**Review Article**

# Methods of Preventing Hospital Acquired Infection

Felor Javadi Bashar*

*MSc (Mal), BSc (IR)*

**Corresponding Author:** Felor Javadi Bashar, E-mail: felor_javadi@yahoo.com

## ARTICLE INFO

## ABSTRACT

Hospital-acquired infections can increase the rate of morbidity and mortality as well as medical costs. Nosocomial infection is spread by various ways such as surgical, intravenous catheters, surface contact (like as hands) and also through the air. Some interventions include appropriate hand and surface decontamination, sufficient staffing, improved ventilator management, usage of coated central venous and urinary catheters have all been linked with considerably lower rate of nosocomial infection. Multiple interventions simultaneously are required for comprehensive infection control and multiple actions may be given better outcome rather than a single action. Some multiple infection control protocols will possibly show more effective result instead of employing a single or few strategies. Several non-pharmacological interventions to prevent HAIs will reduce the requirement for prolonged or multiple-drug antibiotic courses for infected patients. And lower antibiotic usage will decrease risk of antibiotic-resistant organisms and may improve effectiveness of antibiotics therapy to patients with acquired infections.

## INTRODUCTION

Hospital acquired infection (HAIs) are the significant reason of morbidity and mortality every year all around the world either in developed or developing countries. Only, in the USA HAIs are major cause of 1.7 million infections and 99 000 deaths annually (Curtis, 2008). According to Hospital Association Survey, estimated yearly rate of deaths because to this type infection in USA in 2002 was 98 987 and 18 650 patients died in 2005 in the USA due to nosocomial infections (Curtis, 2008). World Health Organization (WHO) has estimated 400,000 cases of nosocomial infections in Malaysia in 2010, average of 13.9 percent of the total health setting admissions.

However, it seems, obtaining an exact rate of deaths due to nosocomial infections when patients die because of various reasons and for patients who die of chronic disease often infection may not be stated on death. In addition, treatment and any intervention of HAIs are quite overpriced and cost estimates of nosocomial infections might be varied.

Reducing of HAI is a crucial aim of the health care. A lot of recent research has been done dealt with the requirement for better antibiotic as well as more practical diagnostic methods to identify infections initially. Appropriate pharmacological management and earlier diagnosis plays key role in reduction morbidity and mortality from hospital-acquired infections (HAIs). Nevertheless, many non-pharmacological interventions can be considerably useful to diminish the incidence of this type of infection, but most of the time these interventions ignored in practice.

HAIs can be spread by various ways such as surfaces particularly hands, water, air, intravenous and oral routes and via surgery. Main non-pharmacological interventions regarding to this priority include exclusive suggestions in related to hospital acquired infection surveillance, carrying out a national hand hygiene procedure, appropriate use of gloves, clean surface, healthier nutrition, adequate staff nurses, management ventilator in applicable way, coating central venous and urinary catheters and continuing training and education programs. Several infection control methods and approaches simultaneously may be offered the greatest opportunity for reducing incidence of HAIs. Majority of these strategies might be more than paid for themselves by saving the costs of medical related to HAIs. Non-pharmacological treatment for prevention of HAIs will diminish the requirement for prolonged or various antibiotic

usage that lead to reduce risk of antibiotic-resistant organisms.

This review is not comprehensive and will not try numerical data analysis but planning to examine available studies regarding to non-pharmacological intermediations for reduction nosocomial infection. In this review was attempted to review some studies in order to better comprehend the crucial features and structure of a perfect infection control and following program. It will also provide briefly an explanation of the mortality, morbidity and medical budgets related to HAIs, beside with a short discussion about common routs of transmission HAIs. Moreover, it underlines some areas that essentially need to improve and provides more recommendations regarding to those changes.

## Method

A bibliographic search between 2004 and 2013 was conducted in databases. CINAHL, Google Scholar, Medline and Sciencedirect databases were researched for this review paper. It involved either qualitative or quantitative review publications, which is involved published reports and some ideas with English language in previous years. Most Key search terms were used included nosocomial and hospital acquired infection; infection control, hand washing, ventilator associated pneumonia, hospital cleaning, urinary tract and central venous line infection and isolation. Total number of articles that included in this review was 30 articles.

