

# **HUMAN-CENTERED DESIGN FOR DEMENTIA CARE**

A Research Paper submitted to the Department of Engineering and Society  
In Partial Fulfillment of the Requirements for the Degree  
Bachelor of Science in Systems Engineering

By

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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All healthcare settings need to operate smoothly and efficiently to provide its unique set of patients with prompt, quality care. For example, out-patient hospital clinics must adapt their logistical operations to fluctuating COVID-19 protocols to meet the health and safety needs of the many patients entering and leaving each day (Korte et al., 2021, p. 1). Despite COVID-19 adjustments at hospital clinics such as UVA Health, problems including long wait times for patients, healthcare worker burnout, difficulty managing bottlenecks in patient flow, and more continue to persist (Norman et al., 2021, p. 1008). Alternatively, dementia care spaces must meet the distinctive needs of dementia patients with complex symptoms such as “impaired communication, disorientation, confusion, poor judgment, [and] behavioral changes” (Alzheimer’s Association, 2022, p. 6). Many family members of dementia patients experience the difficulties of patient care and struggle to decide what methods of care are available and sufficient to meet the dynamic needs of their loved one (Warnecke, 2022). Both out-patient hospital clinics and dementia care spaces have the challenge and opportunity to optimize their design and operation to better support the complex needs of patients, healthcare professionals, family members, and other relevant social groups.

The technical paper focuses on the setting of out-patient hospital clinics by collaborating with Suite 2100 at UVA Health Fontaine Research Park to observe current patient arrivals, analyze how well solutions support an efficient patient admission process, and provide detailed recommendations. Professor Robert Riggs in the Engineering Systems & Environment department at UVA mentored the technical project in collaboration with Dr. Kim Dowdell, an MD and physician in the UVA Fontaine Research Park Primary Care clinic. Fellow classmates, Maggie Cusack, Claire Dozier, Bryce Huffman, Sarah Saas, and Wei Wu are members of the project team. The project expands upon work in a previous UVA capstone project mentored by

Riggs and Dr. Dowdell, “A systems approach to optimizing patient flow during the COVID-19 pandemic”, which analyzed patient arrivals and focused on implementing appointment pre-registration improvements (Korte et al., 2021, p. 4). This technical project alternatively focuses on improving the built environment using signage and providing an in-depth analytical look at the problems and bottlenecks in the current patient admission process to subsequently suggest actionable solutions in the clinic.

The following sections apply the idea of healthcare design improvements to the environment of dementia patients because as the aging population increases, there is a rising urgency for a system that can broadly provide quality care for the unique needs and symptoms of dementia patients. The prevalence of dementia will rapidly increase from the approximately 35.6 million dementia patients worldwide in 2010 “to 65.7 million in 2030 and 115.4 million in 2050” which is a 324% increase in only 40 years (Marquardt et al., 2014, p. 128). Specifically in the United States, the *baby boomer* demographic comprises a large portion of the population and will inevitably require dementia care. The Alzheimer’s Association predicts that by 2030 the projected 74 million [age 65 and] older Americans will make up over 20% of the total population (up from 17% in 2021), which is displayed in Figure 1 on page 3 (Abushusheh & Taylor, 2020, p. 16). With an increasing proportion of aging Americans, more individuals will be susceptible to developing Alzheimer’s or other forms of dementia and more stress will be placed on the diminishing remainder of the population to provide quality dementia care.

Though some dementia patients live in long-term care facilities, many family members must take on the role of caregiver. It is estimated that “more than 11 million Americans provide unpaid care for people with Alzheimer’s or other dementias” which adds up to “an estimated 16 billion hours valued at nearly \$271.6 billion” (Alzheimer’s Association, 2022, p. 38). This issue

