Design Lessons from Three Australian Dementia Support Facilities

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Design Lessons from Three Australian Dementia Support Facilities

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Abstract: There is a significant increase in the number of people with dementia, and the demand for residential support facilities is expected to increase. Providing an appropriate living environment for residents with dementia, which can cater for their specific needs is crucial. Residential aged care design can impact the quality of life and wellbeing of the residents. In this investigation, three recently constructed dementia support facilities in Victoria, Australia are selected for evaluation. Through fieldwork observation, design evaluation and space syntax analysis, the aim of this investigation is to consider the design of these three facilities in the context of current evidence on how the built environment can best accommodate residents with dementia.

Keywords: design for dementia; dementia-friendly; design evaluation; dementia support facilities; residential aged care; built environment; space syntax; wayfinding; behavior cues; orientation cues

1. Introduction

According to the current statistics available from the World Health Organization, around 47 million people have dementia, with 9.9 million new cases being diagnosed every year [1]. Over 425,000 people with dementia are living in Australia, of which about 105,000 people are in Victoria [2,3]. The number of people with dementia in Australia is expected to exceed 1.1 million by 2056. In 2016, over 23% of people with dementia were living in aged care accommodation in Australia [4]. Due to increasing life expectancy, increases in the aging demographic and the significant increase in the number of people with dementia, the demand for residential facilities which provide environments for dementia care is expected to increase. Providing a living environment for residents with dementia, which can cater for their specific needs, is crucial.

Facing the increasing number of people with dementia, the Victorian government developed and published *The Victorian Dementia Action Plan 2014–2018*, which states that designing buildings for people with dementia should be in line with the concept of dementia-friendly environments [5]. A dementia-friendly environment can be defined as "a cohesive system of support that recognizes the experiences of the person with dementia and best provides assistance for the person to remain engaged in everyday life in a meaningful way" [6] (p. 187). The objective is to assist people with dementia to remain socially engaged in everyday life [7].

In this investigation, the following three recently constructed dementia support facilities within residential aged care buildings in Victoria, Australia were selected for field observation: Facility A (inner urban), Facility B (regional), and Facility C (outer urban). All have been managed by the same

service provider who has agreed to collaborate and provide access to these facilities. This paper has evolved from a conference presentation by two of the authors [8]. Through field observation, design evaluation, and space syntax analysis, the aim of this investigation is to consider the design of these three facilities in the context of current evidence on how the built environment can best accommodate residents with dementia. In this research, we focused on the design of communal areas rather than bedrooms or staff spaces. The focus was on how shared spaces might be designed to support residents with dementia. The experiences of residents are impacted by many factors such as staffing, treatment, policy, and family, and these were outside the scope of the study.

2. Characteristics of People with Dementia

In order to design physical environments for people with dementia, it is crucial to understand how dementia impacts people. Dementia can change how people perceive their environments. The appropriate physical environments can help compensate for problems associated with dementia [9]. In the case of people with dementia, design decisions should address cognitive impairments, memory loss, confusion, wandering, over/under stimulation, and reduced judgement.

Dementia is a broad term to describe a collection of symptoms that are caused by disorders affecting the brain. Dementia Australia reported that the most common type of dementia is Alzheimer's disease, which affects up to 70% of all people with dementia [10]. According to a *Dementia in Australia* report published by the Australian Institute of Health and Welfare, residents with dementia showed problematic verbal behaviors (such as being verbally disruptive and having paranoid ideation that disturbs others), problematic physical behaviors (including physically threatening or harmful behavior and prolonged physical agitation), severe cognitive skills impairment, wandering behavior, and depression (Table 1) [1].

Table 1. Behavior characteristics of people with dementia (source: AIHW, 2012 [1]).

Behavior Characteristics	Percentage of Residents with Dementia Showing the Behaviors Twice a Day or More
(1) Problematic verbal behaviors	55%
(2) Problematic physical behaviors	50%
(3) Severe cognitive skills	48%
(4) Wandering behavior	27%
(5) Depression	10%

Besides behavioral issues, people with dementia may also encounter increasing difficulties in handling the activities of daily living, including mobility, personal hygiene, toileting, and continence. Currently, there is no cure for dementia, but medications are available to ameliorate symptoms such as agitation and paranoia.