## RESULTS

### Routes for Transmission HAIs

Typically, it has been considered that nosocomial infections cannot spread by air. Although, most of HAIs are spread by surgical, intravenous catheters, surface contact (like as hands) and also large percentage of HAIs are spread through the air. Previously, it was seemed that majority of pathogenic bacteria could not spread long distances to contaminate patients. Many of pathogenic bacteria can survive but are not culturable, and just some of them are viable as well as culturable (Beggs, 2003).

Thus, according the results of some studies it can conclude that huge number of nosocomial bacterial infections may be transmitted by contact specially hands or by intra venous routes as well as through the air. Hospital contaminated water is another important source of some bacteria and viruses and this issue is very important to prevent infection due to viability of this type of pathogens. These pathogens are able to grow in various sources of hospital water such as water usage for drinking, taking shower, washing hand, dialysis and so on. Annually, huge numbers of patients die due to waterborne nosocomial infections. In fact, legionella is main cause of hospital-contaminated water, which may persist for years (Garcia-Nuñez, Sopena et al. 2008).

Additionally, infections may be spread to patients by either drugs and intravenous solutions or clear-out solutions and foodstuffs. Another vector of spread infection is infected environmental surfaces for instance bedside rails (Otter, Yezli et al. 2011).

Remaining section of this review will be concentrated on some critical non-pharmacological interventions to prevent infection and reduce prevalence of nosocomial infection. Additionally, some recommendation will be suggested for making these interventions more effective. Nevertheless, for evaluate the value, cost and efficiency of this type of intervention rarely few researches were done and published.

### Prevention of Ventilator-associated Pneumonia

Ventilator-associated pneumonia (VAP) is one the frequent type of (12—33.8%) hospital-acquired infection in all area especially in critical care settings (Karhu, Ylipalosaari et al. 2011). Reduction of this type of infection could diminish costs and can influence positively on patient's outcomes and patient safety as well as patient's quality of care (Marra, Cal et al. 2009).

However, usage of appropriate antibiotics is the foundation to treat ventilator-associated pneumonia (VAP), various non-pharmacological interventions are offered which may be considerably reduced risk of this type of hospital acquired infection's incidence. Some valuable methods of reduction risk of VAP are as below according to Isakow and Kollef 2006:

- Preventing tracheal intubation when using of non-invasive positive pressure ventilation is possible.
- Elevation the head of patient's bed and place patient in semi setting position between 30- 45. This intervention may be reduced the rate of aspiration that lead to VAP.
- Trying to use of enteral feeding instead of parenteral feeding if it is possible.

### Prevention of Central Venous Line Infection

Some of interventions considerably prevent central venous catheter (CVC) infections. First, CVC should not be used when it is not essential. If CVC was inserted, would be removed as soon as possible because longer catheterization periods remarkably enhance rate of infection particularly bloodstream infection (Safdar and Maki 2011). Some studies showed that appropriate usage of precautions intervention such as sterile methods to insert CVC, use of mask and cap, use of long sleeved sterile gloves and sterile sheet drape during procedure is associated with a drastically minor rate of bloodstream infections in comparison to ordinary guideline is used. Moreover, researches also have discovered that these types of precautions are extremely cost effective due to save costs of HAIs (Hu, Lipsky et al. 2004). According to other research's reports, insertion of subclavian central venous is significantly safer than femoral insertion because of the lower rate of infection. Also applying chlorhexidine-containing solutions as antiseptic for preparation the CVC area is associated with lower rate of bloodstream infections after catheterization (from 5.31 to 0.69 cases per 1000 CVC-days P<0.05) in comparison to use of others solutions as antiseptic (Popovich, Hota et al. 2009).

