# Extending the Continuum of Care for People with Dementia: Building Resilience

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## 1 Dementia-Friendly Architecture

It is the constant wish of the vast majority of older adults to remain in their current home environment as they grow older. However, most of them are aware that this wish may remain unfulfilled (Binette & Vasold, 2018). Even when home-care networks are available and home modifications to accommodate age-related functional and cognitive decline are implemented, transition to long-term care (LTC) may become necessary, especially for people living with dementia (Holup et al., 2017). Consequently, dementia is present in approximately half of the residents in nursing homes.

An increase in nursing home residents in general and of people living with dementia among them is expected in the future (Liu et al., 2020). However, home and LTC settings are not the only places where it is necessary to consider the needs of people living with dementia. In recent years, hospitals have especially come into focus as the probability of hospitalization increases with age. Currently, approximately half of the patients in hospitals are older than 65 years (World Health Organization, 2020), and the prevalence of dementia symptoms in older patients ranges between 20% and 40% (Bickel et al., 2018; Briggs et al., 2017). To accommodate the needs of a growing number of people with dementia in health-care settings, strategies are necessary to deliver a continuum of care where individuals can move from one place to another without encountering any disruption that may lead to a deterioration of their abilities.

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It has been widely acknowledged that the architectural design of spaces influences human behavior and well-being. Established theories of human-environment research posit that the well-being and behavior of people depend on the interaction of environmental factors and their individual coping skills (Lawton & Nahemow, 1973). People living with dementia are particularly susceptible to their surroundings, as they do not experience them in the same way as healthy older people (Smith et al., 2004). Building on these findings, more than 30 years ago, the first design guidance and buildings accommodating the needs of people living with dementia emerged (Calkins, 1988; Cohen & Weisman, 1991). Currently, numerous researchers worldwide explore ways to design environments that are supportive and therapeutic for persons living with dementia (Calkins, 2018; Fleming et al., 2020a).

In this chapter, first, we summarize the research evidence on supportive, dementia-friendly architectural design and postulate ten evidence-based design criteria. Then we discuss the current state of dementia-friendly architectural design in LTC settings. Afterward, we transfer these findings into the design of hospitals and elucidate ways to implement the ten design criteria in acute care settings. Further, the results of a quasi-experimental study, which evaluated the influence of a redesigned hospital ward on patients with dementia outcomes, are presented. Finally, we argue that our design criteria help to build a continuum of care that brings dementia-friendly care to hospital environments and, ultimately, will even contribute to building resilient health-care settings for the future.

## 1.1  Research Findings on Supportive Nursing Care Environments

Research on dementia-friendly environments has produced a range of findings on how architecture can have a positive influence on alleviating the symptoms and progression of dementia and helps to make individuals living with dementia feel at home in nursing care settings.

The layout and interior design of nursing care settings have been investigated extensively. Small-scale nursing care settings, which house up to 15 people per unit, have shown many advantages for residents. The fact that small-scale units can create opportunities for individualized care and attention to residents' personal needs contributes to a better quality of life and greater well-being (Dyer et al., 2018). Furthermore, fewer hospitalizations, lower use of medication, and better orientation are associated with small-scale settings (de Boer et al., 2018; Harrison et al., 2018; Marquardt, 2011). Less decline in global cognitive functioning compared to that of residents in larger care settings has even been reported (Kok et al., 2016). Most importantly, small-scale settings are conducive to the emergence of a homelike milieu, which is one of the recurring elements of design guidance for people living with dementia.

The architectural layout is a major influencing factor on the abilities and care outcomes of residents. Supporting orientation and way-finding abilities, which deteriorate with the progression of dementia, is an important goal to pursue with the design of the initial floor plan. In small-scale settings, open plan environments allow for better visual access to support orientation, while in larger units, straight corridors with meaningful spatial reference points have been found to be supportive. A live-in kitchen constitutes an excellent spatial reference point, and its design can further facilitate increased resident independence, autonomy, and social interaction (Chaudhury et al., 2017; Davis & Weisbeck, 2016; de Boer et al., 2018; Marquardt & Schmieg, 2009). Spending time outside, maybe even engaging in gardening activities, has also been shown to have a positive influence on people living with dementia (Whear et al., 2014). Therefore, the connection between indoor and outdoor spaces should be planned carefully to allow for residents' independent transition.

The appearance of the interior design of care settings is determined mainly through furniture and fixtures, colors, signs, and pictures. Their design can create a homelike atmosphere that is beneficial for residents' daily life, as it promotes greater engagement in activities and social interaction (de Boer et al., 2017, 2018). Their deliberate design further enables them to serve as cues for orientation to time, place, and situation (Davis & Weisbeck, 2016; Marquardt, 2011). Finally, the interior design needs to provide sensory stimulation that can lead to varied levels of natural environmental signals that lessen boredom, a sense of isolation, and improve the residents' quality of life (Strøm et al., 2016).

## 1.2 Dementia-Friendly Design Criteria to Transfer Research Results into Architectural Practice

At present, we can state that a coherent body of research on dementia-friendly architectural design measures has evolved (Fleming et al., 2020a; Chaudhury et al., 2018; Calkins, 2018). Building on these research findings, extensive design guidance specifically aimed at informing architects, health-care providers, and operators has been published. It covers a wide range of environments (Fung, 2015; Fleming et al., 2020b), such as home care environments (Grey et al., 2015), daycares (Moore et al., 2006), nursing homes (Cunningham et al., 2011), hospitals (Bueter & Marquardt, 2020), outdoor spaces (Pollock & Cunningham, 2018), and public buildings (Fleming et al., 2020b).

Based on the research evidence presented in the previous section of this chapter, we developed ten key criteria for designing dementia-friendly care environments. These design criteria are not all-encompassing, but they specifically provide design strategies that we consider practicing architects and designers should adapt and develop further for their specific projects. These criteria pertain not only to nursing care settings but also to all settings that people living with dementia may encounter.

