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A Critical Study of Common Hospital-Acquired Infections and Their Control Strategies

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Abstract: ***Hospitals, in general, are the places where the patients are admitted for a period of time when ill. This helps the doctors to have their patients under constant observations with essential follow ups and treatments. However, it is a paradox, that the hospitals considered as the curing and treatment centers for patients, often become the places of catching new infections. This owes to the fact that the hospital environment becomes contaminated with many pathogenic micro-organisms. Other reason is that the patients with weak immunity become more susceptible to the infections. These new infections, which patients acquire as a result of healthcare interventions to treat other conditions are called 'Hospital – or Healthcare-Acquired Infections' (HAI). The present article reviews on the critical study of hospital-acquired infections, causative microbial agents and their control strategies.***

Keywords: Hospital-acquired infection, Healthcare-acquired infection, Healthcare interventions, Pathogenic agents, Drug-resistant, Antibiotics

1. Introduction

Hospital-acquired infections or Healthcare-associated infections (HAI), as recently known, denote all such conditions and diseases that are acquired by patients under medical care [1]. All the different types of infections caused by prolonged stay in hospital accounts for various health issues, often leading to death [2]. Considerable morbidity and mortality incidences are known to be caused by hospital infections. There are various factors that lead to an increased risk of infection among hospitalized patients. One of such major reasons for increased risk of infection is the patient's weakend defence mechanisms that make them more susceptible to other infections. Other factors responsible for the hospital infections are the miseffects of certain medical procedures, and poor control practices of infections.

The incidence of healthcare infections have been reported from the advanced countries, and much higher from the over-crowded hospitals. Even, in the cases, when there is no obvious evidence of hospital-acquired infection in patients hospitalized, there is a marked change in patients microbial flora. In such individuals, the normal flora is replaced by the drug-resistant micro-organisms, prevalent in the hospital environment [3,4,5]. Hospital-acquired infections are also called 'Nosocomial infections'. These include all such types of diseases that are developed in the patients during their hospitalization, particularly the ones, which the patients didn't suffer from formally or at the time of admission. Such infections may become evident while the stay of patients in the hospital itself or after their discharge [6].

The present article emphasizes on the critical study of some common hospital-acquired infections , their agents and control strategies.

2. Common 'Hospital-acquired infections'

Nosocomial infections have been classified into 13 types, with 50 infection sites, as according to the National Healthcare Safety Network with Centre for Disease Control (CDC). The common sites of infection are soft tissues, surgical wounds, urinary and respiratory tracts and intestinal sites [7].

The common types of Hospital-acquired infections may be categorized as follows:

- **Wound infections**
  Wound infections include delayed wound healing or abscess in stitches, other skin infections and cracks due to exogenous pathogens. Surgical wound infections occur due to the complexity and duration of surgery, and weak health of the patient. Most wound infections manifest within a day or in a week of surgery. Patients own micro-flora, personnel in the operating room, and the environment at the time of surgery are responsible for contamination of surgical wound. *Staphylococcus epidermidis, Streptococcus pyogenes,* and *Clostridial* species are generally known to cause wound infections. It has been reported that about 50% of wound infections become apparent after discharge from hospital due to shorter post-operative stays. Non-surgical sites of wound infections include ulcers, burns and 'cuts'. Infection in burns is caused by *Pseudomonas aeruginosa.* In case of gastrointestinal or urinary tract surgery, wound infections are caused by Gram-negative bacilli, such as *Escherichia coli.* The common clinical features observed in surgical wound infections are localized pain, swelling, redness and discharge. Infection severity leads to fever within 2-4 weeks of surgery. Antibiotic help in superficial healing of wound infections. Deeper organ or tissue infections are cured by surgical drainage and antimicrobial therapy [8]. Tetanus as hospital-acquired infection, can be prevented by administering toxoid in low immune patient [9].

- **Urinary tract infection due to Catheterization :**
  The infections manifested by the catheter, when in place, or after its removal are known as catheter-associated infections. Urethra, bladder and the complete urinary tract gets infected due to the easy entry of micro-organisms , and also the inner lining gets injured from erosions and trauma. Catheterization also leads to fever and pericatheter discharge. The usual symptoms of UTI are seen after the removal of catheter. The pathogens causing such infections

are *Escherichia coli,* and the hospital-acquired microbes such as Methicillin-resistant *Staphylococcus aureus* (MRSA) and Antibiotic-resistant bacilli. When the symptoms of urethral discomfort increases, the catheter should be removed, followed by diagnose with urine culture and antibiotic treatment. If the catheter be kept in place, the antibiotic therapy should be provided, although the risk of micro-organisms persists.

