

Research Summary  
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# Health Promotion by Design in Long-Term Care Settings

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## Abstract

**Objective:** To assess the relationship between physical environmental factors and resident and staff outcomes in different types of long-term-care settings.

**Methods:** Literature review of more than 250 peer reviewed journal articles published in different fields such as gerontology, architecture, nursing, psychology, and psychiatry. Key words used to access databases included long-term care, physical environment, homelike environment, elderly, falls, sleep, depression, quality of life, dementia, and safety.

**Key Findings:** The physical environment impacts outcomes among patients, their family, and staff in three main areas: (a) resident quality of life, (b) resident safety, and (c) staff stress. Several studies show that different aspects of the physical environment—such as the unit layout, supportive features and finishes, reduced noise, as well as access to outdoor spaces—may be linked to better outcomes, including improved sleep, better orientation and wayfinding, reduced aggression and disruptive behavior, increased social interaction, and increased overall satisfaction and well-being. Further, a growing body of research suggests that the environment should not only support functional abilities, but also provide opportunities for residents to be physically active and healthy. The environment can increase safety among residents by removing barriers to ambulation and performance of critical tasks and by preventing infections and unsafe behaviors such as exiting. Studies also show that if supports for work (such as ceiling lifts) are incorporated within a long-term care setting, it results in greater satisfaction, morale, and fewer work-related injuries. Design enhancements, such as a homelike ambience, are also linked to higher satisfaction among nurses.

**Conclusions:** The design of the physical environment impacts resident and staff outcomes in long-term care settings and contributes to a better quality of life for those who live and work in and visit these facilities.

## Introduction

The prevalence of chronic conditions is projected to increase dramatically with the aging of the population. In fact, by year 2030, nearly 150 million Americans will have a chronic condition. Consequently, the need for quality long-term care will also increase in the years to come. The physical environment is an integral component of the care provided in long-term care settings. It is critical, therefore, to carefully assess how long-term care environments can be designed to promote health and well-being among this growing population.

*Long-term care* refers to any personal care or assistance that an individual might receive on a long-term basis because of a disability or chronic illness that limits his or her ability to function (Kane, 2001). Long-term care may be provided in a range of settings such as an individual's home and residential, assisted-living, nursing-care, or rehabilitation facilities. In some settings, individuals may spend short periods of time (90 days or less) for rehabilitation before returning to the community. In other settings, individuals stay for much longer periods of time, often to their last days. The term *resident* rather than *patient* is more commonly used while referring to individuals residing in long-term care settings. Most individuals receiving long-term care suffer from some chronic illness, and the focus of care is usually on supporting and maintaining health status rather than curing. While all different types of individuals (young and old) might use long-term care services, the overall utilization of long-term care services and products is much higher among older adults (Shi & Singh, 2001).

This report assesses the state of the science linking the physical environment with resident and staff outcomes in long-term care settings. As mentioned earlier, older adults are the main recipients of long-term care. This report primarily focuses on the impact of the physical environment on elderly residents, their families, and staff in long-term care settings in three areas: (a) resident quality of life, (b) resident safety, and (c) staff stress.

This report presents findings from more than 250 articles published in peer-reviewed journals that assess the relationship between physical environmental factors and resident and staff outcomes in different types of long-term care settings—skilled-nursing facilities, assisted-living settings, special-care units, and independent-living facilities. Some of the findings are relevant primarily to one type of setting, while others have wider applicability to different types of long-term care settings.

## Resident quality of life

The care provided in long-term care facilities has traditionally been based on a medical model. This is characterized by nursing units with centralized nursing stations and long, doubly loaded corridors with shared bedrooms and bathrooms. Often, the finishes and ambiance are institutional and bare, and the setting provides few opportunities for residents to personalize their environments. Residents follow a rigid routine that dictates when they eat and when they sleep. In such situations, residents have few choices, resulting in a loss of dignity and sense of self. The focus is on the treatment or the medical care provided, rather than the individual who is receiving the care. Such environments harm more often than they heal.

Enhancing the quality of life of residents in long-term care settings is as important a goal as improving the quality of care and the safety and health of residents (Kane, 2001). Several stud-

ies show that different aspects of the physical environment—such as the unit layout, supportive features and finishes, reduced noise, as well as access to outdoor spaces—may be linked to better outcomes, including improved sleep, better orientation and wayfinding, reduced aggression and disruptive behavior, increased social interaction and increased overall satisfaction and well-being. Further, a growing body of research suggests that the environment should not only support functional abilities, but also provide opportunities for residents to be physically active and healthy.