### 1.2.1 Floor Plan Structure

Simple, clearly defined building structures and room layouts are the basis for dementia-friendly architecture. They have a significant impact on spatial orientation and, as a result, the activities of individuals living with dementia. In addition, they facilitate workflow efficiency. Properties of a supportive floor plan structure are small unit sizes, architectural typologies with a straight design of horizontal circulation areas, and the provision of spatial anchor points, which are meaningful and highly recognizable places.

### 1.2.2 Floor Space Requirements

Due to limited mobility, disorientation, or insecurity in unfamiliar environments, many people living with dementia are unable to move beyond their immediate environment. They may even put themselves in danger, so it is not advisable for some people living with dementia to walk away unaccompanied. As dementia can also lead to an increase in restlessness, there must be sufficient room for them to move about and suitable places for them to spend time within a protective framework. Due to their age-related impairments, many people with dementia require mobility aids, which also necessitate more space.

### 1.2.3 Safety

Safe and protected spaces for moving about are necessary for individuals living with dementia. This does not imply closed environments, however, but rather easily accessible, clearly laid out and high-quality spaces, which promote individuals' mobility and autonomy. Implementing barrier-free design standards as mandated by building regulations is an important prerequisite.

### 1.2.4 Orientation

Dementia-related difficulties with spatial, temporal, and situational orientation manifest in different ways. Design that supports way-finding not only facilitates direct navigation but can also help with temporal orientation (times of the day and durations) and support situational comprehension of their own presence in the environment and, thus, how others expect them to behave in certain situations and in the overall setting.

### 1.2.5   Guidance and Orientation Systems

Guidance and orientation systems help people living with dementia find their way around buildings. Such systems incorporate clearly legible signage and easily interpretable symbols as well as address different senses by including visual, tactile, auditory, and olfactory cues. Guidance and orientation systems must always be developed following a holistic approach by implementing a clearly defined floor plan structure.

### 1.2.6   Lighting

Light intensity and lighting design are key aspects of a dementia-friendly environment. Basic room lighting should be bright and glare-free, which supports the perception of the surrounding space. Natural light is conducive to well-being and controlling the sleep-wake rhythm. Furthermore, lighting concepts can support spatial orientation.

### 1.2.7   Colors and Contrast

The perception of colors changes with age, resulting in the need for stronger contrasts to compensate for age-related visual impairments. Spatial elements that are of importance to the individual can be emphasized by stark contrasts, and nonrelevant elements can be camouflaged by low contrast. Colors create mood and atmosphere, although there is no scientific evidence on how individual colors affect individuals living with dementia.

### 1.2.8   Atmosphere

Transitioning to an unfamiliar environment is challenging for individuals living with dementia. In addition to a calming and aesthetically pleasing interior design, a spatial structure that facilitates and instigates communication, social interaction, and participation is vital. The combined spatial and social environment can create an ambiance that emanates security and orientation, making individuals feel welcome and appreciated.

### 1.2.9   Activation Concepts

Having a purpose and assigned tasks maintains self-confidence and prevents functional and cognitive decline. It also helps to prevent challenging behaviors due to under-stimulation and boredom. In all care settings, spaces for activity, a stimulating design that induces self-sufficient informal activity, and structured programs that keep individuals active are necessary.

### 1.2.10 Stimulus Densities

Dementia limits the ability to adequately filter, process, and interpret environmental information, hampering an appropriate response. Both sensory overload and the absence of sensory stimulation must be avoided. The degree of stimulation needed varies among individuals. Therefore, offering variable stimulus densities to respond to the different needs of individuals is essential.

## 2   Current State of Dementia-Friendly Architectural Design in Long-Term Care Settings

There is widespread consensus among architects in practice and nursing home operators that the implementation of dementia-friendly design measures is possible and useful. To date, there are several publications available that present case studies from LTC with successful designs. The buildings included can be found in various countries around the world and incorporate very different climatic, societal, and economic situations (Feddersen & Luedtke, 2014; Fleming et al., 2020b; Palmer et al., 2021; Regnier, 2018; Tsekleves, & Keady, 2021). Reviewing the designs presented, we realize that many research findings on dementia-friendly design were incorporated. Of course, to varying degrees and with shifting focus, many other factors (such as building regulations and costs) are also to be taken into account in the design of a building. Nevertheless, we find the dementia-friendly design criteria we postulated to be valid in architectural practice.

In light of the extensive information available on dementia-friendly design, the question of why there are still so many facilities that do not adhere to these design criteria inevitably arises. The lack of awareness can be ruled out as a reason since the design guidance has been widely proliferated not only in academic books and journals but also in many outlets directed at the operators of care facilities and architects who are commissioned with the design of refurbishments or new construction of facilities. Even a quick Internet search will yield many results and raise awareness of this topic.

Neither do we find any indication that dementia-friendly design raises costs to the extent that overstrained budgets result in neglecting these design aspects against better knowledge. As a result of these deliberations, we can only assume that care providers and operators that do not implement dementia-friendly design features are unaware of their importance and the benefits both for residents and staff. Additionally, they appear to be fearful of the costs of such measures, which they tend to overestimate (Heiss et al., 2010). To overcome this predicament, we urge architects in practice to familiarize themselves with dementia-friendly design measures, encourage their implementation, and, most importantly, evaluate their impact on construction costs. Researchers, on the other hand, need to provide design guidance that can efficiently be incorporated into the planning process by architects in practice.

## 3 Continuing Dementia-Friendly Care in Hospital Environments

Dementia-friendly design is not only feasible for LTC settings. People living with dementia will encounter other health-care settings and will need to find dementia-friendly design measures to extend there. Often, the carefully balanced situation of older adults living with dementia in a care setting is suddenly disrupted through the urgent need for hospital admission.

Dementia, itself, is rarely the reason for hospitalization. Others, often age-related conditions, including orthopedic, respiratory, and urologic factors, as well as multi-morbidity, polypharmacy, and lower functional ability, come into play. Many patients display multiple conditions concurrently (Toot et al., 2013; Shepherd et al., 2019). When older adults are admitted to the hospital, dementia is often only a secondary diagnosis, if it is known at all (Rao et al., 2016). Nevertheless, 40% of inpatients over the age of 65 exhibit cognitive impairments, and one-fifth show symptoms of dementia (Bickel et al., 2018).

