

Healthcare Facilities and Dementia Development of a Framework to Assess Design Quality

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Abstract. In recent years, thanks to advances in medicine and the role of prevention, life expectancy has experienced rapid growth (from 77.6 to 81.3 years), resulting in an increase in Non-Communicable Diseases (NCDs) and years lived with disability. One of these is dementia, with about 7 million people currently affected in Europe while the number is set to double by 2050. These patients are complex due to the serious changes in their cognitive sphere, altering perceptions of their physical space. Because of age and multimorbidity, they are the most frequent users of healthcare facilities, but these structures often are not suitable to them. For example, during the COVID-19 pandemic, healthcare facilities demonstrated criticalities in structural and social issues. To this end, a rethinking of these spaces is urgent, and the use of Evidence-Based Design (EBD, the design based on findings from scientific research) can be a method to create safe and suitable environments. This study aims to develop an evaluation framework to assess the design quality of healthcare facilities for people with dementia. A systematic literature review was conducted to define a set of requirements that the space must have to be prosthetic for the patient. The framework consists of three macro areas (i.e., physical, social, and cognitive aspects), seven criteria, and 24 sub criteria. The proposed framework is a starting point for the development of inclusive projects for people with dementia and cognitive disabilities. Architecture has recently begun to approach the topic of dementia, especially in Italy. Therefore, it is urgent to investigate which are the main aspects to be considered in the design and renovations of facilities to make them as therapeutic and prosthetic as possible, creating places where the wellbeing of patients is the priority, both physical and psychological. To this end, EBD needs to become a habit for designers to create facilities suitable for people with both cognitive impairments and for every user, in line with the principles of Universal Design.

Keywords. *Dementia, Evidence Based Design, Healthcare Design, Users Centered Design, Wellbeing*

1. Introduction

In 1946 the World Health Organization changed the definition of health, from the absence of diseases to “*a state of complete physical, mental and social well-being*”[1].

Alzheimer's acts on all parameters used by the WHO to define the state of health. In fact, Dementia is defined as “*a syndrome – usually of a chronic or progressive nature – that leads to deterioration in cognitive function (i.e. the ability to process thought) beyond what might be expected from the usual consequences of biological ageing. It*

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affects memory, thinking, orientation, comprehension, calculation, learning capacity, language, and judgement” [2].

Dementia is an *umbrella term* that encompasses several different specific syndromes, including Alzheimer’s disease (the most frequent representing 60% of total diagnoses), Lewy Body Dementia, Vascular Dementia, Frontotemporal Dementia, and others like Parkinson’s disease. Discovered for the first time in 1906 by Alois Alzheimer, Alzheimer’s disease predominantly affects people in their elderly years (over 65 years old) with the World Health Organization (WHO) estimating that about 60% of those affected by a state of dementia are affected by this disease.

These patients are complex due to the serious changes in their cognitive sphere, altering perceptions of the space. Because of age and multimorbidity, they are the most frequent users of healthcare facilities, and often these places become their homes. Unfortunately, a lot of these structures are not suitable to them, as emerged for example during the COVID-19 pandemic, where healthcare facilities have demonstrated criticalities in structural and social issues [3].

It therefore becomes of extreme importance the creation of adequate health structures, correctly designed, and built as places within which the sick find themselves having to live with diseases. One of the major challenges in the relationship between the built environment and aged patients occurs when they have problems with the perceptions, like cognitive disorders and dementia.

Currently, there are no definitive treatments for dementia but only pharmacological therapies which may help manage certain symptoms.

2. Research Aim

Dementia become a health priority only in 2017, when WHO provide the *Global action plan on the public health response to dementia 2017-2025*.

In this document is mentioned as a proposed action to: *Develop a pathway of efficient, coordinated care for people with dementia that is embedded in the health and social care system (including long-term care), to provide integrated, person-centered care as and when it is required.* [2]

Another aspect to take into consideration is that in recent years, the field of healthcare facilities has witnessed a great deal of development also in the field of investments. In fact, we often witness the realization of new structures by large groups present on the European scene.

Healthcare facilities for Alzheimer’s patients are, unlike ever before, a social infrastructure that are to be considered fundamental for a country like Italy. The data of the disease mark a continuous increase on a global scale and the trend does not show signs of decreasing, with a 50% increase from 2005 to 2013 [4].

The problem has both economic, due to the cost in public spending, and social impacts, because of the problems in the cognitive sphere.

It becomes of extreme importance the creation of adequate health facilities, properly designed and implemented as places within which patients find themselves having to live as their disease slowly progresses. There is a clear and urgent need of instruments that can support both institutions and designer in creating news structures and renovate the existent ones in the with a view to putting the patient’s well-being first. The use of Evidence-Based Design (EBD, the design based on findings from scientific research)

offers insight into how to create these safe and suitable environments [5] for people with cognitive diseases.

