CONTROL OF HEALTHCARE ASSOCIATED INFECTIONS: A CONCERTED EFFORT

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Nosocomial infection or Healthcare Associated Infections (HAI) is a significant problem in UK hospitals; recognized also as presenting a significant problem in terms of quality of care and cost for hospitals, governments and consumers in most countries. Although, many researchers and healthcare managers consider HAI as basically a medical issue, it is a result of inadequacies of the 'built environment' subjects as well. Research has confirmed that the healthcare environment is a secondary reservoir for organisms with the potential for infecting patients. It includes all the physical surroundings of patients and staff, i.e. structure, fittings, fixtures, furnishings, equipment and supplies. Poor facilities planning and arrangements facilitate the spread of infections in the healthcare setting. The paper describes FM functions to be considered in the control of HAI during design and construction stages and during building occupancy stage (maintenance). It also suggests that if HAI is to be reduced, it becomes important that infection control is "designed-in" at the planning and design stages of a healthcare-facility (new build or renovation project) meaning that designers, architects, engineers, facilities managers and planners will work in collaboration with infection control teams to deliver facilities in which infection control 'needs' have been planned for, anticipated and met. Therefore, on the whole, this makes tackling the problem of HAI a combination of professional efforts of both parties from the clinical side and non-clinical side.

Keywords: design and construction, facilities management, facilities planning, healthcare associated infection, infection control.

INTRODUCTION

Healthcare Associated Infections (HAI) are infections which are a result of treatment in a hospital or a healthcare service unit, also known as nosocomial infections. Infections are considered nosocomial if they first appear 48 hours or more after hospital admission or within 30 days after discharge (American Thoracic Society and Infectious Diseases Society of America 2005, Kollef *et al.* 2005, Shorr *et al.* 2006). Pittet *et al.* (2008) reported that HAI is a major threat to patients' safety and is known to affect a very large number of patients worldwide each year, it has a high potential for a detrimental impact on patients, their families and healthcare systems. At any time, more than 1.4 million patients worldwide in developed and developing countries are afflicted by healthcare associated infections (Pittet *et al.* 2008). Infection creates a fascinating interplay of biology between microbial populations and human populations, all of it heavily influenced by human behaviour; infection knows no boundaries across health and social care as bacteria travel with their human hosts, the behaviour of patients and healthcare professionals determines the risk of HAI and it is

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the key to its prevention and control (Duerden 2009). It has been established that HAI is a significant problem in UK hospitals, although, considerable research effort has been expended in this area, it is often too narrowly focused, which can lead to contradictory results (Gidney 2008).

In another vein, many researchers and healthcare managers consider HAI as basically a medical issue, it is a result of inadequacies of the 'built environment' functions as well, which should therefore attract professionals from many fields, Liyanage and Egbu (2004) explained that a careful consideration would suggest that Facilities Management (FM) has a vital role to play in the control of HAI; facilities availability, utilization, maintenance and suitability can greatly influence the clinical processes either directly or indirectly. Therefore, FM is an essential function in healthcare which helps to provide a well designed, well maintained, good quality, patient friendly environment in hospitals leading to improvement in the overall healthcare quality.

The National Health Service (NHS) in United Kingdom has had it rough with HAI, because of this it is in the limelight, scrutinized by the public. For example, 'Nursing Management' 2008 publication has an article titled "NHS organizations must comply with criteria on healthcare-acquired infections or face prosecution". (Duffin 2008). It states that NHS trusts may be prosecuted or prevented from providing services if they fail to meet new legal requirements for tackling HAI. In July 2004, the action plan towards cleaner hospitals and lower rates of infection was published and this set a target for a 50% reduction in MRSA bacteraemias (bacteria infections) in the NHS in England by 2008 (Department of Health 2004). The target has been achieved and records show that the first three quarters of 2008/09 showed a reduction of over 60% from the quarterly average in 2003/04. Yet, there should be no rest when it comes to HAI as new variants of microbial infections and worse, may emerge if and while this issue is handled with levity. Therefore, this review looks into Facilities Management functions with respect to infection control in healthcare facilities, highlighting the importance of the built environment in the control of HAI.

MICROORGANISMS: CULPRITS IN HAI

Many different pathogens may cause nosocomial infections. The infecting organisms vary among different patient populations, different health care settings, different facilities, and different countries (WHO 2002). Mainly they are bacterial, virus and fungi. The emergence of new microorganisms coupled with increasing bacterial resistance to antimicrobials (e.g. methicillin (an antibiotic)- resistant Staphylococcus aureus, Klebsiella spp. with extended-spectrum beta-lactamase (enzyme produced by some microorganisms) make nosocomial infections or HAI become even more important as a public health problem (Ducel 1995, Newton 2005 and WHO 2007).

