections. The WHO study, others, has also shown that the

highest popularity of nosocomial infections occurs in intensive care units and in acute surgical and orthopaedic wards. Infection rates are higher among patients with increased susceptibility because of old age, underlying disease, or chemotherapy.

Frequency of Infection

Nosocomial infections occur worldwide and affect both developed and resource-poor countries. Infections acquired in health care settings are among the major causes of death and increased morbidity among hospitalized patients. They are a considerable burden both for the patient and for public health. A prevalence survey conducted under the support of WHO in 55 hospitals of 14 countries representing 4 WHO Regions (Europe, Eastern Mediterranean, South-East Asia and Western Pacific) showed an average of 8.7% of hospital patients had nosocomial infections. At any time, over 1.4 million people worldwide suffer from infectious complications acquired in hospital.[3] The highest frequencies of nosocomial infections were reported from hospitals in the affect the host defences will provide continuing pressure on nosocomial infections in the future. Organisms causing nosocomial infections can be transmitted to the community through discharged patients, staff, and visitors. If organisms are multi resistant, they may cause significant disease in the community.

Impact of Nosocomial Infections

Hospital-acquired infections add to efficient disability and exciting stress of the patient and may, in some cases, lead to disabling conditions that reduce the quality of life. Nosocomial infections are also one of the leading causes of death.[4] The economic costs are substantial.[5,6] The increased length of stay for infected patients is the greatest supplier to cost.[7,8,9] One study showed that the overall increase in the time of hospitalization for patients with surgical wound infections was 8.2 days, ranging from 3 days for gynaecology to 9.9 for general surgery and 19.8 for orthopaedic surgery.

Epidemiology of Nosocomial Infection

Studies throughout the world document that nosocomial infections are a major cause of morbidity and mortality.[10,11,12] A high frequency of nosocomial infections is verification of a poor quality of health service delivery, and leads to avoidable costs. Many factors contribute to the frequency of nosocomial infections: hospitalized patients are often immune compromised, they undergo invasive examinations and treatments, and patient care practices and the hospital environment may make possible the transmission of microorganisms among patients. The selective pressure of intense antibiotic use promotes antibiotic resistance.

Infection Types

Besides several cases of colonization, there were also at least 96 documented cases of nosocomial infections among the 1,449 patients. The most frequent nosocomial infections were surgical site infections (SSI; 256), HBV infections (212), septicemia (67), gastroenteritis (42), hepatitis C virus infections (HCV) (21), urinary tract infections (20), and meningitis (13).

Causative Agent

Transmission of bacteria occurred in 108 of the 152 NO. Viral spread (34 NO) and fungi (10 NO) were less often the causative agents. Table 1 shows a detailed distribution of the most frequently detected microorganisms in NO caused by HCW which were S. aureus (49 NO), HBV (27NO), and Group A streptococci (19 NO). Regardless of the number of patients (LO vs. other NO), spread of the pathogen via direct contact was the main route of transmission, followed by droplets and airborne transmission.

Some Microorganisms Causing Waterborne Nosocomial Infections

Gram-Negative Bacteria

- Pseudomonas aeruginosa
- Aeromonashydrophilia
- Burkholderiacepacia

- Stenotrophomonasmaltophilia
- Serratiamarcescens
- Flavobacteriummeningosepticum
- Acinetobactercalcoaceticus
- Legionella pneumophilaand other

Mycobacteria

- Mycobacterium xenopi
- Mycobacterium chelonae
- Mycobacterium avium-intracellularae

All infections had onset 148 h after hospital admission. The mean time from admission to the ICU until occurrence of bacteremia was 15.0 days (range, 1–63 days). However, one half of the cases occurred within the initial 8 days of the ICU stay. A correlation between patients with nosocomial primary blood stream infections and patients without such infections.

Patients with primary bloodstream infections were more likely to have basic congestive heart failure and chronic obstructive pulmonary disease. They also had increased rigorousness of illness on permission. During the ICU stay, infected patients had more central venous catheters inserted and required catheterization for a longer duration. Patients who acquired primary bloodstream infections were also more likely to require corticosteroids, haemodialysis, mechanical ventilation, and rein duration and tracheotomy during the ICU stay than were un infected ICU patients. Microbiological data for patients with primary bloodstream

The Routes of Transmission

Bacteria can be transmitted from their source to a new host through direct or indirect contact, in the air, or by vectors. Vector-borne transmission is typical of countries in which insects, arthropods, and other bedbugs are extensive spread. These develop into infected by contact with excreta or secretions from an infected patient and transmit the infective organisms instinctively to other patients. Airborne transmission occurs only with microbes that are separate into the air and that are considered by a low minimal infective dose. Only a few bacteria and viruses are present in expired air, and these are circulated in large numbers only as a result of sneezing or coughing.