This study aims to develop an evaluation framework of the main aspect in the design of the built environment for people with dementia.

3. Methods

To deeply analyze the current existing studies and methodologies applied by other researchers and scientific experiences at national and international level, a systematic literature review has been conducted. The goal is to identify, evaluate and interpret the existing body of recorded documents [6].

This phase is focused specifically on the relationship that occurs between the built environment and patients with dementia, analyzing the problem statement and trying to provide which specific criteria can determine the relationship. This research has shown the specific needs that a structure for elderly patients has to provide.

The research was performed in October 2021 using scientific database Scopus, PubMed, and Web of Science but, additional information has been gathered from secondary sources, known as “grey literature”, using search engines that merge both scientific literature and documents not published in an official database. For example, using websites like <https://www.healthdesign.org>.

To specifically select the part of literature which deals with this topic, it is fundamental to select a group of words that belong to different research fields to combine them. The main research field that has been analyzed using three level of keywords as shown in the following Table 1.

Table 1. Searching strategy.

Searching themes	Searching terms
Dementia	"Dementia" OR Alzheimer OR "Memory loss"
Facilities	"Nursing hom*" OR "Long-term care" OR "Assisted living" OR "Care home"
Built Environment	"Built environment" OR Design OR space*

Some combination of words led to literature outputs based on neurobiology or psychology field, as the terms “architecture” and “personal space” generating biases. For these reasons, eligibility criteria have been applied to separate in-scope from out-of-scope results, and avoid biases generated.

Inclusion criteria are English or Italian Language, time: after 2009, when the first village for dementia has been developed. Exclusion criteria included articles that were related only to medical or biological issues.

4. Results

The review began with a total of 276 articles, but thanks to the restrictions of the field, the search returned a total of 173 results.

The application of eligibility criteria allowed for selecting 94 papers (removing 32 duplicates and 45 articles written before 2009). The final articles were selected by

analyzing the keywords, titles, and abstracts, so the other 57 were excluded. Remaining articles have been fully read, resulting in a final 25 selected articles. The Prisma analysis clearly shows the process (Figure 1).

The data collection was made using an Excel table to extract data.

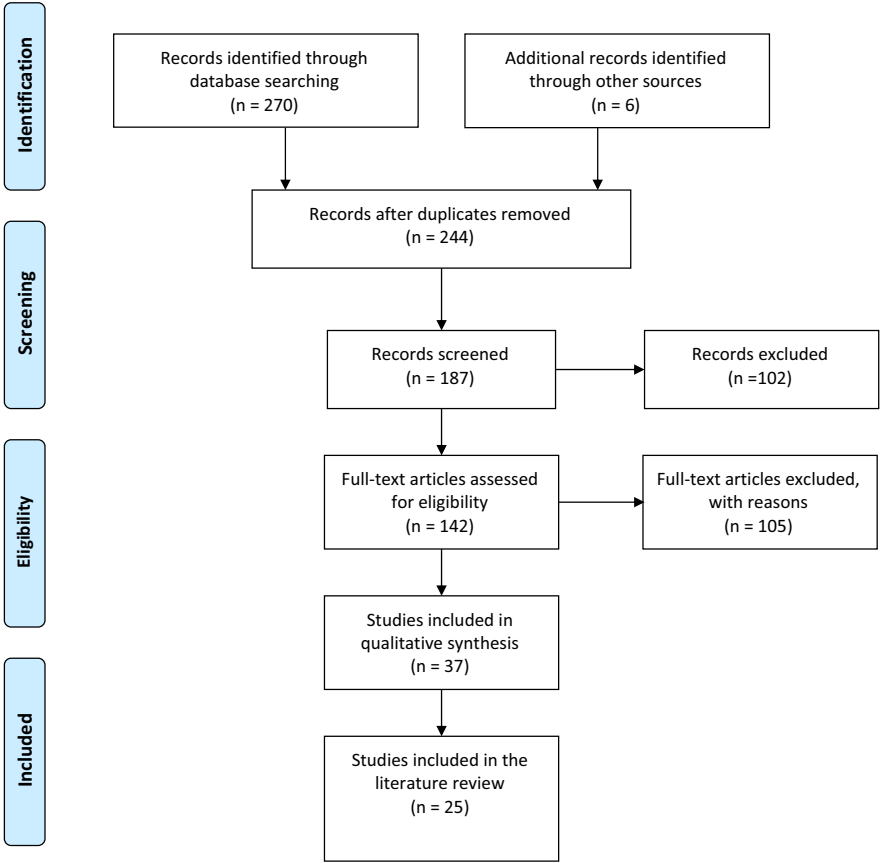


Figure 1. Prisma flow process

Of the total papers, 20 are articles, 4 reviews, and 1 book. The studies were both experimental (11) and theoretical (14). The 28% of papers have been written in 2021, 12% in 2020, and the remaining 60% between 2019 and 2009 (pre covid).