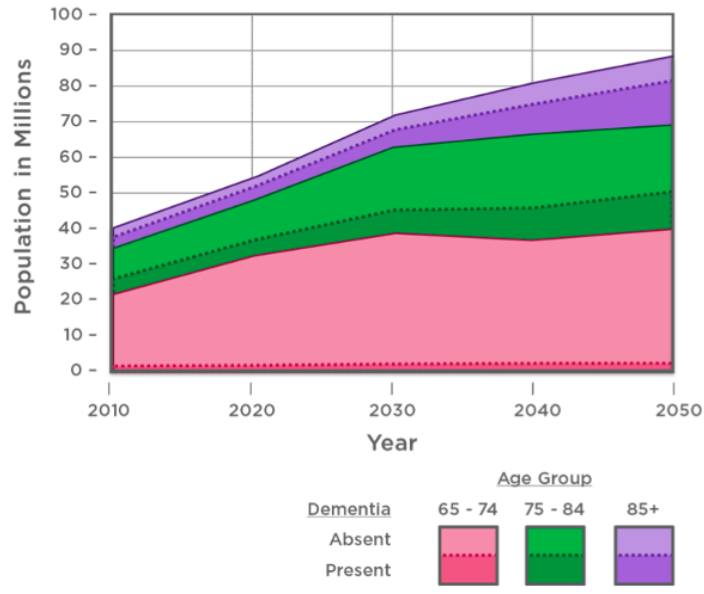


Figure 1: US population forecast: People 65+ with dementia. This figure demonstrates the projected population increase for ages 65-74, 75-84, and 85+ (Abushusheh & Taylor, 2020, p. 16).

has massive economic and healthcare implications in the United States alone, which warrants attention and thoughtful preparation. The United States is posed with the large challenge of creating infrastructure and care systems that not only provide widespread care to millions with dementia, but also support paid and unpaid caregivers alike. Thus, in the face of an aging population, there is a need to develop innovative, creative, and effective solutions for designing environments conducive to the needs of dementia patients and their caregivers.

Therefore, this paper uses the Social Construction of Technology framework created by Pinch and Bijker (1984) to explore the question: how can we implement human-centered design to create spaces that provide quality care to dementia patients while accommodating the needs of all relevant social groups? (p. 401). The purpose of this paper is to establish the relevant social groups of the dementia care space, identify potential built environment solutions, discuss their benefits and drawbacks in meeting relevant social groups' needs, and envision the future of dementia care. The technical and STS papers are closely coupled as they both aim to understand

how healthcare settings can be designed from a logistical, efficiency perspective and a human-centered design thinking perspective.

## **SETTING THE STAGE: DEMENTIA, PATIENT CARE, AND SOCIAL GROUPS**

### **DEFINING DEMENTIA AND ALZHEIMER'S**

In this paper, the terms dementia and Alzheimer's will be used according to the Alzheimer's Association (2022) where dementia is an overarching term for a set of symptoms characterized by "difficulties with memory, language, problem-solving and other thinking skills that affect a person's ability to perform everyday activities," whereas Alzheimer's is a progressive brain disease that results in dementia (p. 5). As the symptoms of dementia impede individuals' executive functioning, dementia care is reliant on memory care to support patients' potential "disruptive memory loss; impaired judgment and recall; confusion over time and place; misunderstanding imagery/spatial relationships; challenges in planning, problem solving, and completing familiar tasks; social withdrawal; language difficulties; and changes in mood and personality" (Abushusheh & Taylor, 2020, p. 6). These complex, dynamic symptoms permeate one's daily life and require family members to decide on a care setting for their loved one.

### **CARE SETTINGS: AT-HOME AND RESIDENTIAL CARE**

Individuals with dementia receive care from a variety of settings, however this analysis will focus on at-home care and residential care settings, including assisted living and specialized dementia care units, while excluding clinical care settings. These spaces will be discussed to evaluate long-term care where managers or designers can implement design changes rather than more rigidly restricted hospital and clinical settings. According to the Alzheimer's Association

(2022), a residential care setting is “housing that includes services to assist with everyday activities, such as medication management and meals, including assisted living facilities” (p. 67). Looking deeper, 34% of residents at residential care facilities have a form of dementia and “58% percent of residential care settings offer programs for residents with Alzheimer’s or other dementias” (Alzheimer’s Association, 2022, p. 69). Residential care is vital to dementia care infrastructure in the United States because it serves as a primary method of providing care.

However, many families and individuals do not have the financial ability to use residential care settings because the median cost is “\$4,300 per month, or \$51,600 per year” (Alzheimer’s Association, 2021, p. 369). Subsequently, many Americans provide care themselves as “83% percent of the help provided to older adults in the United States comes from family members, friends or other unpaid caregivers,” nearly half of which is “for someone with Alzheimer’s or another dementia” (Alzheimer’s Association, 2022, p. 38). Due to this high reliance on at-home and residential care settings, this paper considers how built environment designs and technological developments in these spaces can enhance and ease care for patients and caregivers.