- **Infections related to Intravenous Cannulas**
  The use of an intravenous Cannula often result in localized or systemic sepsis. Skin micro-organisms stick to the cannula and gain entry into tissues and circulation, thereby causing bacteraemia. The infection causing skin flora is either patients' own flora or hospital-acquired organisms. The infected area indicates redness, tenderness and pus at the site. Localized phlebitis with pain results due to acute infection. Systemic sepsis with fever and hypotension are other outcomes. If these signs are developed in the patient, then the intravenous cannula should be removed, and culture of discharge, pus and blood are taken for the proper case report. Infants and children suffering from diarrhea, usually get infected due to the easy access of pathogens through 'cut-downs' in the leg veins. Many children thus, often die in the hospitals due to septicemia. Oral anti-staphylococcal antibiotic therapy, surgical drainage and intravenous antibiotic therapy is followed for the treatment of the infection [10].

- **Respiratory infections**
  Impaired respiratory mechanisms in unconscious state of patients, and also when kept on ventilation and other instrumentation, lead to the varied kinds of respiratory infections. Nosocomial pneumonia, lung infection, etc., are some of the commonly occurring ones, which become more risky in those with pre-existing cardiac disorders. Multi-drug-resistant *Staphylococcus aureus* and bacilli of Gram-negative strain are the common infection-causing agents. Post-ural drainage and antibiotic therapy in such infections, is known to give satisfactory management.

3. Microbial Agents of Hospital Infections

There are many micro-organisms responsible for the hospital-associated infections. Gram-negative and Gram-positive bacteria contribute to the maximum incidences of infections in hospitals. Other causative microbial agents are some parasitic protozoans, viruses, fungi and yeasts [11]. Patients may be considered infected if these pathogens dwell in body fluids and sterile body sites [12]. Some of the most important nosocomial agents are as under:

- ***Staphylococcus* species :**
  Staphylococcus aureus and *Staphylococcus epidermidis* are the immotile and anaerobic bacterial pathogens. They dwell in nasal passages. Their infections include the membrane and cell damages, causing lesions. The toxins of *Staphylococcus* cause food poisoning and skin problems. Skin or physical contact is the mode of transmission. *Stophylococci* species are the causative agents of high frequency of hospital infections, hence called 'Hospital *Staphylococci*'. The species of *Staphylococcus* are drug-resistant too. They are either Penicillin-resistant or Methicillin-resistant due to the presence of certain specialized enzymes [13,14]

- ***Clostridium species :***
  Clostridium tetani and *Clostridium difficle* are the bacterial species that cause many dust and waste-related infections. The species find their way into the body systems through the wounds. They are responsible for muscular, respiratory and digestive disorders. When the tetanus spores spread in the body, then death is the ultimate. Colitis and diarrhea are the infections of common occurrence by the species of *Clostridium*. Transmission occurs through improper treatment of hospital equipments and instruments.

- ***Pseudomonas aeruginosa :***
  The patients with impaired immunity fall prey to the antibiotic-resistant species of *Pseudomonas,* significantly, *Pseudomonas aeruginosa.* It is Gram-negative bacterial species and spread infection fast because of their successful survival and multiplication rate at low temperatures. This microbial agent is known to cause urinary tract infections, bacteremia, fibrosis, pneumonia and wound infections [15].

- ***Klebsiella pneumonia :***
  Another Gram-positive bacillus, causing infections in hospitals, is *Klebsiella pneumonia.* This bacteria dwells in pharynx, respiratory passage, gastrointestinal tract and skin. The infections caused by *Klebsiella pneumonia* are skin diseases, wound infections, septicemia and pneumonia. The transmission of the pathogen is facilated by ventilators and catheters, through exposed wound and physical contact [16].

- ***Escherichia coli :***
  One of the anaerobic and Gram-negative bacteria, *Escherichia coli,* is the most common hospital-associated microbe. It parasitizes the intestine of animals and human beings. The popularly known nosocomial infections caused by *Escherichia coli* are pneumonia, neo-natal meningitis, gastric and digestive disorders, and above all urinary tract infections [17].

