

Review Article

The Influence of the Physical Environment on Residents With Dementia in Long-Term Care Settings: A Review of the Empirical Literature

Habib Chaudhury, PhD,* Heather A. Cooke, PhD, Heather Cowie, MA, and Leila Razaghi, BSc, BA

Department of Gerontology, Simon Fraser University, Vancouver, BC, Canada.

*Address correspondence to Habib Chaudhury, PhD, Department of Gerontology, Simon Fraser University, Vancouver, BC, V6B 5K3, Canada.
E-mail: chaudhury@sfu.ca

Received August 23, 2016; Editorial Decision Date November 21, 2016

Decision Editor: Rachel Pruchno, PhD

Abstract

Background and Objectives: The physical environment in long-term care facilities has an important role in the care of residents with dementia. This paper presents a literature review focusing on recent empirical research in this area and situates the research with therapeutic goals related to the physical environment.

Research Design and Methods: A comprehensive literature search was conducted in Ageline, PsychINFO, CINAHL, Medline and Google Scholar databases to identify relevant articles. A narrative approach was used to review the literature.

Results: A total of 103 full-text items were reviewed, including 94 empirical studies and 9 reviews. There is substantial evidence on the influence of unit size, spatial layout, homelike character, sensory stimulation, and environmental characteristics of social spaces on residents' behaviors and well-being in care facilities. However, research in this area is primarily cross-sectional and based on relatively small and homogenous samples.

Discussion and Implications: Given the increasing body of empirical evidence, greater recognition is warranted for creating physical environments appropriate and responsive to residents' cognitive abilities and functioning. Future research needs to place greater emphasis on environmental intervention-based studies, diverse sample populations, inclusion of residents in different stages and with multiple types of dementia, and on longitudinal study design.

Keywords: Alzheimer's disease, Built environment, Nursing home, Quality of life, Environmental Design

The importance of the physical environment in nursing homes is increasingly recognized as a key component in the care of residents with dementia. Initial work in this area focused on the role of the physical environment on behavioral outcomes (e.g., wandering, agitation, and aggression); more recently, the focus has expanded to include individuals' physical functioning, emotional well-being and social interaction, which are significant contributors to residents' quality of life (Calkins, 2009; Calkins, 2001; Chaudhury & Cooke, 2014; Cooper Marcus, 2007; Day & Calkins, 2002; Marquardt, Bueter & Motzek, 2014). Well-designed,

supportive environments can promote way finding and orientation (Marquardt & Schmieg, 2009), improve activities of daily living function (Reimer, Slaughter, Donaldson, Currie & Eliasziw, 2004), autonomy and meaningful activity (Kane, Lum, Cutler, Degenholtz & Yu, 2007), and reduce anxiety, agitation, aggression (Schwarz, Chaudhury & Tofle, 2004; Zeisel, Silverstein, Hyde, Levkoff, Lawton, & Holmes, 2003) and falls (Detweiler, Murphy, Kim, Myers & Ashai, 2009). The physical environment also plays an important role in the provision of person-centred care (PCC) (Edvardsson, Winblad, & Sandman, 2008) by supporting

residents' remaining abilities, maintaining relationship and enhancing well-being (Wiersma & Pedlar, 2008).

Day and colleagues' (2000) seminal review of the empirical literature on therapeutic design of environments for residents with dementia remains widely-cited, albeit somewhat dated. Although more recent reviews exist, they are less comprehensive (e.g., Verbeek, van Rossum, Zwakhalen, Kempen, & Harners, 2009) and primarily descriptive (e.g., Fleming & Purandare, 2010). A recent review by Marquardt and colleagues (2014) highlighted empirical connections between environmental attributes (e.g., small-scale environments, spatial density) and resident outcomes (e.g., behavior, cognition, and function); however, while the review adds to our understanding of which environmental attributes influence which outcomes, its conceptualization of the environment is problematic with multiple overlaps among several environmental categories.

Building on the work of Day and colleagues (2000), the primary purpose of this paper is to provide a comprehensive review of the empirical work published in this area since 2000. Utilizing the environmental categories provided in Day et al.'s review as an organizing strategy offers a means for meaningfully comparing recent findings with those identified prior to 2000. A secondary goal is to present a preliminary discussion linking empirical findings and conceptually-oriented therapeutic goals associated with dementia care design.

Method

The following keywords were utilized to search for relevant articles: special care unit, long-term care, dementia, physical environment, dining room, bathing area, resident room, and outdoor environment. Five databases were included: Ageline, PsychINFO, CINAHL, Medline, and Google Scholar. References were also selected by searching the reference lists of relevant articles and by reviewing key pieces recommended by experts in the field. Items had to be based on empirical research, relevant to the topic at hand, published in English-language journals, and published after 2000. A total of 103 full-text items were reviewed, including 94 empirical studies and 9 reviews (6 systematic and 3 narrative). A narrative approach (Cronin, Ryan & Coughlan, 2008; Green, Johnson & Adams, 2006; Lin, Bryant, Boldero & Dow, 2015) guided the review and synthesis of the literature. This approach provides the flexibility to include quantitative and qualitative articles in developing a coherent synthesis. Additionally, this approach helps to identify gaps in the literature, therefore stimulating ideas for future research (Cronin, et al., 2008; Green, et al., 2006). The following sections draw on the reviewed literature to highlight the major issues, findings, and recommendations of the physical environment's impact on residents with dementia.

Unit Size

Early research highlighted increased agitation and aggression, intellectual deterioration and emotional disturbance,

and more frequent territorial conflicts/space invasions associated with larger (i.e., 30+ residents) unit size (Annerstedt, 1994; Morgan & Stewart, 1998; Sloane, et al., 1998). In comparison, smaller-sized units of 5–15 residents (known as group living, group homes or Green Houses) have been found to positively impact resident well-being, behavior, functioning, and activity engagement (Verbeek, et al., 2009). Reimer and colleagues (2004) followed 185 residents with dementia over a 1-year period and found that those living in small, 10-bed bungalows exhibited fewer declines in activities of daily living (ADLs) and less negative affect than residents in traditional, larger facilities. Similarly, in a longitudinal comparison of Green House and traditional nursing home (i.e., 50+ bed) environments, Green House residents displayed higher scores on a variety of quality of life domains, including privacy, autonomy, relationships and meaningful activities, as well as greater satisfaction and emotional well-being (Kane et al., 2007).

Studies of Dutch group-living environments report mixed results regarding unit size. Although group-living residents' overall quality of life, agitation and behavioral problems did not differ from residents of larger, more traditional units (i.e., 20+ beds); they experienced increased social engagement, greater positive affect, improved ADL function, felt more at home and had higher quality of life scores (de Rooij, et al., 2012; te Boekhorst, Depla, de Lange, Pot, & Eefsting, 2009; Verbeek, et al., 2010). In a longitudinal controlled intervention study, residents in small-scale care had significantly less decline in global cognitive functioning compared to residents in the larger care home (Kok, Heuvelen, Berg & Scherder, 2016). Interviews with residents of group-living units suggest small-scale environments help support a sense of self and social connection with others (Van Zadelhoff, Verbeek, Widdershoven, van Rossum, & Abma, 2011). Indeed, Funaki, Kaneko, and Okamura (2005) observed a significant improvement in residents' quality of life between entering a group-living home and 3 months thereafter, a finding which appeared related to household activity engagement. Relocation studies conducted in the United States, Japan, and Australia support such findings. Upon relocation from traditional nursing home units to smaller, 9–15 bed units, residents exhibited improved ADL function, activity engagement, and non-verbal social behaviors (McFadden & Lunsman, 2010; Smith, Mathews, & Gresham, 2010; Suzuki, Kanamori, Yasuda, & Oshiro, 2008; Thistleton, Warmuth, & Joseph, 2012). Although smaller unit size may increase resident opportunities for getting to know one another, other research (e.g., Campo & Chaudhury, 2012; Zeisel, et al., 2003) suggests that in housing more residents, larger units offer increased opportunities for social interaction, thus minimizing social withdrawal.