## **RELEVANT SOCIAL GROUPS FOR SOCIAL CONSTRUCTION OF TECHNOLOGY**

There are many relevant social groups that use dementia care spaces such as individuals with dementia, caregivers, family members of patients, nurses, healthcare regulators, physicians’ assistants, long-term care staff, and healthcare providers as displayed in Figure 2 on page 6. The nature of these relationships lends itself well to the Social Construction of Technology developed by Pinch and Bijker (1984) because the needs of each group influence the care space, and conversely, the care space influences the daily operations of each group (p. 401). The main

groups under consideration in the STS paper will be the two primary users of the dementia care space: individuals with dementia and caregivers.

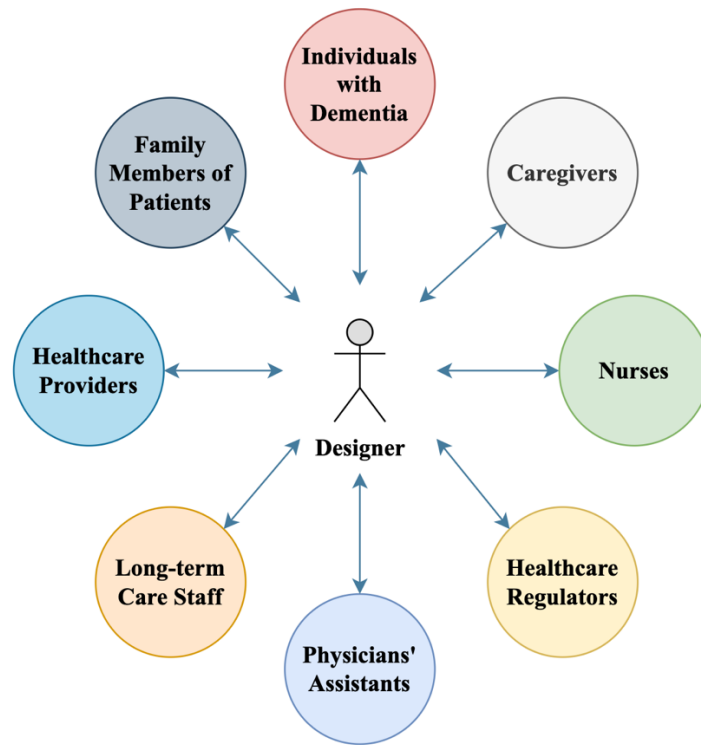


Figure 2: Social construction of technology for the design of dementia care spaces. There are a variety of relevant social groups that impact and are impacted by the design of dementia care spaces (Schmid, 2021).

## **ORGANIZING SPACES: DEMENTIA PATIENTS' NEEDS**

### **DEFINING PATIENT NEEDS**

Dementia patients' symptoms involving difficulties with memory, problem-solving and other functions require environments that “can promote wayfinding and orientation, improve activities of daily living function, autonomy and meaningful activity, and reduce anxiety, agitation, aggression and falls” (Chaudhury et al., 2017, p. 325). Dementia care must support one's daily activities that rely on cognitive functioning to mitigate the impact of dementia's

complex symptoms. In her article “From research to application: Supportive and therapeutic environments for people living with dementia”, Calkins (2018) defines person-centered care as a potential framework for meeting patients’ needs and it aims to: “1. Create a sense of community within the care environment 2. Enhance comfort and dignity for everyone in the care community 3. Support courtesy, concern, and safety within the care community 4. Provide opportunities for choice for all persons in the care community 5. Offer opportunities for meaningful engagement to members of the care community” (p. 117). This method of care focuses on patient engagement, autonomy, and dignity. Individuals with dementia duly need assistance with daily activities, while also maintaining a strong sense of dignity, self-identity, and comfort to live a happier, fuller life.

## **BUILT ENVIRONMENT DESIGNS FOR MEETING PATIENT NEEDS**

In designing a space conducive to individuals with dementia, we must consider the question: how can we design the built environment in at-home and residential care facilities to meet dementia patients’ needs? This section examines potential solutions regarding the physical, man-made dementia care space that may assuage patient’s symptoms and enhance their experience in the areas of wayfinding, homelike spaces, outdoor space, daily activities, and noise level.

### **Wayfinding**

Wayfinding is a key element of enhancing dementia care as patients may have difficulty remembering where rooms and objects are and therefore need clear indications and directions for movement through the space. For example, in an evidence-based literature review of over one hundred sixty-nine studies by Marquardt et al. (2014), “direct visual access to relevant places, the integration of reference points, and the implementation of several zones with a unique



character were identified as helpful for resident’s wayfinding abilities” (p. 137). An open floor plan could provide more opportunities for this direct visual access, which “makes it easier for the individual living with dementia to find a destination but also makes it easier for the care partners to see where the person is” (Calkins, 2018, p. 120). Designing the floor plan and physical structure of care spaces with visual and wayfinding features that create clear lines of vision and visual aids can help patients navigate the space, while also easing the care process for caregivers.