## **Improve sleep**

Insomnia or disturbed sleep is a common complaint of older people, and studies show that 50% of individuals living in the community and 70% of individuals living in a long-term care setting are affected by it (Johnston, 1994). Further, research shows that daytime sleepiness, nighttime insomnia, and sleep disturbance are associated with increased mortality among institutionalized elderly (Dale, Burns, & Panter, 2001). The causes for sleep disturbance among the elderly include medical and geriatric factors as well as behavioral and environmental factors. Environmental factors that contribute to sleep disturbance among the elderly in nursing home include:

- Limited sunlight exposure (Alessi, Martin, Webber, & Kim, 2005).
- Large amounts of time spent in bed (Alessi, et al., 2005).
- Lack of physical activity (Alessi, et al., 2005).
- Nighttime noise (Alessi, et al., 2005; Cruise, Schnelle, Alessi, Simmons, & Ouslander, 1998; Ersser et al., 1999).
- Light (Cruise, et al., 1998).
- Incontinence care routines (Cruise, et al., 1998).

According to Rahman and Schnelle (2002), simple interventions can address environmental factors that disturb sleep in the nursing home. These include individualizing nighttime incontinence-care routines, implementing a noise-abatement program, and sensitizing and educating staff about the importance of uninterrupted sleep for residents. However, studies assessing the effect of such multicomponent interventions on nighttime sleep on nursing-home residents have had variable and inconsistent results (Ouslander, J. G., Connell, B., Bliwise, D. L., Endeshaw, Y., Griffiths, P., & Schnelle, J. F., 2006). For example, in a randomized controlled trial, sleep-disturbed nursing-home residents from four different nursing homes were exposed to an intervention that included efforts to decrease time spent in bed during the day, 30 minutes or more of daylight exposure, increased physical activity, structured bedtime routine, and efforts to decrease nighttime noise and light (Ouslander et al., 2006). This study did not find any significant effect of the intervention on overall nighttime sleep or number of night awakenings (Ouslander et al., 2006). However, there was a decrease in daytime sleeping and increased participation in social and physical activities and social conversation.

On the other hand, a small number of studies have found that timed exposure to artificial bright light might be helpful in improving sleep and circadian rhythms. In one study, community-dwelling older adults exposed to either bright white light or dim red light on 12 consecutive days experienced substantial changes in sleep quality (Campbell, Dawson, & Anderson, 1993). Waking

time within sleep was reduced by an hour, and sleep efficiency improved from 77.5% to 90%, without altering time spent in bed (Campbell, et al., 1993). Two other studies showed that exposure to evening bright light was related to improved rest activity rhythms among persons with dementia in nursing homes (Satlin, Volicer, Ross, Herz, & Campbell, 1992; Van Someren, Kessler, Mirmiran, & Swaab, 1997).

## **Support orientation and wayfinding**

Spatial skills decline with age, and the average institutional resident has difficulty maintaining spatial orientation within the typical institution (Rule, Milke, & Dobbs, 1992). Herman and Bruce (1981) found that, although elderly nursing-home residents accurately recognized and placed locations along the central corridor, their accuracy decreased substantially with distance from it. Characteristics of residential institutions that contribute to confusion and disorientation include:

- Monotony of architectural composition and lack of reference points (Passini, Pigot, Rainville, & Tetreault, 2000).
- Long corridors with many doors (Rule, et al., 1992).
- Lack of windows or lack of access to windows (Rule, et al., 1992).
- Ad hoc signage (Rule, et al., 1992).

These issues can be easily addressed in the design of institutions. Also, attention should be paid to locating culturally relevant landmarks in key locations to support wayfinding and orientation.

Designing to promote spatial orientation and wayfinding are critical in environments for persons with dementia who commonly suffer from disorientation—confusion regarding place, time, personal identity, and social situation (Calkins, 2001; Cohen & Day, 1991; Day, Carreon, & Stump, 2000). In a review of empirical studies linking environments for persons with dementia and outcomes, Day and colleagues (2000) identified the following factors as being related to higher levels of orientation:

- Quiet environments.
- Use of room numbers and distinguishing colors for resident rooms and doors.
- Large signs or location maps supported by orientation training for residents (McGilton, Rivera, & Dawson, 2003).
- Use of significant memorabilia outside resident rooms (Nolan, Mathews, & Harrison, 2001).
- Simple building configuration aided by explicit environmental information (Residents experienced greater spatial orientation in facilities designed around L-, H-, or square-shaped corridors, compared with facilities with corridor designs).