Spatial Layout and Orientation Cues

Unit configuration can play a key role in residents' ability to independently navigate their environment. Early research revealed how residents in group-living units with

I-shaped corridors experienced a higher degree of dyspraxia, restlessness, lack of vitality, and loss of identity than residents in L-, H- or square-shaped units (Elmståhl, Annerstedt, & Ahlund, 1997). Residents' spatial disorientation was less pronounced in the L-, H- or square-shaped units in which the kitchen, dining, and activity areas were located close to one another. More recently, Marquardt and Schmiege (2009) found that residents with moderate and severe dementia were better able to find their way (e.g., to the kitchen, their bedroom, and the toilet) in units with straight circulation systems (i.e., an I-shaped corridor) than in units whose layouts included one or more changes in direction (i.e., L-shaped or square-shaped units). However, the long hallways present in many nursing homes can decrease residents' awareness, orientation, safety, and security (Morgan, Stewart, D'Arcy, & Werezak, 2004). Passini and colleagues (2000) found that despite different color-coded residential floors, none of the residents used such color-coding to locate their floor, but relied instead on the furniture and the large floor number painted on the wall.

Albeit in very small samples of female residents, the use of orientation cues such as photographs of the resident from an earlier point in time, memorabilia items and the resident's name in large (i.e., 65-point) font have been found to increase residents' ability to find their own room by 45%–50% (Nolan, Mathews, & Harrison, 2001; Nolan, Mathews, Truesdell-Todd & Van Dorp, 2002). In a novel study testing the underlying assumptions of room signage, Gross and colleagues (2004) explored the self-recognition ability of 10 female residents with moderate to severe dementia. Participants were significantly more likely to identify their own photograph than that of another resident, and were able to read and recognize their own and others' names, leading the authors to conclude that persons with dementia may well possess the necessary skills to benefit from prosthetic signage (Gross, et al., 2004).

Homelike/Institutional Character

Design guidelines for dementia care settings advocate a more homelike character, including décor (e.g., wall coverings and pictures), furnishings (e.g., upholstered armchairs and coffee tables) and smaller-scale common areas (Brawley, 2006). Initial research highlighted the association between more homelike or enhanced residential environments and improved emotional and intellectual functioning, increased social interaction, autonomy and participation in community, and less trespassing, exit-seeking and agitation (Annerstedt, 1994; Cohen-Mansfield & Werner, 1998; McAllister & Silverman, 1999). Recent research reveals similar findings. Residents living in or relocated to more homelike environments (i.e., open-plan lounge/dining areas, residential furniture, and flooring) displayed reduced verbal and overall aggression, verbal agitation and anxiety (Wilkes, Fleming, Wilkes, Cioffi & Le Miere, 2005;

Zeisel, et al., 2003). Similarly, an enhanced environmental ambience (i.e., warm, embellished, welcoming, colorful and novel) has been shown to be associated with fewer walking/pacing episodes, and shorter pacing and longer sitting duration (Yao & Algase, 2006). Not surprisingly, staff and family members identify homelike environments as central to decreasing behavioral disruptions and improving residents' quality of life (Garcia, et al., 2012; Gnaedinger, Robinson, Sudbury & Dutchak, 2007).

Residents of Dutch facilities with more group-living characteristics (i.e., small-scale common areas with homelike atmosphere) tend to have greater activity engagement, in both overall and preferred activities, task-related and leisure activities and social interaction, than those in facilities with fewer group-living characteristics. Similar findings are reported by Morgan-Brown, Newton, and Ormerod (2013). Following the conversion of two Irish nursing home units to a household model (open-plan design and functioning unit kitchen), residents spent more time in the communal living spaces and were more active and engaged than in the pre-conversion, traditional units.

In North America, a more homelike environment has been shown to support engagement in daily activities and informal social interaction (Campo & Chaudhury, 2012; Milke, Beck, Danes, & Leask, 2009), with a more homelike dining environment increasing resident-directed conversation, autonomy and higher food and fluid intake (Chaudhury, Hung, Rust & Wu, 2016; Reed, Zimmerman, Sloane, Williams, & Boustani, 2005; Roberts, 2011). In addition to offering more opportunities and an enhanced ambience for residents to engage in everyday activities and interaction, homelike environments may also assist staff in engaging residents in such activities (Smit, de Lange, Willemse, & Pot, 2012). This highlights an important caveat—homelike design requires supportive caregiving practices to be fully effective (Day, et al., 2000). Institutional or restrictive policies and practices (e.g., restricted access to a kitchenette unless accompanied by a staff member, or locked doors to outdoor areas) serve only to undermine the therapeutic potential of homelike environmental features (Deforge, van Wyk, Hall & Salmoni, 2011; Saperstein, Calkins, Van Haitsma & Curyto, 2004). Related to the issue of homelike character is the variability of a facility's common spaces. Residents in care homes with a higher gradation of space (i.e., a range of private, semi-private and public spaces) have been found to display greater active behavior and well-being than those in homes with a low gradation of space (Barnes, 2002).

Sensory Stimulation

Although no sound level standards currently exist for nursing homes, several recent studies found noise levels to range from 52 to 57 dB in residents' rooms and 59 to 60 dB in common areas (Bharathan, et al., 2007; Joosse, 2011), which exceed the recommended levels for hospital ward

rooms (e.g., 30–40 dB; level of a whisper to a quiet room) and residential dwellings (e.g., 35–45 dB; level of a quiet room to moderate rainfall) (World Health Organization, 1999). Common noise sources included alarms, intercoms, ringing phones, staff conversations not involving residents, loud televisions and other equipment (Bharathan, et al., 2007; Garre-Olmo, et al., 2012; Joosse, 2011). Increased noise levels are associated with reduced social interaction, increased agitation and aggression, disruptive behavior and wandering (Algase, Elizabeth, Beattie, Beel-Bates, & Yao, 2010; Campo & Chaudhury, 2012; Garcia, et al., 2012; Garre-Olmo, et al., 2012; Joosse, 2012). Conversely, reduced noise levels are positively associated with quality of life (Garcia, et al., 2012). Although variations in sound can increase potentially meaningful wandering (Algase, et al., 2010), there is no association between noise and occupational engagement (Smit, Willemse, de Lange, & Pot, 2014).

Residents with dementia are typically exposed to considerably lower than recommended (i.e., <2,000 lux) lighting levels and thus spend the majority of their days in dim room light (De Lepeleire, Bouwen, De Coninck, & Buntinx, 2007; Schochat, Martin, Marler, & Ancoli-Israel, 2000), negatively impacting both affect and well-being (Garre-Olmo, et al., 2012). Exposure to higher lighting levels (e.g., through the use of a bright light box ranging from 2,500–10,000 lux), is associated with improved circadian rhythm quality and mood, increased consolidation of night-time sleep, increased daytime wakefulness, alertness and MMSE scores, and decreased agitation and disruptive behavior (Ancoli-Israel, et al., 2003; Dowling, Graf, Hubbard & Luxenberg, 2007; Fetveit & Bjorvatn, 2005; Graf, et al., 2001; Nowak & Davis, 2011; Thorpe, Middleton, Russell, & Stewart, 2000). Similarly, exposure to all-day bright light has been shown to increase total sleep duration, decrease restlessness and provide modest benefits in mood, cognition and functional decline (Riemersma-van der Lek, et al., 2008; Sloane, et al., 2007; van Hoof, Aarts, Rense & Schoutens, 2009). Particularly noteworthy is that the observed sleep gains exceed those achieved by hypnotic drug use (Sloane, et al., 2007). The following sections review findings related to specific spaces in the care facilities.

Dining Area

Mealtimes are a key focal point for nursing home residents, offering opportunities for the meeting of social, psychological and nutritional needs (Campo & Chaudhury, 2012; Hung & Chaudhury, 2011). Meals mean more than the absence of malnutrition and behavioral symptoms. However, a review by Chaudhury and colleagues (2013) found the majority of studies focused on increasing caloric intake and reducing problem behaviors, with only a select few examining strategies to improve social interactions and relationships.

Design guidelines focus on the creation of small-scale dining spaces that foster associations of home and appropriate sensory stimulation as a means of facilitating such opportunities (Brawley, 2006). Smaller-sized dining rooms with more homelike décor are associated with reduced anxiety and agitation, increased social interaction and improved food and fluid intake (Desai, Winter, Young, & Greenwood, 2007; Nijs, de Graaf, Kok & van Staveren, 2006; Reed et al., 2005; Roberts, 2011; Schwarz, et al., 2004). Several pre-post renovation studies have highlighted similar benefits. Perivolaris and colleagues (2006) observed that the introduction of three smaller dining areas, each featuring seating for 25–30 residents and homelike decor, significantly increased residents' caloric intake. More recently, dining space renovations featuring a resident-accessible kitchenette with microwave, fridge, coffee machine, facilitated increased resident independence and autonomy, social interaction, weight gain, and effective staff teamwork (Chaudhury, et al., 2016).