Being admitted to a hospital with dementia can have a significant impact on the outcome of treatment and therapy. Hospital processes are designed primarily for patients who understand the purpose of their stay and are accepting and cooperative in their treatments. However, people living with dementia are at odds with standardized, workflow-oriented processes; they may not understand where they are and what condition brought them into the hospital and, thus, have little or no understanding of the necessity for treatment and care procedures. This often results in adverse outcomes for people living with dementia, such as higher complications and mortality rates, increased length of stay, and increased use of psychotropic medication (Moellers et al., 2019).

Patients with dementia are also at particular risk of further cognitive and functional decline because of the passive, "sedentary behavior" that is commonly expected from patients in hospital routines. However, with dementia, self-care abilities quickly atrophy if they are not used, and reduced mobility results in a dramatic loss of muscle mass and aerobic capacity (Sourdet et al., 2015).

In LTC settings, people living with dementia are kept active and maintain their self-care abilities by being encouraged to participate in everyday tasks, such as socializing, sharing meals, cooking, cleaning, and gardening. These activities cannot easily continue in the hospital environment. First and foremost, patients may be too sick to move about and take care of themselves, but even if they could do so, individual activities are often at odds with hospitals' care routines. Most importantly, spatial prerequisites for activities (such as common rooms, therapeutic kitchens, or garden access) are scarce and typically not available on hospital wards at all. Therefore, extending dementia-friendly care to the hospital context relies on specific modifications to the environments encountered there (Belala et al., 2019; Xidous et al., 2020).

## 3.1 Architectural Properties of Dementia-Friendly Hospitals

The disadvantageous situation of people living with dementia in hospitals has become the focus of multiple stakeholders during the past decade. Among others, the King's Fund[1] from the United Kingdom and the Robert Bosch Foundation[2] from Germany have been driving forces to identify ways to redesign hospital wards to accommodate the needs of people with dementia. Both organizations encouraged and funded several model projects and disseminated the results, including design guidance on dementia-friendly hospital environments (Kings Fund, 2014; Kirchen-Peters & Krupp, 2019; Bueter & Marquardt, 2020; Waller et al., 2017). Furthermore, the topic has increasingly gained attention from researchers investigating the relationship between dementia-friendly hospital design and the outcomes of patients with dementia to derive design guidance (Grey et al., 2019; Parke et al., 2017). An empirical study has shown that most dementia-friendly hospital design measures are associated with significant improvement in patients' self-care abilities (Kirch & Marquardt, 2021).

In a dementia-friendly hospital, the goal of all design considerations is to create an environment that has a positive influence on patients' well-being and recovery. Additionally, their family, caregivers, and visitors need space to play their part. At the same time, hospitals are workplaces that must facilitate optimum performance of treatment and care processes. Other framework conditions for architectural design are economic factors and the fulfillment of medical, technical, and hygienic requirements. There can be no trade-offs between these aspects; moreover, they must be integrated into an overall concept.

Specifically, we propose that effective dementia-friendly hospital environments include additional aspects beyond the physical characteristics. Design measures must be embedded in an overall concept to cater to individuals living with dementia, considering organizational and human resources. An architecture presumed to be dementia-friendly should not be based on a stigmatizing design that perpetuates outdated notions of the design preferences of "elderly people."

Rather, hospital designs should mirror the sample principles applied for home care and LTC settings. Specifically, these designs should (1) foster patient independence and encourage mobility and activity to preserve patients' cognitive capabilities and physical functions; (2) give patients emotional security, stability, and orientation; (3) help medical staff work to the best of their ability; (4) make relatives, caregivers, and visitors feel welcome and involved; and (5) combine functionality, hygiene, and aesthetics, offering all users an environment of dignity and respect. Ultimately, hospital architecture must balance requirements such as economy, efficiency, hygiene, and use of technology with the desire to design spaces that promote convalescence. The designs should feature high-quality and contemporary aesthetics that emanate dignity and respect, avoiding the stigmatization of a group of patients. In Table 1, we present ways to easily implement our ten design criteria in hospital environments.

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[1] https://www.kingsfund.org.uk/projects/enhancing-healing-environment/ehe-design-dementia

[2] https://www.bosch-stiftung.de/en/project/people-dementia-hospitals

**Table 1** Implementing dementia-friendly design criteria in the hospital context

| Design criterion | Architectural implementation |
|---|---|
| Floor plan structure | Clear and legible corridors and a central nursing station serve as spatial reference points that support spatial orientation |
| Floor space requirements | Common rooms are large enough to accommodate groups for shared meals. Wall recesses and storage spaces are available for mobility and care aids |
| Safety | Barrier-free design accommodates age-related physical and sensory impairments |
| Orientation | Multisensory information on time, situation, and place is given. Room functions can easily be interpreted |
| Guidance and orientation systems | Simple signs and multiple cues that appeal to different senses are used |
| Lighting | Bright, even and glare-free room lighting supports the perception of ward environments, while individually adjustable lights are available in patients' rooms |
| Colors and contrast | Areas relevant to patients' independent movement are highlighted, while the hospital's functional sections are concealed |
| Atmosphere | Requirements of clinical functionality and a non-institutional ambiance that appeals to a wide range of patients are well balanced |
| Activation concepts | Informal occupational activities are offered in seating niches, and supervised activities are scheduled in common areas |
| Stimulus densities | Secluded seating niches offer privacy to spend time alone or with visitors. Sitting areas near the central nursing station provide distraction |

## 3.2 Quasi-Experimental Study: Results of a Dementia-Friendly Redesign of a Hospital Ward

The following example of redesigning a hospital ward shows how dementia-friendly architecture can be implemented. The project was planned by the authors and executed at the standard care Diakonissenkrankenhaus Hospital in Dresden, Germany. The internal medicine ward was chosen for a redesign because it was found to have the highest percentage of older patients living with dementia within the hospital. It has a total of 22 beds and includes a patient common room. The nursing station, personnel, and storage rooms, as well as the therapeutic bath, were centrally located. There was a focused phase of concept development before the planning process. It was based on a comprehensive status quo analysis to systematically observe how patients used the space. Employee and patient surveys were also conducted. As a result, three major spatial deficits that prevented needs-driven care of patients living with dementia were identified: (1) a lack of common areas and activity options, (2) confusing way-finding systems, and (3) inadequate equipment of patient rooms. Based on this analysis and taking into account the latest findings on dementia-friendly architecture, a design concept was developed and coordinated with the ward's nursing staff, nursing management, and the hospital's construction department.

