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Design Strategies to Reduce Hospital-Acquired Infections

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A visit to a hospital can be risky, even dangerous for your health. Hospital-acquired infections or nosocomial infections affect 1 in 10 patients admitted to UK hospitals. Every year this results in more than 5,000 deaths in the country and costs the National Health Services £1billion (Inweregbu, Dave, & Pittard, 2005). According to Inweregbu et al. (2005), on average, a patient with hospital-acquired infection spent 2.5-times longer in hospital, incurring additional costs of £3,000 more than an uninfected patient. Nosocomial infections typically affect patients whose immune systems have become weak because of age, underlying diseases, or medical or surgical treatments.

Some of the key factors that have led to increasing nosocomial infection rates in hospitals include:

• low handwashing rates by staff between patient contacts,

• sicker and more immuno-compromised patients in hospitals,

• infrastructure repairs and renovations to ageing hospitals and new construction on existing campuses creating risk of airborne fungal diseases caused by dust and spores released during demolition and construction, and

• increasing antimicrobial use in hospital and long-term care facilities creating a large reservoir of resistant microbial strains (Weinstein, 1998).

At least one third of these nosocomial infections are preventable (Weinstein, 1998). A strong body of research shows that the built environment in particular influences the incidence of infection in hospitals and that, by careful consideration of environmental transmission routes - air, surface and water - in the design and operation of healthcare facilities, hospital-acquired infections can be reduced dramatically.

This paper presents three key environmental design strategies that have been successful in reducing the incidence and spread of nosocomial infection in hospitals. This excerpt is taken from a recent review of the literature conducted by The Center for Health Design in the United States, linking physical environmental design factors with hospital-acquired infections in acute care settings. The complete paper titled, 'The Impact of the Environment on Infections in Healthcare Facilities' can be accessed at the Center's website at www.healthdesign.org/research/reports. The paper was funded by a grant from the Robert Wood Johnson Foundation.

Increase Handwashing Compliance through Environmental Design

Most infections are now acquired in the hospital via the contact pathway (Bauer, Ofner, Just, Just, & Daschner, 1990). Microbiologically contaminated surfaces can be reservoirs of pathogens. However, these surfaces are generally not associated with the direct transmission of infection to patients or staff (Sehulster & Chinn, 2003). It is the hands of healthcare staff that is the principal cause of contact transmission from patient to patient (Larson, 1988). Poor handwashing compliance by healthcare staff (rates in the range of 15%–35% are typical) pose a serious problem in this regard. Education programmes to improve handwashing compliance among staff have not been successful.

Ulrich and colleagues (2004) cite studies that show that providing environmental support for handwashing through visual cues (such as posters reminding staff to wash their hands) and the presence of numerous, conveniently-located sinks, and handwashing dispensers and alcohol rubs may result in an increase in handwashing rates. For example, in one study, a combination of bedside, antiseptic hand-rub dispensers, and posters to remind staff to clean their hands was effective in increasing compliance (Pittet et al., 2000). Also, when the ratio of the number of sinks to the number of patient beds is higher, the observed frequency of handwashing increases (Kaplan & McGuckin, 1986).

In addition, regular cleaning and disinfection of environmental surfaces as appropriate is critical to controlling surface contact transmission of infections. High-contact surfaces (i.e. those with frequent hand contact (such as surfaces of medical equipment and high-touch housekeeping

surfaces such as doorknobs, bedrails, light switches, wall areas about the toilet in the patient room, and edges of privacy curtains) in patient-care areas need to be cleaned and disinfected more frequently than minimal contact surfaces (e.g. walls and ceilings).

Provide Single Rooms to Reduce Nosocomial Infections

The evidence from many different studies suggests that providing single rooms might be a critical strategy for reducing nosocomial infection in hospitals. Ulrich and colleagues (2004) identified three studies that suggest that providing single-patient rooms with a conveniently located sink in each room reduces nosocomial infection rates in ICUs, such as neonatal intensive care or burn units, compared to when the same staff and comparable patients are in multi-bed open units with few sinks. Further, single-bed rooms are clearly superior to multi-bed rooms in preventing the transmission of airborne pathogens from one patient to others because of the ease of isolating a patient. Providing high-quality HEPA filters, and negative room pressure prevents a patient with an aerial-spread infection from infecting others, or maintaining positive pressure protects an immunocompromised patient from airborne pathogens in nearby rooms. Compared to single-bed rooms, multi-bed rooms are far more difficult to decontaminate thoroughly after a patient is discharged, and, therefore, worsen the problem of multiple surfaces acting as pathogen reservoirs. Because different staff members who enter a room can touch the same contaminated surfaces, the risk of a nurse unknowingly becoming contaminated should be greater in multi-occupancy rooms (Ulrich, et al, 2004).

Reduce Airborne Infections through HEPA Filtration

Airborne infections are transmitted from person to person as droplets and when environmental reservoir of a pathogen (e.g. soil, water, dust, etc.) are disturbed such as during renovation and construction activities. The importance of good air quality in controlling and preventing airborne infections in healthcare facilities cannot be overemphasized. Providing clean, filtered air and effectively controlling indoor air pollution through ventilation are two key aspects of maintaining good air quality. In this context, High Efficiency Particulate Air filters (HEPA) that are at least 99.97% efficient for removing particles ^{3}0.3 µm have proven effective in preventing the incidence of infection among immunocompromised and high acuity patients and are recommended for special care areas of the hospital such as surgical areas, burn ICU units, and protective environments for such patients. In one study, bone-marrow transplant recipients were found to have a tenfold greater incidence of nosocomial Aspergillus infection, compared to other immunocompromised patient populations, when assigned beds outside of a HEPA-filtered environment (Sherertz et al., 1987).

Other than providing good quality air and ensuring adequate ventilation in patient-care areas, instituting effective prevention and control measures during construction and renovation is critical. Effective measures include using portable HEPA filters, installing barriers between the patient-care and construction areas, using negative air pressure in construction/renovation areas relative to patient-care spaces, and sealing patient windows.

In addition to these key strategies, the regular cleaning and maintenance of Heating, Ventilation and Air Conditioning (HVAC) systems as well as the water supply systems and point-of-use fixtures (such as showers, faucets, respiratory therapy equipment and room-air humidifiers) is critical to prevent the growth of infectious pathogens that may cause airborne and waterborne diseases among patients and staff in the hospital.

To summarize, three key environmental design strategies that may be effective in reducing nosocomial infections in hospitals include:

• Provide numerous, conveniently located alcohol-rub dispensers or washing sinks at the point of care to increase handwashing compliance.

• Provide HEPA-filtered single-bed rooms for immunocompromised patients and other high-acuity patient groups. Also, HEPA filters are strongly recommended in all construction and renovation areas.

• Provide single patient rooms to reduce nosocomial infections.

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