Additional research demonstrates the positive effects of enhanced lighting and maximized visual (i.e., color) contrast between plates and table settings on nutritional intake, agitation and functional independence (Brush, Meehan, & Calkins, 2002; Koss & Gilmore, 1998). Dunne and colleagues (2004) found that using high contrast tableware (e.g., red plates, cups and cutlery) as opposed to low contrast tableware (e.g., white plates, cups and stainless-steel cutlery) resulted in a significant increase in food and fluid intake amongst individuals with severe dementia. High-contrast blue tableware produced similar results, although low contrast (i.e., pastel red and blue) tableware did not.

Bathing Area

Recommendations regarding the design of dementia care units typically pay little attention to the bathing area, in part, due to the paucity of objective data about what features are most important or useful (Sloane, Honn, Dwyer, Wieselquist, Cain, & Myers, 1995). Initial research highlighted the association of mechanical lifts (used to elevate and then lower residents into a water-filled tub), privacy intrusions (staff accessing supply carts stored in the bathing room), inappropriate water and air temperature, running water, loud noises, and mechanical bathtub devices with increased resident confusion and agitation (Kovach & Meyer-Arnold, 1996; Namazi & Johnson, 1996). However, little research has been conducted in this area since Day and colleagues' (2000) review.

Somboontanont and colleagues (2004) examined both environmental attributes (e.g., temperature, noise, and crowding) and caregiver behavior to identify the antecedents of physical assaults against care staff during bathing. Although assaults primarily stemmed from caregiver behavior, they were significantly more likely when residents exhibited signs of temperature discomfort and multiple care aides were present. A more recent study examining the

relative importance of organizational and physical features of the bathing environment on agitation in 47 dementia care units found the provision of privacy, presence of windows and use of side/end-entry bathtubs were all associated with reduced agitation (Cooke, 2006).

Outdoor Area

Outdoor activities that are physical or social in nature, such as going for walks, gardening, and group activities, can benefit residents with dementia (Cooper Marcus & Sachs, 2013; Hyde, Perez, & Forester, 2007; Kwack, Relf & Rudolph, 2005). Other benefits include a positive impact on mental health, quality of life and mood, as well as reduced agitation, aggression and reduced use of behavioral medications (Detweiler, Murphy, Myers, & Kim, 2008). In particular, one study found that with more time spent in an SCU garden, residents with dementia exhibited less agitation and aggressive behavior (Detweiler, et al., 2008). This outcome persisted through the winter months despite no physical access to the space (Detweiler, et al., 2008).

Studies have shown stress-reducing, restorative effects associated with time spent outdoors (e.g., Ottosson & Grahn, 2006). Residents with dementia who spent more time participating in activities outdoors, exhibited improved sleep efficiency and sleep duration, as well as less verbal agitation than residents who participated in similar activities indoors (Calkins, Szmerekovsky, & Biddle, 2007; Connell, Sanford, & Lewis, 2007). Detweiler and colleagues (2008; 2009) examined the influence of a wander garden on behavioral outcomes of 34 male veterans with dementia. Twelve months following the garden opening, all participants showed a reduced need for PRN (i.e., as needed) medications (Detweiler, et al., 2008), although participants in the high-use group (i.e., >22 visits) experienced a significant decrease in antipsychotic medication intake, fewer scheduled psychiatric medications, and a greater reduction in falls and fall severity than those in the low-use group (Detweiler, et al., 2009). Visiting the wander garden resulted in reduced agitation levels for both ambulatory and non-ambulatory residents (Murphy, Miyazaki, Detweiler, & Kim, 2010).

Linking Empirical Findings With Therapeutic Goals

This section presents a preliminary discussion linking the reviewed empirical research with common therapeutic goals, thereby offering a starting point from which to develop further analysis and elaboration of the conceptual relationships/linkages. Therapeutic goals identify the desired relationship between the physical environment and people with dementia in care settings (e.g., Cohen & Weisman, 1991; Regnier, 2002; Weisman & Calkins, 1999; Zeisel, 1999). Although useful for articulating the purpose of discrete environmental features and their potential influence on residents' behavioral and psychosocial outcomes,

they also serve as a framework for evaluating the physical environment (Regnier, 2002). Common therapeutic goals include to maximize awareness and orientation, provide opportunities for stimulation and change, establish links with the health and familiar, and provide opportunities for socialization (e.g., Calkins, 1988; Cohen & Weisman, 1991; Regnier, 2002; Weisman & Calkins, 1999; Zeisel, 1999). As an illustration, the goal "maximize awareness and orientation" refers to how well an individual (e.g., resident, staff, or visitor) can understand and navigate the physical, social and/or temporal environment (Weisman, Lawton, Calkins & Sloane, 1996).

Table 1 provides an overview of the association between the reviewed empirical evidence and a select set of therapeutic goals, thereby highlighting the prevalence of evidence in relation to behavioral and psychosocial outcomes. The selected goals were chosen for their appearance in multiple conceptual frameworks (i.e., Brummett, 1997; Cohen & Weisman, 1991; Marsden, Calkins & Brillier 2003; Regnier, 2002; Sloane, et al, 2002; Tyson, 1998; Weisman & Calkins, 1999; Zeisel, 1999).

Environmental characteristics from the review are broadly grouped in two sections—unit or facility level (e.g., unit size, architectural layout, homelike/institutional character, and interior design) and selected areas (dining, bathing, and outdoor). These particular areas are included in this paper due to the relatively higher number of empirical studies focused on these areas, compared to very few studies on other areas, such as activity areas, bathing areas, or resident rooms. Empirical studies are marked with a positive (+) or negative (–) notation to indicate the nature of the association with respective therapeutic goals. Although somewhat simplistic, given the complex and multifaceted associations, we believe it is helpful to identify the primary association as beneficial or not in acknowledgment of the extant evidence and then further discuss the association in narrative fashion. As previously noted, this is an illustrative presentation and discussion of the linkages, given the paper's primary purpose as a literature review.

Substantial empirical evidence exists examining the association between unit size, spatial layout and homelike/institutional character across the various therapeutic goals. There is a broad range of evidence at the unit level characteristics associated with "support of functional abilities," "facilitation of social contact," "opportunities for personal control," and "regulation and quality of stimulation." For example, the spatial layout of a unit impacts not only "orientation and way finding" behavior, but also influences informal "social contacts and interactions." The spatial layout of a unit also has the potential for reducing "negative stimulation" (e.g., glare from hallway floor, institutional overhead lighting) and introducing opportunities for "positive stimulation" (e.g., hallway alcove used as a familiar activity centre). Likewise, a clearly legible spatial layout with shortened hallways can support the functional ability of a resident with dementia to go from her/his resident

Table 1. An overview of environmental characteristics related to therapeutic goals