In addition to the larger physical space, thoughtful decisions about contrast and lighting can promote wayfinding. Calkins’s (2018) article finds that “individuals with Alzheimer’s disease have a reduced contrast perception ability ..., meaning they need higher visual contrast to maximize function in any visual task,” though additional contrast is unnecessary for flooring (p. 121). Additionally, amber-colored night lights can be used for bathrooms, doorways, and motion sensors as displayed in Figure 3 below “to create a clear path from bed to toilet” because “amber-colored night lights do not disturb the circadian rhythm the way regular incandescent or fluorescent lighting does” (Calkins, 2018, p. 22). These visual considerations for high contrast



Figure 3: Amber-colored lights line bathroom doorway. Amber-colored lights can be used to bring residents’ attention to doorways and pathways without disturbing circadian rhythms (Calkins, 2018, p. 22)

and amber lighting can better indicate wayfinding paths and improve navigation capabilities for individuals with dementia, which can ultimately reduce confusion and anxiety and increase quality of life.

Finally, visual and orientation cues that prompt patient memories and recognition can be used in dementia care spaces. For example, The Christopher Memory Care Center in Charlottesville, Virginia features a memory box “just outside the door that showcases a resident’s personal photos and mementos,” which allows residents to recognize their room and allows others to admire their identity and values (“Memory care,” 2020). Additionally, in an empirical literature review by Chaudhury et al. (2017), “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 [were] found to increase residents’ ability to find their own room by 45% - 50%” (p. 327). Incorporating memory-focused orientation elements can help residents with wayfinding, while prompting memory recall and promoting individuality, identity-preservation, and dignity.

### **Homelike Spaces**

Spaces that emulate a more residential home in their design and decoration create more comfortable, soothing spaces, which starkly contrasts a clinical, hospital setting. Different dementia care studies suggest adjustments in the size of care spaces, number of patients, and décor or props. For example, Calkins’ (2018) article envisions that an ideal comfortable, homelike setting involves “a small grouping (typically 10–20) of residents and their dedicated staff with the purpose of fostering self-directed relationship-based life” and “pleasing homey spaces with a functional kitchen at its hub - nurturing daily life, responding to individual residents, and fostering community life” (p. 118). Chaudhury et al.’s (2017) empirical review

establishes the effectiveness of such a homelike setting and found that “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,” which attests to the potential for assuaging negative patient behavior and experience (p. 327). Another method of creating a more homelike environment involves “setting out clear props that indicate a room’s use, such as keeping the dining room table at least partially set with a place mat and glass of water, [which] can help with understanding the purpose of this space and encourage the individual living with dementia to participate in daily household activities such as setting or clearing the table” (Calkins, 2018, p. 119). Giving clear visual and physical indications about the purpose of a space while allowing for safe and simple interactions can give residents more autonomy and functionality in the space. Overall, increasing comfortability and creating a more homelike environment that patients are likely more familiar with can ease patient symptoms of anxiety and aggression to create a better experience for patients and caregivers.

### **Outdoor Space**

Access to the outdoors combined with safe freedom of movement promotes autonomy and assuaged symptoms. For example, “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” (Chaudhury et al., 2017, p. 329). Providing access to the outdoors appears to have a calming effect as it promotes positive health outcomes regarding sleep and social behavior. These effects coupled with the autonomy, in some facilities, of using the outdoor space freely allows residents to have more control in their daily activities and to seek spaces that bring more happiness into their lives.

## **Noise Levels**

Caregiver education on the importance and subtleties of the built environment, such as noise level, can improve symptoms and functioning for dementia patients. According to Calkins (2018), “care partners and caregivers generally are not trained to think about the importance of turning on a light, or closing curtains to reduce glare, or eliminating unnecessary background noise, all of which either contribute to excess disabilities or support more independent functioning in individuals” (p. 124). Furthermore, high noise levels have been associated with negative patient outcomes such as “reduced social interaction, increased agitation and aggression, disruptive behavior and wandering” (Chaudhury et al., 2017, p. 328). Therefore, thoughtful consideration by caregivers of loud equipment and appliances, accompanied by communication with visitors about keeping noise levels low can help ease patients’ agitation and negative symptoms.