Lubczynski (2014) recommended that when providing care facilities for people with dementia, design decisions should address cognitive impairments, memory loss, confusion, wandering, over/under stimulation, and reduced judgment [11]. Maintaining independence, dignity, a sense of belonging, privacy, and social interaction might also be supported by design [12]. As mentioned by Weisman et al. (1990), "even modest changes in the environments of people of reduced competence may have significant positive consequences" [13].

3. Designing for People with Dementia

3.1. Evidence

The publication titled *Evidence Based Design (EBD) Journal 1: Aged Care* summarised common themes emerging in the process of collating multiple, small, and often non-randomized research projects on design for aging. Evidence for the impact of space, design, and indoor environment quality

(IEQ) on the wellbeing of people with dementia has been growing over recent decades informing a range of guidelines which are largely aligned in their recommendations [14].

In this section, we summarize the key elements of guidelines informing design for people with dementia and the evidence on which they are based. In a later section, we consider how the three dementia support facilities align with the guidelines. The broad, common patterns that have emerged over time and informed the range of guidelines are still evolving. However, there is growing knowledge about what constitutes a home-like environment in terms of dignity, independence, self-expression, scale, familiarity, control, and autonomy. The evidence base has been developed largely by iteratively testing hypotheses through longitudinal post-occupancy evaluation seeking user feedback on design decisions. Sensor-based data collection on IEQ and movement holds promise for future research. More involvement by residents as active participants in design and evaluation teams is needed while understanding the ethical challenges of research involving people with dementia.

People with dementia perceive their environment in ways that differ from people without dementia [15]. The research culture linked to design for dementia has shifted from design for impairment to a more positive focus on designing for remaining abilities, understanding how much of the self is retained even as cognition reduces, and how important this sense of self is to wellbeing [14].

Guidelines developed over the last two decades include the dementia audit tool (DAT), the Dementia Design Checklist developed in Scotland, EVOLVE, Enhancing the Healing Environment (EHE) Assessment Tool, and the Environment Audit Tool (EAT) [16].

3.2. Design Principles

The key elements of the many design guidelines for people with dementia can be summarized as design for [a] homelike settings, [b] orientation, [c] independence, [d] stimulation, [e] safety, and [f] a balance between privacy and community.

[a] Homelike settings are small and familiar, thereby reducing confusion. Homes are an expression of self through personalized furnishings. Personalizing spaces within bedrooms and entries suggests ownership and belonging. Developing a sense of home within a residential aged care setting requires reconciliation of ambiguities in regard to ownership and how private, privileged, and public spaces are defined. Access to smaller semi-private sitting areas where residents can meet with family and guests can help replicate the living space of a home. Smaller clusters of residents also contribute to a sense of home, particularly if dining settings are also domestic in scale or if the dining areas allow for choices similar to choosing a restaurant or cafe. These smaller settings have been linked to increased food intake and social interaction [17,18]. Evidence suggests the residual skills needed for activities of daily living (ADL) are retained for longer when persons with dementia live in a homelike setting [19]. Design can help camouflage those elements that are needed for health care but usually give the appearance of a hospital or an institutional setting. For example, medical files and nursing offices can be back-of-house, thus avoiding the need for nurses' stations.

[b] Orientation using visual clues can reduce the need for mental maps that rely on memory. Clear pathways, memory boards at entry doors to private spaces, landmarks, and destinations help with spatial orientation [20]. A simple network of visually connected spaces helps mobile residents by giving direct lines of sight between bedrooms and destinations. Research indicates that kitchens opening directly onto dining areas facilitates orientation and purpose for residents while enabling care staff to provide unobtrusive oversight. Long corridors with many doors and dead-end corridors should be avoided. New research suggests implicit memory remains intact after other modes of wayfinding are no longer possible, suggesting that unique markers along route and beacon markers at destinations can help orientation [14].

