

**BUILDING BETTER
HOMES, TOWNS
AND CITIES**

Ko ngā wā kāinga hei
whakamāhorahora



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Disclaimer

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Glossary

Building design – architectural, engineering and technical aspects of designing a building, such as its siting, size, floorplan, structure, layout, materials, fixtures and fittings (e.g. doors, windows, hardware), utilities services (e.g., lighting, heating, water, power) and the building's relationship to the site.

Building design solutions – building features that improve people's ability to use the building, enhance their safety and meets their needs.

Carer and *caregiver* – care can be provided by formal carers through paid services, or informal caregivers such as partners, family members and friends. Where possible, the type of carer is specified in the report. Sometimes the term 'carer' is used in a reference, but it is not specified whether it refers to formal or informal caregivers.

Housing – a private dwelling that is owned or rented. This is distinguished from non-private residential care accommodation.

Residential care – non-private, institutional accommodation for people with dementia where 24 hour care is provided.

Supported housing – also termed extra-care housing. This type of housing is private housing that includes formal support services to help people to live independently.

Universal design (UD) – the design of environments that are accessible for people of all abilities and at any stage of life. Key features are: level access to the building, avoiding long narrow corridors and sharp turns, ensuring corridors and doorways are wide enough for a wheelchair, providing sufficient space around the toilet and provision for grab bars, and a 'walk in' shower. See New Zealand's universal design standard, Lifemark <https://www.lifemark.co.nz/>

Executive Summary

We conducted a literature review of New Zealand and international evidence concerning building design solutions for people with dementia living in their own homes. Just under 70 percent of New Zealanders with dementia are estimated to live in their own homes, rather than in residential care.

Housing poses a challenge for many people living with dementia, since cognitive impairments can hinder their ability to understand and adapt to their living environment. Therefore, their housing must address and adapt to their changing needs. The focus of this review is on building design elements that address:

- Entrance and exit solutions.
- Self-navigation.
- Individual function, day-to-day self-management and independence.
- Enjoyment and ambience of the home.
- Mitigation of behavioural issues that might lead to institutionalisation.

In all, 34 studies were included in this review. Fifteen of those provided extensive reviews of the literature. We found that research about building design solutions has primarily focused on residential care, despite the majority of people with dementia living at home. Recommendations for home design have evolved from this research. While many design features in institutional settings may be useful in housing, there is a lack of research assessing the applicability, transferability and efficacy of those design features to housing.

Eight broad themes were identified in the literature:

- *Enabling decision-making for people with dementia.* Building design needs to take into account the interrelated impacts of design solutions on the multiple needs and varied circumstances of people with dementia, their design preferences, and how they use their living environment. However, these aspects are often missing in research or only cursorily considered. This is due to a lack of consultation with people with dementia, although a more person-centred focus is evolving.
- *The importance of the home for people with dementia.* The home is associated with wellbeing, security, identity, familiarity, and enjoyment. Dementia-friendly building design needs to enhance the sense of home.
- *The contribution of building design to wellbeing and quality of life.* There is evidence that the physical environment of the home can be a protective factor for health and wellbeing, that it has a therapeutic effect, and that addressing physical defects of the home environment can delay entry to residential care.
- *A holistic approach to building design.* Several studies advocate for design features to adopt a holistic approach that enables social, cultural and psychological wellbeing, in addition to physical wellbeing.

- *Design to address the diversity of people with dementia.* No single building design solution can address the housing needs of all people with dementia. They are a diverse group with different experiences of health and disability and varied social and cultural backgrounds. Furthermore, their needs change as they experience different stages of dementia.
- *Design responding to the diversity of housing within the community.* Characteristics, such as dwelling size, layout, number of levels, and tenure all influence the type of design solutions that are possible and effective for people with dementia.
- *Building design to enhance care.* Building design has the potential to reduce the burden on formal or informal caregivers and to increase their safety. It can also reduce or delay the demand for health and care services.
- *Barriers to take-up of building design solutions.* A wide range of barriers were identified including: lack of dementia-friendly design principles and standards in housing policy and building regulations; low awareness of dementia-friendly building design among people with dementia, their carers, professional groups and practitioners, and in the wider community; a lack of precise, easy to use design specifications; concerns about stigmatising impacts of design; and misunderstanding about costs of design interventions.

Many of the building design solutions have not been well studied as to efficacy. There is good-to-strong evidence for some specific interventions but evidence about other solutions is inconclusive or contradictory. For example, there is a lack of synergy and potential conflicts between dementia-friendly design and accessible and universal design. There is some evidence of contradictions between design for sight loss, and design for controlling challenging behaviour, or regulating access. Designing for safety can also conflict with dementia-friendly design. No reference was found that compared the cost-effectiveness of alternative solutions.

A range of research gaps were identified, including specific building design solutions as well as knowledge gaps. Knowledge gaps are mainly concerned with understanding more about how people with dementia experience their home environment, their views about particular design interventions and differing needs for and access to interventions.

Despite the limitations of the research, the literature reviewed highlights building solutions where there is evidence of efficacy. Those areas include:

- Regulating access, through camouflage, placement of locks and limiting the number of entrance/exit points.
- The use of colour and different materials to distinguish between different spaces and functions, and to enhance visibility.
- Simple, easy to understand layout and avoidance of long corridors.
- Direct visual sightlines to relevant and important places and spaces.

- Ensuring that spaces have an unambiguous and unique character and function, which do not give confusing messages.
- Ensuring natural and artificial lighting is appropriate to the space and specific tasks, and glare is reduced.
- Appropriate siting and sizing of windows.
- Controlling unnecessary sensory stimuli such as light and noise.
- Ensuring thermal comfort.
- Universal design features such as non-slip flooring, level entrances, walk-in shower, lever handles and taps, providing these features are understandable and easy to use for the person with dementia.
- Use of systems with safety features that monitor or shut off gas or water if required.

To develop strong New Zealand-based evidence that builds on international evidence for dementia-friendly building design solutions, there is a need for research about the adequacy of housing in which New Zealanders with dementia live, their design preferences and their ability to access design features that support their independence and wellbeing.

1 Introduction

Currently around 70,000 people in New Zealand have dementia. The number of people with dementia is expected to increase, mainly due to our ageing population, since the chances of developing dementia increases with age. By 2050 we can expect that more than 170,000 people will have dementia.¹

Dementia is an umbrella term for a collection of diseases that affect how the brain works. Dementia is complex, multi-faceted and progressive, resulting in changes in memory, thinking, sensory perception, behaviour, personality and emotions. In turn, those changes can affect the performance of everyday tasks, personal independence and the ways in which the home environment is experienced.²

Most New Zealanders who have dementia or cognitive impairment live in their own homes, not in residential care, and they live in those homes almost to the end of their lives. This is consistent with experience in other countries such as the United Kingdom, United States, Australia, Italy, Ireland, Netherlands and Japan.³ Yet, despite most people with dementia living in their own homes, the home:

“ ... seems to be a largely ignored territory in research and government policies, which implies that many problems concerning aging in place and environmental interventions for dementia are not adequately dealt with”.⁴

Housing poses a challenge for many people living with dementia, since their cognitive impairments hinder their ability to understand aspects of the building, such as layout. Furthermore, because of the varying effects of different types of dementia, the range of symptoms and its progressive nature, the living environment must address and adapt to changing needs.⁵ This literature review focuses on building design solutions to improve the functionality of housing for people with dementia. In particular this review looks at how housing can respond to the diverse needs of people with dementia, including mobility and

¹ Smith, E., Lamb-Yorski, R., Thompson, A., and Grootveld, C. (2019). *This is our story: A qualitative research report on living with dementia*. Wellington, New Zealand: Litmus.

² Deloitte (2017). *Dementia Economic Impact Report 2016* New Zealand: Deloitte; Evans, S., Waller, S., Bray, J. and Atkinson, T. (2019). Making Homes More Dementia-Friendly through the Use of Aids and Adaptations *Healthcare* 7(43) doi:10.3390.