- ***Enterococcal* species *:***
  The significant antibiotic resistant species amongst the nosocomial pathogens is *Enterococcus*. They are Gram-positive and anaerobic microbes causing blood-borne and urinary tract infections. Being drug-resistant microbe, *Enterococcus* are mainly vancomycin-resistant. These are also resistant to penicillin, tetracyclines and ampicillin [18,19]

- **Other Nosocomial pathogens :**
  Entamoeba histolytica, different *Trypanosomal* and *Plasmodium* species are the Protozoan pathogens that cause many of the nosocomial infections. Yeasts, moulds, fungi and viral species are also microbial agents of health-associated infections [11]

4. Prevention and Control Strategies for Hospital-acquired Infections

The usual practice of implementation of measures for prevention of hospital-acquired infections is strictly followed as merely a spasmodic exercise, during an outbreak. Pathogens with resistant ability make it very difficult to devise any proper plan or strategy for control [3]. However, recently a number of control strategies have been framed out in reducing the incidences of hospital infections. The various prevention and control measures for HAI is reviewed as follows :

a) Control Interventions for Surgical Infections

- **Prophylaxis during operative vaginal delivery :**
  In comparison to the spontaneous vaginal delivery, the increase in incidence of infection has been reported in operative vaginal delivery. Vacuum and forceps used during the process are responsible in increasing infections. The safety of antibiotic prophylaxis is, therefore, necessary in reducing such infections.
- **Prevention methods for Post-caesarean section-infections :**
  Incidences of infections is higher for Caesarean section than for the vaginal birth. The use of proper methods and effective agents in skin preparation prior to the operative process may prevent post-caesarean infection to a great extent.
- **Preventive measures for infection after liver transplantation :**
  Infections that increase mortality, morbidity and overall transplant costs after liver transplantation include bacterial sepsis and wound complications. Use of suitable antibiotics and operative precautions can prevent the wound infections and sepsis. Also, the stretchful stay at hospital could also be avoided, thereby protecting from further nosocomial infection.
- **Prevention of Post-operative infection after appendicectomy :**
  Appendicitis is the serious abdominal problem. The surgical intervention to remove it, give rise to post-operative infection, such as wound infection and intra-abdominal abscess, that is very harmful for the patients, often resulting in death. This can be prevented by the use of effective antibiotics and skin preparation, as compared to placebo or no precautionary treatment in patients undergoing appendicectomy.
- **Antiseptic prophylaxis for surgical-site infections :**
  The usual surgical procedures involve the cuts and wounds during surgery and transplants, with use of different instruments. The carelessness in treatment and sterilization of such instruments, as well as the invasion of pathogens through the wounds, are responsible for high incidences of infections. The methods of prophylaxis must include pre-operative bathing or applying antiseptic wash on the skin at the surgical-sites. This will reduce skin microflora / bacteria, and hence lower the incidence of hospital-acquired surgical site infections. Using of plastic adhesive drapes protect the surgical site from the infectious micro-organisms present on the surrounding skin.

b) Interventions to prevent hospital-acquired infections

- **Preventive measures for respiratory tract infections:**
  Increased incidences of Nosocomial pneumonia and other respiratory tract infections in intensive care unit (ICU) are responsible. Selective decontamination of the digestive tract (SDD) is popularly known for the prevention of respiratory tract infections. Overall mortality in adults in ICU is also controlled. Ventilator-associated pneumonia is the serious respiratory disorder in the patients who are already critically unwell. Oral hygiene care and proper expelltion of respiratory secretions are the effective measures in reducing the mortality. Antibiotic prophylaxis, short stay in ICU and reduced span of mechanical ventilation, also prove to be beneficial.
- **Control measures for urinary tract infections :**
  The catheter-associated urinary tract infections arise in people requiring long-term bladder draining. About 80% of urinary tract infections acquired in hospital are associated with the use of urinary catheters. People who have invasive urodynamic symptoms also develop urinary tract infections and bacterial presence in the urine or blood. In all such cases, certain catheter policies determined and followed religiously, as well as, the use of prophylactic antibiotics and hygiene regimens, may control the urinary tract infections.
- **Antibiotic treatment for diarrheal infections :**
  The micro-organisms causing digestive and intestinal ailments may result in diarrhea and colitis. *Clostridium difficile* is the pathogen for the frequent occurrence of diarrhea. Antibiotic therapy is the best preventive measure for the infection.