[c] Independence is supported by environments that are familiar and small and where the daily cycles of activity are implicitly understood through visual, aural, and olfactory clues that do not rely on memory and decision-making. Independent functioning is associated with a sense of self whether it is choosing where to be, who to talk with, or what to do, and when to do it. Movement is linked

to independence, as is the choice to be inside and outside. Providing a safe and interesting precinct without the perception of being within a locked environment supports a sense of independence and choice [14]. High contrast settings such as a colored toilet seat or contrasting crockery and table colors can help retain independence and avoid confusion [21].

[d] Stimulus is a complex issue for people with dementia as some may be disturbed by minor environmental stimuli that an unimpaired person would ignore. The challenge is to include positive stimulation that promotes engagement and pleasure while avoiding sensory overstimulation. There is growing evidence that sound has a measurable impact on pleasure [14]. While it is conceivable that light, volume, movement, connection to nature, and smell might also be positive stimuli, there is not yet sufficient research. This issue is linked to orientation and independence. Attention to the indoor environment quality is needed to ensure comfort levels are appropriate for the elderly in terms of air temperature, relative humidity, air movement, light level, ventilation rate, air pollutant concentrations, sound pressure level, room acoustics quality, etc. Spaces for meaningful activities and socialization, as well as withdrawal spaces and a choice of settings, can enable residents to choose their preferred level of stimulation.

[e] Safe and secure spaces can be designed to reduce stressors. A lack of handrails, sharp projections, uneven surfaces and lightweight furniture can increase the risk of injury. Unobtrusive safety reduces the perception of being closed in. Higher lighting levels are necessary as eyes age. Doors in end walls can be attractors for exit-seeking behaviors, whereas side doors can reduce this behavior.

[f] Balancing privacy and community supports wellbeing in a range of ways. Balancing a resident's need for privacy within the context of social connections is difficult within an institutional residential aged care setting. Small spaces near private rooms may provide interstitial or privileged settings shared primarily by a sub-group. Connections into broader familiar communities can be achieved by locating cafes, galleries, or maker spacers at ground level. Other strategies for community connections have been explored elsewhere, particularly in Northern Europe. Childcare has been collocated with aged care, university students have been given accommodation in exchange for a few hours of engagement each week, and in some facilities, pools and services are shared with communities. Each has spatial implications.

4. Observations and Discussion of Findings of the Three Dementia Support Facilities

4.1. General Layout

The three selected dementia support facilities in Victoria, Australia were built in the 2010s (Facility A in 2014, Facility B in 2015 and Facility C in 2017). All of them provide single bedrooms with ensuites and small sitting areas. Among them, Facility B has the capacity to accommodate up to 34 residents. The 34 bedrooms are grouped into four wings, with eight bedrooms in two wings, and seven and nine bedrooms in the remaining two wings. Bedrooms are located on both sides of the corridors, with a maximum length of five bedrooms. Communal spaces at the central portion link the four corridors together. On the northeast side of the facility, there is an outdoor garden (Figure 1).

Facility A has the smallest capacity among the three facilities catering for 13 residents, with seven bedrooms on one side (House 1) and six bedrooms on the other side (House 2). Bedrooms are in L-shaped configuration in House 1 and in linear arrangement in House two with a corridor of three bedrooms in length. House 1 and House 2 are separated by an activity room, but are open to the same covered terrace outside. (Figure 2, left). Facility C has a slightly larger capacity than Facility A and can cater for 17 residents. It has eight bedrooms on one side (House 1) and nine bedrooms on the other side (House 2). Corridors in each house are in a T-shape configuration. House 1 and House 2 are connected by a service corridor for staff access. Each House opens to an outdoor terraced garden. (Figure 2, right).

All these three dementia support facilities have homelike settings with small sitting areas with views to facilitate social interaction and provide unrestricted access to safe exteriors, either secured

gardens or balconies. Facility B is located within a retirement village in a regional area, whereas Facilities A and C are located in residential aged care buildings with cafes on ground floor, so Facilities A and C have stronger connections to local communities than Facility B.

A comparison table of the general layout of these three facilities is shown in Table 2. For any variable, there are the three following levels: *, **, and ***, which is indicative of relative assessment, according to the level of engagement of a particular variable, ranging from good (*), better (**) to the best (***).