According to the analysis of 25 papers that have been selected, some common points emerged. In particular: criteria for reach patients' wellbeing (11), assessment tools (7) or checklists (2), and design strategies (5).

The review of the papers about criteria (11) and design strategies (5) allows also to identify some aspects that emerged as relevant in the relationship between built environment and architecture, that are: *homelike environments* (7), *safety* (8), *layout* (5), *outdoor and green spaces* (3), *wayfinding* (5), *activities* (3), *scale* (3), *location* (2), *indoor environmental quality* (IEQ) (5) and *technologies* (2).

These findings have been identified by comparing the two analyses that were then divided into three macro areas (i.e. physical, social, and cognitive aspects) with 7 criteria

and 24 sub criteria, fundamental in the relationship between built environment and dementia (Figure 2).

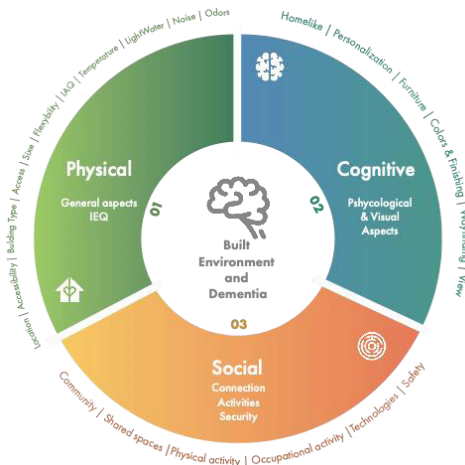


Figure 2 - Framework

Regarding the *macro areas* and *criteria*, it is possible to describe them as follows through the information gathered from through the literature.

Physical Aspects, the physical environment in which we live significantly influences our well-being. A patient with dementia who finds themselves living in a different place than the one they have long been accustomed, will experience the relationship with his new living environment in a unique and challenging way. For this reason, some aspects may particularly affect their well-being and behavior.

Physical aspects are those related to the configuration of the various rooms in the facility and can be divided into *general aspects* and aspects of *indoor environmental quality*.

General aspects: those related to the configuration of the space.

- **Location:** the place where a structure stand can play a crucial role. An ideal facility must necessarily be well connected to the urban center to enable caregivers to travel to it easily.
- **Accessibility:** easy accessibility must be allowed (e.g., bus stops and large parking areas), and environments must be easily used by different users (considering the distance, size, weight, and number of people)
- **Building Type:** architectural conformation can have a positive or negative effect on the users of a space, architecture should provide a connection between indoor and outdoor spaces, connecting outdoor and indoor spaces at each level
- **Access:** the access should be controlled 24/7 and be placed in strategic locations
- **Size:** the size of each facility should be 8/10 people per household and no more than 20 to provide a family environment
- **Flexibility:** space should be able to be repurposed as needed, for example, the creation of several small areas for activities

Indoor Environmental Quality (IEQ): these are the aspects related to space quality according to different parameters such as air quality, temperature, light.

- **Indoor Air Quality (IAQ):** Indoor air comes from the outside (outdoor) atmospheric air and enters confined spaces through ventilation (natural and/or artificial). Adequate ventilation, as well as a stable humidity level (40-60%), must be ensured in enclosed or semi-enclosed spaces
- **Temperatures:** inside the facility, temperatures should be between 20°C and 24°C in winter and between 22°C and 26°C in summer
- **Natural Light:** Natural light should be provided in as many places as possible to promote circadian rhythm
- **Artificial Light:** Artificial light must make up for the absence of natural light and provide even lighting throughout the facility
- **Water:** The water temperature of bathroom faucets should be controlled, as well as the amount of flow, to avoid scalding accidents and excessive water consumption
- **Noise:** The level of noise within spaces must be controlled to avoid situations that may cause confusion and disorientation in patients with dementia.
- **Odors:** Odors should be used as positive stimulation for patients, and bad odors should be contained through, for example, appropriate storage of soiled material

Cognitive Aspects, Cognitive/perceptive aspects are those related to perceptions of the environment. Indeed, the patient with dementia has among the symptoms a different perception of the environment, often accompanied by significant visual disturbances. Two sub-criteria are included in this macro-area, those related to psychological aspects and those more purely related to the visual sphere.