In the following section, we show how the identified spatial deficits were addressed by implementing different dementia-friendly design criteria:

**Floorplan Structure**  A new common area was created at a central location on the ward corridor. It was built as a nook by reorganizing secondary rooms and remodeling walls and ceilings. The nook is opposite the nursing station, offering a direct line of sight between the two areas.

**Activation Concepts and Stimulus Densities**  The new common area offers seating, a table with clearance for wheelchair users, and various activities and occupations for patients, which can be pursued without significantly increasing the workload on the nursing staff. For example, a flush-mounted screen emulates an aquarium, an audio station lets patients listen to music and short stories, and there are books, photo books, and magazines for reading (Fig. 1).

**Guidance and Orientation Systems**  An orientation system was added to the ward corridor to support way-finding and orientation. Based on a pilot study (Motzek et al., 2017), all patient room doors were fitted with signage consisting of large-format room numbers and a regional image. The ward corridor was also given a bright coat of paint, the patient room doors were highlighted through colors, and writing and symbols were added to patient-relevant rooms. The letter was hung in patients' field of vision, and a highly legible size and font were chosen. Doors to patient-relevant rooms, such as the patient common area or the nurses' station, were given larger letters than doors to storage and function rooms (Fig. 2).

**Atmosphere and Orientation**  Patient rooms were given a new, dementia-friendly design. A new floor covering in warm and dark colors promotes clear spatial orien-



**Fig. 1** The new common area offers seating and several activities for patients. Diakonissenkrankenhaus Hospital in Dresden

**Fig. 2** The patient room signage is made up of the room number and a regional image. Diakonissenkrankenhaus Hospital in Dresden

tation and creates a non-institutional atmosphere. Medical and media equipment was concealed behind a wall clad with a wood finish to be less prominent. Personal areas such as beds and coat racks are color-coded. This color is repeated in the patient bathrooms to mark personal shelves and towel rails. New signage was also added to the bathroom door, consisting of a large-format bathtub symbol and the word "Bathroom" in large letters. A light strip was installed in the skirting board along the wall opposite the beds and above the bathroom door to help patients find the bathroom at night. The light is switched on from a call bell control panel that can be operated from the bed. An analog clock and a wall mural were also added on the wall opposite the beds to support temporal and situational orientation. The wall mural features the hospital logo, the room number, and the same regional image as on the door. In the en suite bathrooms, the original white fittings, such as handles, toilet seats, shelves, and towel hooks, were replaced with high-contrast fittings to increase visibility and, therefore, facilitate independent use (Fig. 3).

To assess the effectiveness of the architectural redesign measures, a quasi-experimental study was conducted. A pre-post design was chosen, and data were collected over 5 weeks at an interval of roughly 1 year. Ninety-four hours of observation were recorded per data collection period, and the hours of observation were distributed evenly. The key objective was to identify structural and design factors that influence the mobilization and activation of individuals living with dementia in acute care hospitals. Behavior mapping, a method of systematically observing the behavior of persons in relation to their spatial environment (Ng, 2016), was the primary data surveying instrument. Due to their symptoms, asking individuals living with dementia directly is either impossible or of limited value. Therefore, behavioral observation is a suitable alternative to measure the influence of the spatial environment on persons living with dementia. The type, time, duration, and

**Fig. 3** Warm colors and materials make the patient rooms more homelike. Individual areas are color-coded. Diakonissenkrankenhaus Hospital in Dresden
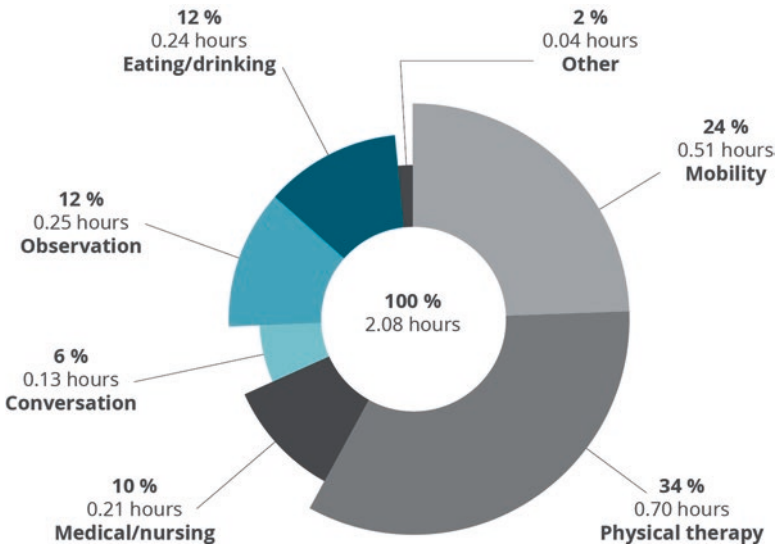


**Fig. 4** Patients' activities before the redesign

location of behaviors are noted on a data survey form. As part of the study, patients were observed in the public areas of the hospital ward—the ward corridor and common area. No observations were conducted in the patient rooms due to patient privacy reasons.