³ Andrews, J. and P. Molyneux (2013). *Dementia: Finding housing solutions*. London: National Housing Federation; Gabriel, M., Stirling, C., Faulkner, D. and Lloyd, B. (2014) *Future housing and support needs of people with dementia*, AHURI Positioning Paper No. 159, Melbourne: Australian Housing and Urban Research Institute; Pierce, M., Cahill, S., Grey, T. and Dyer, M. (2015). *Research for Dementia and Home Design in Ireland Looking at New Build and Retro-Fit Housing from a Universal Design Approach: Key Findings and Recommendations*. Report prepared for the National Disability Authority Centre of Excellence in Universal Design, Dublin, Ireland: NDA; Thoma-Lurken, T., Bleijlevens, Michel, H., Lexis, M. and De Witte, L. (2017). Facilitating aging in place: A qualitative study of practical problems preventing people with dementia from living at home. *Geriatric Nursing*, 39(1): 29-38; Van Hoof, J., Kort, H., van Waarde, H. and Blom, M. (2010). Environmental Interventions and the Design of Homes for Older Adults with Dementia: An Overview. *American Journal of Alzheimer's Disease & other Dementias*, 25(3): 202-232.

⁴ Van Hoof, Kort, van Waarde, and Blom (2010):202.

⁵ Pierce et al. (2015).

safety needs and changes in capabilities over time as their condition progresses. The ageing process itself imparts physical frailty, and those experiencing dementia or other cognitive impairment can experience other disabling conditions such as visual impairment, hearing difficulty, physical disability, mental health conditions or substance abuse.⁶ Those conditions must also be taken into account in building design.

This report is part of the *Building Solutions* research programme in the Building Better Homes, Towns and Cities National Science Challenge, and is a companion report to *Home, Space and Place: A Review of Māori and Indigenous literature contributing to dementia-friendly housing design*. The research programme is designed to support affordable housing providers, procurers, designers and builders by addressing social and technical barriers to delivering affordable housing that is intended to meet changing needs, and able to deliver comfortable homes across the life cycle for our ageing communities.

The report is structured as follows:

- Section 2 presents the research purpose, focus and method.
- Section 3 provides an overview of the literature covered in the review and its key characteristics.
- Section 4 sets out the broad themes in the research.
- Section 5 describes key findings about dementia-friendly building design.
- Section 6 discusses the quality of research covered in this review and research gaps are identified.
- Section 7 presents a selection of dementia-friendly building design guides.
- Section 8 presents overall conclusions about the literature reviewed, and implications of research findings for building design solutions.

⁶ Gabriel et al. (2014); Pierce et al. (2015).

2 Research Purpose, Focus and Method

The purpose of this review is to provide information about dementia-friendly building design solutions based on research evidence. The target audience is community housing providers, designers and builders who are interested in how design can support older people with dementia to stay living in their homes, and which contributes to maintaining their wellbeing.

Building design solutions can address a range of challenges that people with dementia face with their housing. Key design solutions that help to make the home work better for people with dementia include: appropriate lighting levels, use of flooring materials and colours to help with wayfinding and to identify specific spaces in the home, acoustic materials to control noise, and attention to accessibility. Specific building design solutions are discussed in Section 5.

The focus of this research is on building design solutions for people with dementia living in housing in the community, not in a residential care facility. Just under 70 percent of New Zealanders with dementia are estimated to live in their own homes.⁷ New Zealand information about the suitability of housing for people with dementia is very sparse. Nevertheless, some insights about their housing and their care needs can be gleaned from interRAI assessments for home-based care, which include clients with dementia or moderate-to-severe cognitive impairment. That data shows:⁸

- 17 percent of clients with dementia or moderate-to-severe cognitive impairment live independently without support, i.e., they manage daily activities such as eating, dressing, personal hygiene and moving around.
- 35 percent need extensive assistance or are dependent on carers.
- One-third has daily episodes of troubling behaviours such as abusive behaviour or resisting care.
- 44 percent of carers report feeling depressed or angry because of the demands of care, and 55 percent feel overwhelmed by the needs of the person they care for.

Qualitative research shows that New Zealanders with dementia want to maintain their independence and stay in their homes, and that they and their families work to create an enabling living environment where they remain independent as long as possible. Sometimes to support their independence, and if they can afford it, they move to another house that is more manageable or closer to services. Alternatively, they may make changes to their home to maintain their independence. Most of the changes they make are changes to routine, the introduction of aids, such as labelling, or the use of assistive technology.⁹ These changes are non-building solutions, which have little or no impact on the physical structure of the dwelling.

⁷ Deloitte (2017).

⁸ TAS and InterRAI NZ (2017). *Annual Report 2016/17*. Wellington, Central Region's Technical Advisory Services Ltd.

⁹ Smith et al. (2019).

2.1 Research Scope

The scope of this literature review is on:

Value-for-money solutions that improve the functionality, safety and liveability of dwellings for older people with dementia or cognitive sensory compromise, who are living in housing in the community.

There is a focus on residential building design solutions concerned with architectural and technical design aspects. These include building components and interior design that address:

- Entrance and exit.
- Self-navigation.
- Individual function, day-to-day self-management and independence.
- Enjoyment and ambience of the home.
- Mitigation of behavioural issues that might lead to institutionalisation.

The review considers the intersection between dementia-friendly, age-friendly and disability-friendly housing design solutions. It also includes some studies on building design solutions that not only consider features promoting a safe and secure home environment, but design that enables older people living with dementia to connect with others and to receive the support and services they need to stay in their own homes. The situation and needs of both informal caregivers, and workers providing care in the home has been identified in research as important considerations in the design of building interventions to support those with dementia.¹⁰ As noted above, InterRAI data shows that 35 percent of those with dementia living in their own homes need extensive assistance or are dependent on carers.

Solutions for managing frailty, impaired mobility and sensory impairment were also identified in the literature but are not the primary focus of investigation.¹¹ In this report, design for visual impairment, home modifications and universal design are considered in the context of supporting people with dementia. Non-building solutions such as aids and equipment can also assist people with dementia, and some of the literature reviewed includes assessment of both building and non-building solutions. However, aids, equipment and the interaction between building solutions and assistive technology are not a focus in this review.

There is a substantial literature on dementia-friendly building guidelines, which provides important context for this review. Many guidelines are based on research evidence and a

¹⁰ Calkins, M., Sanford, J. and Proffitt M. (2001). Design for dementia: Challenges and Lessons for Universal Design. In Preiser, W. and Ostroff, E. (eds), *Universal Design Handbook 1E*. New York: McGraw-Hill Professional.

¹¹ There has been a lot of literature review work done about universal design and home modifications to assist with frailty and mobility impairment, e.g. see James, B., Saville-Smith, N., Saville-Smith, K. and Isaacs, N. (2018). *Doing Better in Residential Dwellings: Going Beyond the Code in Energy and Accessibility Performance*. BRANZ report ER27. Judgeford, Wellington: Building Research Association New Zealand. This work is not repeated in this review.

selection of guidelines specifically targeted to people with dementia living in their own homes is discussed in Section 7 and listed in Appendix 2. Design guidance concerning dementia-friendly neighbourhoods and urban environments is beyond the frame of this review.

Additional studies not primarily focused on building design solutions are included where they provide important contextual information about living with dementia. Those studies are acknowledged in footnotes.

2.2 Research Method

The literature to be reviewed is diverse. A preliminary examination of five references showed that the literature is conceptually and methodologically diverse, as well as spanning different disciplines.¹² There is no precise or standardised definition of dementia-friendly design with which to search for and categorise the literature.¹³ Nor is there a clearly identified set of studies on the types of building solutions that are the subject of this review; instead, the research straddles several different fields including age-friendly design, disability-friendly design and universal design. The research also takes a broad approach to building design interventions, including architectural design, materials, products and utility services (lighting, heating, ventilation and acoustics). This diversity makes aggregation of results and the application of statistical methods of systematic review impractical and inappropriate.

Accordingly, methods for conducting a qualitative literature review and synthesis have been used, primarily the development of descriptive and analytic themes.¹⁴ The storyline approach, which identifies the foundational theoretical and empirical work on a research topic that has developed over time, is also helpful in understanding how a body of evidence is constructed and used to influence the development of policy and practice.¹⁵

¹² Marquardt, G., Büter, K. and T. Motzek (2014). Impact of the Design of the Built Environment on People with Dementia: An Evidence-Based Review. *Health Environments Research and Design Journal*, 8(1): 127-157; O'Malley, L. and K. Croucher (2005). Housing and Dementia Care – A Scoping Review of the Literature. *Health and Social Care in the Community*, 13(6): 570-577.

¹³ Kirch, J., Marquardt, G. and Bueter, K. (2018). Breaking Down Barriers: Promoting a New Look at Dementia-Friendly Design. pp. 125-133 in: Langdon P., Lazar J., Heylighen A. and H. Dong (eds) *Breaking Down Barriers*. London: Springer-Verlag.