According to WHO (2002), infections may be caused by a microorganism acquired from another person in the hospital (cross-infection) or may be caused by the patient's own flora (endogenous infection). Some organisms may be acquired from an inanimate object or substances recently contaminated from another human source (environmental infection). Furthermore, Most infections acquired in hospitals today are caused by microorganisms which are common in the general population, in whom they cause no or milder disease than among hospital patients (Staphylococcus aureus, coagulase-negative staphylococci, enterococci, enterobacteriaceae), this emphasizes more the great risk to which patients are being put, if efforts are not made to prevent and control HAI. Nosocomial bacteremia (bacterial infection) is a major subgroup of hospital acquired infections (Sligl *et al.* 2006). Viral infections can also be contacted

in the healthcare facility, an example is H1N1 influenza commonly referred to as "swine flu", which was recently declared as a pandemic infection by the World Health Organization.

PREVENTING HAI: A CONCERTED EFFORT

Commonly, microbial infection results from the interaction between an infectious agent (source) and a susceptible host. The way the interaction occurs is known as transmission. Three interrelated factors; the source, transmission, and the susceptible host, represent the chain of infection. Herein, 'source' is the root which releases infectious agents (bacteria, viruses, fungi). It can be any of people, water, food or built environment. According to Victorian Rural Infection Control Practice Group (2002), the five main routes of transmission of infections are contact transmission, droplet transmission, airborne transmission, common vehicle transmission and vector-borne transmission. The infectious agent transmitted by one of the five ways stated above can enter to a susceptible host through broken skin, mucous membranes or respiratory or urinary tracts. The susceptibility of the host can be varied due to numerous factors such as age, immune system, medical interventions or physical wellbeing (WHO 2002). For example, an immune-suppressed patient is more highly susceptible to catch an infection than a person who has a high immune response. Preventing an HAI occurrence can be done by interrupting the aforementioned chain of infection (refer to Figures 1 and 2).
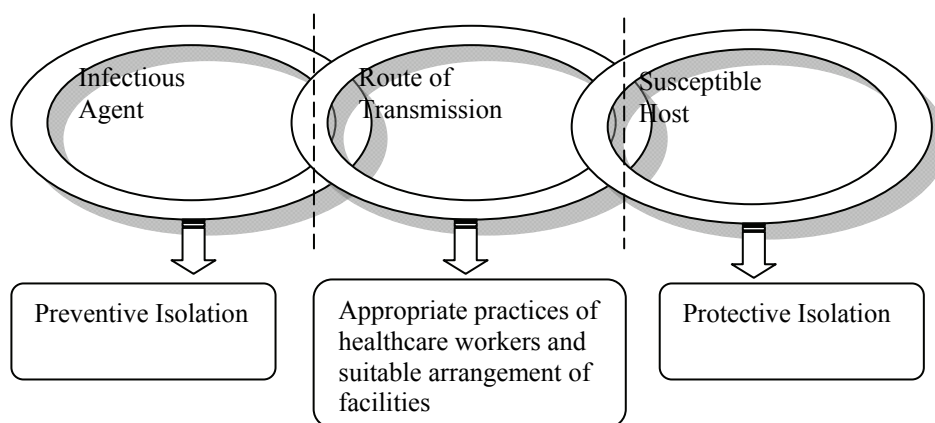

Figure 1: Interrupting the chain of infection (Rural Infection Control Practice Group Victoria 2002)

In Figure 1, taking the three main factors of the chain of infection in to account, the most effective ways of interrupting the chain is by separating either the agent from the host or host from the agent. Although it sounds similar, separating agent from the host is commonly called 'preventive isolation', this not only protects the said 'host' but other susceptible hosts as well. Separating host from the agent is 'protective isolation'. This protects only the concerned host from the infectious agent. Isolation can be simply defined as a means of keeping away the host or agent in a detached controlled environment where they normally do not have a connection with the environment outside their room. For example, a tuberculosis patient, who heavily sheds microorganisms, can be placed in a separate room to protect other patients, staff or visitors from HAI- preventive. In the same way an elderly person, who has low immunity (who can easily be infected), can be placed in a separate room to protect transfer of infections from others- protective. But the room where these patients are placed requires suitable arrangement of facilities. It primarily needs appropriate

heating and ventilation requirements. Negative pressure room is required in preventive isolation and positive pressure room in case of protective isolation (Rural Infection Control Practice Group Victoria 2002). If facilities are properly provided, containment of infection risk will be more effective in 'isolation' practices. In hospitals, FM department is very instrumental in the maintenance of ventilation equipments which could be a source of infection if not properly maintained. Figure 2 simply shows that breaking the chain of infection in healthcare setting require the working together of professionals, including staff and management.