Direct contact involving patients does not frequently occur in health-care conveniences, but an infected health-care worker can touch a patient and directly transmit a large number of microbes to the new host.

The most recurrent route of transmission, however, is indirect make contact with the infected patient touches and contaminate a thing, an apparatus, or a surface. Consequent contact involving that item and another patient is likely to contaminate the second individual who may then develop an infection for the duration of general care and/or medical treatment, the hands of health-care workers often come into close contact with patients. The hands of the clinical personnel are thus the most regular vehicles for nosocomial infections. Transmission by this route is much more common than vector borne or airborne transmission or other forms of direct or indirect contact.

Urinary Infections

The most common nosocomial infection; the usage of an indwelling bladder catheter are related to 80% of these infections.[1,2,3] Less morbidity are related with urinary infections than other nosocomial infections, this can commonly lead to bacteraemia and death. Infections can be defined by microbiological criteria such as positive quantitative urine culture (≥105 microorganisms/ml, with a maximum of 2 isolated microbial species). The bacteria responsible arise from the gut flora, can be normal (Escherichia coli) or else acquired in hospital (multi resistant Klebsiella).

Surgical Site Infections

Surgical site infections are also frequent: the prevalence varies from 0.5 to 15% depending on the type of operation and underlying patient status.[13,14,15] Based on these problems it limits the potential benefits of surgical interventions. The affect on hospital costs and postoperative

length of stay (between 3 and 20 additional days).[16,17,18] is considerable. The definition is mainly clinical: purulent discharge around the wound or the insertion site of the drain, or spreading cellulitis from the wound. Infections of the surgical wound (whether above or below the aponeurosis), and deep infections of organs or immune compromised patients, Legionella spp. And Aspergillus pneumonia may occur. In countries with a high prevalence of tuberculosis, particularly multi resistant strains, transmission in health care settings may be an important problem.

Nosocomial Bacteraemia

A small amount of nosocomial infections represent infections (approximately 5%). In this case fatality rates are high more than 50% for some microorganisms. The increase in frequency, mainly for definite organisms such as multi resistant coagulase-negative Staphylococcus and Candida spp is observed. Infection can occur at the skin entry site of the intravascular device, and also in the subcutaneous path of the catheter (tunnel infection). The colonization of organisms in the catheter within the vessel may produce bacteraemia without visible external infection. The source of infection is resident or transient cutaneous flora. There are several risk factors such as the length of catheterization, level of asepsis at insertion, and continuing catheter care.

Other Nosocomial Infections

There are 4 frequent and important nosocomial infections, but there are many other potential sites of infection.

For example:

1. Skin and soft tissue infections: open sores (ulcers, burns and bedsores) this will encourage bacterial colonization and may lead to systemic infection.
2. Gastroenteritis is the most common nosocomial infection in children, rotavirus is a chief pathogen: In developed countries Clostridium difficileis the major cause of nosocomial gastroenteritis in adults.
3. Sinusitis and other enteric infections, infections of the eye and conjunctiva.
4. Endometritis and other infections of the reproductive organs following childbirth.

Bacteria

These are the most common nosocomial pathogens.

Commensal bacteria found in normal flora of healthy humans. These bacteria have an important protective role by preventing colonization by pathogenic microorganisms. If natural host is compromised some commensal bacteria may cause infection. For example, cutaneous coagulase negative staphylococci cause intravascular line infection and intestinal Escherichia coli are the most common cause of urinary infection.

Pathogenic bacteria have greater virulence, and cause infections (sporadic or epidemic) regardless of host status.

For example:

- Anaerobic Gram-positive rods (e.g. Clostridium) cause gangrene.
- Gram-positive bacteria: Staphylococcus aureus (cutaneous bacteria that colonize the skin and nose of both hospital staff and patients) causes a variety of lung, bone, heart and blood stream infections and are frequently resistant to antibiotics; beta-haemolytic streptococci are also important.
- Gram-negative bacteria: Enterobacteriacae (e.g. Escherichia coli, Proteus, Klebsiella, Enterobacter Serratiamarcescens), may colonize sites when the host defences are compromised (catheter insertion, bladder catheter, cannula insertion) and cause serious infections (surgical site, lung, bacteraemia, peritoneum infection). They may also be highly resistant.
- Gram-negative organisms such as Pseudomonas spp. are repeatedly isolated in water and damp areas. They may colonize the digestive tract of hospitalized patients.

- Selected other bacteria are a risk in hospitals. For instance, Legionella species may cause pneumonia (sporadic or endemic) through inhalation of aerosols containing contaminated water (air conditioning, showers, and therapeutic aerosols).