Therapeutic goals	Unit/Facility level characteristics			Key spaces on the unit/facility	
	Unit size	Spatial layout	Homelike/ Institutional character	Dining area	Outdoor area
Maximize safety & security	(+) Morgan et al. (2004)	(-) Hung & Chaudhury (2011)	(+) Morgan et al. (2004)	(-) Hung & Chaudhury (2011)	(+/-) Chapman et al. (2007)
	(+/-) Parker et al. (2004)	(+/-) Milke et al. (2009)	(+) Reimer et al. (2004)	(+) Hung et al. (2015)	(+/-) Cohen-Mansfield (2007)
	(+) Reimer et al. (2004)	(+/-) Morgan et al. (2004) (+) Reimer et al. (2004)		(+) Ullrich et al. (2011)	(+) Detweiler et al. (2009) (+/-) Hernandez (2007) (+/-) Kearney & Winterbottom, (2006) (+/-) Lovering et al. (2002)
Maximize awareness & orientation	(-) Caspi (2014)	(-) Caspi (2014)	(-) Caspi (2014)	(+) Brush et al. (2002)	(+) Kearney & Winterbottom, (2006)
	(+/-) Marquardt & Schmiege (2009)	(+/-) Marquardt & Schmiege (2009)	(+) Marquardt & Schmiege (2009)	(+) Marquardt & Schmiege (2009)	(+) Lovering et al. (2002)
	(+) Morgan et al. (2004)	(-) Morgan et al. (2004) (+/-) Passini et al. (2000)	(+) Morgan et al. (2004)		(+) Marquardt & Schmiege (2009)
Support functional abilities	(-) Caspi (2014)	(-) Caspi (2014)	(+/-) Algase et al. (2010)	(+) Brush et al. (2002)	(+/-) Calkins et al. (2007)
	(+/-) Milke et al., (2009)	(+/-) Milke et al., (2009)	(+) Chaudhury et al. (2016)	(-) Carrier et al. (2006)	(-) Chapman et al., (2007)
	(+) Morgan et al. (2004)	(+/-) Morgan et al. (2004)	(+) Morgan et al. (2004)	(+) Chaudhury et al. (2016)	(+/-) Cohen-Mansfield (2007)
	(+/-) Parker et al. (2004)	(+) Reimer et al. (2004)	(+) Reed et al. (2005)	(+) Desai et al. (2007)	(+) Connell et al. (2007)
	(+) Reed et al. (2005)	(+) Smit et al. (2014)	(+) Reimer et al. (2004)	(+) Dunne et al. (2004)	(+) Detweiler et al. (2009)
	(+) Reimer et al. (2004)	(+) Smith et al. (2010)	(+) Smit et al. (2012)	(+) Hung et al. (2015)	(+) Hernandez (2007)
	(+) Smit et al. (2012)	(+) Te Boekhorst et al. (2009)	(+) Smit et al. (2014)	(+) Keller et al. (2010)	(+) Innes et al. (2011)
	(+) Smith et al. (2010)		(+) Smith et al. (2010)	(+) McDaniel et al. (2001)	(+) Kearney & Winterbottom, (2006)
	(+) Suzuki et al. (2008)		(+) Suzuki et al. (2008)	(+) Milke et al., (2009)	(+/-) Lovering et al. (2002)
	(+) Te Boekhorst et al. (2009)		(+) Te Boekhorst et al. (2009) (+) Yao & Algase (2006)	(+) Nijs et al. (2006)	(+) Ottosson & Grahn (2006)
				(+) Perivolaris et al. (2006) (+) Reed et al. (2005) (+/-) Shantenstein & Ferland, (2000)	
Facilitation of social contact	(+/-) De Rooij et al. (2012)	(+) Campo & Chaudhury (2012)	(+/-) Campo & Chaudhury (2012)	(+) Brush et al. (2002)	(+) Cohen-Mansfield (2007)
	(-) McFadden & Lunsman (2010)	(+/-) Doyle et al., (2011)	(+) Chaudhury et al. (2016)	(+) Campo & Chaudhury (2012)	(+) Hernandez (2007)

Table 1. Continued

	Unit/Facility level characteristics			Key spaces on the unit/facility	
	Unit size	Spatial layout	Homelike/ Institutional character	Dining area	Outdoor area
Therapeutic goals	(+) Parker et al. (2004)	(+) Schwarz et al. (2004)	(+) Schwarz et al. (2004)	(+) Chaudhury et al. (2016)	(+) Innes et al. (2011)
	(+) Schwarz et al. (2004)	(+) Smith et al. (2010)	(+) Smit et al (2012)	(+) Hung et al. (2015)	(+) Kearney & Winterbottom,(2006)
	(+) Smit et al (2012)	(+) Te Boekhorst et al. (2009)	(+) Smith et al. (2010)	(+) Keller et al. (2010)	(+) Lovering et al. (2002)
	(+) Smith et al. (2010)	(+) Zeisel et al. (2003)	(+)Te Boekhorst et al. (2009)	(+) Ullrich et al. (2011)	
	(+) Te Boekhorst et al. (2009)		(+) Zeisel et al. (2003)		
Provision of privacy	(+) Slaughter et al. (2006)	(+) Slaughter et al. (2006)	(+) Slaughter et al. (2006)		(+) Cohen-Mansfield (2007)
					(+) Kearney & Winterbottom, (2006) (+) Lovering et al. (2002)
Opportunities for personal control	(+/-) De Rooij et al. (2012)	(+) Kane et al. (2007)	(+) Garcia et al. (2012)	(+) Chaudhury et al. (2016)	(+/-) Calkins et al. (2007)
	(-) Garcia et al. (2012)	(+/-) Morgan et al. (2004)	(+) Kane et al. (2007)	(-) Garcia et al. (2012)	(+/-) Cohen-Mansfield (2007)
	(+) Kane et al. (2007)	(-) Passini et al. (2000)	(+) Morgan et al. (2004)	(-) Hung & Chaudhury (2011)	(+) Connell et al. (2007)
	(+) Morgan et al. (2004)	(+/-) Reimer et al. (2004)	(+/-) Reimer et al. (2004)	(+) Hung et al. (2015)	(+) Detweiler et al. (2008)
	(+/-) Parker et al. (2004)	(+) Slaughter et al. (2006)	(+) Slaughter et al. (2006)	(+)Nolan & Matthews (2004)	(+/-) Hernandez (2007)
	(+/-) Reimer et al. (2004)	(+) Te Boekhorst et al. (2009)	(+) Te Boekhorst et al. (2009)		(+) Innes et al. (2011)
	(+) Slaughter et al. (2006)	(+) Wilkes et al. (2005)	(+) Wilkes et al. (2005)		(+) Kearney & Winterbottom, (2006)
	(+) Te Boekhorst et al. (2009)	(+) Zeisel et al. (2003)	(+) Zeisel et al. (2003)		(+) Lovering et al. (2002)
	(+) Wilkes et al. (2005)				(+) Murphy et al. (2010)
	Regulation & Quality of stimulation	(+) Hung & Chaudhury (2011)	(-) Hung & Chaudhury (2011)	(+) Chaudhury et al. (2016)	(+) Brush et al. (2002)
(-) Isaksson et al. (2009)		(-) Isaksson et al. (2009)	(+) Hung et al. (2015)	(+) Chaudhury et al. (2016)	(+/-) Cohen-Mansfield (2007)
(+) Morgan et al. (2004)		(-) Passini et al. (2000)	(+) Morgan et al. (2004)	(+/-) Hung & Chaudhury (2011)	(+) Hernandez (2007)
(+/-) Reimer et al. (2004)		(+/-) Reimer et al. (2004)	(+/-) Reimer et al. (2004)	(+) Hung et al. (2015)	(+/-) Kearney & Winterbottom, (2006)
(+/-) Slaughter et al. (2006)		(+/-) Slaughter et al. (2006)	(+/-) Slaughter et al. (2006)	(+) Morgan et al. (2004)	(+) Lovering et al. (2002)
(-) Sloane et al. (2000)		(-) Sloane et al. (2000)	(+) Te Boekhorst et al. (2009)	(+)Nolan & Matthews (2004)	(+) McMinn et al., (2000)

Table 1. Continued

Therapeutic goals	Unit/Facility level characteristics			Key spaces on the unit/facility	
	Unit size	Spatial layout	Homelike/ Institutional character	Dining area	Outdoor area
	(+) Te Boekhorst et al. (2009)	(+) Te Boekhorst et al. (2009)	(+) Wilkes et al. (2005)	(+) Perivolaris et al. (2006)	(+) Murphy et al. (2010)
	(+) Wilkes et al. (2005)	(+) Wilkes et al. (2005)	(+) Yao & Algase (2006)	(-) Roberts (2011)	
		(+) Zeisel et al. (2003)	(+) Zeisel et al. (2003)	(+) Ullrich et al. (2011)	

Note: (+) = positive effect on therapeutic goal; (-) = negative effect on therapeutic goal; (+/-) = positive and negative effect on therapeutic goal.

room to a social space without getting lost. The size of a unit can positively or negatively influence multiple behavioral and psychosocial outcomes for residents. The most notable benefit regarding unit size is the association of smaller unit size and “facilitation of social contact.” Multiple studies addressing this association identify a positive influence of the smaller unit size on both informal social exchange and increased engagement in planned activities (e.g., De Rooij, et al., 2012; Reimer, et al., 2004; Smith, et al., 2010; Zeisel, et al., 2003). It is important to note that smaller unit size is not the sole determining factor here; rather, the features are multi-layered; for example, the potential positive impact of a smaller unit could be influenced by other environmental features, such as unit configuration and spatial layout (e.g., cluster design vs. hallway-based layout, single vs. multiple activity spaces). Moreover, the quality of the sensory environment (e.g., availability of daylight and noise levels) and interior design features (e.g., institutional vs. homelike furniture) could further mitigate the resulting impact on residents’ psycho-social outcomes.

Among the specific spaces on the unit, there is a fair amount of empirical research for dining and outdoor areas. For instance, mealtime environmental characteristics (e.g., higher illumination levels, reduced noise, and appropriate music) can “support residents’ functional ability” to take food and fluids, and also positively contribute to “improved social interaction.” The positive association of well-designed outdoor areas and multiple therapeutic goals underscore the importance of an outdoor space with appropriate design features to foster safe and effective use of such spaces, which and in turn, can influence quality of life outcomes.