Wayfinding was less successful among residents in facilities with low lighting in public areas (Netten, 1989). Passini and colleagues (2000) found that elevators were a major anxiety-causing barrier to wayfinding among demented residents. Also, signage was critical in compensating for loss of memory and spatial understanding. Floor patterns and dark lines or surfaces can disorient the person and cause anxiety (Passini, et al., 2000).

## Reduce aggression and disruptive behavior

Disruptive behaviors are very prevalent in most long-term care facilities (Morgan & Stewart, 1998a). In most settings, the prevalence of agitated or disruptive behavior was higher among residents with dementia than nondemented residents. Environmental interventions can be effective in reducing agitated behaviors, especially among demented residents.

- *Unit size and ambiance*: Sloane and colleagues (1998) found that higher levels of agitation among residents in dementia special-care units was associated with the following environmental features: large unit size, poor scores on a rating of homelikeness, poor scores in cleanliness of halls, poor maintenance of public areas and bathrooms, absence of nonglare nonslip floors, odors or urine in public areas and bathrooms, and absence of a family kitchen for activities and family use. Families of residents in large units perceived staff as being under time pressure and also perceived a reduced quality of life for residents (Pekkarinen, Sinervo, Perala, & Elovainio, 2004). Other studies have documented the impact of ward interior redesign on reduction in disruptive behaviors (Christenfeld, Wagner, Pastva, & Acrish, 1989; McGonagle & Allan, 2002).
- *Private rooms*: There is limited evidence that persons with dementia are less agitated in private rooms rather than shared rooms. When dementia residents moved from a multiple occupancy unit to a smaller unit with private rooms, residents slept better at night, there were fewer conflicts between residents, and less rummaging and loss of belongings. Also, the number of interventions to control aggressive behavior (medications) reduced during follow-up (Morgan & Stewart, 1998b).
- *Music (white noise)*: Other environmental interventions that have been successful in reducing verbal agitation among dementia residents include use of music (white noise) (Burgio, Scilley, Hardin, Hsu, & Yancey, 1996; Burgio et al., 1994; Goddaer & Abraham, 1994). Goddaer and Abraham (1994) found a 74.5% reduction in verbally agitated behaviors when relaxing music was played at a level of 65 to 69 dB (A) (over average noise level in dining room during meal time) in two units in two nursing homes with severely cognitively impaired residents. Loud noises, on the other hand, are associated with agitated behavior and disturbed sleep.
- *Light*: Sloane and colleagues (1998) found that residents in facilities with low light levels displayed higher agitation levels. La Garce (2002) studied the impact of environmental lighting interventions (full-spectrum lighting, microslatted glazed windows, and electronic controls to maintain a constant level of light intensity) on agitated behaviors among residents with Alzheimer's disease. She found a significant drop in disruptive behaviors when residents were in the experimental setting rather than the control setting (LaGarce, 2002). Lovell and colleagues (1995) also found a reduction in agitated behavior among institutionalized elderly subjects when exposed to bright light. Exposure to bright light is also related to decrease in depression among institutionalized older adults (Sumaya, Rienzi, & Moss, 2001).
- *Access to outdoors*: Wandering (defined as extended periods of aimless or disoriented movement without full awareness of one's behavior) is a major behavioral symptom of Alzheimer's disease and related dementia. Historically, physical and chemical restraints



were used to deal with wanderers. This is no longer considered appropriate. The environment can be designed to provide positive outlets for residents who wander (Cohen-Mansfield & Werner, 1999; Namazi & Johnson, 1992). For example, providing access to safe outdoor spaces rather than completely blocking access to the outdoors may be an efficient strategy (Namazi, 1993; Namazi & Johnson, 1992). Mooney and Nicell (1992) found that violent episodes among residents decreased over time in facilities with outdoor environments, whereas violent episodes increased during the same time period in facilities without outdoor environments. Agitated behaviors among residents with Alzheimer's disease reduced when doors to a secure outdoor garden were kept unlocked (Namazi & Johnson, 1992).

