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# Positive impacts of environmental characteristics on health and wellbeing in health-care facilities: A review

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## SUMMARY

Well-designed indoor environments can support people's health and welfare. In this literature review, we identify the environmental features that affect human health and wellbeing. Environmental characteristics found to influence health outcomes and/or wellbeing included: environmental safety; indoor air quality (e.g. odour and temperature); sound and noise; premises and interior design (e.g. construction materials, viewing nature and experiencing nature, windows versus no windows, light, colours, unit layout and placement of the furniture, the type of room, possibilities to control environmental elements, environmental complexity and sensory simulations, cleanliness, ergonomics and accessibility, 'wayfinding'); art, and music, among others. Indoor environments that incorporate healing elements can, for instance, reduce anxiety, lower blood pressure, lessen pain and shorten hospital stays.

## KEYWORDS

*Indoor environment, Healing, Wellbeing, Design, Health-care space*

## 1 INTRODUCTION

The positive effects of space and the environment on people were well known in the era before modern science. For many centuries in ancient Greece, temples to the god Asklepios were designed to surround patients with nature, music, and art in order to restore harmony and promote healing in the absence of other treatment modalities (Lyons and Petrucelli, 1987). Later, many studies have shown that environments that incorporate healing features improve patient safety, reduce stress, improve outcomes, shorten hospital stays, reduce the need for pain-killing drugs, reduce staff stress and fatigue, and increase the overall quality of health and effectiveness of its delivery (e.g. Ulrich, 2000; Ulrich et al. 2004).

Some environmental elements in themselves may foster or hinder healing. Furthermore, the environment may also have an impact on health by influencing the behaviours, actions, and interactions of patients and their families as well as those of the staff members providing care (Ulrich et al. 2008).

The aim of this paper is to provide an overview of scientific research addressing the environmental features that affect human health and wellbeing.

## 2 MATERIALS/METHODS

The material in this literature review consists of peer-reviewed journal articles and research reports published in the fields of medicine, infection control, architecture, epidemiology,

ergonomics, and environmental psychology. The relevant literature was located using Google and Pubmed. The search terms were based on individual words and combinations such as environment, healing, restorative, health-care space. We then searched the reference lists of the papers first identified in the literature search.

### 3 RESULTS AND DISCUSSION

The broad literature indicates the existence of evidence that several environmental characteristics – such as environmental safety, indoor air quality (e.g. odours and temperature), sound and noise, premises and interior design (e.g. construction material, viewing and experiencing nature, windows versus no windows, light, colours, unit layouts and the placement of furniture, room type, possibilities for control, cleanliness, ergonomics and accessibility, ‘wayfinding’) – as well as art and music may affect patient outcomes, staff, and family/visitors in health-care facilities.

**Environmental safety** and experiencing the environment as safe can be an important factor for human rehabilitation (Zeisel et al. 2003). Perception of the indoor environment (clarity) can enhance safety. Placement of thoroughfare signs, guides, and various structures should be taken into account so that incidents do not occur. Building components, furniture and equipment should be selected so that they are durable, meet fire and safety regulations and do not emit harmful indoor air pollutants (Rakennustietosäätiö, 1998).

**Proper and efficient ventilation** combined with low-emission building materials are key factors for good indoor air quality and control of infections spread by the airborne route (Spengler et al. 2001). **Odours** (‘unpleasant smells’) may trigger strong negative physical reactions in some people. For example, the odour of dimethyl sulphoxide (DMSO) is unpleasant and gives nurses headaches and gastrointestinal reactions. (Prior et al. 2000). **Indoor temperature** is another fundamental characteristic of the indoor environment. The effects of temperature on comfort, perceived air quality, symptoms of sick building syndrome, performance at work, worker productivity, and sleep quality and quantity are widely recognised (Kaplow and Hardin, 2007; Kosonen and Tan, 2004; Pandey et al. 2005).

**Noise** is a common problem in many health-care settings. Excessive noise in health-care settings can contribute to stress and burnout, elevate emotional exhaustion, induce headaches, cause irritability, prolong healing processes, increase sensitivity to pain and the use of pain medications, contribute to sleep deprivation, increase sleeplessness, contribute to hearing loss, elevate heart rate, elevate blood pressure, cause confusion and disorientation, prolong hospital stays, affect workplace performance, decrease job satisfaction, and reduce safety (e.g. through errors caused by the distracting or interrupting effects of noise (Anjali, 2010; Beyea, 2007; Mazer, 2006).

**Floor material selection** may affect patients’ well-being and comfort. Comparisons of the advantages for patients of different types of flooring materials, including carpet and hard or glossy materials such as vinyl composition and linoleum, have found increasing indications that carpet is superior from the standpoint of certain patient-centred considerations (Ulrich, 2000). However, the need for appropriate cleaning should be balanced against this (i.e. linoleum floors are far easier to disinfect and clean than carpet) (Anjali, 2006).