Implications for Future Research

There is a fairly large body of literature on the impact of the physical environment of dementia care settings; however, notable gaps and limitations exist that need to be addressed in future work. Much of the research in this area is cross-sectional (Algase, et al., 2010; Chaudhury, et al., 2013; Wilkes, et al., 2005), and in some cases, exploratory

with small and homogenous samples (Chaudhury, et al., 2013; Detweiler, et al., 2008; Hernandez, 2007; Smit, et al., 2014; Wilkes, et al., 2005). Few randomized control studies have been conducted (Reimer, et al., 2004; Wilkes, et al., 2005; Zuidema, de Jonghe, Verhey, & Koopmans, 2010).

The interconnectedness of the organizational, social and physical environment (Chaudhury, et al., 2016; Garcia, et al., 2012) makes it difficult to ascertain which environmental aspect is impacting residents’ functioning and well-being. Additionally, it is heuristically challenging to measure a single environmental factor (e.g., studying unit size without considering the impact of a homelike setting) (Wilkes, et al., 2005). Many studies rely on subjective measures, such as family and staff perceptions (Garcia, et al., 2012; Reimer, et al., 2004; Smit, et al., 2014). Little attention is paid to the type and/or severity of dementia; certain features may differentially impact individuals depending on their diagnosis (Zuidema, et al., 2010). There is a need for more research on specific topics, for example—environmental characteristics of bathing areas and bathing options; another area is related to privacy issues in resident rooms and the need to examine comparable effects of single versus double occupancy rooms on outcomes like residents’ quality of sleep, family visitation opportunities, personal care practices, residents’ anxiety levels, etc. Studies also need to examine contradictory findings regarding spatial layout and maximizing safety.

Future research can substantiate or refute earlier findings and examine unexplored relationships (Chaudhury, et al., 2013; Wilkes, et al., 2005; Zuidema, et al., 2010). For example, there is a lack of studies utilizing a pre- and post- methodology in this area (Garcia, et al., 2012). It will also be worthwhile to adopt mixed methods and take into account the subjective perspectives of the residents with dementia (Chaudhury, et al., 2013). Further, it would be important to include diverse sample populations, for example, cultural/ethnically diverse groups, different stages and types of dementia, and rural settings (Chaudhury, et al., 2013; Zuidema, et al., 2010). Little is known about specific environmental features responsive to people in different stages of Alzheimer’s disease. Finally, longitudinal research

is needed on the effect of environment on residents' outcomes associated with their cognitive status and functioning levels (Kok, et al., 2016; Verbeek, et al., 2009).

The preliminary discussion linking empirical evidence with therapeutic goals is an important first step in the provision of a comprehensive and in-depth analysis of the associations between environmental characteristics and therapeutic goals. The goals holistically link environmental characteristics with key quality of life dimensions (cognition, behavior and well-being), thereby grounding the existing evidence in the theoretical knowledge base, and providing an actionable framework for policy and care planning. We believe Table 1 and the associated, albeit brief, narrative will stimulate such analysis and discussion in future work.

Conclusion

The physical environment in care settings has a salient role in enhancing residents' quality of life and quality of care practices. Specifically, this review highlighted the influence of unit size, spatial layout, homelike character, sensory stimulation, and specific spaces (i.e., dining, bathing, and outdoor spaces) on residents' behaviors and well-being in dementia care facilities. As people with dementia have heightened sensitivity to environmental stressors and cues, it is important that the physical environment is appropriate and responsive to their cognitive abilities and functioning. At the same time, we need to acknowledge that a good physical environment alone cannot create a therapeutic milieu. The potential of a therapeutic physical setting is meaningfully utilized only when there is a corresponding recognition of the importance of appropriately inspired organizational policies and care/relational practices.

References

- Algase, D. L., Beattie, E. R., Antonakos, C., Beel-Bates, C. A., & Yao, L. (2010). Wandering and the physical environment. *American Journal of Alzheimer's Disease and Other Dementias*, 25, 340–346. doi:10.1177/1533317510365342
- Ancoli-Israel, S., Gehrman, P., Martin, J. L., Shochat, T., Marler, M., Corey-Bloom, J., & Levi, L. (2003). Increased light exposure consolidates sleep and strengthens circadian rhythms in severe Alzheimer's disease patients. *Behavioral Sleep Medicine*, 1, 22–36. doi:10.1207/S15402010BSM0101_4
- Annerstedt, L. (1994). An attempt to determine the impact of group living care in comparison to traditional long-term care on demented elderly patients. *Aging (Milan, Italy)*, 6, 372–380.
- Barnes, S. (2002). The design of caring environments and the quality of life of older people. *Ageing and Society*, 22, 775–789.
- Bharathan, T., Glodan, D., Ramesh, A., Vardhini, B., Baccash, E., Kiselev, P., & Goldenberg, G. (2007). What do patterns of noise in a teaching hospital and nursing home suggest? *Noise & Health*, 9, 31–34.
- Brawley, E. C. (2006). *Design innovations for aging and Alzheimer's: Creating caring environments*. NJ: John Wiley and Sons, Inc.
- Brummett, W. (1997). *The essence of home: Design solutions for assisted living housing*. New York: Van Nostrand Reinhold.
- Brush, J. A., Meehan, R. A., & Calkins, M. P. (2002). Using the environment to improve intake for people with dementia. *Alzheimer's Care Quarterly*, 3, 330–338.
- Calkins, M. P. (1988). *Design for dementia: planning environments for the elderly and the confused*. Owings Mills, MD: National Health Pub.
- Calkins, M. P. (2001). The physical and social environment of the person with Alzheimer's disease. *Aging & Mental Health*, 5, S74–S78.
- Calkins, M. P. (2009). Evidence-based long term care design. *Neurorehabilitation*, 25, 145–154. doi:10.3233/NRE-2009-0512
- Calkins, M., Szmerekovsky, J. G., & Biddle, S. (2007). Effect of increased time spent outdoors on individuals with dementia residing in nursing homes. *Journal of Housing for the Elderly*, 21, 211–228.
- Campo, M. & Chaudhury, H. (2012). Informal social interaction among residents with dementia in special care units: Exploring the role of the physical and social environments. *Dementia: The International Journal of Social Research and Practice*, 11, 401–423.
- Carrier, N., West, G. E., & Ouellet, D. (2006). Cognitively impaired residents' risk of malnutrition is influenced by foodservice factors in long-term care. *Journal of Nutrition for the Elderly*, 25, 73–87.
- Caspi, E. (2014). Wayfinding difficulties among elders with dementia in an assisted living residence. *Dementia (London, England)*, 13, 429–450. doi:10.1177/1471301214535134
- Chapman, N. J., Hazen, T., & Noell-Waggoner, E. (2007). Gardens for people with dementia. *Journal of Housing for the Elderly*, 21, 249–263.
- Chaudhury, H. & Cooke, H. (2014). Design matters in dementia care: The role of the physical environment in dementia care settings. In M. Downs & B. Bowers (Eds.), *Excellence in dementia care* (2nd ed) (pp. 144–158). UK: Open University Press.
- Chaudhury, H., Hung, L., & Badger, M. (2013). The role of physical environment in supporting person-centered dining in long-term care: a review of the literature. *American Journal of Alzheimer's Disease and Other Dementias*, 28, 491–500. doi:10.1177/1533317513488923
- Chaudhury, H., Hung, L., Rust, T., & Wu, S. (2016). Do physical environmental changes make a difference? Supporting person-centred care at mealtimes in nursing homes. *Dementia: The International Journal of Social Research and Practice*. doi: 10.1177/1471301215622839.
- Cohen-Mansfield, J. (2007). Outdoor wandering parks for persons with dementia. *Journal of Housing for the Elderly*, 21, 35–53.
- Cohen, U., & Weisman, G. D. (1991). *Holding on to home: Designing environments for people with dementia*. Baltimore: The Johns Hopkins University Press.
- Cohen-Mansfield, J., & Werner, P. (1998). The effects of an enhanced environment on nursing home residents who pace. *The Gerontologist*, 38, 199–208.
- Connell, B. R., Sanford, J. A., & Lewis, D. (2007). Therapeutic effects of an outdoor activity program on nursing home residents with dementia. *Journal of Housing for the Elderly*, 21, 194–209.
- Cooke, H. A. (2006). *Organizational and physical environmental correlates of bathing-related agitation in dementia special care*