### **Increase social interaction while providing privacy and control**

Many older adults in institutional settings may voluntarily withdraw from social interaction as an adaptation strategy (substitute for loss of privacy) or other factors may lead to involuntary reduction in social interaction (Rule, et al., 1992). There is a relationship between the degree of privacy and control (ability to control who you interact with and when you choose to do so) and participation in social behavior (Ittelson, Proshansky, & Rivlin, 1970; Pinet, 1999). Ittelson et al. (1970) introduced the concept of privacy/sharing to explain that residents from shared bedrooms lack privacy and feel less at home in their own bedrooms. Thus, residents in shared rooms are more likely to spend more time in social spaces to leave their roommate alone. Firestone and colleagues (1980) found that ward residents viewed their dwelling as less secure and felt less able to control social encounters than did single-room residents.

Pinet (1999) conducted a study among 50 nursing home residents to examine if the use of social spaces in a facility was related to the distance of residents' bedroom from the space. She looked at the behavior of residents in private and shared rooms. She found that social spaces closest to resident rooms were used more often than spaces that were farther away. Also, residents walked farther to participate in activities than to visit nonactivity-related social spaces. Residents from shared bedrooms tended to traverse longer distances. Forty-four percent of the residents from semiprivate rooms reported going to social spaces when visitors came to visit them. Also, in homes with shared bedrooms, residents observed in social spaces were more withdrawn than in other homes.

These findings suggest the importance of providing single rooms so that residents can control the degree of privacy and social interaction. However, there are insufficient studies on the relative merits of private and shared rooms in long-term care environments.

Other factors that may be important in promoting use of social spaces in long-term care environments include views to activities and interesting focal points that generate conversation (Cohen & Day, 1991; Howell, 1980; Pinet, 1995; Regnier, 2002).

The size of the facility may be related to resident participation in social and other activities in a facility. Lemke and Moos (1989), in a study of 1,428 residents in 42 facilities, found that smaller size and scale of facility supports activity for moderate- to low-functioning residents, while younger independent residents are more active in a larger facility with a more challenging program.



There is strong evidence that placement of furniture in small flexible groupings in public spaces such as lounges and waiting areas can support social interaction. A few studies in psychiatric wards and nursing homes have found that appropriate arrangement of movable seating in dining areas enhances social interaction and also improves eating behaviors, such as increasing the amount of food consumed by geriatric residents (Melin & Gotestam, 1981; Peterson, Knapp, & Rosen, 1977). Much research on day rooms and waiting areas has shown that the widespread practice of arranging seating side by side along room walls inhibits social interaction (Holahan, 1972; Sommer & Ross, 1958). A study by Harris (2000) found that family and friends stayed substantially longer during visits to rehabilitation units when resident rooms were carpeted rather than covered with vinyl flooring.

### **Promote quality of life by providing links to the familiar**

Many design guidelines endorse the importance of providing non-institutional or homelike design features to promote well-being among residents in institutional settings. The premise is that being in an environment that is more like the homes they left behind when they transitioned to long-term care would be more comforting for long-term care residents than one that is reminiscent of an institution. This is often interpreted in terms of residential architectural features, domestic furniture and finishes, use of artwork, natural elements, and personalized rooms. However, the concept of home is very subjective and different for every individual. A homelike environment is also one where residents have the opportunity to participate in activities that are familiar from their past lives (as opposed to rigid institutional routines) and in spaces that are similar in scale and form to those found in people's homes (Day & Cohen, 2000; Lundgren, 2000).

Day and Cohen (2000) reported on studies conducted on the effect of non-institutional environments among residents with dementia. Such environments were related to different aspects of resident well-being such as:

- Improved intellectual and emotional well-being.
- Enhanced social interaction.
- Reduced agitation.
- Reduced trespassing and exit seeking.
- Greater preference and pleasure.
- Improved functionality.

Compared to residents in traditional (institutional) nursing homes and hospitals, those in non-institutional settings were less aggressive, able to preserve better motor functions, required lower dosage of tranquilizing drugs, and had less anxiety. Relatives reported greater satisfaction and less burden associated with non-institutional facilities (Annerstedt, 1997; Cohen-Mansfield & Werner, 1998).

Other studies have shown that a non-institutional dining-room atmosphere was related to increased food intake among dementia residents (Evans & Crogan, 2001; Melin & Gotestam, 1981; Reed, Zimmerman, Sloane, Williams, & Boustani, 2005). Most of these studies emphasize

the importance of staff support and staff culture in promoting a homelike non-institutional environment of care.