A huge research was concluded that multiple interventions simultaneously ('bundling') could be the perfect strategy to prevent CVC-related infections (Safdar and Maki 2011). Another way that may be meaningfully reduced the risk of CVC infection is using of coated CVCs with chlorhexidine, silver sulfadiazine with odds ratio 0.16 [95%CI

0.04-0.64]) (Novikov, Lam et al. 2012). Moreover, program in ICUs related to hand washing before CVC insertion, using of chlorhexidine to clean skin, to avoid the femoral vein and the use of unessential catheters may be reduce the risk of infection.

Patients involve in haemodialysis are vulnerable to nosocomial infections particularly gram-negative bacteria and candida due to temporary catheters. They are at important risk for hepatitis C as well that can be reduced by using of separate haemodialysis equipment for HCV and HCV positive patients, appropriate use of glove and further precautions ways by health care provider, cleaning and disinfection devices properly, using of disposables equipment as much as possible and reprocessing after using (Thompson, Novak et al. 2009).

### Prevention of Urinary Tract and Catheter Infections

According to many studies, almost 80 -95% of urinary tract infections is due to f urinary catheters. Urinary catheters should not use just if essential and should remove as soon as possible (Doyle, Mawji et al. 2001). Some researchers have concluded that we can decrease the rate of infection by removing urinary catheters as soon as practicable. The main cause of urinary infection has been associated to inappropriate hand washing and insignificant aseptic methods to clean urinary meatus area before and after inserting and maintaining the catheters. However, researches have indicated that using of systemic antimicrobials, sterile packing catheter junctions and tubes, applying silver alloy or silver hydrogel-tipped for cleaning can prevent urinary infection dramatically (Hooton, Bradley et al. 2010). Results of other studies have indicated that usage of nitrofurazone-coated catheters may be linked with 0.5-32% reductions in urinary tract infection (Beattie and Taylor 2011).

### Prevention of Surgical Wound Infections

Approximately, 2% of all patients after surgery will develop an important infection at the wound area and surgical site infections are the most frequent HAIs with 20% (Lissovoy, Fraeman et al. 2009). Whereas, antibiotics have a vital role to prevent and treat surgical infections, several other factors are also significant to control infections after surgery. Most of the surgical infections are linked with long time operation, contaminated procedure, or insufficient scrubbing techniques. Recently it has been reported that clipping hair of the surgical sites is much better than shaving for prevention infection (Cheadle, 2006).

Additionally, some researchers have found that cleaning surgical area with chlorhexidine alcohol group is more effective (9.5%) in compared with traditional antiseptic methods including iodine compounds (16.1%) (Darouiche, Wall et al. 2010).

Another way to reduce significantly rate of surgical infection is warming patients during surgery as well as before surgery. It seems, warming may be improved immune function and blood circulation (Wick, Hobson et al. 2012).

Furthermore, retrospective analysis has suggested that generally laparoscopic surgery is safer than open surgery due to lower rate of infection (0.5% vs 1.8%) as well as further complications. In fact, surgeons can perform laparoscopy instead of open surgery for some abdominal procedures such as cholecystectomy, appendectomy, peptic ulcer surgery and so on (Varela, Wilson et al. 2010).

### Hand Decontamination

From many researches it has been concluded that hand washing is the very effective technique to prevent spread infection in hospital (Wu, Lee et al. 2012). Despite of importance of hand decontamination, numerous evidences have been provided that hand washing is not done well by health care workers specialty nurses.

Some studies in intensive care unit showed that hands generally were washed less than half of all contacts with patients and additionally it was apparent that hands were cleaned rarely intervals rather than following by most heavy contamination activity such as handling a bedpan. Therefore, rates of acceptable hand decontamination between healthcare professionals typically range from just about 20 to 50% per patient contacts, while some researches have proven hand washing rates as high as 81% (Boyce and Pittet 2002).

On the other hand, health care worker most of time prefer applying alcohol based cleaners rather than water and soap. Using of alcohol-based solution instate of antiseptic soap has some advantages such as time saving, less abrade and less skin irritation. Some complain were also made including dry out and crack skin due to use of this type of cleaners (Marra, Camargo et al. 2012).