- units. (Unpublished master's thesis). Simon Fraser University, Vancouver, British Columbia, Canada.
- Cooper Marcus, C. (2007). Alzheimer's Garden Audit Tool. *Journal of Housing for the Elderly*, *21*, 179–191.
- Cooper Marcus, C., & Sachs, N. A. (2013). *Therapeutic landscapes: An evidence-based approach to designing healing gardens and restorative outdoor spaces*. NJ: John Wiley & Sons.
- Cronin, P., Ryan, F., & Coughlan, M. (2008). Undertaking a literature review: a step-by-step approach. *British Journal of Nursing (Mark Allen Publishing)*, *17*, 38–43. doi:10.12968/bjon.2008.17.1.28059
- Day, K & Calkins, M. (2002). Design and dementia. In R. Bechtel & A. Churchman (Eds.), *Handbook of Environmental Psychology*. NY: John Wiley and Sons.
- Day, K., Carreon, D., & Stump, C. (2000). The therapeutic design of environments for people with dementia: a review of the empirical research. *The Gerontologist*, *40*, 397–416.
- De Lepeleire, J., Bouwen, A., De Coninck, L., & Buntinx, F. (2007). Insufficient lighting in nursing homes. *Journal of the American Medical Directors Association*, *8*, 314–317. doi:10.1016/j.jamda.2007.01.003
- de Rooij, A. H., Luijckx, K. G., Schaafsma, J., Declercq, A. G., Emmerink, P. M., & Schols, J. M. (2012). Quality of life of residents with dementia in traditional versus small-scale long-term care settings: a quasi-experimental study. *International Journal of Nursing Studies*, *49*, 931–940. doi:10.1016/j.ijnurstu.2012.02.007
- DeForge, R., van Wyk, P., Hall, J., & Salmoni, A. (2011). Afraid to care: unable to care: A critical ethnography within a long-term care home. *Journal of Aging Studies*, *25*, 415–426.
- Desai, J., Winter, A., Young, K. W., & Greenwood, C. E. (2007). Changes in type of foodservice and dining room environment preferentially benefit institutionalized seniors with low body mass indexes. *Journal of the American Dietetic Association*, *107*, 808–814. doi:10.1016/j.jada.2007.02.018
- Detweiler, M. B., Murphy, P. F., Kim, K. Y., Myers, L. C., & Ashai, A. (2009). Scheduled medications and falls in dementia patients utilizing a wander garden. *American Journal of Alzheimer's Disease & Other Dementias*, *000*, 1–11.
- Detweiler, M. B., Murphy, P. F., Myers, L. C., & Kim, K. Y. (2008). Does a wander garden influence inappropriate behaviors in dementia residents? *American Journal of Alzheimer's Disease and Other Dementias*, *23*, 31–45. doi:10.1177/1533317507309799
- Dowling, G. A., Graf, C. L., Hubbard, E. M., & Luxenberg, J. S. (2007). Light treatment for neuropsychiatric behaviors in Alzheimer's disease. *Western Journal of Nursing Research*, *29*, 961–975. doi:10.1177/0193945907303083
- Doyle, P. J., de Medeiros, K., & Saunders, P. A. (2011). Nested social groups within the social environment of a dementia care assisted living setting. *Dementia*, *0*, 1–17.
- Dunne, T. E., Neargarder, S. A., Cipolloni, P. B., & Cronin-Golomb, A. (2004). Visual contrast enhances food and liquid intake in advanced Alzheimer's disease. *Clinical nutrition (Edinburgh, Scotland)*, *23*, 533–538. doi:10.1016/j.clnu.2003.09.015
- Edvardsson, D., Winblad, B., & Sandman, P. O. (2008). Person-centred care of people with severe Alzheimer's disease: current status and ways forward. *The Lancet. Neurology*, *7*, 362–367. doi:10.1016/S1474-4422(08)70063-2
- Elmståhl, S., Annerstedt, L., & Ahlund, O. (1997). How should a group living unit for demented elderly be designed to decrease psychiatric symptoms? *Alzheimer Disease and Associated Disorders*, *11*, 47–52.
- Fetveit, A., & Bjorvatn, B. (2005). Bright-light treatment reduces actigraphic-measured daytime sleep in nursing home patients with dementia: a pilot study. *The American Journal of Geriatric Psychiatry: Official Journal of the American Association for Geriatric Psychiatry*, *13*, 420–423. doi:10.1176/appi.ajgp.13.5.420
- Fleming, R., & Purandare, N. (2010). Long-term care for people with dementia: environmental design guidelines. *International Psychogeriatrics*, *22*, 1084–1096. doi:10.1017/S1041610210000438
- Funaki, Y., Kaneko, F., & Okamura, H. (2005). Study on factors associated with changes in quality of life of demented elderly persons in group homes. *Scandinavian Journal of Occupational Therapy*, *12*, 4–9.
- Garcia, L. J., Hébert, M., Kozak, J., Sénécal, I., Slaughter, S. E., Aminzadeh, F. ... Eliasziw, M. (2012). Perceptions of family and staff on the role of the environment in long-term care homes for people with dementia. *International Psychogeriatrics*, *24*, 753–765. doi:10.1017/S1041610211002675
- Garre-Olmo, J., López-Pousa, S., Turon-Estrada, A., Juvinyà, D., Ballester, D., & Vilalta-Franch, J. (2012). Environmental determinants of quality of life in nursing home residents with severe dementia. *Journal of The American Geriatrics Society*, *60*, 1230–1236. doi:10.1111/j.1532-5415.2012.04040.x
- Gnaedinger, N., Robinson, J., Sudbury, F., & Dutchak, M. (2007). Renovating the built environment for dementia care: lessons learned at the Lodge at Broadmead in Victoria, British Columbia. *Healthcare quarterly (Toronto, Ont.)*, *10*, 76–80.
- Graf, A., Wallner, C., Schubert, V., Willeit, M., Wlk, W., Fischer, P., ... Neumeister, A. (2001). The effects of light therapy on minimal state examination scores in demented patients. *Biological Psychiatry*, *50*, 725–727.
- Green, B. N., Johnson, C. D., & Adams, A. (2006). Writing narrative literature reviews for peer-reviewed journals: secrets of the trade. *Journal of Chiropractic Medicine*, *5*, 101–117. doi:10.1016/S0899-3467(07)60142-6
- Gross, J., Harmon, M. E., Myers, R. A., Evans, R. L., Kay, N. R., Rodriguez-Charbonier, S., Herzog, T.R. (2004). Recognition of self among persons with dementia: Pictures versus names as environmental supports. *Environment and Behavior*, *36*, 424–454.
- Hernandez, R. O. (2007). Effects of therapeutic gardens in special care units for people with dementia. *Journal of Housing for the Elderly*, *21*, 117–152. doi:10.1300/J081v21n01_07
- Hung, L., & Chaudhury, H. (2011). Exploring personhood in dining experiences of residents with dementia in long-term care facilities. *Journal of Aging Studies*, *25*, 1–12.
- Hung, L., Chaudhury, H., & Rust, T. (2015). The effect of dining room physical environmental renovations on person-centered care practice and residents' dining experiences in long-term care facilities. *Journal of Applied Gerontology*, *35*, 1279–1301.
- Hyde, J., Perez, R., & Forester, B. (2007). Dementia and assisted living. *The Gerontologist*, *47*, 51–67.
- Innes, A., Kelly, F., & Dincarslan, O. (2011). Care home design for people with dementia: What do people with dementia and their