## **Promote physical activity**

The benefits of physical activity for older people include prevention and treatment of chronic illnesses, a longer disability-free life expectancy, and better physiological and psychological health (Leveille, 1999; Miller, 2000; Shephard, 1997; United States Department of Health and Human Services, 1996). There is evidence from different fields that the environment influences participation in physical activity among older adults.

Factors such as perceived aesthetics of the neighborhood (Brownson et al., 2000), perceived safety of walking paths in the neighborhood (Carnegie et al., 2002), and convenient location and access to recreational facilities and shops (Brownson et al., 2000; Carnegie et al., 2002) were found to be associated with *higher levels of walking* among older adults. There are fewer studies that examine how the design of long-term care environments may support participation in physical activity among residents.

A survey of 800 not-for-profit continuing-care retirement communities (CCRC) looked at the relationship between building and site-level features on CCRC campuses and participation in different types of physical activity among residents. The findings from this study suggest that communities with more indoor and outdoor physical-activity facilities and amenities tend to have more residents participating in physical activity (Joseph, Zimring, Harris-Kojetin, & Kiefer, 2006 (in press)). Modest but significant associations were found between the presence of outdoor features such as courtyard gardens and covered outdoor paths and resident participation in walking clubs (Joseph, et al., 2006 (in press)). Also, more independent-living residents walked to meals on campuses that had covered connections between buildings.

In a recent study of path use for walking on CCRC campuses, Joseph (2006) found that independent active residents walked extensively both indoors and outdoors for recreation. Key aspects of the paths that were chosen by residents for recreation included path length, presence of steps in path, and location of path within the network of paths on campus. Residents used looped routes of different length and difficulty level for walking on campus according to their health and functional abilities (Joseph, 2006).

Many of the studies described in this paper were conducted in the context of the nursing home, which was the primary model of care for older adults until about 20 years ago. The concepts regarding improving the quality of life of residents have been applied in the development of new models of housing and care, such as assisted living, continuing care retirement communities (CCRC), and the Eden Alternative. These evolved in response to the need to improve the quality of life of residents and to provide care in a homelike residential environment where the patterns of living would more closely resemble those of a home than an institution.

Assisted living is defined as “a long term care alternative which involves the delivery of professionally managed personal and health care services in a group setting that is residential in character and appearance in ways that optimizes the physical and psychological independence of residents” (Regnier, 1994). Although the main component of assisted living involves personal care

help with ADLs, the overall philosophy is one of personal self-management. These facilities do not provide skilled nursing care. They are known by different names in different parts of the United States: Board and Care, Residential Care Facilities, Community Based Retirement Care Facilities, Personal Care, Adult Living Facilities, Adult Foster Care, etc. Therapeutic goals aimed at improving quality of life for residents require active support by physical and organizational aspects of the facility.

CCRCs are residential campuses that provide a continuum of care – from private units to assisted living and skilled nursing care – all in one location. CCRCs are designed to offer active seniors an independent lifestyle from the privacy of their homes, but also include the availability of services in an assisted living environment and onsite intermediate or skilled nursing care if necessary.

The Eden Alternative focuses on improving the quality of life of nursing home residents and creating a homelike setting by enabling residents to interact with pets, plants, and children and by empowering staff in bringing about these changes (Coleman, et al., 2002). The Green House Project is an offshoot of Eden Alternative (Thomas & Johansson, 2003). According to William Thomas, the founder of Eden Alternative, the Green House Project is “an attempt to design, build and test a radically new approach to residential long-term-care for the elderly” (Thomas & Johansson, 2003). The Green House is designed to be a home for eight to ten elders, which blends architecturally with its surroundings, is aesthetically appealing, and includes many outdoor spaces. Thus, it alters the facility size (much smaller scale than typical nursing facility), interior design (more homelike and residential), staffing patterns, and methods of delivering skilled professional services.

According to the founders, one of the key differences is that in the Green House, residents are not dictated by an institutional schedule, rather they perform daily activities (sleeping, eating, participating in activities) as they choose. Studies are planned to test the effectiveness of the Green House in improving resident outcomes as well as staff outcomes such as retention, turnover and satisfaction (Kane, 2003).