c) Interventions to prevent Antibiotic-resistance infections

- The widespread antibiotic use has led to the increased antibiotic-resistance infections. Methicillin-resistant *Staphylococcus aureus* (MRSA) is the most common hospital-acquired pathogen in hospitals all over the world. Increased risk of such infections is observed in the nursing homes for older people, where MRSA find the environment suitable for fast transmission. Minimizing the selective pressure of antibiotics, and abiding by the policies and practices of control strategies have proved useful in prevention of antibiotic-resistant infections. Incidences of nasal carriage of *Staphylococcus aureus* account for specific infections. Use of certain nasal drops and ointments like mupirocin also have known to reduce infections. The use of variety of antibiotics in animal husbandry, such as avoparcin, has known to be the growth promoter in the development of vancomycin-resistant *Enterococci* in humans. Prohibition in veterinary use of this antibiotic, and hygiene measures has been found effective in lowering down the infection incidences [20].

d) Interventions to improve Behavior and Hygiene conditions

- **Hand and Health hygiene improvements**
  Healthcare-associated infection may be prevented to a great extent by primarily improving the hand and health hygiene conditions. Proper washing and cleaning of hands, and strictly following the hygiene measures, account for reducing the hospital-acquired infections. This results in fast recovery in the health of the patients. Sir William Oslers' statement that "Soap, Water and Commonsense are

the best disinfectants", applies best in today's context of hospital infection.

- **Improvement in guidelines for prevention of device-related infections**
  The use of invasive medical devices, such as urinary catheters, mechanical ventilators, pumps, intravenous cannula etc., often become the risk factors for HAIs. The guidelines should be improved and followed religiously about the sterilization and post-operative treatment / disinfection methods of the medical devices used.

- **Inspection and Infection control systems in Healthcare settings**
  'Infection control team' should be every hospital's major inspection body. The healthcare specialists, microbiologists, medical and nursing staff, and hospital administrators constitute such control team. The inspection systems work to promote healthcare quality by bringing about improvised changes in organizational structures and processes. This helps in investigating and controlling of outbreaks periodically. The healthcare team function in formulating appropriate guidelines for admission, nursing and treatment of infectious patients. Also the standards and behavior of healthcare professional can be improved by proper training on sterilization, disinfectant practices, antibiotic policies, immunization schedules, and educating patients and hospital staff on infection control.

e) Surveillance

Surveillance is a part of health control program, and accounts for the data related to infected individual with their infection sites. Such data may prove helpful if hospital management works on it, thereby controlling the incidences of infections. This attempt may be carried on by evaluating the efficacy of treatment. The findings, then help to follow infection control practices. Surveillance should be considered strictly for the inpatient surgical wound infections and post-discharge status, in the patients discharged earlier. Surveillance system should also include infections occurring in home-nursing setting conditions too. Diabetes and Obesity, have been recently reported to be independent factors of prediction of surgical site infection in same surgery [9,21].

f) Routinary Surveillance and control team

The most important of the strategy includes day-to-day surveillance in both, hospitals and the community as well. The hospital personnels and infection control staff may follow surveillance discussion about any practice not controlled satisfactorily.

g) Molecular Surveillance

The recent method in hospital infection surveillance is the use of molecular methods. It helps to identify the organisms and thereby make evident the incidence and nature of the out breaks. Some endemic or MRSA infections are infact, a series of mini-outbreaks, that has been confirmed by molecular surveillance [22, 23]

h) Biomedical Waste Management

Hospital waste, also called, Biomedical waste, constitute any waste generated during health care, testing or related procedures, research on human beings and animals, conducted in hospitals and laboratories. The hazardous agents infect the patients, their visitors, hospital personnel and the people, in general. If left untreated, the biomedical waste would decay, ferment and make the place unhygienic, leading to the outbreak of many bacteria and other pathogens. The biomedical waste also contains needles, broken glass, slides, etc., that can cause injury and infection. If not managed carefully, biomedical wastes can be serious pollutants of soil, water and air. Several methods of waste treatment, in order to minimize the incidences of infections, need to undergo through the process of disinfections. These -include chemical disinfection, incineration, autoclaving, and appropriate treatment of liquid waste with disinfectants before their disposal.

5. Discussion and Conclusion

The hospital-associated infections appeared long before the origination of hospitals. This spread fast as the health problem during antibiotic era. These infections led to the increase in the cost of the antibiotics and their use as well, with an extended hospitalization. This elevated the incidences of morbidity and mortality. The world-wide survey reports show that more than 40% hospitalizations with nosocomial infections were found in Latin America, Asia and many parts of Africa. In North America and Europe, on the contrary only 5%-10% of all hospitalizations result in nosocomial infections [24]. The incidence of health-associated infection in the patients is between 5%- 10% during their admission. The larger and over-crowded hospitals showed the highest rates of such infections [4]. The United States also showed the increased rates of hospital-acquired incidences [22].