## **Dining**

Providing a more soothing experience for daily activities such as dining can improve positive outcomes for individuals with dementia. For example, Chaudhury et al. (2017) found that “smaller dining areas, each featuring seating for 25–30 residents and homelike decor, significantly increased residents’ caloric intake” and can ensure residents are not feeling overwhelmed or overstimulated (p. 328). Additionally, dining spaces that promote individual choice by “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., 2017, p. 328). Dining is an integral part of patient health and occurs frequently throughout the day, so making concerted efforts to create a more comfortable dining experience for individuals with dementia can improve health and behavior.

## **PERSONAL DEMENTIA CARE EXPERIENCE: KAREN WARNECKE**

To gain more information about personal experiences with dementia care settings, I interviewed Karen Warnecke whose mother lived at The Christopher Memory Care Center of Our Lady of Peace in Charlottesville, Virginia. When discussing her search for a dementia care setting, Karen stated that many other facilities “have their dementia units, but they’re just a wing of the place and they don’t do anything to help the person with dementia live a fuller, more productive life” (Warnecke, 2022). This sentiment conveys the seeming haphazardness of many current specialized-care units that are not designed for patients, further exacerbate symptoms, and deteriorate quality of life by not incorporating thoughtful design features. Alternatively, Karen highlighted the superior wayfinding and comfort of The Christopher Center with a manageable number of twenty to twenty-five rooms that open out to a big open living space, “so that when you come out of your room and you open the door, you're in your living room, you’re not looking at a hallway” (Warnecke, 2022). She stated that this eased residents’ anxiety and helped them feel more comfortable in such a homelike space. She also raved that the memory boxes outside patients’ doors “tell the staff something about that person” and through it “you got to know a lot of the other residents because there was a lot of interaction” surrounding the memory boxes (Warnecke, 2022). Not only do the memory boxes help individuals identify their room, but they also increase engagement between residents, family members, and staff to create a more social environment.

Karen additionally highlighted the autonomy inherent in the outdoor space at Our Lady of Peace. She said the staff and management try “to give [residents] as much autonomy as possible; they could walk outside and there were planter beds where they could stand and work in the garden or walk along paths” (Warnecke, 2022). Creating this outdoor space provides many

benefits to residents in the form of autonomy and self-choice about activities, as well as the soothing effects of being outdoors. Overall, Karen's experience reflects that of so many others who struggle to find care for their loved ones. Thankfully she has enjoyed the thoughtful and supportive designs of the care space she found for her mother (Warnecke, 2022).

## **PRESERVING PATIENTS' DIGNITY AND IDENTITY**

Due to dementia patients' difficulties with memory, how can caregivers and physical dementia care spaces help preserve the dignity and identity of dementia patients? According to Matthews (2020), a senior research fellow at the Plunkett Centre for Ethics in Melbourne, Australia, identity preservation is a difficult matter because "when the machinery of moral self-orientation ... does not [function well], alienation, stigma, rejection, or worse still, an identity crisis threatens" the individual's stability, coherence, and self-value (p. 142). Matthews' framework of moral self-orientation identifies what it may look and feel like for a patient to lose their self-image, and thus can help define success and failure in identity preservation and recognition in the dementia care space. As mentioned in the previous section, artifacts, such as a memory box, can preserve identity by attesting to patients' past experiences and memories. In Matthews' (2020) article, he describes an anonymous Dr. B who is an intellectual and professor with moderate to severe dementia living in a long-term care facility (p. 145). Dr. B displays various artifacts, similar to a memory box, including letters from colleagues and schedules of his intellectual activities that attest to his achievements and helps him maintain recognition and pride in his identity (Matthews, 2020, p. 145). Using artifacts that convey an individual with dementia's traits, values, or experiences can express their identity to others and themselves as their dementia progresses and doing so becomes more difficult.

Additionally, caregivers play an important, respectful, and empathetic role in fostering an environment where patients feel valued and understood for who they are at heart. Weigel (2019) asserts that “caregivers have a special kind of responsibility to maintain the narrative sense of self [and values] for the person with dementia”, however this responsibility puts further stress and pressure on caregivers’ performance and interaction with dementia patients (p. 76). A study by Toubøl et al. (2020) conducted focused interviews with stakeholders involved in dementia care, including caregivers, and compiled a thematic representation of how to ethically preserve the quality of life and ideals of patients as displayed in Figure 4 below (p. 1507). This framework suggests manageable actions and areas of focus for caregivers and family members to promote an individual with dementia’s identity and help foster a supportive care environment.