¹⁴ Dixon-Woods, M., Bonas, S., Booth, A., Jones, D., Miller, T., Sutton, A., Shaw R., Smith J., and Young, B. (2006). How can systematic reviews incorporate qualitative research? A critical perspective *Qualitative Research* 6(1):27-44; Thomas, J. and Harden, A. (2008). Methods for the thematic synthesis of qualitative research in systematic reviews *BMC Medical Research Methodology* 8:45 <https://doi.org/10.1186/1471-2288-8-45>

¹⁵ Greenhalgh, T., Robert, G., Macfarlane, F., Bate, P., Kyriakidou, O., and Peacock, R. (2005). Storylines of research in diffusion of innovation: a meta-narrative approach to systematic review *Social Science & Medicine* 61:417-430.

2.3 Research Steps

The main research steps were:

- Literature scoping, search and collection using specific criteria and search terms. This step included refinement of search terms.
- Selection criteria were used to include or exclude the literature to be reviewed.
- A set of questions with which to interrogate each selected reference was drawn up and formatted into a template.
- A summary of each selected reference was entered on to the template, according to the research questions. This formed the review database.
- The review database was analysed by identifying and coding the range of descriptive data and analytic themes within and across studies.
- Finally the research findings were collated and assessed.

Literature scope and selection criteria

The review included both published research (journal articles, books etc) and grey literature, such as commissioned reports (e.g. reports for government or organisations), conference proceedings, unpublished research reports and theses. To be included in the selected literature, a reference had to primarily report on dementia-friendly building solutions research; i.e., a particular investigation or study of technical design solutions using research methods. Literature primarily reporting data, monitoring reports, issues papers, government briefing/cabinet papers, legislation, regulatory impact statements, policy statements, technical standards, codes of practice, design guidelines, media reports, and other literature that does not have a substantial research component was not included, although it was found that some of that literature provided useful information, which is referenced in this report.

Initial literature search focused on research since 2010 and started with the intention of selecting studies that fitted within pre-defined search parameters and terms. A preliminary list of search terms was derived from a review of 10 studies. Those search terms were added to as necessary during the early stage of literature search. The list of search parameters and terms is presented in Infobox 1.

Although the intention was to select studies that fitted within the search parameters, this approach was refined and expanded to accommodate the diverse scope and content of studies, and to better capture research that would address the focus of this review. Such refining is typical when developing a qualitative review, since standard systematic review techniques are not well adapted to dealing with complex and amorphous bodies of literature such as typical of this field.¹⁶ The key changes made to our approach were to:

- Minimise the number of excluded studies. It was considered that the search criteria may have excluded some studies with important insights for developing design solutions.

¹⁶ Dixon-Woods et al. (2006).

Therefore a more inclusive approach was taken. The number of excluded studies and reasons for exclusion are discussed below.

- Consideration of research outside of the timeframe. It was found that much of the foundational research was completed prior 2010. As a consequence, some key earlier references were included where they contributed to the ‘storyline’ of research development in the topic area.
- Extending the search to include research on building design in residential care facilities where it makes a strong contribution to understanding design applicable to housing in the community.
- Extending the search to include design guidelines. Many of these are based on research that is outside of the review timeframe. While these guidelines are not analysed as part of the review, they are discussed in Section 7 and listed in Appendix 2.
- While not included in the detailed analysis in sections 4 and 5, some literature about dementia is included to provide contextual information.

Search Parameters	Search terms
<p>The international focus is on Australia, UK, USA, Canada, Japan, Singapore and Europe.</p> <p>Research covering both new builds and existing housing stock is included.</p> <p>The housing stock is lived in by people living independently (including the use of in-home help and/or living with others). Supported housing and extra-care housing are included.</p> <p>Housing can be held in any tenure.</p> <p>Solutions must focus on the dwelling’s ability to support and enhance the individual’s functionality, safety and independence.</p> <p>Solutions may address social and technical barriers.</p> <p>There is a focus on value-for-money solutions.</p> <p>There is a focus on selected building components and interior design that address:</p> <ul style="list-style-type: none"> • Entrance and exit. • Self-navigation. • Individual function, day-to-day self-management and independence. • Enjoyment and ambience of the home. • Mitigation of behavioural issues that might lead to institutionalisation. 	<p>dementia</p> <p>Alzheimer’s</p> <p>cognitive impairment</p> <p>housing</p> <p>housing design</p> <p>dementia friendly design</p> <p>community care</p> <p>home care</p> <p>ageing in place</p> <p>small scale housing</p> <p>extra care housing</p> <p>sheltered housing</p> <p>assisted living</p> <p>self navigation</p> <p>wayfinding</p> <p>self management</p> <p>behaviour management</p>

Infobox 1: Search parameters and terms

Literature search was done through the websites of relevant research and other organisations and search engines such as Google and Google scholar. Key organisation websites searched were: the Australian Housing and Urban Research Institute, the Home Modifications Information Clearinghouse Australia, the Centre for Excellence in Universal Design Ireland, Dementia Services Development Centre University of Stirling, Alzheimers New Zealand, and Alzheimers Society UK.

Excluded references

An initial reading of each reference was done, using the abstract, and if that provided insufficient information for deciding whether or not to include the reference, a more detailed reading was done. This process resulted in 21 references being excluded and 34 references being selected for detailed examination. Table 1 sets out the reasons for exclusion. Some references met more than one criterion for exclusion.

Reason for exclusion	Number of references excluded
Insufficient information on building design solutions	15
Insufficient focus on dementia, cognitive impairment	8
Insufficient focus on living in the community / primary focus on institutional care settings	8
Insufficient research data (e.g. focus on monitoring, standards, policy commentary)	3
Insufficient information about methods or findings to understand nature or efficacy of design solution	2
Duplicates information/findings contained in another document included	1

Table 1: Reasons for excluding references

Review template

Each of the 34 references was read and summarised according to the review template. The template captured the information set out in Infobox 2 concerning literature characteristics, and major and supporting research themes. In addition to those themes, a small number of other themes were identified during analysis of the content of references and added to the coding frame. Those additional themes are also included in Infobox 2 under supporting themes.

Literature Characteristics	Major research themes	Supporting research themes
Research purpose/objective Discipline Sector Location of research Housing – independent, supported, residential care New build or existing housing Methods Strengths/limitations of methods Main findings Key conclusions	Entrance/exit Self-navigation Visual cues Spatial orientation Safety Independence Ability to carry out daily activities Enjoyment of home Ambience of home Behavioural issues	Home modifications Universal design Enhancement of formal or informal caregiver support Assistive technology Lighting Acoustics Visual impairment

Infobox 2: Summary of literature characteristics and research themes

3 Literature Overview

Appendix 1 lists each of the 34 reviewed references with a brief summary of their contents. This section sets out the broad characteristics of those references.

The bulk of the research about designing living environments specifically for people with dementia dates from the 1980s.¹⁷ Most of the literature covered in this report considers research from the 1990s onwards. Much of the foundational work on dementia-friendly design was done before the 2000s and that work, along with some more recent work, has been influential in the development of evidence-based design standards and guidelines to inform practice (see Appendix 2).

3.1 Literature Reviews and Systematic Reviews

Fifteen of the 34 references provided extensive reviews of other studies, either using systematic review (8) or literature review (7) methods (see Infobox 3). Those reviews covered studies of housing (i.e., people with dementia living independently including with the use of in-home help and/or living with others), supported or extra-care housing (where formal support services are provided in association with housing) and residential care facilities. Some studies covered not only building design features, but also care needs.

Reference	Type of review	Research	Setting
Bowes et al. 2014	Systematic review	Designing environments for people with dementia and sight loss	Housing Supported housing Residential care
Davis and Weisbeck 2016	Literature review	Visual cues, wayfinding	Housing Supported housing Residential care
Fleming et al. 2008	Systematic review	Building design	Residential care
Gabriel et al. 2014	Literature review	Housing and support needs	Housing
Hodges et al. 2007	Systematic review	Building design features influencing aggressive or self-injuring behaviour	Housing
Marquardt et al. 2014	Systematic review	Impact of building design	Residential care
O'Malley and Croucher 2005	Literature review	Housing and care provision	Housing Supported housing Residential care

¹⁷ Fleming, R., Cookes, P. and Sum, S. (2008). *A Review of the empirical literature on the design of the physical environment for people with dementia*. Faculty of Health and Behavioural Sciences, University of Wollongong, Australia.