Figure 1. Floor plan of Facility B.

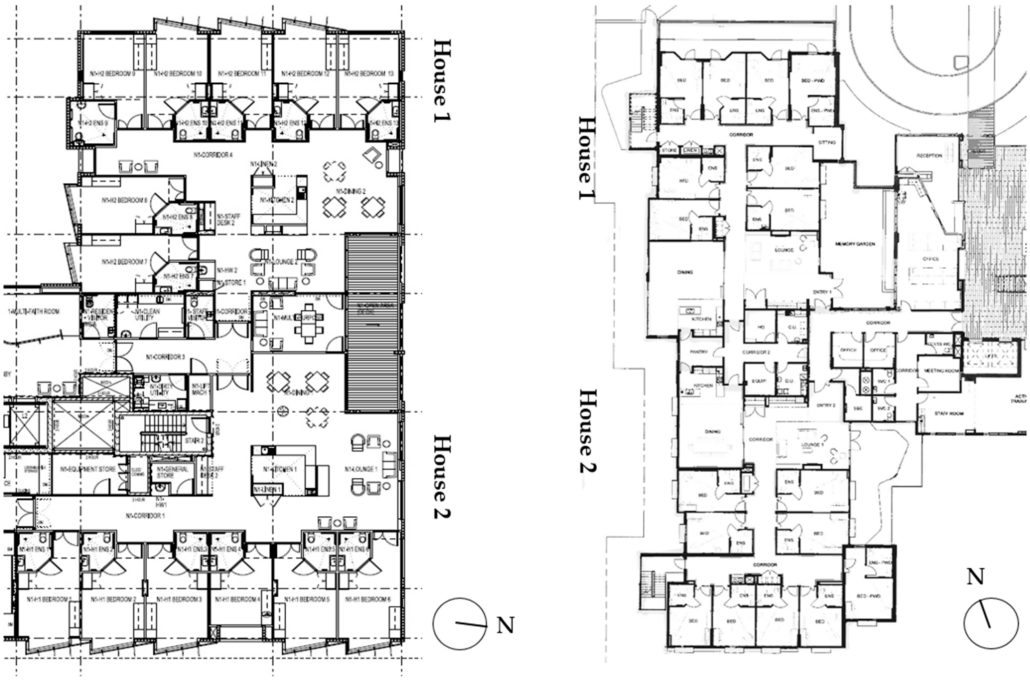

Figure 2. Floor plans of Facility A (**left**) and Facility C (**right**).

Table 2. Comparison of the general layout.

Design Principles	Facility A	Facility B	Facility C
Homelike: Small	***	*	**
Homelike: Access to small sitting areas	***	***	***
Orientation: Simple layout	***	**	***
Orientation: Short corridors	***	*	**
Balancing privacy and community: Connection to community	***	**	***

Notes: * = Good; ** = Better; *** = Best.

4.2. Dining Area and Kitchen with Domestic Setting

The dining hall at Facility B can be divided into two halves by sliding partitions, resulting in two smaller dining areas to cater for 17 residents on one side. This offers adaptive spatial usage to cope with the needs of the residents. Since the gathering of 34 people together at the same place may create too high a noise level, resulting in overstimulation, agitation, and confusion to some residents, the flexibility of spatial subdivision can reduce the possibility of disruptive behaviors during mealtimes [22]. The dining hall offers visual and physical access to gardens on both sides providing spatial orientation cues and helpful stimulation to residents. Windows at both the southeastern side and northwestern side can also allow natural light to enter to the interior with control mechanisms against glare.

At Facility B, the domestic setting of the kitchen is the focal point of the dining area. It does not replace the full-service kitchen, but breakfast preparation, beverage making, and dessert baking can contribute to the domestic ambience of the space, reducing the image of the overall institutional setting. The distinctive smell of food during meal preparation provides olfactory cues to residents. The kitchen next to the dining area also facilitates the staff to cater for personal dietary requirements and allows residents to make choices, especially during breakfasts, so that they may feel more in control of their lives, which has positive implications for the sense of competence and self-esteem of people with dementia. The kitchen is not merely a food preparation area, but also "a practical and non-institutional alternative to the traditional nurses' station" [10]. Staff at the kitchen enjoy an unobstructed view of the dining area, adjacent living areas and the outdoor garden beyond, which offers informal surveillance and ease of monitoring of the residents.