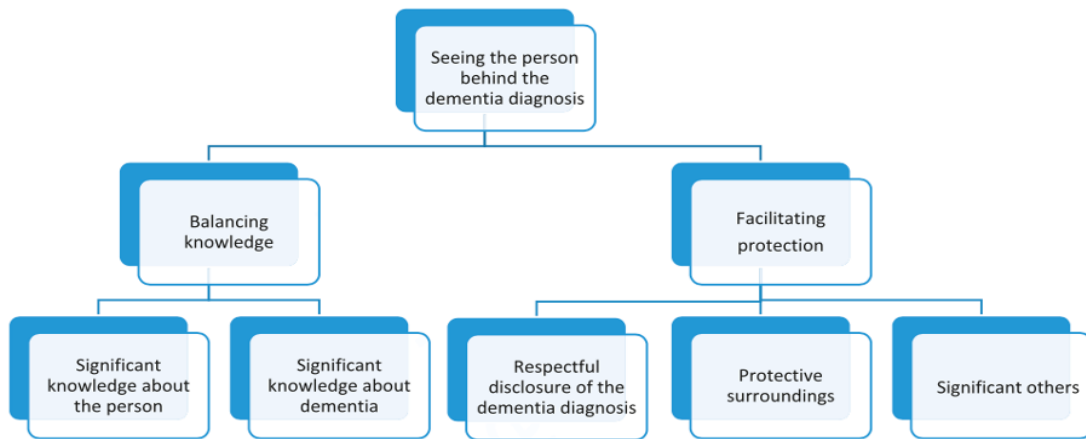


Figure 4: Thematic map of ethical dementia care considerations. The map in this figure displays the themes and corresponding sub-themes for evaluation in creating dementia care environments (Toubøl et al., 2020, p. 1507).

## ORGANIZING SPACES: THE WORKER’S PERSPECTIVE

Caregivers serve as the primary support for the extensive care of dementia patients, engaging in difficult emotional, mental, and physical tasks. Therefore, they are an important

social group to incorporate in the design process, as both an expert in care and a user of the dementia care space.

## **CAREGIVER THOUGHTS ON DESIGN**

Caregivers provide a unique and experienced perspective on the effectiveness of built environment designs for dementia patients. For example, Lee et al. (2016) interviewed staff at a long-term care facility in Vancouver who believe “poor environmental factors, including stimulation overload, safety risks, wayfinding challenge, and rushed care” negatively impacted patients while “comfort, familiarity, and an organized space were important therapeutic resources” (p. 743). One of the interviewed staff members described an experience with a patient who always waters flowers on the patio even if it’s raining and emphasized that the patio is “a good place to distract the residents, if they get agitated; it’s easy for us to distract their attention by bringing them to the garden” (Lee et al., 2016, p. 748). This anecdotal account from a caregiver and Karen Warnecke’s experience as a family member demonstrate the frequent praise of outdoor spaces for individuals with dementia. Their experiences attest to the outdoors’ inherent benefits in providing positive distractions, activities, or familiar routines for individuals with dementia. From their nuanced experiences, caregivers have valuable insight into activities and elements of design that can help soothe patients, including integrating outdoors activities into daily life and creating comfortable, familiar environments suited to patients’ needs.

## **REDUCING STRESS ON CAREGIVERS**

Caregivers and family members play an important role in caring for dementia patients, and this role’s intensity can make them “vulnerable ... to social isolation, physical exhaustion, stress, and loss of income from missed work” for family members providing at-home care



(Weigel, 2019, p. 74). Thus, caregivers are heavily impacted by the inherent nature of their role, the care environment, and the individuals with dementia they are caring for. As such an important and impacted user of the dementia care space, caregivers' needs should be factored into its design. Therefore, the following section addresses the question: how can we use design and technology to reduce stress on caregivers?

In interviews from the article "Exploring staff perceptions on the role of physical environment in dementia care setting", Lee et al. (2016) found creating a homelike and comforting environment "made [it] easier for staff to connect with and care for the residents, which led staff to be more effective in their work and have higher job satisfaction" (p. 748). Additionally, staff noted the big windows, bright lights, and short walks to see patients as beneficial to their work environment and ability to care for patients (Lee et al., 2016, p. 748). Designers can create spaces that are comfortable, calming, and efficient for not only patients, but caregivers as well. One interviewed staff member stated, "I appreciate having all my things [and] resources right at my fingertips, so ... I always have what I need to do my programs" (Lee et al., 2016, p. 749). Easily accessible and convenient organization makes the care process more seamless and less stressful for caregivers. Caregivers should be able to operate in a work environment that is conducive to their daily tasks and operations. From handling the complex needs of dementia patients and the immense pressure of providing care that meets those needs, caregivers benefit from environments that ease patients' symptoms and provide them with organized resources.