Pierce et al. 2015	Literature review	Designing new builds and retrofitting existing housing for people with dementia	Housing Supported housing
Powell et al. 2017	Systematic review	Home modifications Visual impairment	Housing
Soilemezi 2017	Systematic review	Perceptions and experiences of the home environment and design interventions	Housing Supported housing
Soilemezi, et al. 2017	Systematic review	Perceptions and experiences of the home environment	Housing Supported housing
Struckmeyer and Pickens 2016	Literature review	Home modifications for people with Alzheimers	Housing
Utton 2009	Systematic review	Application of design principles	Supported housing Residential care
van Hoof, Kort, Duijnsteet al., 2010	Literature review	Indoor environment – air, light, acoustics	Housing
van Hoof, Kort, van Waarde and Blom 2010	Literature review	Design principles Design goals Environmental interventions	Housing Residential care

Infobox 3: Research covered by literature reviews and systematic reviews

It is notable that, while those reviews in Infobox 3 sourced a large number of studies, some were excluded from assessment because they did not cover the building design intervention of concern, or research quality was poor. Furthermore, the pool of empirical evidence on building design solutions for housing was very limited, because the bulk of research has been done in residential care settings.¹⁸

¹⁸ Bowes, A., McCabe, L., Dawson, A., and Greasley-Adams, C. (2014). *Good practice in the design of homes and living spaces for people living with dementia and sight loss* Research Findings No. 42. London: Thomas Pocklington Trust; Dementia Care (2015) *Housing Options for People with Dementia: Discussion Paper*, September 2015, Brunswick Village, Newcastle upon Tyne; O'Malley and Croucher (2005); Marquardt, G., Johnston, D., Black, B., Morrison, A., Rosenblatt, A., Lyketsos, C. and Samus, Q. (2011a). A Descriptive Study of Home Modifications for People with Dementia and Barriers for Implementation. *Journal of Housing for the Elderly*, 1:25(3): 258-273; Pierce et al. (2015); van Hoof, J. and Kort, H. (2009). Supportive Living Environments: A first concept of a dwelling designed for older adults with dementia. *Dementia*, 8(2): 293-316.

3.2 Country Focus of the Research

Table 2 sets out the country focus of the research where that is made explicit. Most studies did not report on research relating to one country, and the systematic and literature reviews covered various countries. Of those references that did focus on one country, most research related to the United Kingdom (eight references) and the Netherlands (six references). Other references focused on the United States, Australia, Belgium and Ireland.

Country	Number of references
United Kingdom	8
Netherlands	6
United States	4
Australia	2
Belgium	1
Ireland	1

Table 2: Country focus of references

3.3 Author Disciplines

Table 3 sets out the disciplines of authors, where these were clearly identified. It was most common for authors to be in health sciences, such as neuroscience, occupational therapy, nursing, public health and health services (21 references) or architecture and design (16 references).

Discipline	Number of references
Health Sciences	21
Architecture and design	16
Housing Studies	8
Gerontology	9
Social Work	5
Policy Studies	4
Building/construction	4
Anthropology	2
Planning	2
Social Science (not specified)	2
Demography	1
Epidemiology	1
Assistive Technology	1
Disability Studies	1
Sociology	1
Urban Design	1

Table 3: Disciplines

3.4 Types of Housing Studied

While the focus of this report is on building design research for people with dementia living in housing, 15 included research about residential care facilities. In addition, 14 studies included research about supported or extra-care housing.

Most studies (23) covered building design features applicable to both new and existing dwellings. Two studies only covered new builds, and one study only covered existing dwellings. The remaining studies did not specify whether designs were applicable to new or existing buildings.

3.5 Research Methods and Participants

Research methods in the studies covered both qualitative and quantitative methods (Table 4). Studies used multi-methods, with the most common methods being literature review or systematic review (24 references), interviews (10 references) and technical assessment of building design features or interventions (nine references). The latter included assessments of the use of spaces, spatial layout, safety features, home modifications and wayfinding.

Method	Number of references
Literature review or systematic review	24
Interview	10
Building design assessment	9
Focus group	7
Case study	5
Policy and document review	5
Survey	5
Observation	3

Table 4: Research Methods

A range of participants was involved in the studies (Table 5). Eleven included people with dementia. Carers and family were involved in eight and four studies respectively. Few studies involved health professionals, architects or builders.

Participant	Number of references
People with dementia	11
Carers (formal and informal)	8
Residential care providers	5
Family	4
Housing providers (supported and independent living)	4
Service providers	3
Community-based care providers	3
Local government	3
Health professionals (e.g., general practice, nurse)	2
Architects and designers	2
Central government agency	1
Landscape architects	1
Residential builders	1

Table 5: Research participants

4 Research Themes

This section discusses the key themes emerging from the literature reviewed. It does not discuss particular building design solutions. Those are discussed in the Section 5.

Eight broad themes were identified in the literature:

- Enabling decision-making for people with dementia
- The importance of home for people with dementia
- The contribution of building design to wellbeing and quality of life
- A holistic approach to building design
- Design to address the diversity of people with dementia
- Design responding to the diversity of housing within the community
- Building design to enhance care
- Barriers to take-up of building design solutions

4.1 Enabling Decision Making

Earlier research on building design interventions tended not to include people with dementia. In recent years a more people-centred focus has evolved, with an emphasis on the lived experiences of people with dementia, their symptoms, personal preferences and needs as well as those of their caregivers.

Many of the references reviewed advocate for involving people with dementia in building solutions research and decision-making about their living environment, so that the reality of living with dementia can be better understood, and information gained from research with people with dementia applied to ensure interventions respond to individuals' symptoms, preferences, fears and aspirations. It is also important that specific design interventions are tested with people with dementia, to minimise irritation and confusion in response to change.¹⁹

The reviewed research does not provide guidance on how to involve people with dementia in decision-making about their housing or specific building solutions. However, there is guidance on involving people with dementia in decisions affecting them, through shared

¹⁹ Bowes et al. (2014); Calkins et al. (2001); Hodges, L., Bridge, C., Donnelly, M., and Chaudhary, K. (2007) *Designing Home environments for people who experience problems with cognition and who display aggressive or self-injurious behaviour*, Evidence Based Practice Reviews, The Home Modification: Information Clearinghouse Project; Kirch et al. (2018); Marquardt et al. (2011a); O'Malley and Croucher (2005); Pierce et al. (2015); Powell, J., Macintosh, S., Bird, E., Ige, J., Garrett, H., and Roys, M. (2017). *The role of home adaptations in improving later life* Centre for Ageing Better, University of the West of England, Bristol; Utton, D. (2009). The design of housing for people with dementia. *Journal of Care Services Management*, 3(4): 380-390; van Hoof, Kort, van Waarde and Blom (2010); Van Steenwinkel I., Van Audenhove C. and Heylighen, A. (2017). Insights into living with dementia: Five implications for architectural design. Paper presented at the 3rd International Conference on Architecture, Research, Care, Health (Arch 17), Copenhagen, Denmark; Verbeek, H., Kane, R., van Rossum, E. and Hamers, J. (2011) Chapter 19 Promoting Resilience in Small-Scale, Homelike Residential Care Settings for Older People with Dementia: Experiences for the Netherlands and the United States, in Resnick et al., (eds), *Resilience in Ageing: Concepts, research and outcomes*, Springer Science + Business Media.

decision-making. This is a process where the person with dementia is included in decision-making, along with their caregiver and sometimes also a health or service support worker. Characteristics of shared decision-making include: encouraging people with dementia to express their views and opinions, likes and dislikes; allowing sufficient time for reflection; and providing opportunity to change the decision. Visual aids and simplified text can also support decision-making.²⁰

4.2 The Importance of Home

The research emphasises the critical importance of the home for people with dementia. However, this does not mean that one must stay in the same home. Part of valuing the importance of the home may involve moving to another dwelling, which is more suitable and helps the person to maintain independence.²¹

A sense of home imparts wellbeing as it provides a secure haven, which is central to people's lives. The home is an expression of identity and has a special focus as a place of familiarity, enjoyment and good memories.²² There is evidence that, while quality of life is subject to many influences, a key factor associated with better quality of life is living in one's own home, rather than in residential care.²³

Despite the importance of the home, it has also been observed that for people living with dementia, the home becomes a place associated with illness and care, and this can jeopardise the positive aspects of home. Consequently, the challenge for design is to "... restore normalcy and, most importantly, maintain their identity" of both the individual and their family caregiver.²⁴

²⁰ Alzheimers New Zealand (n.d.) Evidence at a Glance Issue 4: Shared Decision-Making. Wellington: Alzheimers New Zealand. <https://www.alzheimers.org.nz/getattachment/Information-and-support/Information/Information-for-health-professionals/Evidence-at-a-glance-Issue-4-Shared-decision-making.pdf/>

²¹ Smith et al. (2019).