The diagram shows how patients with dementia spent their time during their hospital stay. Before the redesign (Fig. 4), patients with dementia were primarily
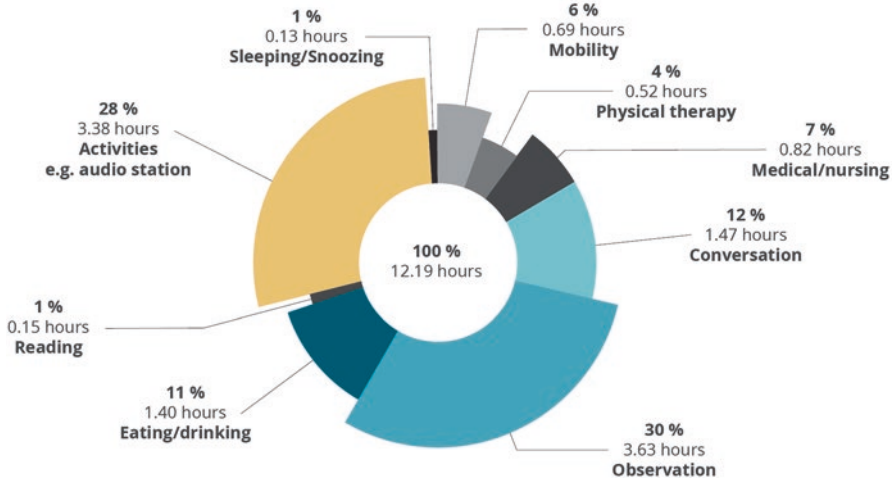
**Fig. 5** Patients' activities after the redesign

involved in mobility-related activities (24.4%) and physical therapy activities (33.3%). The third most common activities were medical and nursing activities, which took up 19.2% of their active time, followed by the categories of observation (12%) and eating/drinking (11.6%). Significant changes can be observed after the redesign (Fig. 5). The patients are now involved in more diverse activities. The primary activities are now observation (29.8%) and using the new audio stations (27.8%). They were also seen conversing (12%) and eating/drinking (11.5%). The absolute duration of mobility and physiotherapy remained virtually unchanged between the two survey periods. However, due to the higher overall duration of observations, these activities took up proportionately less time.

The dementia-friendly redesign of the ward was found to have positive effects on the nursing staff. The results of the staff survey reveal a lower perceived level of stress and load on the part of the nursing staff. Improvements were reported in almost all areas surveyed. Both the orientation problems of patients with dementia and the risk of their leaving the ward unnoticed were considered less of a strain. Increased job satisfaction among the nursing staff was also reported after the interventions. Nurses also indicated improvements in nurse-patient interactions. They expressed greater satisfaction with the standard of care for patients with dementia in their ward. They also described looking after patients as a more enjoyable experience and stated that they had a good relationship with them. This can be interpreted as a better standard of care for patients with dementia in the ward.

Concluding this example of a dementia-friendly redesign of a hospital ward has shown that the dementia-friendly design criteria that are valid in LTC can be extended to the hospital context, thus expanding the continuum of care for people living with dementia.

# 4 Discussion

## 4.1 Dementia-Friendly Design as a Driver for Human-Centered Design

Dementia-friendly design not only benefits a group of individuals with a very specific condition. Moreover, the properties of a dementia-friendly environment are deeply rooted in design efforts that center on the fulfillment of very basic human needs. As such, we could see people living with dementia as seismographs for the design quality of the built environment. It needs to be made clear that environments for people with dementia do not have a fundamentally different appearance from other environments. It is not necessary to apply a specific style of furnishing or to make use of a certain set of wall colors, which may lead to the stigmatization of people in this specific environment. In this way, the architectural design would even work against the human need for social inclusion. However, to further promote the implementation of dementia-friendly design, some barriers need to be broken down. First, a modern and individualized image of aging, which reflects the actual diversity of our aging society, should be advanced. Second, the perception that the primary way to design for dementia entails old-fashioned, stereotypical architecture needs to be overcome. Architects and designers must show that dementia-friendly design is a creative challenge, which implies high aesthetic quality and designers' knowledgeability and sensibility. Thus, the entire setting of health-care facilities should become as supportive as possible to benefit all the people they serve. By incorporating the available evidence on dementia-friendly design into the principles of inclusive design, a better health-care environment for everyone, including visitors and staff, will emerge. For example, spacious, safe, and barrier-free architecture is needed not only by wheelchair users but also by young parents with strollers. Intuitive cues for orientation to place, time, and situation not only help to compensate for cognitive decline due to dementia but are also helpful for anyone affected by fear and stress during hospital admission. Guidance and orientation systems make visitors feel welcome. Finally, supporting the maintenance of self-care abilities is necessary for anyone recovering in a hospital. In light of these findings, we can hypothesize that a stronger orientation toward vulnerable people and their needs might lead to increased sensitivity by architects and designers, resulting in an increase in human-centered designs.

Therefore, the challenge of a growing number of individuals with dementia in health-care facilities holds great potential to inspire health-care providers, operators, architects, and designers to reimagine health-care buildings and design them with human beings and their needs in mind, resulting in positive outcomes for all patients, visitors, and staff. The dementia-friendly design criteria introduced in previous chapters can serve as helpful guidance toward a more friendly architecture that meets the needs of all people. Against the background of increasing life expectancy and the correspondingly growing number of people living with dementia, implementing appropriate design measures can become a driving force toward the

further proliferation of human-centered design efforts in many aspects of our built environment, especially in health-care settings.

## *4.2 Potential of Dementia-Friendly Design in Building Resilient Structures in the Future*

The architectural designs of newly built (health) care facilities will need to serve their purpose for many years, often decades. However, when integrating the available scientific evidence into design, it remains uncertain whether our existing principles and evidence will help to envision structures that accommodate the challenges and changes that lay ahead. We assert that buildings that perform well in the future must be resilient, capable of standing up to disasters, disruptions, and adverse events. Some future developments are already visible now, and they need to be incorporated into today's designs:

**Demographic Change**  A growing number of older adults will require care, and many of them will have dementia. At the same time, the number of younger people is shrinking and thus reducing the pool of available caregivers, nurses, and doctors (United Nations, 2019).

**Climate Change**  For older adults and people in (health) care facilities, heat waves increase the risk of mortality. This effect is even higher for people living with dementia (Fritze, 2020). Furthermore, heat stresses nursing professionals, adding additional strain to those required to wear personal protective equipment (Jegodka et al., 2021). Both exacerbation and acceleration of recurring events, such as regional droughts, floods, and storms, also need to be accommodated in building designs.