Conversely, poor environmental factors, such as high stimulation, confined spaces, insufficient ventilation, temperature, confusing floor layouts, and high levels of legwork can negatively affect both staff and patients, who then exacerbate the problem on the other party:

“you can be less patient and, so it does affect how we feel, and how we feel directly impacts the residents as much as you try to not allow it to” (Lee et al., 2016, p. 750). This interconnectedness attests to the close relationship and interaction between caregivers and patients, so designing spaces for both social groups is vital to providing quality care and creating a positive work environment. This sustainable work environment may help with caregiver retention at residential care facilities, which creates familiarity for patients. For example, Karen Warnecke noted that The Christopher Center has “a very active and stable staff which makes a huge difference and helps with familiarity and eases anxiety” as the same staff members are consistently working and patients are less likely to be alarmed, uncomfortable, or aggravated by seeing new caregivers (Warnecke, 2022). When spaces are designed with both caregivers’ and patients’ needs in mind, both social groups can thrive and operate contently in dementia care settings.

## **TECHNOLOGICAL INNOVATION: CARE AND ETHICAL CONSIDERATIONS**

### **TECHNOLOGICAL DEVELOPMENTS FOR AN AGING POPULATION**

Due to the aging population, a two-fold problem arises: there are a limited number of potential caregivers, and it is difficult to find caregivers that possess the appropriate skills and knowledge to provide quality care for individuals with dementia (Vollmer Dahlke & Ory, 2020, p. 1). With such a rapid increase in the aging population, it will be difficult for the current infrastructure, healthcare facilities, and healthcare staff to accommodate all individuals with dementia that need long-term care. Thus, to assuage this compounding issue, intelligent assistive technology (IAT), which includes “devices, robotics, and sensors in many forms, ... may offer opportunities to reduce caregiver burden and enhance healthcare services while improving the quality of life among older adults with mild to severe cognitive deficits” (Vollmer Dahlke &

Ory, 2020, p. 1). Intelligent technology may help alleviate stress on the broader healthcare system by providing widely available assistance in a variety of at-home and long-term care settings.

Technology can create more accessible methods of monitoring and providing care for those with dementia to potentially fill gaps created by the high price of residential care facilities. The developments in IAT may assuage the dual problem of a projected increase in dementia patients in the next twenty-five years and a shortage of caregivers, because technologies can prolong the independence of individuals with dementia and assist at-home caregivers who may not be able to afford or find availability for residential care facilities (Vollmer Dahlke & Ory, 2020, p. 2). Though technology may provide large benefits, we must thoroughly evaluate its potential uses, implications, costs, and ethics in dementia care.

## **TECHNOLOGICAL DEVELOPMENTS TO ASSIST PATIENTS**

There are a variety of new technologies on the market and in development whose functions “range widely, including activities of daily living (ADL) assistance, behavioral and health monitoring, cognitive assistance and monitoring, and environmental and emotional support” (Berridge et al., 2021, p. 2). According to a Delphi study conducted by Berridge et al. (2021), twenty-one domain experts contributed to the following general list of technologies that will likely be prevalent for dementia care in the next five years including, “Smart home systems to control environmental settings and appliances, ... Video conferencing that allows a caregiver to turn the webcam on and “enter” the room visually for social connection and visual assessment of person and home, ... Using an AI conversational agent to stimulate engagement and connection with the outside world ... , Recording audio in a person’s home to respond to emergencies and security threats, monitor socialization, or detect cognitive change and other

conditions” (p. 6). Many of these technologies help monitor individuals with dementia, monitor environmental factors, assist individuals with dementia or foster interactions between dementia patients and caregivers, which can ease the caregiving process or provide further challenges.