- family carers value? *Aging & Mental Health*, 15, 548–556. doi:10.1080/13607863.2011.556601
- Isaksson, U., Aström, S., Sandman, P. O., & Karlsson, S. (2009). Factors associated with the prevalence of violent behaviour among residents living in nursing homes. *Journal of Clinical Nursing*, 18, 972–980. doi:10.1111/j.1365-2702.2008.02440.x
- Joosse, L. L. (2011). Sound levels in nursing homes. *Journal of Gerontological Nursing*, 37, 30–35. doi:10.3928/00989134-20110329-01
- Joosse, L. L. (2012). Do sound levels and space contribute to agitation in nursing home residents with dementia? *Research in Gerontological Nursing*, 5, 174–184. doi:10.3928/19404921-20120605-02
- Kane, R. A., Lum, T. Y., Cutler, L. J., Degenholtz, H. B., & Yu, T. C. (2007). Resident outcomes in small-house nursing homes: a longitudinal evaluation of the initial green house program. *Journal of the American Geriatrics Society*, 55, 832–839. doi:10.1111/j.1532-5415.2007.01169.x
- Kearney, A. R. & Winterbottom, D. (2006). Accommodating culturally meaningful activities in outdoor settings for older adults. In S. Rodiek & B. Schwarz (Eds.), *The role of the outdoors in residential environments for aging* (pp. 7–28) New York: The Haworth Press, Inc.
- Keller, H. H., Martin, L. S., Dupuis, S., Genoe, R., Edward, H. G., Cassolato, C. (2010). Mealtimes and being connected in the community-based dementia context. *Dementia*, 9, 191–213.
- Kok, S. J., Heuvelen, M. J. G., Berg, I. J., & Scherder, E. J. A. (2016). Small scale homelike special care units and traditional special care units: effects on cognition in dementia: a longitudinal controlled intervention study. *BMC Geriatrics*, 16. doi:10.1186/s12877-016-0222-5.
- Koss, E., & Gilmore, G. (1998). Environmental interventions and functional ability of AD patients. In B. Vellas, J. Filten, & G. Frisoni (Eds.), *Research and practice in Alzheimer's Disease 1998* (pp.185–193). New York: Springer.
- Kovach, C. R., & Meyer-Arnold, E. A. (1996). Coping with conflicting agendas: the bathing experience of cognitively impaired older adults. *Scholarly Inquiry for Nursing Practice*, 10, 23–36.
- Kwack, H., Relf, P. D., & Rudolph, J. (2005). Adapting garden activities for overcoming difficulties of individuals with dementia and physical limitations. *Activities, Adaptation & Aging*, 29, 1–13.
- Lin, X., Bryant, C., Boldero, J., & Dow, B. (2015). Older Chinese immigrants' relationships with their children: A literature review from a solidarity-conflict perspective. *The Gerontologist*, 55, 990–1005. doi:10.1093/geront/gnu004
- Lovering, M. J., Cott, C. A., Wells, D. L., Taylor, J. S., & Wells, L. M. (2002). A study of a secure garden in the care of people with Alzheimer's disease. *Canadian Journal on Aging*, 21, 417–427.
- Marquardt, G., & Schmieg, P. (2009). Dementia-friendly architecture: environments that facilitate wayfinding in nursing homes. *American Journal of Alzheimer's Disease and Other Dementias*, 24, 333–340. doi:10.1177/1533317509334959
- Marquardt, G., Bueter, K., & Motzek, T. (2014). Impact of the design of the built environment on people with dementia: an evidence-based review. *HERD*, 8, 127–157. doi:10.1177/193758671400800111
- Marsden, J. P., Calkins, M. P., & Briller, S. H. (2003). Educating LTC staff about therapeutic environments. *Journal of Architectural and Planning Research*, 20, 68–74.
- McAllister, C. L., & Silverman, M. A. (1999). Community formation and community roles among persons with Alzheimer's disease: a comparative study of experiences in a residential Alzheimer's facility and a traditional nursing home. *Qualitative Health Research*, 9, 65–85.
- McDaniel, J. H., Hunt, A., Hackes, B., & Pope, J. F. (2001). Impact of dining room environment on nutritional intake of Alzheimer's residents: a case study. *American journal of Alzheimer's disease and other dementias*, 16, 297–302.
- McFadden, S. H., & Lunsman, M. (2010). Continuity in the midst of change: behaviors of residents relocated from a nursing home environment to small households. *American journal of Alzheimer's disease and other dementias*, 25, 51–57. doi:10.1177/1533317508320088
- McMinn, B. G., & Hinton, L. (2000). Confined to barracks: the effects of indoor confinement on aggressive behavior among inpatients of an acute psychogeriatric unit. *American Journal of Alzheimer's Disease and Other Dementias*, 15, 36–41.
- Milke, D. L., Beck, C. H., Danes, S., & Leask, J. (2009). Behavioral mapping of residents' activity in five residential style care centers for elderly persons diagnosed with dementia: Small differences in sites can affect behaviors. *Journal of Housing for the Elderly*, 23, 335–367.
- Morgan, D. G., & Stewart, N. J. (1999). The physical environment of special care units: needs of residents with dementia from the perspective of staff and family caregivers. *Qualitative Health Research*, 9, 105–118.
- Morgan, D. G., Stewart, N. J., D'arcy, K. C., & Werezak, L. J. (2004). Evaluating rural nursing home environments: dementia special care units versus integrated facilities. *Aging & Mental Health*, 8, 256–265. doi:10.1080/1360786041000166796
- Morgan-Brown, M., Newton, R., & Ormerod, M. (2013). Engaging life in two Irish nursing home units for people with dementia: quantitative comparisons before and after implementing household environments. *Aging & Mental Health*, 17, 57–65. doi:10.1080/13607863.2012.717250
- Murphy, P., Miyazaki, Y., Detweiler, M., & Kim, K. (2010). Longitudinal analysis of differential effects on agitation of therapeutic wander garden for dementia patients based on ambulation ability. *Dementia*, 9, 355–373.
- Namazi, K. H., & Johnson, B. D. (1996). Issues related to behavior and the physical environment: bathing cognitively impaired patients. *Geriatric nursing (New York, N.Y.)*, 17, 234–238; quiz 238.
- Nijs, K. A., de Graaf, C., Kok, F. J., & van Staveren, W. A. (2006). Effect of family style mealtimes on quality of life, physical performance, and body weight of nursing home residents: cluster randomised controlled trial. *BMJ (Clinical research ed.)*, 332, 1180–1184. doi:10.1136/bmj.38825.401181.7C
- Nolan, B. A., & Mathews, R. M. (2004). Facilitating resident information seeking regarding meals in a special care unit: an environmental design intervention. *Journal of Gerontological Nursing*, 30, 12–16; quiz 55.
- Nolan, B. A., Mathews, R. M., & Harrison, M. (2001). Using external memory aids to increase room finding by older adults with dementia. *American Journal of Alzheimer's Disease and Other Dementias*, 16, 251–254.
- Nolan, B. A., Mathews, R. M., Truesdell-Todd, G., & VanDorp, A. (2002). Evaluation of the effect of orientation cues on wayfinding in persons with dementia. *Alzheimer's Care Quarterly*, 3, 46–49.