**Pandemics**  COVID-19 has developed into a pandemic that affects human societies worldwide, and we must assume that this virus will become endemic in humans (Philips, 2021). Even if living with COVID-19 will become feasible in the future, epidemics that infect the world's population to a significant degree are expected every 10 to 20 years (Dodds, 2019). The rise of bacteria resistant to antibiotics further increases the need to avoid the transmission of infections through hygiene measures integrated into building design (Gradmann, 2018). (Health) care facilities were largely unprepared for the rapid spread of COVID-19, resulting in numerous deaths among residents in long-term care facilities (AARP, 2021). Structural unpreparedness, not only with regard to the availability of personal protective equipment and tests but also to the quick adaptation of the care processes, contributed to this.

Clearly, the future of dementia-friendly designs will need to consider the application of design principles that will facilitate resident safety while providing care during staff shortages and natural disasters. At this point, we would like to elucidate whether dementia-friendly design can contribute to building resilient structures in the future. To do so, in Table 2, we once again draw on the design criteria we have postulated, this time in light of resilience toward future crises.

**Table 2** Potential of dementia-friendly design criteria in light of building resilience toward future crisis

| Design criterion | Architectural implementation |
|---|---|
| Floor plan structure | Circulation systems that feature short paths reduce encounters between visitors, staff, and patients/residents and avoid the transmission of germs. Small unit sizes can operate independently to contain infections and can form clusters for the daily lives of patients/ residents |
| Floor space requirements | Sufficient space allows for an ad hoc adaptation of care routines, e.g. built temporarily sluice rooms and add additional technical devices such as air cleaning, heating, or cooling. Furthermore, buffer zones can be created where people may be queuing, waiting or safely passing each other in hallways |
| Safety | Critical information can be shared immediately through communications technology. Sensors detecting unusual heat, cold, water, viral or bacterial load alert staff and facility management |
| Orientation | Contingency plans for adverse events can be incorporated into guidance systems. If frequent contact and communication with the world outside the ward or facility are cut off, necessary information can be conveyed through environmental cues |
| Guidance and orientation systems | Short-notice and emergency assistance by individuals not familiar with the environment are facilitated. Strong way-finding measures help avoid wandering and unnecessary encounters |
| Lighting | Ample natural light permeating the building sustains daytime lighting during power outages. Windows not only let light into the building but also air, allowing for energy-neutral cooling and heating concepts for interior spaces as well as dilution of contaminated air |
| Colors and contrast | Stark contrast highlights objects and places that are relevant in emergencies, such as evacuation or firefighting. Low contrasts camouflage objects and places that may be dangerous to patients or residents |
| Atmosphere | Encouraging frequent social interaction builds trust among patients or residents, staff, and visitors, thus building community and promoting a sense of belonging |
| Activation concepts | Individuals who maintain their self-sufficiency and self-care abilities are less reliant on the availability of care and support. Outdoor spaces can encourage exercise, and the risk of infection transmission is lower outdoors. Communication technology not only allows access to information but also a chance to reduce isolation |
| Stimulus densities | In unstable situations, quickly increasing or reducing stimuli may become necessary to deescalate. Variable stimuli can be interchanged (e.g., use tactile material discontinued when contamination likely) |

## 5   Conclusion

Concepts of dementia-friendly design have been well researched over the past decades, and a coherent body of scientific evidence has evolved. As dementia-friendly designs have been implemented in many countries worldwide, the translation of these research results into practice has proven feasible. Nevertheless, the extension of corresponding design efforts to the hospital context is still emerging.

Even though hospitals operate differently from LTC settings in many ways, we identified design criteria that pertain to both environments. We argue that architects, hospital operators, and health-care providers need to be open to incorporating successful design strategies from LTC. We would also like to stress that dementia-friendly design does not imply the creation of environments that are perceived as different from others. We argue that dementia-friendly design is an integral part of any human-centered design, leading to inclusive designs that are conducive to everyone's well-being and best performance. Our reassessment of our criteria for dementia-friendly design in the face of staff shortages and natural disasters also points to the need to challenge current principles to design resilient structures that accommodate crises that inevitably will challenge us in the future. In this respect, dementia-friendly design not only benefits all stakeholders of today but also contributes to building structures that are resilient to future developments.

# References

AARP. (2021). *AARP nursing home COVID-19 dashboard*. https://www.aarp.org/ppi/issues/caregiving/info-2020/nursing-home-covid-dashboard.html

Belala, N., Maier, C., Heldmann, P., Schwenk, M., & Becker, C. (2019). A pilot observational study to analyze (in)activity and reasons for sedentary behavior of cognitively impaired geriatric acute inpatients. *Z Gerontol Geriat, 52*, 273–281. https://doi.org/10.1007/s00391-019-01644-x

Bickel, H., Hendlmeier, I., Heßler, J. B., Junge, M. N., Leonhardt-Achilles, S., Weber, J., & Schäufele, M. (2018). The prevalence of dementia and cognitive impairment in hospitals: Results from the general hospital study (GHoSt). *Deutsches Ärzteblatt International, 115*(44), 733.

Binette, J., & Vasold, K. (2018). Home and community preferences: A national survey of adults age 18-plus. *AARP Research*. https://doi.org/10.26419/res.00231.001

Briggs, R., Dyer, A., Nabeel, S., Collins, R., Doherty, J., Coughlan, T., O'Neill, D., & Kennelly, S. P. (2017). Dementia in the acute hospital: The prevalence and clinical outcomes of acutely unwell patients with dementia. *QJM: Monthly Journal of the Association of Physicians, 110*(1), 33–37. https://doi.org/10.1093/qjmed/hcw114

Bueter, K., & Marquardt, G. (2020). *Dementia-friendly hospital building. Construction and design manual*. DOM Publishers.

Calkins, M. P. (1988). *Design for dementia: Planning environments for the elderly and the confused*. National Health Publishing.