There are some variables that can be affected on frequency and correctness of hand washing specialty among nurses who are working in intensive care units. The most significant factor is nursing workload. However, few studies have been published about the impact of nursing workload on the appropriate performance of hand washing. Another factor is Knowledge. The effect of knowledge on the infection-control behaviors have been overlooked in prior studies, maybe because very few evidence is accessible regarding nurses knowledge related to infection control. Inadequate resource for performance hand washing is another variable that has not been studied previously (Jackson, Lowton et al. 2013).

Many of the researches considered clinical setting as variable that influence the hand decontamination. However, there is no clear evidence that education develops performance regarding infection control or decreases rates of infection, especially in the long-term (Ward, 2011).

### Gloves and Gowning

Epidemiological researches showed that appropriate usage of gloves plays major role to reduce cross infection. Gloves should be worn before patients encounter in order to hand contamination. However, it is not assured usage of which glove is the perfect way for infection control. Thus, some of them have mentioned that latex gloves are more effective in reducing penetration of virus and water rather than vinyl gloves. However, some of healthcare providers are shown allergies to latex such as respiratory reactions because of pow-

dered latex. Otherwise, using of nitrile gloves is safer barrier penetration but is high-priced and heavier as well than latex or vinyl gloves (Flores, Tuula Estlander et al. 2012).

Wearing gowns are common applied in rooms of patients with communicable illness. Result of some researches were conducted that statistics of nosocomial prevention and gowns wear are mostly sparse (Grant, Ramman-Haddad et al. 2006). Head covers and shoe are regularly suggested to use in zones containing surgical patients or immunocompromised. Though bacterial pathogens generally have been gathered from shoes, but researches in relation to use of this type covers and cross of infection has been meager (McGovern, Albrecht et al. 2013).

Various nosocomial pathogens may be presented on numerous items of healthcare workers including laboratory coats, stethoscopes, blood pressure cuffs, EKG electrodes, pens, finger rings, neck ties, artificial nails and ambulances. To avoid transmission of nosocomial infections, these things should be sterilized or cleansed frequently. One-use electrodes now exist. For restriction of cross infection, some equipment such as blood pressure cuffs or stethoscopes should be dedicated for each patient individual (PC Carling, MF Parry et al. 2008).

### Cleaning Techniques

Some studies mentioned that a correct cleaning technique is also significant activities to reduce risk of infections at hospitals. Cleaning after discharging of patients may be able to clean sufficiently clean, it means just 49% of the standardized surfaces that is less than 30% for whole room. Monitoring of cleaning worker's performance was recommended that could be lead to identify weakness of knowledge, practice relation to this issue, and provide more effective cleaning training (PC Carling, MF Parry et al. 2008).

The result of studies regarding the used germicidal bleach wipes to clean surfaces including floors, tables and walls has been effective. The result showed usage of bleach (hypochlorite) solution could reduce significantly the rate of infection. This intervention can decrease hospital-acquired infection incidence by 85% as well as prolonged the average time between HAIs cases from 8 to 80 days (Orenstein, Aronhalt et al. 2011).

### Health Care Providers

Insufficient nurse staffing might increase the rate of risk for infections (Kong, Cook et al. 2012). A US study tried to determine relationship between number of nursing staff and rates of hospital-acquired infections and nurse. The results (P < 0.05 for all comparisons) concluded that more number of nurses was associated with considerably lower levels of infections (Stone, Mooney-Kane et al. 2007). Nurses for undertaking this type of activity need to acquire sufficient knowledge, Skills and expertise. Actually, infection prevention behavior is linked with beliefs, values and social understanding of dirt and infection (Jackson, Lowton et al. 2013).

Constantly, clinical expertise and qualified practice are associated. Therefore, managers, healthcare provider and policy makers should be kept up-to-date on regulation, rules, guidelines in regarding to patient safety standards, as well as on clinical expertise and competency (Young 2009, Goeschel et al. 2010).

### Isolation the Common Way to Prevent Spread of Infection

Contact isolation commonly has been used for limitation the transmission of infection especially tuberculosis infection, hospital required infection, multidrug resistant organisms (MDROs) between patients. The estimation rate of hospital-acquired MRSA is considerably different around the world, although in some health care settings ranges is from 25 to 50% (Graham, Lin et al. 2006). In many hospitals, patients either with known or suspected to a specific infection are placed in contact isolation till are concluded not to have infection any more. The main purpose of isolation is attempting to prevent more spread of infection.