The design of the physical environment of long-term care settings can play a very important role in increasing quality of life of residents by improving sleep, supporting orientation, reducing agitation, and increasing social interaction and providing control and choice. Different aspects of the environment, such as unit size and layout, provision of private rooms, noise levels, and supportive design features, contribute to better outcomes among residents.

## **Resident safety**

Residents in long-term care settings usually suffer from one or more chronic conditions. Due to illness and aging processes, their functional abilities are reduced and they experience problems in navigating the environment in which they live. Due to poor vision, frailty, and balance and gait problems, many elderly residents fall and get injured. Residents in nursing homes and other long-term care settings are also exposed to nosocomial infections. Cognitively impaired residents run the risk of hurting themselves in an unsafe environment. A supportive, well-designed environment can increase resident safety.

## Reduce falls

More than one-third of older persons fall each year, and, in most cases, falls are recurrent (Tinetti, 2003). Falls are the costliest category of injury among older persons, accounting for nearly 71% of the total costs of injury among persons 60 years of age and older (Rizzo, Friedkin, Williams, Acampora, & Tinetti, 1998). Connell and Wolf (1997) identify three main categories of causal factors for falls among the elderly: personal factors (e.g., chronic disorders and neurological deficits), environmental factors (e.g., obstacles), and behavioral factors (activities and choices that can destabilize balance such as improper shoes). Situations in which falls or near-falls occurred in a sample of healthy elderly subjects included (Connell & Wolf, 1997):

- Collisions in the dark while walking to and from bedrooms in the night.
- Failing to avoid temporarily hazardous conditions.
- Frictional variations between shoe and floor coverings.
- Environmental demands that exceeded physiological abilities (e.g., a doorway threshold that was higher than a regular step).
- Habitual environmental use (when ways of doing habitual activities do not change despite changes in a person's abilities).
- Inappropriate environmental use.

In addition to events such as the above that are likely to occur in institutional settings as well as at home, use of bedrails and physical restraints have been associated with falls among the elderly in institutional settings. Staff may use bedrails and restraints to prevent residents, especially those with cognitive impairments, from getting out of bed independently and potentially harming themselves (Hofmann, Bankes, Javed, & Selhat, 2003). However, studies indicate that rails may contribute to serious injury and even death by falls over, under, between, and around bedrails (Capezuti, Maislin, Strumpf, & Evans, 2002).

Several studies have documented the effect of multifaceted interventions on reducing falls among nursing-home residents (Becker et al., 2003; Hofmann, et al., 2003; Jensen, Nyberg, Gustafson, & Lundin-Olsson, 2003). These interventions included different components such as attempts to reduce bedrail use, education, restorative therapy, or exercise programs and environmental modifications. Environmental modifications were usually undertaken on an individualized basis in response to specific environmental conditions. This may include repositioning furniture (Hoffman, Powell-Cope, MacClellan, & Bero, 2003; Hofmann, Bankes, Javed & Selhat, 2003), adding floor mats to cushion falls and antislip mats to improve footing and traction (Hoffman, Powell-Cope, MacClellan, & Bero, 2003), providing nightlights and stair rails (Tinetti, 2003), and improving lighting levels (McMurdo, Millar, & Daly, 2000). In these studies, while the combined interventions were effective, it is difficult to isolate the effect of the environment on reduction in falls.

Two studies have specifically assessed the impact of flooring type on incidence of falls, though the results are not consistent. Donald and colleagues (2000) found that elderly residents in a rehabilitation ward in a community hospital incurred fewer falls on vinyl surfaces as compared to carpet. On the other hand, elderly residents exhibited higher gait speed and step length on

a carpeted surface as compared to vinyl (Willmott, 1986). There is insufficient evidence to support the use of one type of surface over the other to reduce falls among the elderly.

## **Reduce infection**

The confined living arrangements and group activities of nursing homes, combined with understaffing and failure of staff to comply with infection-control measures, are associated with high infection rates in nursing homes (Zimmerman, Gruber-Baldini, Hebel, Sloane, & Magaziner, 2002). Nursing-home residents contract more than 1.5 million infections per year, and each resident faces a 5% to 10% risk per year of acquiring infections (Ernst & Ernst, 1999). While different medical conditions increase susceptibility to infection among elderly in long-term care settings, environmental factors are also related to infection rates. A large body of evidence shows clearly that infections are spread in acute-care settings through airborne and contact pathways (Ulrich, Zimring, Joseph, Quan, & Choudhary, 2004).