Calkins, M. P. (2018). From research to application: Supportive and therapeutic environments for people living with dementia. *The Gerontologist, 58*(Suppl 1), S114–S128. https://doi.org/10.1093/geront/gnx146

Chaudhury, H., Hung, L., Rust, T., & Wu, S. (2017). Do physical environmental changes make a difference? Supporting person-centered care at mealtimes in nursing homes. *Dementia, 16*(7), 878–896. https://doi.org/10.1177/2F1471301215622839

Chaudhury, H., Cooke, H. A., Cowie, H., & Razaghi, L. (2018). The influence of the physical environment on residents with dementia in long-term care settings: A review of the empirical literature. *The Gerontologist, 58*(5), e325–e337. https://doi.org/10.1093/geront/gnw259

Cohen, U., & Weisman, J. (1991). *Holding on to home: Designing environments for people with dementia*. Johns Hopkins University Press.

Cunningham, C., Galbraith, J., Marshall, M., McClenaghan, C., McManus, M., McNair, D., & Dincarslan, O. (2011). *Dementia design audit tool*. University of Stirling.

Davis, R., & Weisbeck, C. (2016). Creating a supportive environment using cues for way-finding in dementia. *Journal of Gerontological Nursing, 42*(3), 36–44. https://doi.org/10.3928/00989134-20160212-07

de Boer, B., Hamers, J. P., Zwakhalen, S. M., Tan, F. E., Beerens, H. C., & Verbeek, H. (2017). Green care farms as innovative nursing homes, promoting activities and social interaction for people with dementia. *Journal of the American Medical Directors Association, 18*(1), 40–46. https://doi.org/10.1016/j.jamda.2016.10.013

de Boer, B., Beerens, H. C., Katterbach, M. A., Viduka, M., Willemse, B. M., & Verbeek, H. (2018). The physical environment of nursing homes for people with dementia: Traditional nursing homes, small-scale living facilities, and green care farms. *Healthcare, 6*(4), 137. https://doi.org/10.3390/healthcare6040137

Dodds, W. (2019). Disease now and potential future pandemics. In W. Dodds (Ed.), *The world's worst problems* (pp. 31–44). Springer. https://doi.org/10.1007/978-3-030-30410-2_4

Dyer, S. M., Liu, E., Gnanamanickam, E. S., Milte, R., Easton, T., Harrison, S. L., Bradley, C. E., Ratcliffe, J., & Crotty, M. (2018). Clustered domestic residential aged care in Australia: Fewer hospitalisations and better quality of life. *Medical Journal of Australia, 208*(10), 433–438. https://doi.org/10.5694/mja17.00861

Feddersen, E. & Luedtke, I. (2014). *Lost in Space. Architecture and Dementia.* Birkhaeuser.

Fleming, R., Zeisel, J., & Bennett, K. (2020a). *World Alzheimer report 2020: Design dignity dementia: Dementia-related design and the built environment* (Vol. 1). Alzheimer's Disease International. https://www.alzint.org/u/WorldAlzheimerReport2020Vol1.pdf

Fleming, R., Zeisel, J., & Bennett, K. (2020b). *World Alzheimer report 2020: Design dignity dementia: Dementia-related design and the built environment* (Vol. 2). Alzheimer's Disease International. https://www.alzint.org/u/WorldAlzheimerReport2020Vol2.pdf

Fritze, T. (2020). The effect of heat and cold waves on the mortality of persons with dementia in Germany. *Sustainability, 12*(9), 3664. https://doi.org/10.3390/su12093664

Fung, J. C. (2015). *Dementia design sourcebook. Design guide + design elements*. Centre for Advanced Studies in Architecture (CASA), Department of Architecture, National University of Singapore.

Gradmann, C. (2018). From lighthouse to hothouse: Hospital hygiene, antibiotics and the evolution of infectious disease, 1950–1990. *History and Philosophy of the Life Sciences, 40*(1), 1–25. https://doi.org/10.1007/s40656-017-0176-8

Grey, T., Pierce, M., Cahill, S., & Dyer, M. (2015). *Universal design guidelines dementia friendly dwellings for people with dementia, their families and carers*. Centre for Excellence in Universal Design. http://universaldesign.ie/Web-Content-/UD_Guidelines-Dementia_Friendly_Dwellings-2015-full-doc.pdf

Grey, T., Fleming, R., Goodenough, B. J., Xidous, D., Moehler, R., & O'Neill, D. (2019). Hospital design for older people with cognitive impairment including dementia and delirium: Supporting inpatients and accompanying persons. *Cochrane Database of Systematic Reviews, 11*. https://doi.org/10.1002/14651858.CD013482

Harrison, S. L., O'Donnell, L. K., Milte, R., Dyer, S. M., Gnanamanickam, E. S., Bradley, C., Liu, E., Hilmer, S. N., & Crotty, M. (2018). Costs of potentially inappropriate medication use in residential aged care facilities. *BMC Geriatrics, 18*(1), 1–10. https://doi.org/10.1186/s12877-018-0704-8

Heiss, O., Degenhart, C., & Ebe, J. (2010). *Barrier-free design: Principles, planning, examples*. Birkhäuser.

Holup, A. A., Hyer, K., Meng, H., & Volicer, L. (2017). Profile of nursing home residents admitted directly from home. *Journal of the American Medical Directors Association, 18*(2), 131–137. https://doi.org/10.1016/j.jamda.2016.08.017

Jegodka, Y., Lagally, L., Mertes, H., Deering, K., Schoierer, J., Buchberger, B., & Bose-O'Reilly, S. (2021). Hot days and Covid 19-unusual heat stress for nursing professions in Germany. *Med Rxiv*. https://doi.org/10.1101/2021.01.29.21250592

King's Fund. (2014). *Is your ward dementia friendly? EHE environmental assessment tool.* The King's Fund. https://www.kingsfund.org.uk/sites/default/files/EHE-dementia-assessment-tool.pdf.