Psychological aspects: aspects that can influence the psychological well-being of patients are contained

- **Homelike:** the space should resemble as much as possible the common domestic environment of homes, presenting comfortable furnishings and spaces
- **Personalization:** the facility should allow, within the limits of the legal provisions on fire prevention, for personalization of spaces, especially the most private ones such as patient rooms
- **Furniture:** furniture should be usable and comfortable for all patients, regardless of physical condition. For example, tables and counters must be of adequate height to be easily used even by elderly people in wheelchairs and with mobility difficulties

Visual aspects: these are the aspects related to the visual perception of spaces and signs by patients with visual impairment

- **Colors and Finishing:** the colors should be used as prosthetics for people (e.g., providing contrast to make certain aspects such as doors and bathroom fixtures stand out clearly)
- **Wayfinding:** aspects that help patients recognize the space they are in; signage should be properly designed, according to the latest guidance, using both text and images in contrasting colors
- **View:** a view toward the cornerstones of the city or town where the facility is located allows the patient to understand where he or she is and identify with a known context

Social Aspects, are related to the patient's sociality, both toward caregivers and through activities that may affect behavior

Connection: the presence of connection with caregivers, for example in activities and time spent together

- **Community:** allowing connection with the community through different activities
- **Shared Spaces:** the presence of different spaces that can encourage sociality between patients

Activities: the facility must provide different activities to maintain cognitive function

- **Physical activity:** the physical activity must be allowed and guaranteed within the facility, either through the presence of special gyms or by encouraging movement through protected and safe circular paths
- **Occupational activity:** occupational activity is essential for patients to control behavioral disorders and is a nonpharmacological approach to therapy control. These activities must be carried out in specially designed areas, in spaces properly sized to accommodate groups of patients in varying numbers.

Security:

- **Technologies:** the use of various technologies to monitor patients' health conditions, movements, and provide rehabilitation strategies as needed
- **Safety:** ensuring safety in both emergency and common situations for different users, without stigmatized solutions and minimizing risk

Table 2. Framework definition

Macro areas	Criteria	Sub Criteria
PHYSICAL ASPECTS	General Aspects	P.01.1 LOCATION
		P.01.2 ACCESSIBILITY
		P.01.3 BUILDING TYPE
		P.01.4 ACCESS
		P.01.5 SIZE
		P.01.6 FLEXIBILITY
	Indoor Environmental Quality	P.02.1 IAQ
		P.02.2 TEMPERATURE
		P.02.3 LIGHT
		P.02.4 WATER
		C.02.5 NOISE
		C.02.6 ODORS
COGNITIVE ASPECTS	Psychological	C.01.1 HOMELIKE
		C.01.2 PERSONALIZATION
		C.01.3 FURNITURE
	Visual	C.02.1 COLORS AND FINISHING
		C.02.2 WAYFINDING
		C.03.3 VIEW
SOCIAL ASPECTS	Connection	S.01.1 COMMUNITY
		S.01.2 SHARED SPACES
	Activity	S.02.1 PHYSICAL ACTIVITY
		S.02.2 ACTIVITIES (OCCUPATIONAL)
	Safety/Security	S.03.1 TECHNOLOGIES
		S.03.2 SAFETY

5. Conclusions

The environment in which one lives assumes a role of primary importance for the definition of one's identity, allowing a person to acquire self-awareness through a path of continuous exchange, experiences, and stimuli coming from space as a scenario of life. In other words, humans recognize themselves through the relationship we establish with the physical and emotional environment in which we move. Several aspects of the built environment in care homes can impact residents with dementia [7].

This research sets the stage for a thorough definition of what specific design/architecture requirements a health care facility for the elderly with dementia should have.

This literature review showed how relationships between the built environment and patients occur in different qualities of space, whether physical, perceptual, or social. These can have different implications on users, acting as a positive stimulus on patients' quality of life and clinical outcomes.

This framework is proposed as a starting point for the development of inclusive projects for people with dementia and cognitive disabilities. Architecture has recently begun to approach the topic of dementia, especially in Italy. Therefore, it is urgent to investigate which are the main aspects to be considered in the design and renovations of facilities to make them as therapeutic and prosthetic as possible, creating places where the physical and psychological wellbeing of patients is a priority. The next step in the research is to analyze in detail the aspects most likely to influence outcomes such as disease progression and affect objective factors such as activities of daily living or well-being. To this end, EBD needs to become a habit for designers to create facilities suitable for people with both cognitive impairments and for all users [8], in accordance with the principles of Universal and Inclusive Design [9].

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