However, there are relatively fewer studies conducted in long-term care settings examining how infections are transmitted in such settings and how design may address environmental sources of infection. Some of the studies that link environmental factors with infection found the following.

High rates of hospitalization among nursing-home residents was associated with poor rating of environmental quality (cleanliness, odors, noises, homelikeness, cues, and environmental quality) (Zimmerman, et al., 2002).

Nosocomial pneumonia among long-term-care residents may be related to colonization of potable water with *Legionella* (Seenivasan, Yu, & Muder, 2005).

Methicillin-resistant *Staphylococcus aureus* (MRSA) positive residents were identified in nursing homes contaminated with MRSA strains, while nursing homes without detectable environmental contamination had either no detectable positive contamination or just one positive resident (Fraise, Mitchell, O'Brien, Oldfield, & Wise, 1997).

Rates of cross infection were higher when residents with indwelling urinary catheters (IUC) were nursed in the same room (Fryklund, Haeggman, & Burman, 1997). This study supported nursing IUC residents in separate rooms.

There are few studies that have specifically examined the pathways by which infection is acquired and spread in long-term care settings. If findings from acute-care settings are directly applied to long-term care, these settings might be overdesigned to prevent risk of infection since long-term care residents are not as severely ill or immunocompromised as patients in acute-care settings. However, the importance of containing and preventing spread of infection through proper handwashing practices, good air quality, and provision of private rooms for residents with infections are applicable in long-term care environments as well.

## **Reduce wandering and unsafe exiting for cognitively impaired residents**

Cognitively impaired residents' attempts to leave facilities or homes are a source of concern for staff and caregivers (Cohen & Day, 1991; Day, et al., 2000). Wandering and unsafe exiting from buildings increases the risk of injury among cognitively impaired residents. Several studies show that environmental approaches may be adopted to prevent unsafe exiting and may eliminate the

need for chemical and physical restraints for cognitively impaired residents. Design strategies that are effective in reducing exiting behavior among dementia residents include the following.

*Two-dimensional grid patterns on the floor:* In a quasi experiment with eight residents, two-dimensional grid patterns eliminated most attempts to exit the building (Hussian & Brown, 1987). This strategy may have been effective because persons with dementia perceive two-dimensional patterns on the floor as three dimensional barriers due to problems with depth perception. However, in other studies, two-dimensional floor patterns were not successful in reducing exiting behavior (Chafetz, 1990; Namazi, Rosner, & Calkins, 1989). The lack of success in reducing exiting was attributed to the presence of glass panes in exit doors and windows that provided views to the outdoors that enabled residents to overcome the barrier imposed by the grid pattern (Day, et al., 2000).

*Disguised exit panels and restricted light and views through exit-door windows:* Findings from several studies support the effectiveness of disguising exit doors in different ways, including:

- Placing cloth panels over door knobs eliminated exit attempts by most residents (Dickinson, McLain-Kark, & Marshall-Baker, 1995; Namazi, et al., 1989), though both these studies assessed behavior of a small number of residents.
- Installation of closed, matching miniblinds that restricted light, and views through exit-door windows reduced exiting attempts by half (Dickinson, et al., 1995).
- A wall mural painted over an exit significantly reduced resident attempts to leave the unit (Kincaid & Peacock, 2003).

*Access to safe outdoor areas:* A few studies showed that an alternative to prevent exiting—providing access to safe outdoor spaces—generated positive outcomes such as reduced agitation among dementia residents (Mooney & Nicell, 1992; Namazi & Johnson, 1992).

The environment can increase safety among residents by removing barriers to ambulation and performance of critical tasks and preventing infections and unsafe behaviors such as exiting.

## Staff stress

Nursing staff in long-term care settings work under challenging conditions and experience both physical and emotional stress. The residents they work with are often seriously ill and cognitively impaired. The high level of stress experienced by staff members is also likely to affect the quality of care they provide. A few studies have examined how work stressors affect employee job performance in long-term care facilities (Pekkarinen, et al., 2004). Some of these have examined the impact of the environment on staff outcomes in long-term care settings. The key findings that are relevant in this regard include the following.