## **TECHNOLOGICAL IMPACT ON CAREGIVERS AND FAMILY MEMBERS**

Domain experts in the study conducted by Berridge et al. (2021) holistically evaluated the potential advantages and disadvantages of the previously listed technologies (p. 10). Experts viewed “prolonging independent living and caregiver peace of mind ... as potential benefits across all technologies, while unactionable data, information or alert overload, and caregiver fatigue were cited as likely to make caregivers anxious” (Berridge et al., 2021, p. 10). There may be potential negative impacts including, “risks of inaccurate data, false positives and negatives, and a false sense of safety” fostered by technology that appears more certain and secure than actuality (Berridge et al., 2021, p. 10). Finally, Berridge et al. (2021) cautions caregivers when choosing technologies to “enhance the care of adults with Alzheimer’s or dementia [because] it becomes even more critical to consider how the technology will primarily assist the caregiver and reduce their burden rather than be used as a substitute ... for their in-person engagement” (p. 11). Despite the immense capabilities of technology, individuals with dementia have needs, such as bathing and dining, that can only be met by a human caregiver and thus, we cannot rely solely on technology for all care. When incorporating any new element of design or technology into the dementia care space, it’s important to consider how it will impact patients and caregivers in beneficial or harming ways in the areas of privacy, safety, ease of implementation, accuracy, and more.

## **ETHICAL CONSIDERATIONS OF TECHNOLOGY**

Maintaining robust ethical standards for developing dementia care technology requires participation, input, and action from multiple stakeholders including engineers, interface designers, caregivers, and individuals with dementia. For example, there are various potential design frameworks that engineers and designers can adopt such as value-sensitive design that “focuses systematically on human values through theory, methods, and practice in the design process”, privacy-by-design that works on “anticipating and preventing privacy invasion”, and ethical adoption which is based on “inclusive participatory design, emotional alignment, adoption modeling, ethical standards assessment, and education and training” (Berridge et al., 2021, p.18). These frameworks or the combination of frameworks can help prioritize user safety, privacy, and health to produce positive outcomes for relevant social groups. In addition to adopting frameworks, designers can make distinct design decisions that promote privacy and security “in surveillance technologies, such as uncoupling data sources, capturing silhouettes rather than actual images, and collecting only necessary data while balancing between utility and data granularity” (Berridge et al., 2021, p. 13). Other elements that can preserve dignity include alerts to confirm patient status, permission for using more invasive audio or video feeds, choice about what data is used and when, data security, data transparency, continuous informed consent, and proactive user education (Berridge et al., 2021, p. 14). When creating dementia care products and technologies, designers and engineers must consider how to both meet users’ needs and protect users.

Families must make decisions about what technology to use, how to use it, and how to consider their family member with dementia’s preferences and values. Families implementing technology to monitor and care for their elderly family members should engage in conversations

about the technology's use, especially because the technologies rated "most likely to cause family conflict were also predicted to be most prevalent in five years in dementia care" (Berridge et al., 2021, p. 19). Domain experts from the Berridge et al. (2021) study foresee differences in perspectives and opinions from various family members and thus advise having thorough, informed conversations about dementia care before proceeding with new technologies (p. 19).

Finally, there are broader implications for technological development in dementia and aging care. Despite innovative progress in technology, problems of equity due to socioeconomic status, digital literacy, and accessibility limit the sweeping implementation of intelligent assistive technology devices for all elderly patients who may benefit from these new technologies (Vollmer Dahlke & Ory, 2020, p. 2). Technological development requires integrating diverse users into the design process that are different in "socio-demographics such as race, ethnicity and socioeconomic status as well as the diversity of the condition itself with wide variations in behavioral, cognitive, and emotional aspects" (Vollmer Dahlke & Ory, 2020, p. 3). In aging technology's infancy, there are likely limited perspectives incorporated into the design process, warranting further testing and development for broad use by people of all socioeconomic statuses, ethnicities, genders, cognition levels, etc.

## **THE FUTURE OF INNOVATIVE HEALTHCARE**

Healthcare settings have great potential for innovation in not only their logistics and efficient operations, but their promotion of patient wellbeing, to ultimately provide the best care and create a favorable environment for patients, healthcare professionals, caregivers, and family members. Research should be conducted in the areas of efficiency, optimization, and design to provide healthcare workers at out-patient hospital clinics with positive work environments and to

ultimately improve the efficiency and quality of patient care. The technical paper addresses the issue of hospital design and efficiency through its efforts to implement data-informed recommendations that optimize patient flows at UVA Health. This STS paper focuses on the design of a different healthcare setting: dementia care spaces. The paper explores how design innovations can be applied to the built environment of dementia patients in the context of not only patients, but caregivers, family members, and other prominent users of the space. With a future rise in the aging population, it is pertinent to design dementia care spaces that fully meet the needs of patients while reducing stress and negative impacts on caregivers and family members. There is a need to design in the context of patient and caregiver needs to provide quality dementia care that's effective, affordable, and ethical. The future of innovative healthcare is bright for hospital and dementia care settings because they have the potential for improving patient care, quality of life, healthcare worker burnout, and so much more.

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