²² Gabriel, M., Faulkner, D. and Stirling, C. (2015). *Housing priorities of people with dementia: security, continuity and support*. AHURI Final Report No.242. Melbourne: Australian Housing and Urban Research Institute; Soilemezi, D. (2017). Living Well with Dementia at Home: Understanding the Role of the Home Environment. *Presidents Award for Research 2016*, 1-37; Soilemezi, D., Drahota, A., Crossland, J. and Stores, R. (2017). The role of the home environment in dementia care and support: Systematic review of qualitative research. *Dementia*. <https://doi.org/10.1177/1471301217692130> ; van Hoof and Kort (2009).

²³ Martyr, A., Nelis, S., Quinn, C., Wu, Y., Lamont, R. et al. (2018). Living well with dementia: a systematic review and correlational meta-analysis of factors associated with quality of life, well-being and life satisfaction in people with dementia. *Psychological Medicine* 48(13):2130-2139.

²⁴ Soilemezi (2017:17).

4.3 The Contribution of Building Design to Wellbeing and Quality of Life

Building design is fundamental to the wellbeing of people with dementia. There is evidence that the physical environment of the home can be a protective factor for health and wellbeing²⁵, and that it has a “therapeutic effect” in helping people with dementia to “preserve their wellbeing, behaviour, independence and functionality”²⁶. There is also evidence that addressing physical defects of the home environment can delay entry to residential care.²⁷

People with dementia are particularly sensitive to their indoor environment as their sensory perception differs from that of people without dementia.²⁸ They have a reduced ability to interpret their environment, resulting in difficulties such as finding their way and judging temperature.²⁹ Poor design can also contribute to environmental sensitivity that triggers behavioural symptoms. It is therefore essential that the physical environment is adapted to the person’s needs and capability.³⁰

4.4 A Holistic Approach to Design

Several studies critically observe that building design tends to narrowly focus on functional/physical features targeted to physical health, safety and disability. Instead, those studies advocate for design features to adopt a holistic approach that enables social, cultural and psychological wellbeing, in addition to physical wellbeing.³¹

²⁵ Gabriel et al. (2015); Gabriel et al.(2014).

²⁶ Marquardt et al. (2014:128).

²⁷ Andrews and Molyneux (2013); Marquardt et al. (2011a); O’Malley and Croucher (2005); Thoma-Lurken et al. (2017); Van Hoof, J., Kort, H., Duijnste, M., Rutten, P. and Hensen, J. (2010). The indoor environment and the integrated building design of homes for older people with dementia. *Building and Environment*, 45(5): 1244-1261.

²⁸ Hadjri, K., Rooney, C. and Faith, R. (2015) Housing Choices and Care Home Design for People with Dementia, *Health Environments Research and Design journal*, 8(3), 80-95; Torrington, J. and Tregenza, P. (2007). Lighting for people with dementia, *Lighting Research and Technology*, 39(1), 81-97; van Hoof, Kort, Duijnste et al. (2010).

²⁹ Bowes et al. (2014); Pierce et al. (2015).

³⁰ Soilemezi (2017); Torrington, J. (2006) What has architecture got to do with dementia care? Explorations of the relationship between quality of life and building design in two EQUAL projects, *Quality in ageing: policy, practice and research* 7(1): 34-48; van Hoof and Kort 2009; van Steenwinkel, I. (2015). *Offering architectural insights into dementia: Three case studies on orientation in space-time-identity*. (Doctoral Dissertation) University of Leuven, Belgium.

³¹ Gabriel et al. (2015); Hodges et al. (2007); Kirch et al. (2018); Pierce et al. (2015); van Hoof and Kort (2009); Wright, C., Zeeman, H. and Whitty, J. (2017) Design Principles for housing people with complex physical and cognitive disability: towards an integrated framework for practice, *Journal of Housing and the Built Environment*, 32:339-360.

Wright et al. (2017) identify five environments that should be taken into account in building design:³²

- Physical environment – accessibility to foster a sense of control, independence and safety and provision for privacy.
- Social environment – provides access to others and enables participation.
- Natural environment – views, outlook, ability to engage with the outdoors.
- Symbolic environment – homeliness, self-expression, identity, restorative, sense of place, ‘ordinary life’.
- Care environment – supporting carers and enabling care to be functional and efficient.

4.5 Design to Address the Diversity of People with Dementia

No one building design solution will meet the needs of all people with dementia, who are a diverse group with different experiences of health and disability and varied social and cultural backgrounds.³³ Some of the literature reviewed focuses on people with dementia who have multiple health needs or age-related frailty and physical impairments that require assistance with home modifications or equipment.³⁴ A few studies focus on visual impairments.³⁵

The housing and care needs of people with dementia change at different stages. Accordingly it is ideal if design solutions allow for further, relatively simply implemented alterations as impairment increases.³⁶ Building design interventions should also be introduced as early as possible so as to support the ability of people with dementia to remain independent for longer and to reduce premature admission to residential care.³⁷

People with dementia live in different types of households. While many live with a partner or other family members, the growing trend of people with dementia to live alone, which is part of a general trend for the older population to live alone, is noted in both the United Kingdom and in Australia.³⁸ Internationally, estimates of the proportions of people with dementia who live alone differ, from about 12 percent in Australia, to studies in England and

³² Wright et al. (2017:345).

³³ Dementia Care (2015); Kirch et al. (2018); Lipman, V. and Manthorpe, J. (2018). *Gearing Up; housing associations' responses to tenants with dementia from black and minority ethnic groups*. London: Age UK.

³⁴ Calkins et al. (2001); Pierce et al. (2015); Powell et al. (2017); Struckmeyer, L. and N. Pickens (2016). "Home Modifications for People with Alzheimer's Disease: A Scoping Review." *The American Journal of Occupational Therapy*, 70(1): 1-9.

³⁵ Bakker, R. (2003). Sensory Loss, Dementia and Environments. *Generations*, 27(1): 46-51; Bowes et al. (2014); Torrington and Tregenza (2007).

³⁶ Calkins et al. (2001); Struckmeyer and Pickens (2016); Utton (2009); van Hoof, Kort, van Waarde and Blom (2010).

³⁷ Andrews and Molyneux (2013).

³⁸ Gabriel et al. (2014); Alzheimer's Society UK online "A lonely future: 120,000 people with dementia living alone, set to double in the next 20 years" <https://www.alzheimers.org.uk/news/2019-05-15/lonely-future-120000-people-dementia-living-alone-set-double-next-20-years>

Ireland that estimate one-third of people with dementia live alone.³⁹ No New Zealand data was found on the proportion of people with dementia living alone.

Living alone poses particular challenges for a person with dementia, including deteriorating social skills, personality changes, self-neglect and poor nutrition. They are also at risk of not accessing services. As a result their changing needs are not recognised, and they do not receive support or design interventions until the situation becomes problematic.⁴⁰ There is also the challenge of people with different disabilities or age-related frailty living together, and the different design interventions required. Care needs to be taken to ensure that interventions are compatible for both those with dementia and for those with other impairments.⁴¹

4.6 Design Responding to the Diversity of Housing within the Community

Dwelling characteristics, such as size, layout and number of levels, all influence the type of design solutions that are possible and effective. For example, bigger dwellings may offer scope to accommodate environmental design interventions, modifications, storage for equipment, and space for formal or informal caregivers. Open-plan provides visual and acoustic access, but enclosed rooms can screen off potentially unsafe areas, clearly associate different areas with different functions and provide privacy. Stairs can be a safety risk and multi-level housing raises questions about the best placement of service areas such as toilet, bathroom and laundry.⁴²

Tenure is also a key consideration in implementing design solutions. Both public and private renters find accessing design interventions and modifications difficult for a range of reasons including landlord reluctance to make changes, lack of awareness of solutions, cost and stigma.⁴³ With regard to new builds, some research has found that plans to incorporate dementia-friendly elements in mixed tenure developments have been resisted due to stigma and lack of understanding of dementia.⁴⁴

4.7 Building Design to Enhance Care

The potential of building design to reduce the burden on formal or informal caregivers and to increase their safety is considered in several studies. When building design takes into account how it can support delivery of in-home care services and informal care, it not only improves the lives of people with dementia and those who care for them, but also reduces

³⁹ Evans, S., Atkinson, T., Cameron, A., Johnson, E., Smith, R., Darton, R., Porteus, J. and Lloyd, L. (2018). Can extra care housing support the changing needs of older people living with dementia? *Dementia*, doi: [10.1177/1471301218801743](https://doi.org/10.1177/1471301218801743); Gabriel et al. (2014); Pierce et al. (2015).