A similar domestic kitchen arrangement is also provided at Facility C. Compared to the open plan kitchens at Facilities B and C, the domestic kitchen at Facility A is more enclosed with glass doors to prevent unauthorized entry (Figure 3, Table 3).

Figure 3. Kitchen with domestic setting: Facility A (**left**), Facility B (**middle**), and Facility C (**right**).

Table 3. Comparison of dining areas and kitchens with the domestic setting.

Design Principles	Facility A	Facility B	Facility C
Homelike: Access to small dining settings	***	**	***
Stimulus: Olfactory cues during meal preparation	***	***	***
Independence: Choice of spaces with views	***	***	***

Notes: * = Good; ** = Better; *** = Best.

4.3. Outdoor Gardens

Among the three dementia support facilities, the outdoor garden at Facility B is the biggest. Doors opening to the garden are unlocked during the daytime, which enables residents going outside as one of their choices. This may lead to the decrease in negative aggressive behaviors of the residents [23]. In fact, a well-designed garden is a therapeutic environment for people with dementia as it can provide visual, tactile, olfactory, and auditory stimulation through the combination of natural landscape, fragrance, sunlight, wind, and birds. The timber trellis at the entrance of the garden serves as an iconic structure for residents' spatial orientation. If more interest points can be provided along the looped path and appropriate shelters can be erected to protect seating areas from excessive solar radiation exposure and strong wind, this may attract more residents to visit the garden. Wheelchair-accessible raised planting beds can also be provided to allow residents with remaining abilities to participate in gardening.

The open terraced garden at Facility C is relatively small and there was not much planting at the time of visit prior to occupation by residents. The garden has potential to be a source of sensory stimulation to residents if it is properly landscaped. Gardens at Facilities B and C face northeast and southeast respectively. Both of them can capture favorable morning sunlight, encouraging residents to go outside. The outdoor activity area at Facility A is the smallest with a covered terrace and limited planting. It faces north, but due to its openings on one side and its close proximity to the adjacent building, solar radiation exposure is unavoidably affected. Solar penetration to the communal space behind the covered terrace is further reduced due to the setback from the façade (Figure 4, Table 4).

Figure 4. Outdoor gardens: Facility A (**left**), Facility B (**middle**), and Facility C (**right**).

Table 4. Comparison of outdoor gardens.

Design Principles	Facility A	Facility B	Facility C
Independence: Unrestricted access to safe exteriors	***	***	***
Stimulus: Landscape, fragrance and sunlight	*	***	**

Notes: * = Good; ** = Better; *** = Best.

4.4. Corridors

In Facility A, there are memory boxes outside residents' rooms along the corridors. The inclusion of personal objects in the memory boxes, such as photos and other artefacts, facilitates residents with dementia to reinforce their long-term memory and reflect upon their past experiences within their remaining capabilities. This can personalize the institutional setting and enhance the sense of identity by creating a familiar environment and serve as an effective orientation cue for wayfinding [24]. Displaying personal objects along the corridor may also stimulate social interaction and conversation among residents and enable the staff to have better understanding of the residents about their stories and preferences [25]. However, the corridors at Facilities B and C only have pictures hanging on walls and color contrast without memory boxes (Figure 5, Table 5).

Table 5. Comparison of corridors.

Design Principles	Facility A	Facility B	Facility C
Orientation: Visual cues	***	**	**
Safety: Well-positioned handrails	***	***	***

Notes: * = Good; ** = Better; *** = Best.

Figure 5. Corridors: Facility A (**left**), Facility B (**middle**), and Facility C (**right**).