Kirch, J., & Marquardt, G. (2021). Towards human-centred general hospitals: The potential of dementia-friendly design. *Architectural Science Review, 1–9.* https://doi.org/10.1080/00038628.2021.1933889

Kirchen-Peters, S., & Krupp, E. (2019). *Praxisleitfaden zum Aufbau demenzsensibler Krankenhäuser*. Robert Bosch Stiftung.

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*(1), 1–8. https://doi.org/10.1186/s12877-016-0222-5

Lawton, M. P., & Nahemow, L. (1973). Ecology and the aging process. In C. Eisdorfer & M. P. Lawton (Eds.), *The psychology of adult development and aging* (pp. 619–674). American Psychological Association.

Liu, J., Hlávka, J., Hillestad, R. J., & Mattke, S. (2020). 2020 Alzheimer's disease facts and figures. *Alzheimer's Dement, 16*, 391–460. https://doi.org/10.1002/alz.12068

Marquardt, G. (2011). Wayfinding for people with dementia: A review of the role of architectural design. *HERD: Health Environments Research & Design Journal, 4*(2), 75–90. https://doi.org/10.1177/2F193758671100400207

Marquardt, G., & Schmieg, P. (2009). Dementia-friendly architecture: Environments that facilitate wayfinding in nursing homes. *American Journal of Alzheimer's Disease & Other Dementias, 24*(4), 333–340. https://doi.org/10.1177/2F1533317509334959

Moellers, T., Stocker, H., Wei, W., Perna, L., & Brenner, H. (2019). Length of hospital stay and dementia: A systematic review of observational studies. *International Journal of Geriatric Psychiatry, 34*(1), 8–21. https://doi.org/10.1002/gps.4993

Moore, K. D., Geboy, L. D., & Weisman, G. D. (2006). *Designing a better day: Guidelines for adult and dementia day services centers*. JHU Press.

Motzek, T., Bueter, K., & Marquardt, G. (2017). Investigation of eligible picture categories for use as environmental cues in dementia-friendly environments. *HERD: Health Environments Research & Design Journal, 10*(4), 64–73. https://doi.org/10.1177/2F1937586716679403

Palmer, L., Wallace, K., & Hutchinson, L. (2021). *Architecture for dementia. Stirling gold: 2008–2020*. University of Stirling.

Parke, B., Boltz, M., Hunter, K. F., Chambers, T., Wolf-Ostermann, K., Adi, M. N., Feldman, F., & Gutman, G. (2017). A scoping literature review of dementia-friendly hospital design. *The Gerontologist, 57*(4), e62–e74. https://doi.org/10.1093/geront/gnw128

Phillips, N. (2021). The coronavirus is here to stay-here's what that means. *Nature, 590*(7846), 382–384. https://doi.org/10.1038/d41586-021-00396-2

Pollock, A., & Cunningham, C. (2018). *The room outside. Designing outdoor living for older people and people with dementia*. HammondCare Media.

Rao, A., Suliman, A., Vuik, S., Aylin, P., & Darzi, A. (2016). Outcomes of dementia: Systematic review and meta-analysis of hospital administrative database studies. *Archives of Gerontology and Geriatrics, 66*, 198–204. https://doi.org/10.1016/j.archger.2016.06.008

Regnier, V. (2018). *Housing design for an increasingly older population: Redefining assisted living for the mentally and physically frail*. John Wiley & Sons.

Shepherd, H., Livingston, G., Chan, J., & Sommerlad, A. (2019). Hospitalisation rates and predictors in people with dementia: A systematic review and meta-analysis. *BMC Medicine, 17*(1), 1–13. https://doi.org/10.1186/s12916-019-1369-7

Smith, M., Gerdner, L. A., Hall, G. R., & Buckwalter, K. C. (2004). History, development, and future of the progressively lowered stress threshold: A conceptual model for dementia care. *Journal of the American Geriatrics Society, 52*(10), 1755–1760. https://doi.org/10.1111/j.1532-5415.2004.52473.x

Sourdet, S., Lafont, C., Rolland, Y., Nourhashemi, F., Andrieu, S., & Vellas, B. (2015). Preventable iatrogenic disability in elderly patients during hospitalization. *Journal of the American Medical Directors Association, 16*(8), 674–681. https://doi.org/10.1016/j.jamda.2015.03.011

Strøm, B. S., Ytrehus, S., & Grov, E. K. (2016). Sensory stimulation for persons with dementia: A review of the literature. *Journal of Clinical Nursing, 25*(13–14), 1805–1834. https://doi.org/10.1111/jocn.13169

Toot, S., Devine, M., Akporobaro, A., & Orrell, M. (2013). Causes of hospital admission for people with dementia: A systematic review and meta-analysis. *Journal of the American Medical Directors Association, 14*(7), 463–470. https://doi.org/10.1016/j.jamda.2013.01.011

Tsekleves, E., & Keady, J. (2021). *Design for People Living with dementia: Interactions and innovations*. Routledge.

United Nations. (2019). *World population prospects 2019: Highlights*. https://population.un.org/wpp/Publications/Files/WPP2019_10KeyFindings.pdf

Waller, S., Masterson, A., & Evans, S. C. (2017). The development of environmental assessment tools to support the creation of dementia friendly care environments: Innovative practice. *Dementia, 16*(2), 226–232. https://doi.org/10.1177/2F1471301216635829

Whear, R., Coon, J. T., Bethel, A., Abbott, R., Stein, K., & Garside, R. (2014). What is the impact of using outdoor spaces such as gardens on the physical and mental well-being of those with dementia? A systematic review of quantitative and qualitative evidence. *Journal of the American Medical Directors Association, 15*(10), 697–705. https://doi.org/10.1016/j.jamda.2014.05.013

World Health Organization (2020). The top 10 causes of death. Factsheet. https://www.who.int/news-room/fact-sheets/detail/the-top-10-causesof-death

Xidous, D., Grey, T., Kennelly, S. P., McHale, C., & O'Neill, D. (2020). Dementia friendly hospital design: Key issues for patients and accompanying persons in an Irish acute care public hospital. *HERD: Health Environments Research & Design Journal, 13*(1), 48–67. https://doi.org/10.1177/2F1937586719845120