- Nowak, L., & Davis, J. (2011). Qualitative analysis of therapeutic light effects on global function in Alzheimer's disease. *Western Journal of Nursing Research*, *33*, 933–952. doi:10.1177/0193945910386248
- Ottosson, J., & Grahn, P. (2006). Measures of restoration in geriatric care residences: the influence of nature on elderly people's power of concentration, blood pressure and pulse rate. *Journal of Housing for the Elderly*, *19*, 227–256.
- Parker, C., Barnes, S., McKee, K., Morgan, K., Torrington, J., & Tregenza, P. (2004). Quality of life and building design in residential and nursing homes for older people. *Ageing and Society*, *24*, 941–962. doi:10.1017/S0144686X04002387
- Passini, R., Pigot, H., Rainville, C., & Tétreault, M. H. (2000). Wayfinding in a nursing home for advanced dementia of the Alzheimer's type. *Environment and Behavior*, *32*, 684–710.
- Perivolaris, A., LeClerc, C. M., Wilkinson, K., & Buchanan, S. (2006). An enhanced dining program for persons with dementia. *Alzheimer's Care Quarterly*, *7*, 258–267.
- Reed, P. S., Zimmerman, S., Sloane, P. D., Williams, C. S., & Boustani, M. (2005). Characteristics associated with low food and fluid intake in long-term care residents with dementia. *The Gerontologist*, *45*, 74–80.
- Regnier, V. (2002). *Design for assisted living. Guidelines for housing the physically and mentally frail*. New York: J. Wiley.
- Reimer, M. A., Slaughter, S., Donaldson, C., Currie, G., & Eliasziw, M. (2004). Special care facility compared with traditional environments for dementia care: a longitudinal study of quality of life. *Journal of the American Geriatrics Society*, *52*, 1085–1092. doi:10.1111/j.1532-5415.2004.52304.x
- Riemersma-van der Lek, R. F., Swaab, D. F., Twisk, J., Hol, E. M., Hoogendijk, W. J., & Van Someren, E. J. (2008). Effect of bright light and melatonin on cognitive and noncognitive function in elderly residents of group care facilities: a randomized controlled trial. *JAMA*, *299*, 2642–2655. doi:10.1001/jama.299.22.2642
- Roberts, E. (2011). Six for lunch: A dining option for residents with dementia in a special care unit. *Journal of Housing for the Elderly*, *25*, 352–379.
- Saperstein, A.R., Calkins, M.P., Van Haitsma, K., & Curyto, K.J. (2004). Missed opportunities: the disconnect between physical design and programming and operations. *Alzheimer's Care Quarterly*, *5*, 324–331.
- Schwarz, B., Chaudhury, H., & Tofle, R. B. (2004). Effect of design interventions on a dementia care setting. *American Journal of Alzheimer's Disease and Other Dementias*, *19*, 172–176.
- Slaughter, S., Calkins, M., Eliasziw, M., & Reimer, M. (2006). Measuring physical and social environments in nursing homes for people with middle- to late-stage dementia. *Journal of the American Geriatrics Society*, *54*, 1436–1441. doi:10.1111/j.1532-5415.2006.00851.x
- Sloane, P. D., Honn, V. J., Dwyer, S. A., Wieselquist, J., Cain, C., & Myers, S. (1995). Bathing the Alzheimer's patient in long term care: Results and recommendations from three studies. *American Journal of Alzheimer's Disease*, *10*, 3–11.
- Sloane, P. D., Mitchell, C. M., Calkins, M., & Zimmerman, S. I. (2000). Light and noise levels in Alzheimer's disease special care units. *Research and Practice in Alzheimer's Disease*, *4*, 421–429.
- Sloane, P. D., Mitchell, C. M., Preisser, J. S., Phillips, C., Commander, C., & Burker, E. (1998). Environmental correlates of resident agitation in Alzheimer's disease special care units. *Journal of the American Geriatrics Society*, *46*, 862–869.
- Sloane, P. D., Mitchell, C. M., Weisman, G., Zimmerman, S., Foley, K. M., Lynn, M., ... Montgomery, R. (2002). The Therapeutic Environment Screening Survey for Nursing Homes (TESS-NH): an observational instrument for assessing the physical environment of institutional settings for persons with dementia. *The Journals of Gerontology. Series B, Psychological Sciences and Social Sciences*, *57*, S69–S78.
- Sloane, P. D., Williams, C. S., Mitchell, C. M., Preisser, J. S., Wood, W., Barrick, A. L., ... Zimmerman, S. (2007). High-intensity environmental light in dementia: effect on sleep and activity. *Journal of the American Geriatrics Society*, *55*, 1524–1533. doi:10.1111/j.1532-5415.2007.01358.x
- Smit, D., de Lange, J., Willemse, B., & Pot, A. M. (2012). The relationship between small-scale care and activity involvement of residents with dementia. *International Psychogeriatrics*, *24*, 722–732. doi:10.1017/S1041610211002377
- Smit, D., Willemse, B., de Lange, J., & Pot, A. M. (2014). Wellbeing-enhancing occupation and organizational and environmental contributors in long-term dementia care facilities: an explorative study. *International Psychogeriatrics*, *26*, 69–80. doi:10.1017/S1041610213001397
- Smith, R., Mathews, R. M., & Gresham, M. (2010). Pre- and post-occupancy evaluation of new dementia care cottages. *American Journal of Alzheimer's Disease and Other Dementias*, *25*, 265–275. doi:10.1177/1533317509357735
- Somboontanont, W., Sloane, P. D., Floyd, F. J., Holditch-Davis, D., Hogue, C. C., & Mitchell, C. M. (2004). Assaultive behavior in Alzheimer's disease: identifying immediate antecedents during bathing. *Journal of Gerontological Nursing*, *30*, 22–29.
- Suzuki, M., Kanamori, M., Yasuda, M., & Oshiro, H. (2008). One-year follow-up study of elderly group-home residents with dementia. *American Journal of Alzheimer's Disease and Other Dementias*, *23*, 334–343. doi:10.1177/1533317508319155
- te Boekhorst, S., Depla, M. F., de Lange, J., Pot, A. M., & Eefsting, J. A. (2009). The effects of group living homes on older people with dementia: a comparison with traditional nursing home care. *International Journal of Geriatric Psychiatry*, *24*, 970–978. doi:10.1002/gps.2205
- Thistleton, W., Warmuth, J., & Joseph, J. M. (2012). A cottage model for eldercare. *HERD*, *5*, 99–114.
- Thorpe, L., Middleton, J., Russell, G., & Stewart, N. (2000). Bright light therapy for demented nursing home patients with behavioral disturbance. *American Journal of Alzheimer's Disease and Other Dementias*, *15*, 18–26.
- Tyson, M. (1998). *The healing landscape*. New York: Wiley.
- Ullrich, S., McCutcheon, H., & Parker, B. (2011). Reclaiming time for nursing practice in nutritional care: outcomes of implementing Protected Mealtimes in a residential aged care setting. *Journal of Clinical Nursing*, *20*, 1339–1348. doi:10.1111/j.1365-2702.2010.03598.x
- Van Hoof, J., Aarts, M. P. J., Rense, C. G., & Schoutens, A. M. C. (2009). Ambient bright light in dementia: Effects on behaviour and circadian rhythmicity. *Building and Environment*, *44*, 146–155. doi:10.1016/j.buildenv.2008.02.005

- van Zadelhoff, E., Verbeek, H., Widdershoven, G., van Rossum, E., & Abma, T. (2011). Good care in group home living for people with dementia. Experiences of residents, family and nursing staff. *Journal of Clinical Nursing*, *20*, 2490–2500. doi:10.1111/j.1365-2702.2011.03759.x
- Verbeek, H., van Rossum, E., Zwakhalen, S. M., Kempen, G. I., & Hamers, J. P. (2009). Small, homelike care environments for older people with dementia: a literature review. *International Psychogeriatrics*, *21*, 252–264. doi:10.1017/S104161020800820X
- Verbeek, H., Zwakhalen, S. M., van Rossum, E., Ambergen, T., Kempen, G. I., & Hamers, J. P. (2010). Dementia care redesigned: Effects of small-scale living facilities on residents, their family caregivers, and staff. *Journal of the American Medical Directors Association*, *11*, 662–670. doi:10.1016/j.jamda.2010.08.001
- Weisman, G. & Calkins, M. (1999). Models for environmental assessment. In B. Schwarz & B. Brent (Eds.), *Aging, autonomy, and architecture: Advances in assisted living* (pp. 130–140). Baltimore: Johns Hopkins University Press.
- Weisman, G., Lawton, P., Calkins, M., & Sloane, P. (1996). *Professional Environmental Assessment Protocol*. n.p.: Institute on Aging & Environment
- Wiersma, E. C., & Pedlar, A. (2008). The nature of relationships in alternative dementia care environments. *Canadian journal on aging = La revue canadienne du vieillissement*, *27*, 101–108. doi:10.3138/cja.27.1.101
- Wilkes, L., Fleming, A., Wilkes, B. L., Cioffi, J., & Le Miere, J. (2005). Environmental approach to reducing agitation in older persons with dementia in a nursing home. *Australasian Journal on Ageing*, *24*, 141–145.
- World Health Organization (1999). *Guidelines for community noise*. Retrieved March 12, 2013 from <http://www.who.int/docstore/peh/noise/guidelines2.html>.
- Yao, L., & Algase, D. (2006). Environmental ambiance as a new window on wandering. *Western Journal of Nursing Research*, *28*, 89–104.
- Zeisel, J. (1999). Life-quality Alzheimer care in assisted living. In B. Schwarz & R. Brent (Eds.), *Aging, autonomy, and architecture: advances in assisted living* (pp. 110–129). Baltimore: Johns Hopkins University Press.
- Zeisel, J., Silverstein, N. M., Hyde, J., Levkoff, S., Lawton, M. P., & Holmes, W. (2003). Environmental correlates to behavioral health outcomes in Alzheimer's special care units. *The Gerontologist*, *43*, 697–711.
- Zeisel, J. & Tyson, M. M. (1999). Alzheimer's treatment gardens. In C. C. Marcus & M. Barnes (Eds.), *Healing gardens: Therapeutic benefits and design recommendations* (pp. 437–504). New York: John Wiley & Sons Inc.
- Zuidema, S. U., de Jonghe, J. F., Verhey, F. R., & Koopmans, R. T. (2010). Environmental correlates of neuropsychiatric symptoms in nursing home patients with dementia. *International Journal of Geriatric Psychiatry*, *25*, 14–22. doi:10.1002/gps.2292