5. Space Syntax Analysis of the Three Dementia Support Facilities

Apart from design evaluation through field observation, space syntax analysis was applied for comparing the configurations of the three facilities. Space syntax relies on the use of mathematics of graph theory to measure the spatial and social properties of plans for tracing the underlying layer of space that accommodates real conditions of human movement, access, and surveillance [26–28]. Spatial variables such as visibility (visual connectivity, openness, visual cues) and the relative depth of spaces (proximity, accessibility) can influence the social interactions, spatial orientation, and wayfinding abilities of people with dementia [29–31]. In this investigation, the depthmapX software developed by the Space Syntax Laboratory at the University College London (UCL) was employed to accomplish visibility graph analysis, isovist analysis, and step depth analysis for comparison and discussion [32].

5.1. Visibility Graph Analysis

Visibility graph analysis is a common computational approach of space syntax based on two-dimensional representations of space. The properties of the plans are abstracted and mathematically analyzed to reveal the connectivity of different spaces [33]. Full-height partitions and walls are taken as boundaries, while doors and openings are considered as connection points. Visibility graphs are colored, ranging from red to dark blue to represent different degrees of connectivity.

As shown in Figure 6, the four wings of the Facility B have low connectivity values (dark blue), which are more visually and socially isolated. On the contrary, both Facilities A and C have higher connectivity, especially their communal spaces (living and dining areas), which can facilitate social interaction among users with the ease of physical and visual access (Table 6). The least connected spaces are bathrooms and service rooms, as represented by dark blue on the analysis diagrams.

Table 6. Comparison of connectivity of spaces.

Design Principles	Facility A	Facility B	Facility C
Orientation: Visually connected spaces	***	**	*

Notes: * = Good; ** = Better; *** = Best.

Figure 6. Visibility graph analysis: Facility A (**left**), Facility B (**middle**), and Facility C (**right**).

5.2. Isovist Analysis

Isovist analysis was initially developed by Tandy in 1967 for landscape surveys [33]. By defining 'isovist' as a 'set of all points visible from a given vantage point in space', Benedikt introduced an analytic method for quantitative descriptions of spatial environments in 1979 [34,35]. This is an effective tool to illustrate the visibility of a particular point in the layout plan. Since the domestic kitchen, found at each dementia support facility, is a key focal point in the communal space, it is used for developing the isovist analysis diagrams in Figure 7.

Figure 7. Isovist analysis: Facility A (**left**), Facility B (**middle**) & Facility C (**right**).

The domestic kitchen at Facility A is strategically located at the center of the whole layout, which provides the carers the ease of surveillance for ensuring the safety and wellbeing of residents with dementia. Visibility may be further enhanced if the domestic kitchen is not enclosed by full-height partitions.

The visibility of domestic kitchens at both Facilities B and C is restricted to communal spaces and cannot reach the corridors. On the other hand, the layout configuration of Facility B enables the carers at the domestic kitchen to be visually connected to different types of communal spaces (dining areas, living areas, and lounges facing the garden outside). Comparatively, the visibility of the domestic kitchen at Facility C is more confined due to its location at the corner of the layout (Table 7).

Table 7. Comparison of direct lines of sight.

Design Principles	Facility A	Facility B	Facility C
Orientation: Direct lines of sight	***	**	*

Notes: * = Good; ** = Better; *** = Best.

5.3. Step Depth Analysis

In view of the wandering behavior and cognitive impairment of residents with dementia, it is preferable for dementia support facilities to have lower relative depth for ease of wayfinding and spatial orientation. Step Depth Analysis is an effective visual tool to illustrate the relative depth of the spaces. Different types of spaces on the layout plan are firstly labelled. Spaces with different levels of step depth are represented in the layout by different colours, ranging from red, orange, green, cyan, to purple (Figure 8). The physical connections of different spaces on the layouts are then represented by a tree diagram using the main entrance as Level 0 (Figure 9). In general, communal spaces close to the main entrance have lower step depth, whereas bedrooms have higher step depth.

Among the three dementia support facilities, Facility A has the least step depth (bedrooms have only Level 2 step depth), while Facility C has the greatest step depth (all bedrooms have Level 3 step depth). Due to the balcony outside some bedrooms, the step depth of Facility C can even reach Level 4 (Table 8).

Figure 8. Relative depth analysis layout: Facility A (**left**), Facility B (**middle**), and Facility C (**right**).