According to National Healthcare Safety Network with Center for Disease Control (CDC) for Surveillance, the common nosocomial infection sites showed a shift with time. It is due to the frequent use of chemotherapy, organ transplantation and immunotherapy methods, advanced diagnostic and therapeutic techniques. The elevated prevalence of pneumonia cases from 17% - 30% in the past few years is the perfect example [25].

Amongst all the infection causing microbes in health-care settings, bacteria are known for the highest percentage (about 90%) of infections. Protozoans, fungi and viruses are responsible for lower incidence of nosocomial infections as compared to that of bacterial infections [11]. Out of many pathogenic *Enterococci, Pseudomonas aeruginosa, Staphylococcus aureus* and *Escherichia coli* majorly contribute to the hospital-acquired infections [26]. *Escherichia coli* cause UTI[27], and *Staphylococcus aureus* is responsible for many other body infections, including blood-borne diseases. *Staphylococcus* is the most common drug resistant bacteria [21]. One-tenth of all infections are reported to be caused by *Pseudomonas aeruginosa* [12].About 4-5 decades back, *Escherichia* and *Klebsiella* species were responsible for most of the health-associated infections. But in the following years, *Pseudomonas* and *Acinetobactes* species elevated clinical problems [28].

Surveillance and strategies contribute in effective infection control and prevention of hospital-acquired infections. The control strategies, primarily, involve the measurement of

infection rates in different healthcare settings. For this, which is quite a difficult task, it is important to know the species of micro-organisms involved, and the accurate site too. Necessarily, the strategies followed must efficiently prevent both development of antibiotic resistance and spread of resistant organisms. Various guidelines for sterilization and disinfection of invasive devices and surgical instruments used, may help in control of nosocomial infections. The guidelines, in such a string, were devised in 2009, in order to prevent catheter –associated UTI [29]. Training of health-care professionals is extremely important for the control and prevention of infections. Many preventive strategies include timely hand washing, antimicrobial and aseptic techniques, minimal use and early removal of invasive devices, and short hospital stay. However, the control attempts of hospital-acquired infections would be fruitful only when the gap between the existence of guidelines and their actual implementation is bridged [30,2].