⁴⁰ Gabriel et al. (2014); Gabriel et al. (2015).

⁴¹ Pierce et al. (2015).

⁴² Gabriel et al. (2015); Marquardt et al. (2011a); Soilemezi (2017); Soilemezi, et al. (2017).

⁴³ Gabriel et al. (2015); Lipman and Manthorpe (2018); Pierce et al. (2015).

⁴⁴ Evans et al. (2018).

or delays the demand for health and care services, improves the rate of diagnosis for dementia and delivers improved health and social outcomes at a reduced cost.⁴⁵

Several studies argue for designs that allow divisions between caring and non-caring spaces, privacy for caregivers, as well as enhancing carer safety and enabling care tasks.⁴⁶ Features such as spatial layout, defining and separating spatial functions, accessibility, appropriate lighting, acoustic features to manage noise levels, management of temperature levels and air quality can all affect the provision of both formal and informal care.⁴⁷

4.8 Barriers to take-up of Building Design Solutions

Barriers to take-up of solutions were identified in the literature. These covered policy and regulation, knowledge and information needs, and financial barriers. Key barriers are:

- There is a lack of consideration of the needs of people with dementia in housing policy, despite emphasis on supporting people with dementia to age in place.⁴⁸
- Dementia design principles and standards are rarely included in building regulations, so there are few mandatory requirements to incorporate dementia-friendly design in new builds or when renovating existing dwellings.⁴⁹
- There is low awareness of dementia-friendly building design among people with dementia, their informal and formal caregivers, and in the wider community.⁵⁰
- There is low awareness among professionals and practitioners about the needs and capabilities of people with dementia, as well as about building solutions. Those include tenancy managers, architects and designers, and builders.⁵¹
- Design knowledge lacks insight into the day-to-day experiences of people with dementia, how and why they use the spaces in which they live. As a consequence, that knowledge is rarely integrated into practice.⁵²
- There is a lack of precise, easy to use design specifications, examples of solutions and practical demonstrations to promote information about interventions to key professionals and practitioners. The plethora of guidelines is confusing rather than enabling.⁵³
- Low awareness is compounded by assumptions among professionals, practitioners, people with dementia, those who care for them and the wider community that

⁴⁵ Andrews and Molyneux (2013).

⁴⁶ Calkins et al. (2001); Struckmeyer and Pickens (2016); Soilemezi (2017); van Hoof, Kort, Duijnsteet et al. (2010).

⁴⁷ O'Malley and Croucher (2005); Pierce et al. (2015).

⁴⁸ Dementia Care (2015).

⁴⁹ Kirch et al. (2018).

⁵⁰ Andrews and Molyneux (2013); Gabriel et al. (2015); Marquardt et al. (2011a); Struckmeyer and Pickens (2016).

⁵¹ Gabriel et al. (2015); Kirch et al. (2018); Lipman and Manthorpe (2018); Pierce et al. (2015); van Steenwinkel (2015).

⁵² Van Steenwinkel et al. (2017).

⁵³ Kirch et al. (2018); Pierce et al. (2015); van Hoof, Kort, van Waarde and Blom (2010); van Steenwinkel (2015).

implementing design solutions risks stigmatising people with dementia and those who care for them.⁵⁴

- Costs of design interventions inhibit some from taking up solutions. For example, one study of housing associations providing for people with dementia found that the cost of adapting properties is both a feared and actual problem. As a result, the housing provider's willingness and abilities to meet the needs of the tenant are compromised and the tenant may ultimately have to move elsewhere because the accommodation is unsuitable for them.⁵⁵

⁵⁴ Evans et al. (2018); Kirch et al. (2018).

⁵⁵ Lipman and Manthorpe (2018).

5 Key Findings on Building Solutions

The main building design aspects covered in the references are presented in Table 6. It was common for more than one aspect to be included in each reference, particularly in the literature reviews and systematic reviews. The most common design aspect to be considered was safety, followed by visual cues, home ambience and supporting independence. Also commonly considered was spatial orientation.

Main area	Number
Safety	23
Visual cues	21
Home ambience	20
Supporting independence	20
Spatial orientation	19
Ability to carry out daily activities	16
Self-navigation	16
Managing behavioural disturbances	15
Home modifications	13
Enhancing enjoyment of the home	12
Entrance/exit	11
Universal design	6

Table 6: Main building design areas

Many design solutions are interlinked and have impacts across different aspects of experience of the home. For example, a solution may be aimed at facilitating self-navigation, and also support independence and improve safety. To acknowledge the interlinked nature of design solutions, and to avoid repetition, the following discussion combines solutions into the following sub-sections. Solutions relating to light and noise are not dealt with separately, but included as appropriate in the following sub-sections. It is also noted in each sub-section where solutions benefit the caregiver or enhance the provision of care. The sub-sections are:

- Entering and leaving the home
- Self-navigation, spatial orientation and visual cues
- Independence and ability to carry out activities of daily living
- Enjoyment and ambience of the home
- Behavioural issues
- Home modifications and universal design
- Safety

5.1 Entering and Leaving the Home

Designs that assist people with dementia to enter or leave their home are not only concerned with improving accessibility, but also in some circumstances, with controlling access. These different objectives can lead to a potential conflict between the universal design principles of accessibility and flexibility, and the dementia design principle of regulating or restricting access to certain areas and activities. There is general agreement that aspects of universal design dealing with entrance and exit need to be adapted to the specific needs of people with dementia.⁵⁶

There is strong evidence that depression is correlated with exit design, and that if secure exits are required, residents feel less depressed if those are well camouflaged.⁵⁷ There is also evidence that sudden loss of freedom to access all areas of the home can lead to aggression in people with dementia.⁵⁸

Infobox 4 presents building design solutions relating to entrance and exit that the literature identifies as effective.

Regulating access ⁵⁹	Assisting with entrance/exit ⁶⁰
<p>Camouflaging of exits e.g., with paint or wall coverings to match with walls, or curtaining.</p> <p>Install locks out of the sightline of the person with dementia.</p> <p>Plan circular paths so that if people walk about, they are not led straight to the road.</p>	<p>Provide a shelter or porch over the entrance.</p> <p>Ensure adequate lighting at the entrance.</p> <p>Level entry.</p> <p>Lever door handles for ease of use.</p> <p>Limit the number of entrance/exit points to reduce confusion and assist with orientation.</p> <p>Personalisation of doorways/entrances e.g., through use of colour, to help people to identify their place.</p>

Infobox 4: Building Design Solutions for Entry and Exit

⁵⁶ Calkins et al. (2001); Pierce et al. (2015).

⁵⁷ Bakker (2003); Fleming et al. (2008).

⁵⁸ Hodges et al. (2007).

⁵⁹ Bakker (2003); Gabriel et al. (2015).

⁶⁰ Andrews and Molyneux (2013); The Dementia Services Development Centre (2013) *Improving the design of housing to assist people with dementia* Stirling: University of Stirling; Marquardt et al. (2014); Soilemezi (2017).

5.2 Self-navigation, Spatial Orientation and Visual Cues

Self-navigation, or wayfinding, refers to the ability to find one's way around the home environment. Spatial orientation refers to the ability to locate oneself in relation to physical space and objects in the home. Visual cues are salient and meaningful features that attract attention and stand out from their surrounding environment. These cues provide clear prompts to help people to move confidently from place to place. Visual cues can be objects or can be incorporated into architectural features.

Being able to find one's way around the home is important for quality of life, as without this ability, a person can become disorientated, finding it hard to locate the places they need to be and to do everyday activities. As a consequence they lose independence and must rely on others. Various studies show that difficulty with wayfinding is a very common symptom of dementia. One study suggests that over half of individuals, even with mild dementia, have problems with wayfinding.⁶¹ Another study found that in the severe stage of dementia, 42 percent could find their way independently, while 42 percent needed some visual cueing.⁶²

The process of ageing involves visual changes, which decrease the sharpness of vision and sensitivity to contrast. Moreover, some eye diseases are associated with ageing, such as cataracts and macular degeneration. Visual impairment is more prevalent among those with dementia than among those who do not have cognitive impairment.⁶³ One English study estimates that one-third of people with dementia have visual impairment, higher than the prevalence among the general population of the same age.⁶⁴ People with dementia experience not only visual loss associated with ageing, but due to neurological impairments, they can also experience issues with depth perception, pattern recognition, contrast sensitivity, spatial awareness, and visual misinterpretation. They can also experience visual hallucinations.⁶⁵ Visual impairment can result in disorientation, sleep disturbance, confusion and behavioural issues. It increases the risk of falls and decreases the ability to find one's way.⁶⁶

People with dementia can benefit from building design to support wayfinding, and, if design is appropriate, can learn to navigate their environment.⁶⁷ Wayfinding features also help people with visual impairment. One systematic literature review of design for both dementia and visual impairment found this to be a relatively new area of research, with only

⁶¹ Davis, R. and Weisbeck, C. (2016). Creating a Supportive Environment using Cues for Wayfinding in Dementia. *Journal of Gerontological Nursing* 42(3):36-44.