**Viewing and experiencing nature** both have significant positive outcomes. Giving patients, families, and staff access to nature by providing indoor and outdoor gardens, views of nature through windows, and artwork of nature scenes is an effective means of relieving stress,

improving wellbeing, and increasing job satisfaction (Leather et al. 1998; Lewis, 1996; Ulrich and Gilpin, 2003). Views of nature can reduce anxiety and pain and have a restorative effect on both patients and staff (e.g. mood improvement, lower blood pressure, and reduced heart rates) (Ulrich and Gilpin, 2003). **A lack of windows** may worsen outcomes by reducing positive stimulation and aggravating the negative effects of sensory deprivation associated with factors such as the repetitive sound of respirators (Ulrich, 1991a). Employees with window views of natural environments are less stressed, report better health, and have higher levels of job satisfaction than comparable groups without such views (Leather et al. 1997).

**Light** makes vision possible and has healing properties. The two acknowledged pathways for the biologic effect of light are the skin and the eyes. Skin exposure is related to the body's production of vitamin D (Edwards and Torcellini, 2002). Visible light has an effect on both systemic physiological responses and mood (Zilber, 1993), as well as on visual needs. In addition, light has been reported to affect the length of patient stays through its direct influence on circadian rhythms (Ulrich et al. 2004).

**Colours** affect blood pressure, heart rhythm, the psyche, and the electrical activity of the brain (Arnkil, 2007). Good interior colour design can reduce feelings of alienation and thus promote wellbeing and recovery (Arnkil, 2007).

Well-designed **layouts** of the health-care facilities support different work (e.g. treatment) processes. For example, unit layout influences the time nurses spend on patient-care activities and interaction with family members (Shepley, 2002). Research suggests that appropriate movable-seating arrangements in dining areas not only enhance social interaction but can have important positive effects on eating behaviours (Melin and Gotestam, 1981; Peterson et al. 1977).

The benefits of **single bedrooms** include lower nosocomial infection rates, fewer patient transfers (due to roommate conflicts) and associated medical errors, far less noise, much better patient privacy and confidentiality, better communication from staff to patients and from patients to staff, better accommodation of family, and consistently higher satisfaction with the overall quality of care (Anjali, 2010; Page, 2004; Ulrich and Zimring 2004).

There is an extensive body of research linking **possibilities to control** elements of the indoor environment with both physical and psychological health (Carr, 2011). The ability of the patient and staff to control the environment directly contributes to successful outcomes. Among both patients and staff, loss of the sense of control is a major problem that can lead to stress (Ulrich, 1991b).

**Cleaning** is the process of identifying, containing, removing, and properly disposing of contaminants from a surface or environment. Cleaning remains crucial even if source management, activity management, design intervention, and dilution ventilation have all been used optimally to control infectious aerosols (Cole and Cook, 1998).

Many experts and organisations have advocated the use of **ergonomics and accessibility** tools, methods, concepts, and theories as means to improve patient safety and staff members' work (Carayon, 2010). According to the innovation model of Greenhalgh et al. (2004), various factors can either hinder or facilitate the spread of ergonomics innovations in healthcare organisations. Ergonomic and usable mobile technology is also becoming more important in modern health care. When an appropriate infrastructure is available, mobile

technology can improve communication, facilitates access to information, eliminate redundant documentation, and increases the quality of patient care in the long term (Ammenwerth et al., 2000).

Successful ‘‘**wayfinding**’’ is an important part of a building’s function. The circulation routes should be clear, simple, and logical (NSW Health, 2008) and wayfinding should be as straightforward as possible (Kopec, 2006; Verhe, 1996). Clear signage creates a sense of safety and caring; it also reduces the need for staff to advise patients and visitors (Hossi and Jänkälä, 2008).

Several studies have shown that **music and art** have healing effects. Pleasant music, when controlled, can promote relaxation, reduce anxiety or stress, improve coping with pain, affect sleep patterns, improve stroke patients’ memories and decrease the amount of sedative medication needed for some patients (Gill, 2008). Art allows patients and visitors to focus on something other than their condition. Art improves the perception of care at the hospital, serves as an element that users identify with, makes the hospital less intimidating, is a de-stressor for patients, staff members and visitors, and can serve as landmarks for patients and visitors (Hathorn and Nanda, 2008). The mechanism underlying the impact of art is assumed to be a lowering of stress and anxiety levels, promotion of restoration from stress, and improvement in mood (Ulrich, 1991; Ulrich, Lunden et al. 1993; Ulrich, 1999).

#### **4 CONCLUSIONS**

Environmental characteristics found to influence positive health outcomes and/or wellbeing are an important basis for evidence-based space planning and management of health-care facilities. It is also important that this knowledge is employed in a user-centric and participative way that allows the needs of all user groups and stakeholders to be accommodated. However, additional studies on the expansion of healing and health-supportive environments are required in order to provide guidance on how to achieve the optimal indoor environment in health care settings.

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