References

[1] Krishna Prakash S. **(2014)**. Nosocomial infection – an overview. http://www.researchgate net/publication/18951524.
[2] Brusaferro S, Amoldo L, Cattani G, Fabbro E, Cookson B, Gallagher R, *et al.,* **(2015)**. Harmonizing and supporting infection control training in Europe. *J Hosp Infect.* 89(4) : 351-356
[3] Obiero CW, Seale AC, Berkley JA. **(2015).** Empiric treatment of neonatal sepsis in developing countries*Pediatr Infect Dis J.* 34(6) : 659-661.
[4] McLaws ML, Gold J, King K, *et al.,* **(1988)**. The prevalence of nosocomial and community-acquired infections in Australian hospitals. *Med J Aust.* 149 : 582-590.
[5] Henderson DK. **(1995)**. Principles and practice of infectious diseases. *Churchill Livingstone*. 4th ed. New York
[6] Hassan Ahmed Khan, Aftab Ahmad, Riffat Mehboob. **(2015).** Nosocomial infections and their control strategies. *Asian Pac J Trop Bio Med.* 5(7) : 509-514.
[7] Raka L, Zoutman D, Mulliqi G, Krasniqi S, Dedushaj I, Raka N, *et al.,* **(2006)**. Prevalence of nosocomial infections in high –risk units in the university clinical center OF Kosova. *Infect Control Hosp Epidemial.* 27(4) : 421-423
[8] Mitchell DH, Swift G, Gilbert GL. **(1999)**. Surgical wound infection surveillance : the importance of infections that develop after hospital discharge. *Aust NZJ Surg.* 69 : 117-120
[9] Spelman D, Russo P, Harrington G, *et al.,* **(2000)**. Risk factors for surgical wound infection and bacteremia following coronary artery bypass surgery. *Aust NZJ Surg.* 70 : 47-51.
[10] Pearson ML, **(1996)**. Hospital Infection Control Practices Advisory Committee. Guideline for prevention of intra-vascular device related infections. *Infect Control Hosp Epidemiol.* 17 : 438-473.
[11] Gatermann S, Funfstuck R, Handrick W, Leitrirz L, Naber KG, Podbielski A, *et al.,* **(2005)**. MIQ 02 : Urinary Tract Infections : Quality standards for microbiology infections 8-21 *Urban & Fischer,* Munchen German.
[12] Murray PR, Rosenthal KS, Pfaller MA. **(2005)**.Medical Microbiology. *Mosby Inc.* Missouri. 5th ed.
[13] Fridkin SK. **(2001).** Vancomycin-intermediate and resistant *Staphylococcus aureus :* what the infectious disease specialist needs to know. *Clin Infect Dis.* 32 : 108-115.
[14] Vandenesch F, Lina G, Henry T. **(2012).** *Staphylococcus aureus* hemolysins, bi-component leukocidins, and cytolytic peptides : A redundant aresinal of membrane-damaging virulence factors ? *Front Cell Infect Microbiol.* 2 : 12.
[15] Balasoiu M, Balasoiu AT, Manescu R, Avramescu C, Lonete O. **(2014)**. *Pseudomonas aeruginosa* resistance phenotypes and phynotypic highlighting methods. *Curr Health Sci J.* 40(2) : 85-92.
[16] Lin YT, Wang YP, Wang FD, Fung CP. **(2015)**. Community-onset *Klebsiella pneumoniae* pneumonia in Taiwan : Clinical features of the disease and associated microbiologist characteristics of isolates from pneumonia and nasopharynx. *Front Microbiol.* 9 : 122.
[17] Lausch KR, Fuursted K, Larsen CS, Storgaard M. **(2013)**. Colonisation with multi-resistant *Entero-bacteriaceae* in hospitalized Danish patients with a history of recent travel : A cross-sectional study. *Travel Med Infect Dis.* 11(5) : 320-323.
[18] Karti S, Leder K, Cheng AC. **(2015).** Should we continue to isolate patients with Vancomycin-resistant enterococci in hospitals ? *Med J Aust.* 202(5) : 234-236.
[19] Kafil HS, Azgharzadeh M. **(2014)**. Vancomycin-resistant *Enterococcus faecium* and *Enterococcus faecalis* isolated from education hospital of Iran. *Maedica (Buchar).* 9(4) : 323-327.
[20] The Joint Expert Technical Advisory Committee on Antibiotic Resistance (JETACAR). **(1991)**. The use of antibiotics in food-producing animals : antibiotic-resistant bacteria in animals and humans. Canberra : Office of National Health and Medical Research. Accessed Aug. 2005.
[21] Kavangh KT, Calderon LE, Saman DM. **(2015)**. View point : a response to "screening and isolation to control methicillin-resistant *Staphylococcus aureus* : sense, nonsense, and evidence". *Antimiorob Resist Infect Control.* 4:4.
[22] Hacek DM, Suriano T, Noskin GA, *et al.,* **(1999)**. Medical and economic benefit of a comprehensive infection Control program microbial clonality. *Am J Clin Pathol.* 111 : 647-654.
[23] Ward PB, Johnson PDR, Grabsch EA, *et al.,* **(2001)**. Treatment failure due to methicillin-resistant *Staphylococcus aureus* (MRSA) with reduced susceptibility to vancomycin. *Med J Aust.* 15 : 480-483.
[24] World Health Organization. **(2002)**. Prevention of hospital-acquired infections : a practical guide World Health Organization. Geneva Accessed in Feb 2015.
[25] Duque AS, Ferreira AF, Cezario RC, Filho PPG. **(2007)**. Nosocomial infections in two hospitals in Uberlandia, Brazil. *Rev Panam Infectol.* 9(4) : 14-18.
[26] Horan TC, Andrus M, Dudeck MA. **(2008)**. 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.* 36(5) : 309-332.

[27] Shinagawa N, Taniguchi M, Hirata K, Furuhata T, Fukuhara K, Mizugucwi T *et al.,* **(2014)**. Bacteria isolated from surgical infections and its susceptibilities to antimicrobial agents special references to bacteria isolated between April 2010 and March 2011. *Jpn J Antibiot.* 67(5) : 293-334.
[28] Gordan RJ, Lowy FD. **(2008)**. Pathogenesis of methicillin-resistant *staphylococcus aureus* infection. *Clin Infect Dis.* 46 (Suppl 5) : S350 S359.
[29] Stone PW, Herzig CTA, Pogorzelska-Maziarz M, Carter E, Bjarnadottir RI, Semeraro PK. **(2015).** Understanding infection, prevention and control in nursing homes : a qualitative study. *Geriatr Nurs.*
[30] Pegram A, Bloomifield J. **(2015)**. Infection prevention and control. *Nurs Stand.* 29(29) : 37-42.