Additionally, the first experience of patients is quite critical to acceptance and participation in continuing care. Some researchers have shown that identifying the patients' experience of isolation can enable health care providers to enhance patients' quality of life and to promote adherence (Gonzalez-Angulo, Geldenhuys et al. 2013).

Some studies have indicated that the patient's experience of contact isolation by patients has either negative or positive outcomes. Isolation may be influenced negative psychological impact on patients such as depression, anxious and stress. In addition, patients also may receive substandard or poor care. In despite of disadvantages, it may be affected positively on patient's treatments by placing in noiseless and private rooms. All healthcare providers should look for methods for improving the patient's experience about contact precautions (Barratt and Shaban 2011).

Another impact of isolation on patients can be referred as social isolation due to segregation patients from others and restriction on social communications. Social limitations is included reducing contact with others, rarer visitors and few communication with health care workers, can be contributed feelings of aloneness, rejection and social isolation (Chua, Cheung et al. 2004).

Many studies have showed the quality of care among patients in isolation is dramatically linked with patient safety. Patients in isolation may be received less therapeutic care or rare access to treatment; they also are at higher risk of medical error. Most of these patients mentioned that they are not satisfied of the quality of their care (Abad, Fearday et al. 2010).

### DISCUSSION

Many non-pharmacological interventions play critical role to reduce prevalence of hospital-acquired infection, but many results have been showed that clinical practice is significant component as well as intervention. Generally, various interventions all have been known to considerably prevent nosocomial infection and reduce the rate of mortality and morbidity due to this type of infection. These studies also have indicated that non-pharmacological intervention in

terms of control infection is a precious way in order to reduction medical and clinical cost as well.

According to previous studies, multiple interventions are required for comprehensive infection control and multiple actions may be given better outcome rather than a single action. Some multiple infection control protocols will possibly show more effective result instead of employing a single or few strategies. It seems more studies should be done to identify the best and optimal method to control infection. However, it is challenging to identify effectiveness of single interventions while many protocols are employed simultaneously.

On the other hand, the rate of multidrug-resistant bacteria currently is increased and multiple non-pharmacological interventions can extensively reduce the rate of usage hospital antibiotics consequent reduction in the infection rate. Therefore, reduction in total antibiotic usage will decrease rate of antibiotic-resistant organisms and may increase effectiveness of antibiotics prescribed to patients who are suffering from nosocomial infections.

Results from some studies mentioned that patient awareness and knowledge about infection control strategies could strongly effect delivering intervention in order to prevent infection. Therefore, patient preferences demand to be combined into any patient educational and engagement strategy for reduction infection. Future researches should assess interventions to increase patients in related to this important issue should identify whether or not patients awareness is linked with risk of healthcare associated infection (Anderson, Ottum et al. 2013).

Furthermore, an ongoing improvement related to education and more effective performance strategies are genuinely essential. In fact, there is a strong relationship and association between the professional experience and knowledge scores. On the other hand, some barriers can impact this type of intervention to improve infection control including lack of skills and knowledge as well as guidance; procedure may be considered unessential, forgetfulness of personnel and lack of staff. For achievement the best result in clinical area, professional health car leaders should inform local practice and encourage discussion about prevention of hospital-acquired infections. They also should develop and reinstruct guideline as well as tools to reduce infection (Jansson, Ala-Kokko et al. 2013).

## CONCLUSION

Finally, much more support to prevent hospital infection is needed especially on the part of nursing, medical association, hospital managers, and advocacy groups, insurance association, media and public officials (Curtis, 2008). More researches and implementation in terms of infection control approaches should obviously be one of the main significance healthcare aims. Infection control team should be continued to be more evident and available in any health care setting in order to ensure the best practice. The challenge in the future is to apply powerful surveillance and effort to prevent and reduce the rate of healthcare associated infections.

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