Figure 2: The chain of infection can be broken (Rural Infection Control Practice Group Victoria 2005)

THE IMPORTANCE OF DESIGN, CONSTRUCTION AND MAINTENANCE OF HEALTHCARE FACILITIES IN INFECTION CONTROL

The impact of facility's design on patients' health has been in debate since the past 151 years. Nightingale (1859), explained in her book; 'Notes on Hospitals', the key factors that influenced patient safety in the hospitals of that time and concluded that the fatalities experienced during the Crimean war resulted from exposure to infection caused by the "agglomeration" of sick patients under one roof, poor sanitation, ventilation, insufficient space per bed, and a deficiency of light-most of these are FM issues. Many factors may contribute to the shortfalls in the quality of healthcare, including the way care is delivered and the adequacy of the facility within which that care takes place (Agency for Healthcare Research and Quality 2005). Patient wellbeing can also be diminished due to construction-related infection, current construction practices can impact on patient wellbeing by disseminating bacteria and filamentous fungi that can cause nosocomial infections (Loddon Mallee Region Infection Control Resource Centre 2005). Hence, it is clear that prevention of HAI goes beyond disinfecting or maintaining a clean hospital environment. Nonclinical

functions such as facilities management (FM) need to be considered to complement clinical efforts if HAI is to be controlled effectively (Horton and Parker 2002).

Furthermore, poor facilities planning and arrangement is a ground to develop infections in the healthcare setting. Thus, facilities planning and management is vital in infection control; making facilities managers very important in the control of HAI without whom facilities may not be properly managed, and if this is not done from the planning stage through to execution stage of the facility, a world of things will go wrong which do not exclude HAI. Duerden (2009) explained that responsibility for HAI control is a tripartite partnership between clinicians and carers who are responsible for safe patient care and the diagnosis, treatment, prevention and control of infection in their patients; boards, chief executive and managers who are responsible for providing the corporate environment for good prevention and control of HAI, and for having systems in place to ensure that it happens; and the government/Department of Health that sets standards, ensures priority for HAI prevention and control, sets targets and monitors outcome, and uses the systems of performance management to ensure that it happens throughout the NHS.

To control HAI during design and construction stages and during building occupancy stage, the FM functions to be considered include:

- Design and maintenance of water supply systems in order to control potential water borne microorganisms like Legionella.

- Cleaning- It is important to design the facility such that it is easy to clean and maintain, the importance of cleaning in healthcare environment can not be over-emphasized; the global pandemic officially declared by WHO makes it essential that housekeepers and administrators understand the vital role that cleaning plays in extenuating the risk of an outbreak. Functional design of healthcare facilities allows effective cleaning of facilities.

- Bed Spacing- Adequate bed spacing reduce the risk of cross infection, facilitating cleaning around and underneath objects, allowing for storage of items to reduce clutter and prevent dust accumulation, permitting easy use of ancillary equipment, lifting devices, trolleys, etc. reducing contact between patients; minimizing the risk of droplet spread and providing sufficient space to carry out treatments and procedures at the bedside. The spread of infection increases when patients with existing infections are in close proximity to the susceptible patients (Meers *et al.* 1992).

- Control of Airborne Infection- Ventilation and air-conditioning system should be designed to control and maintain temperature, humidity and purity of the air within the prescribed limits to control airborne infections (Phillips 2001). Health (2001) provides following considerations when designing an appropriate ventilation systems:

- Controlling the quantity and quality of intake and exhaust air

- Maintaining different air pressures between adjacent areas

- Designing airflow patterns in particular clinical areas, e.g. operating rooms providing separately ventilated or pressurized single room accommodation to prevent transmission of airborne infections agents, e.g. negative pressure room and positive pressure rooms. The ventilation and air-conditioning systems

should be monitored regularly and serviced by the FM staff. Maintenance schedules should be documented so that a standard is set for all procedures.

- Control of Contact Transmission- Hand hygiene is the most important intervention in the control of contact transmission (SHFN 30 2002) and it is the single most important factor in the prevention of healthcare associated infection (Ayliffe *et al.* 2000, SHFN 30 2007). Those working in clinical and FM services must be aware of the risks of infection to patients during their journey through care and what their roles are in lowering these risks. Hand washing should be done by staff after attending to each patient; enough wash-hand basins should be fitted and visibly located within the facility.

CONCLUSIONS

Infection control in healthcare facilities requires the efforts of facilities managers as well as other infection control specialists. A review of the literature has shown that without the involvement of FM specialists in the control of HAI, even the positive results achieved will not be the optimum result. It is therefore important that infection control is designed-in in any healthcare facility construction project; a very crucial way of achieving this is by considering FM related issues (construction dust/air handling, bed-spacing, ventilation etc. which are best carried out by facilities managers. In the same vein, to be in control of HAI, facilities managers should be involved from the planning stage through to the building occupancy stage of healthcare facilities without exclusion to new-build and renovation projects. It is recommended that facilities managers in healthcare settings see the need to look beyond the rudimentary FM services like cleaning, to see the huge need to strategically get more involved in the control of HAI with the other professionals. There is a need for the improvement of FM services in healthcare facilities; this will in turn improve the infection control practices in hospitals. Hence, facilities managers not only need to learn and adopt infection control practices into their day-to-day routines but also to gauge their performance in terms of infection control, bearing in mind their duties as healthcare workers, to help achieve the hospitals' goal of 'doing no harm to patients'.

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