An Infection Control Committee provides a forum for multidisciplinary input and cooperation, and information sharing. This committee should include wide representation from relevant programmes: e.g. management, physicians, other health care workers, clinical microbiology, pharmacy, central supply, maintenance, housekeeping, training services. The committee must have a reporting relationship directly to either administration or the medical staff to promote programme visibility and effectiveness. In an emergency (such as an outbreak), this committee must able to meet promptly. It has the following tasks:

1. To review and approve a yearly programme of activity for surveillance and prevention.
2. To review epidemiological surveillance data and to review and approve a yearly programme of activity for surveillance and prevention.
3. To review epidemiological surveillance data and identify areas for intervention.
4. To assess and promote improved practice at all levels of the health facility.
5. To ensure appropriate staff training in infection control and safety.
6. To review risks associated with new technologies, and monitor infectious risks of new devices and products, prior to their approval for use.
7. To review and provide input into investigation of epidemics.
8. To communicate and cooperate with other committees of the hospital with common interests such as Pharmacy and Therapeutics or Antimicrobial Use Committee, Bio-safety or Health and Safety Committees, and Blood Transfusion Committee.

Diagnosis

Indications for Testing

- Clinical deterioration and/or new onset fever in hospitalized patient

Laboratory Testing

- Initial testing – CBC, urine and blood culture
- Urine – significant bacteruria for indwelling catheter
- $\geq 10^2$ CFU/mL in indwelling catheter or in catheter specimen from patient with intermittent catheterizing
- $\geq 10^3$ CFU/mL of ≥ 1 bacterial species in catheter-free patients
- Specific site cultures to identify pathogen and antimicrobial resistance profile
- Pneumonia – new infiltrates plus ≥ 2 of the following symptoms
- Body temperature >38°C or <35.5°C
- WBC >12 K/μL or <4 K/μL Purulent respiratory secretions
- Broncho-alveolar lavage specimen $>10^4$ CFU/mL
- Sputum $>10^5$ CFU/mL.
- Bacterial strain characterization – identify causative organism and source to aid in infection control and in the investigation of outbreaks

Imaging Studies

- Chest x-ray – rule out pneumonia.
- May need further imaging based on clinical evaluation.

Prevention of Nosocomial Infections

The requirements include an integrated, monitored, programme which includes the following key components:

- Transmission of organisms between patients in direct patient care through adequate hand washing and glove use, and appropriate

aseptic practice, isolation strategies, sterilization and disinfection practices, and laundry is to be limited.

- Controlling environmental risks for infection.
- Protecting patients with appropriate use of prophylactic antimicrobials, nutrition, and vaccinations.
- Limiting the risk of endogenous infections by minimizing invasive procedures, and promoting optimal antimicrobial use.
- Surveillance of infections, identifying and controlling outbreaks.
- Prevention of infection in staff members.
- Enhancing staff patient care practices, and continuing staff education.

Optimal "Hand Hygiene" Requirements

For Hand Washing

Running water: large washbasins should require little maintenance, with anti-splash devices and hands-free controls products: soap or antiseptic depending on the procedure facilities for drying without contamination (disposable towels if possible).

For Hand Disinfection

Specific hand disinfectants: alcoholic rubs with antiseptic and emollient gels which can be applied to physically clean hands.

Routine Care (Minimal)

Hand washing with non-antiseptic soap. Quick hygienic hand disinfection (by rubbing) with alcoholic solution.

Antiseptic Hand-Cleaning (Moderate) — Aseptic Care of Infected Patients

Hygienic hand washing with antiseptic soap following manufacturer's instructions (e.g. one minute) Quick hygienic hand disinfection: as previously.

Surgical Scrub (Surgical Care)

Surgical hand and forearm washing with antiseptic soap and sufficient time and duration of contact (3–5 minutes).

Surgical hand and forearm disinfection: simple hand wash and drying followed by two applications of hand disinfectant, then rub to dry for the duration of contact defined by the product.

Personal Hygiene

All hospital staff, workers should maintain good personal hygiene. Nails must be clean and kept short. False nails should not be worn. Hair must be worn short or pinned up. Beard and moustaches must be kept trimmed short and clean.

Clothing

Working Clothes

Staff can normally wear a personal uniform or street clothes covered by a white coat. In special areas such as burn or intensive care units, uniform trousers and a short-sleeved gown are required for men.

Safe Injection Practices

To prevent transmission of infections between patients with injections:

- Eliminate unnecessary injections
- Use sterile needle and syringe
- Use disposable needle and syringes, if possible
- Prevent contamination of medications
- Follow safe sharps disposal practices.