⁶² Marquardt et al. (2011a).

⁶³ Pierce et al. (2015); van Hoof, Kort, Duijnsteet et al. (2010).

⁶⁴ Bowen, M., Edgar, D., Hancock, B., Haque, S., Shah, R., Buchanan, S., et al. (2016). The Prevalence of Visual Impairment in People with Dementia (the ProVIDe study): a cross-sectional study of people aged 60–89 years with dementia and qualitative exploration of individual, carer and professional perspectives. *Health Services Delivery Research* 2016, 4(21).

⁶⁵ Bakker (2003); Bowen et al. (2016); Bowes et al. (2014); Davis and Weisbeck (2016); Torrington and Tregenza (2007).

⁶⁶ Pierce et al. (2015).

⁶⁷ Davis and Weisbeck (2016).

three sources identified that were concerned with both dementia and visual impairment. That review found that design recommendations for dementia and visual impairment can be contradictory. While design for people with visual impairment promotes independence, choice and supporting the individual's capability, design for dementia tends to focus on control of behaviours and containment.⁶⁸

There are examples of dementia-friendly design for self-navigation and spatial orientation that support people's mobility, independence, safety and ability to carry out routine everyday tasks, as well as supporting the provision of care.⁶⁹ The main design principles advocated in the research are to ensure:

- Good visual access and sightlines. People with dementia have a greater chance of finding their way if they can see their destination or objective from where they are.
- Good signage.
- Appropriate and meaningful visual cues.
- Legibility; i.e., signage and cues are easy to understand.

Infobox 5 sets out design solutions that the research suggests are effective for self-navigation and spatial orientation. Solutions not only include building features, but also materials and objects.⁷⁰

Materials	Objects	Building features
<p>Colour coding and personalisation of entrances to help residents find their door (e.g., to their dwelling, or room).</p> <p>Use of colour to distinguish between different spaces and functions.</p> <p>Use of contrasting colour tones to make surfaces, switches and objects more visible.</p> <p>Contrast between surface materials e.g. tactile surfaces to alert users to a change in direction.</p>	<p>Outdoor areas can use planting, signage, and navigation markers such as garden features.</p> <p>Signage should be mounted at the appropriate height so that it is easy to see.</p>	<p>Simple, easy to understand layout.</p> <p>Avoidance of long corridors.</p> <p>Direct visual sightlines to relevant places/spaces.</p> <p>The use of sightlines to key views to help with wayfinding.</p> <p>Appropriate sizing and positioning of windows at allow natural light, views and assist with orientation.</p> <p>Spaces have an unambiguous and unique character, which do not give confusing messages.</p>

⁶⁸ Bowes et al. (2014).

⁶⁹ Bakker (2003); Torrington (2006); Marquardt et al. (2014); van Steenwinkel (2015).

⁷⁰ Andrews and Molyneux (2013); Bakker (2003); Davis and Weisbeck (2016); Dementia Care (2015); Fleming et al. (2008); Gabriel et al. (2014); Gabriel et al. (2015); Hadjri et al. (2015); Marquardt et al. (2014); Pierce et al. (2015); Soilemezi et al. (2017); Torrington and Tregenza (2007); Utton (2009); van Hoof and Kort (2009).

<p>Glass-fronted cupboards to help with finding objects.</p> <p>Highly polished surfaces should be avoided.</p> <p>Repetitive and reflective patterns should be avoided as they can be experienced as depth and cause confusion and falls.</p>		<p>Defining spaces in which specific activities usually take place.</p> <p>Spaces are appropriate for their function.</p> <p>Straight circulation systems.</p> <p>A small number of doors and exit points.</p> <p>Entrances are clearly distinguished.</p> <p>Artificial lighting appropriate to the space and to help with way-finding.</p> <p>Localised task lighting.</p> <p>Curved walls have been found to help orientation.</p>
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Infobox 5: Design Solutions for Self-Navigation and Spatial Orientation

Appropriate lighting levels, both natural and artificial, are critical for supporting wayfinding and orientation, as they help the person with dementia to recognise and distinguish between particular spaces. There is good evidence for improving light levels for people with dementia beyond what is considered normal.⁷¹ One study argues that lighting is the most important factor in housing for people with dementia.⁷² Another study recommends the following actions to make the best use of both natural and artificial light:⁷³

- Ensure sufficient daylight exposure.
- Ensure dark sleeping conditions.
- Avoid excessive brightness contrast within a room.
- Enhance visual differences between rooms.
- Minimise direct and reflected glare.
- Increase visibility of tasks.

There is some research about the use of open-plan layouts to assist wayfinding. However, the benefits of open-plan, compared to enclosed rooms, are debated. While it helps with wayfinding and mobility, open-plan may interfere with the independent performance of daily living tasks as it disrupts the clearly legible meaning and function of enclosed spaces.⁷⁴

⁷¹ Andrews and Molyneux (2013); Fleming et al. (2008).

⁷² Van Hoof, Kort, Duijnsteet et al. (2010).

⁷³ Torrington and Tregenza (2007).

⁷⁴ Marquardt, G., Johnston, D., Black, B., Morrison, A., Rosenblatt, A., Lyketsos, C. and Samus, Q. (2011b). Association of the Spatial Layout of the Home and ADL Abilities Among Older Adults With Dementia. *American Journal of Alzheimer's Disease & Other Dementias* 26(1): 51-57; Pierce et al. (2015).

The use of sliding doors can assist openness and visual sightlines, while also providing privacy when needed.⁷⁵

Another area of debate concerns the potential impacts of assistive technologies on spatial orientation. One study warns against including technological interventions that interfere with perceptions of spatial meaning.⁷⁶ A second study comments that technologies that turn on automatically, such as light sensors, can be confusing and upsetting, especially when they cannot be controlled by the user.⁷⁷

5.3 Independence and Activities of Daily Living

Activities of daily living refer to basic everyday activities related to personal care, such as feeding, bathing, dressing, grooming and personal hygiene. Activities such as housework, cooking and shopping are also included. Being able to carry out these activities is important for personal independence. For people with dementia, those activities can become a challenge and needing help with them can threaten their independence. Yet it has also been found that people with dementia value doing everyday tasks such as housework and do not want to give them up, regardless of difficulty.⁷⁸

Living in an environment where there is no ability, expectation or encouragement to do routine activities can result in a rapid loss of functional ability. On the other hand, good design can enable people to maintain their activities of daily living, focus on the skills that they have (not those they have lost), enhance independence, self-esteem and choice and reduce the need for care.⁷⁹

In determining appropriate design that will help support functional abilities, it is important to take into account the stage of dementia and personal physical abilities.⁸⁰ There is a lack of empirical studies of home environments, and very few assessment tools focusing on spatial configuration and functionality.⁸¹ The few building design solutions for enhancing independence and ability to perform daily tasks that this review identified are:⁸²

- Space for personal possessions and privacy.
- Spaces that are easy to access and navigate.
- Good visual access. For example, frequency of toilet use increases when there are good sightlines to the toilet.⁸³
- Adequate lighting, including task-specific lighting for eating and other daily activities.

⁷⁵ van Hoof and Kort (2009).

⁷⁶ Torrington (2006).

⁷⁷ Van Hoof and Kort (2009).

⁷⁸ Pierce et al. (2015).

⁷⁹ Andrews and Molyneux (2013); Dementia Care (2015); Kirch et al. (2018); Torrington (2006), Utton (2009).

⁸⁰ Hodges et al. (2007); Kirch et al. (2018); Van Hoof, Kort, van Waarde and Blom (2010).

⁸¹ Marquardt et al. (2011b).

⁸² Dementia Care (2015); Torrington and Tregenza (2007).

⁸³ Marquardt et al. (2014).