*Smaller units contribute to reduced stress and increased staff satisfaction.* A cross-sectional survey of 1,194 employees and 1,079 relatives of residents in 107 residential-home units and health-center bed wards found that large unit size was related to increased time pressure among employees and reduced quality of life for residents (Pekkarinen, et al., 2004). Other studies found that small unit sizes were positively associated with increased supervision and interaction between staff and residents in a special-care unit for residents with dementia (McCracken &



Fitzwater, 1989). Annerstedt (1993) found that staff members in group-living units reported greater competence, more knowledge in dealing with dementia, and greater satisfaction than their counterparts in nursing homes. However, no consistent numbers are offered on what makes a unit large or small (Day, et al., 2000). Further, even in small units, especially those designed for persons with dementia, it is important to consider how the design impacts staff ability to monitor residents. Morgan and Stewart (1998a) found that in a newly designed, low-density special-care unit with private rooms, enclosed charting spaces, and secluded outdoor areas and activity areas, staff spent increased time monitoring and locating residents.

*Presence of amenities and environmental supports reduces staff turnover.* In a study of staff turnover in 117 community nursing homes and 57 long-term care veteran's facilities, Brennan and Moos (1990) found that, in the veteran's facilities, turnover was greater where there were fewer physical amenities, social-recreational aids, prosthetic aids, and less environmental diversity. The authors suggest that the physical design features in these facilities supported the staff's work efforts and thereby reduced turnover (Brennan & Moos, 1990).

*Physical design enhancements improve morale and satisfaction.* Studies show that physical design changes in long-term care settings such as interior design modifications, natural elements, furniture repositioning to support social interaction, design supports for resident independence (such as large clocks, handrails, additional mirrors) and orientation (large, clear signposts and reality orientation boards), and artwork were related to improved morale and satisfaction among staff (Christenfeld, et al., 1989; Cohen-Mansfield & Werner, 1998; Cox, Burns, & Savage, 2004; Jones, 1988; Parker et al., 2004).

*Back injuries among nursing staff are reduced by using patient lifts.* Patient lifting is the primary occupational back stressor for nursing personnel (Brophy, Achimore, & Moore-Dawson, 2001; Miller, Engst, Tate, & Yassi, 2006). Reducing injuries that result from resident-lifting tasks can not only result in significant economic benefit (reduced cost of claims, staff lost workdays), but also reduce pain and suffering among workers. Ergonomic programs, staff education, a no-manual lift policy, and use of mechanical lifts have been successful in reducing back injuries that result from patient-handling tasks (Engst, Chhokar, Miller, Tate, & Yassi, 2005; Garg & Owen, 1992; Garg, Owen, Beller, & Banaag, 1991; Garg, Owen, & Carlson, 1992; Miller, et al., 2006). Miller and colleagues (2006) studied the impact of installing portable ceiling lifts in a long-term care facility (ratio of ceiling lifts to resident beds was one to six) on risk of resident-handling injuries and compensation costs. After the intervention, staff members perceived that they were at less risk for injury when they used the ceiling lifts compared to manual methods. Also, 75% of the staff preferred using ceiling lifts over any other method for lifting and transferring residents. Compensation costs for resident-handling injuries reduced in the intervention facilities (Miller, et al., 2006).

## Conclusions

The review of the existing literature clearly suggests that design of the physical environment impacts resident and staff outcomes in long-term care settings and contributes to a better quality of life for those who live, work, and visit these facilities. In fact, the environment is being increasingly accepted as an important component in supporting wellness and health among residents in long-term care environments.

Though a large number of studies exist in different areas, the findings are sometimes mixed and many studies utilize small sample sizes that limit the ability to generalize the findings. Additional research is needed using larger sample sizes and rigorous methods to strengthen the findings reported in this report. While there is a growing body of literature examining the impact of the environment on residents with cognitive impairments, there are relatively fewer studies examining outcomes among cognitively intact long-term care residents. Also, there has been much less focus on staff outcomes in long-term care settings. Some areas for future research include:

- Assessment of environmental modifications to reduce resident falls and to identify environmental causes for falls in nursing-home settings.
- Environmental factors such as homelikeness that are potentially related to better quality of life for residents and staff.
- The impact of light (natural and artificial) as a cost-effective strategy for improving sleep quality and depression among institutionalized elderly.
- The impact of unit layout and size on resident agitation and well-being, social interaction, and participation in activities.
- Comparison of private and shared bedrooms in long-term care settings to assess impact on social interaction, privacy and control, sleep quality, and staff ability to monitor residents.
- Impact of amenities and environmental supports on staff work stress and job performance.

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