For more information, refer to the WHO guide "Best infection control practices for skin-piercing intradermal, subcutaneous, and intramuscular needle injections".[19]

Preventing Transmission from the Environment

To minimize the transmission of microorganisms from equipment and the environment should follow some specific methods for cleaning, disinfecting and sterilizing must be in place. Written policies and

procedures which are updated on a regular basis must be developed for each facility.

Cleaning of the Hospital Environment

Routine cleaning is necessary to ensure a hospital environment which is visibly clean, and free from dust and soil. Ninety per cent of microorganisms are present within "visible dirt", and the purpose of routine cleaning is to eliminate this dirt. Neither soap nor detergents have antimicrobial activity, and the cleaning process depends essentially on mechanical action. There must be policies specifying the frequency of cleaning and cleaning agents used for walls, floors, windows, beds, curtains, screens, fixtures, furniture, baths and toilets, and all reused medical devices

Treatment

Symptomatic treatment of shock, hypoventilation, and other complications should be provided, along with administration of empiric broad-spectrum antimicrobial therapy.

Bloodstream Infections

Line removal should be considered if the line is no longer needed; if the infection is caused by S aureus, Candida species, or mycobacteria; if the patient is critically ill; if the patient fails to clear bacteremia in 48-72 hours; if symptoms of bloodstream infection persist beyond 48-72 hours; and if non-infectious valvular heart disease, endocarditis, metastatic infection, or septic thrombophlebitis is present.[20]

Antibiotics with coverage against gram-positive and gram-negative organisms, including Pseudomonas, should be empirically started and then tailored according to susceptibility pattern of isolated organisms.

Antifungal therapy (eg, fluconazole, caspofungin, voriconazole, amphotericin B) in some cases is added to empiric antibiotic coverage. Antiviral therapy (eg, ganciclovir, acyclovir) can be used in the treatment of suspected disseminated viral infections.

Duration of therapy depends on several factors, including isolated pathogen, retention of catheter, or presence of complications (endocarditis, sepsis). For most bacterial organisms, the duration of therapy is 10-14 days after blood cultures become negative.

Pneumonia

Initial empiric antibiotic therapy should be broad and later on streamlined based on results of examination and cultures of sputum, endotracheal suction material and bronchial lavage wash. The choice of empiric antibiotic coverage should take into consideration the risk for multidrug-resistant (MDR) pathogens. Risk factors for MDR include antimicrobial therapy over the past 90 days, current hospitalization of 5 days or more, high frequency of antibiotic resistance in the community, or hospital and immune-suppression.[20]

No clear consensus has been reached as to the duration of antimicrobial therapy for ventilator-associated pneumonia (VAP). Many experts treat for 14-21 days. However, shorter course of antibiotic therapy (about 1 wk) may be adequate therapy for some cases.[20]

Antiviral medications against influenza have been used to treat symptomatic patients and patients with immunodeficiency or chronic lung diseases to limit morbidity and mortality.

Urinary Tract Infection

Indwelling catheters should be removed if possible, to avoid persistence and recurrence of infection. In some cases, removal of catheter may result in spontaneous resolution of bacteriuria or asymptomatic cystitis. Empiric antibiotic and antifungal therapy should be considered to avoid major complications, including pyelonephritis, renal damage, and bloodstream infections. Duration of therapy is controversial. Most experts recommend at least 10-14 days of therapy for children with sepsis, pyelonephritis, or urinary tract abnormalities.

Surgical-Site Infection

Surgical-site infections (SSIs) should be managed with a combination of surgical care and antibiotic therapy. Antibiotic coverage should be modified once culture results are available.

Severe infections such as streptococcal gangrene and extensive tissue necrosis need aggressive surgical intervention. For these kinds of infections, antibiotics alone may not work.

Other Healthcare-Associated Infections

Rotavirus gastroenteritis is a self-limited disease and only needs supportive care. Medical management should focus on preventing dehydration.

Treatment is not necessary for asymptomatic carriers of Clostridium difficile. For those who have mild symptoms, discontinuance of antibiotics alone may result in resolution of symptoms. For those who have more severe diarrhoea, oral metronidazole is the preferred treatment. Oral vancomycin is reserved for treatment failure with metronidazole. Clinical improvement is usually seen within 2 days of initiating therapy, and duration of treatment is usually 10 days.

CONCLUSION

If particular species of microorganisms are involved, the possibility of a carrier should be taken into account. The major advances in overall control of infectious diseases have resulted from immunization and improved hygiene, particularly hand washing. We must work with hospital personnel on better implementation of existing infection control technologies so that we will not need to rely solely on technologic advances.

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