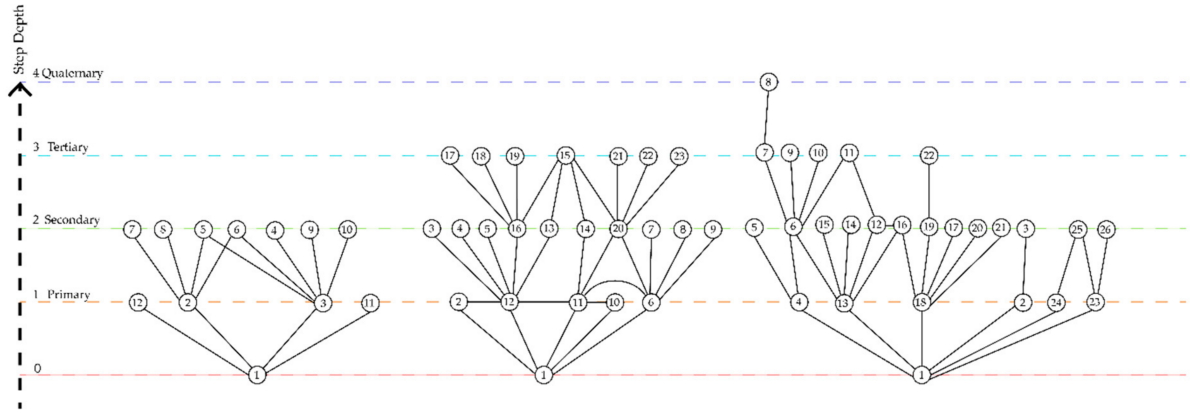

Figure 9. Tree diagrams: Facility A (**left**), Facility B (**middle**), and Facility C (**right**).

Table 8. Comparison of relative depth of spaces for wayfinding.

Design Principles	Facility A	Facility B	Facility C
Orientation: Depth of spaces for wayfinding	***	**	*

Notes: * = Step depth Level 4; ** = Step depth Level 3; *** = Step depth Level 2.

6. Conclusions

What are the design lessons learnt from this investigation? Through fieldwork observation, design evaluation, and space syntax analysis, the general building layouts of the three selected dementia support facilities were compared. How each design addressed current guides on design for dementia was explored in terms of providing a homelike setting and designing for better spatial orientation, independence, stimulus, and safety, as well as balancing privacy with community. Key design factors were identified and appropriate provisions within the facilities were discussed, including the following:

(1) visual access and clear sight line within the domestic ambience of the space
(2) use of kitchen with domestic setting as an alternative to the traditional nurses' station
(3) adaptive spatial usage to cope with disruptive behaviors of residents with dementia
(4) outdoor activity spaces for connection to nature, particularly in Facilities B and C
(5) overall layout with higher visual connectivity for enhancing social interaction and lower step depth for ease of spatial orientation

Design evaluation of these three dementia support facilities can be summarized in Table 9:

Table 9. Design evaluation of the three dementia support facilities.

Design Principles	Facility A	Facility B	Facility C
[A] Homelike			
Small	***	*	**
Access to small sitting areas	***	***	***
Access to small dining settings	***	**	***
[B] Orientation			
Simple layout	***	**	***
Short corridors	***	*	**
Visual cues	***	**	**
Visually connected spaces	***	**	***
Direct lines of sight	***	**	*
Depth of spaces for wayfinding	***	**	*

Table 9. *Cont.*

Design Principles	Facility A	Facility B	Facility C
[C] Independence			
Choice of spaces with views	***	***	***
Unrestricted access to safe exteriors	***	***	***
[D] Stimulus			
Olfactory cues during meal preparation	***	***	***
Landscape, fragrance, and sunlight	*	***	**
[E] Safety			
Well-positioned handrails	***	***	***
[F] Balancing privacy and community			
Connection to community	***	**	***

Notes: * = Good; ** = Better; *** = Best.

The research on the impact of design of living environment on the quality of life and wellbeing of residents with dementia is ongoing. Further ethnographic analysis including photo elicitation and semi-structured interviews with carers and relevant design practitioners will be carried out to collect and collate their feedback. This can inform the design strategies of future dementia support facilities to suit the specific needs of people with dementia.

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