One study of the spatial layout of the homes of people with dementia concluded that enclosed rooms with a clearly legible meaning and function resulted in better performance of activities of daily living. In contrast, open spaces such as circulation spaces and interconnected rooms were associated with dependence on others for performing daily activities. This study suggested adaptations that could be made to improve the individual's ability to do daily tasks, such as using different flooring to distinguish areas, and using colours and lighting to increase legibility of the meaning and function of rooms. The use of a room could also be changed to improve accessibility or to better match its function or the time spent in it. For example, this could mean moving a bedroom to be closer to the bathroom, or re-purposing a sunny room as a living room. Finally, the study suggested that design incorporates spatial flexibility to meet the individuals' changing needs.⁸⁴

Several non-building solutions are identified in the literature to enhance independence and support functionality. Those include: medication dispensers with reminder systems; audible or visual prompts for eating and drinking; whiteboards, touch-activated lamps and clocks or agendas designed for people with dementia to support daily routines.⁸⁵

5.4 Enjoyment and Ambience of the Home

Building design solutions to enhance enjoyment and ambience of the home should enable privacy, socialising, personalisation of space, individual likes and preferences, access to the natural environment, and familiarity.

Familiarity of surroundings has been found to support a person's long term memory and connection to identity.⁸⁶ However, some studies have found that people with dementia may wish to move to housing more suited to their needs or closer to services. In those circumstances, familiarity in the new home can be developed by retaining familiar objects and furniture, recreating a familiar layout, minimising confusing and disorientating elements, and using fittings or appliances that are easily understood and require minimal or no new learning.⁸⁷

A few building design solutions for enhancing enjoyment and ambience of the home were identified in the literature reviewed:⁸⁸

- Ensuring space and storage for personal possessions.
- Designing private spaces.
- Spaces for socialising with others.
- Appropriate lighting levels for activities and tasks.
- Access to natural light.

⁸⁴ Marquardt et al. (2011b).

⁸⁵ Evans et al. (2019); Thoma-Lurken et al. (2017).

⁸⁶ Pierce et al. (2015); Utton (2009).

⁸⁷ Kirch et al. (2018); Pierce et al. (2015); Soilemezi (2017).

⁸⁸ Gabriel et al. (2015); Pierce et al. (2015); Torrington and Tregenza (2007); Soilemezi (2017).

- Appropriate siting and sizing of windows and sill heights to take account of both standing and sitting. Windows are focal points for people with dementia, providing company, stimulation and access to the outside world.
- People with dementia report that a connection with the natural environment, for example, access to and a view of the garden, is very important to them.⁸⁹

The literature also identifies a few non-building solutions relating to enjoyment and ambience of the home, including the creation of “strategic space” such as a comfortable chair⁹⁰ and installation of familiar objects, furniture and surroundings.⁹¹

5.5 Behavioural Disturbances

Behavioural disturbances associated with dementia include wandering, aggression, anxiety and unwillingness to accept care. Such behaviours may pose a safety risk to the person with dementia, as well as being difficult for formal and informal caregivers to manage.⁹²

Poor building design and layout can result in agitation, aggression, anxiety, distress, insomnia, self-injury and social dysfunction.⁹³ Specific building features have been found to have a detrimental effect on behaviour. For example, corridors, particularly long corridors, can make people with dementia restless, anxious and violent.⁹⁴ Excess noise levels are associated with increased wandering, agitation, stress, aggressive and disruptive behaviours.⁹⁵ Inadequate or inappropriate lighting increases agitation, compromises safety, causes confusion and disturbed behaviour and can cause problems with eating, sleeping and other daily activities.⁹⁶

There is strong evidence that residents are less aggressive when sensory stimuli such as light, temperature and noise are controlled.⁹⁷ Good lighting has been found to be essential in managing behavioural disturbances as it helps with regulating circadian rhythm, and thus reduces restlessness and wandering and may ameliorate aggressive behaviour.⁹⁸ Thermal comfort is associated with less agitation and disruptive behaviour.⁹⁹ Reduction in noise is associated with reduction in strange movements, and more social engagement.¹⁰⁰

⁸⁹ van Steenwinkel (2015); Wright et al. (2017).

⁹⁰ van Steenwinkel et al. (2017).

⁹¹ Gabriel et al. (2014); Utton (2009).

⁹² Thoma-Lurken et al. (2017).

⁹³ Andrews and Molyneux (2013); Hadjri et al. (2015); Hodges et al. (2007); Pierce et al. (2015); van Hoof and Kort (2009); van Hoof, Kort, Duijnsteet et al. (2010).

⁹⁴ Marquardt et al. (2014); van Hoof and Kort (2009).

⁹⁵ Marquardt et al. (2014).

⁹⁶ Bakker (2003); Gabriel et al. (2015); Torrington and Tregenza (2007).

⁹⁷ Fleming et al. (2008).

⁹⁸ Torrington and Tregenza (2007); van Hoof and Kort (2009).

⁹⁹ Marquardt et al. (2014); Pierce et al. (2015).

¹⁰⁰ Marquardt et al. (2014); van Hoof, Kort, Duijnsteet et al. (2010).

Building design cannot easily address some factors contributing to behavioural disturbances, such as pain and depression, but the literature reviewed identified some building design solutions that positively influence behaviour:¹⁰¹

- Appropriate lighting.
- Control of noise.
- Reduction of glare.
- Use of flooring surfaces, sound-absorbing materials and acoustic panels that reduce, rather than amplify noise.
- Open and accessible floor plans.
- Space for privacy.
- Additional space for family members or formal or informal caregivers to stay, and for their privacy.

5.6 Home Modifications and Universal Design

Home modifications are adaptations to housing to help people with physical impairments to move around their home, carry out daily tasks, and improve their independence and safety. Home modifications also enable care to be delivered in the home more effectively as they improve safety for caregivers. Some modifications are minor, such as grab rails or a hand-held showerhead. Others are major, such as the installation of a ramp or a wet-area shower, or widening doorways. People with dementia are likely to be living with multiple health conditions and may have impaired mobility, so there is good reason to integrate assistive modifications into the home.

Universal design is about the design of the physical environment so that it can be accessed and used by all, regardless of age and ability. When applied to dwellings, universal design is generally incorporated into the build process to make the dwelling easy to use. Universal design is not a 'one size fits all' approach, therefore customising the living environment is still required to suit individual needs, such as needs associated with dementia. Examples of universal design include level access, widened hallways and doorways, adequate circulation space and adequate space in rooms for a wheelchair user.

There are clear overlaps between home modifications and universal design, as both approaches focus on improving physical accessibility, usability and safety of the home environment. But the overlap between universal design and dementia-friendly design is less apparent, and debated. Some research argues that, while universal design and home modifications address physical accessibility, they do not adequately address the cognitive and behavioural needs of people with dementia, which change over time and have implications for the amount of space needed, and the way spaces are interpreted and used.¹⁰² Contradictions between the different approaches have been identified. For example, interventions to help mobility may affect the ambience and familiarity of home,

¹⁰¹ Bakker (2003); Hodges et al. (2007); van Hoof and Kort (2009).

¹⁰² Calkins et al. (2001); Wright et al. (2017).

which are important principles in dementia-friendly design.¹⁰³ There is also tension between the universal design principle of accessibility and the use of design to prevent or restrict access of people with dementia in some situations.¹⁰⁴ In contrast, other research considers that many universal design principles are connected to and support dementia-friendly design.¹⁰⁵

There are few studies of the impacts and cost-effectiveness of home modifications for people with dementia, although there is good-to-strong evidence about the effectiveness of home modifications for people with physical impairments. For example:¹⁰⁶

- There is strong evidence that minor home adaptations are cost-effective for preventing falls and injuries, improving performance of daily activities and improving mental health.
- Major modifications have been less extensively studied, but evidence shows that they can improve safety and help with the performance of daily activities.
- Modifications can delay the need for more intensive forms of care and help to prevent hospital admission and readmission.
- Home modifications are especially effective when they are combined with necessary repairs and safety measures, such as improving lighting and removing trip and fall hazards.
- A number of studies show that home modifications are very important for people with sight loss as they tend to fall more frequently.
- There is good evidence that people and their family caregivers can be reluctant to install modifications until they reach a point of crisis, in part because they do not wish to change or 'medicalise' their home. However, delays in installing home modifications can reduce their effectiveness.

The few studies specifically focusing on the effectiveness of home modifications for people with dementia show that modifications not only contribute to a safe home environment, but may also reduce behavioural stressors and support the individual's existing competencies. Modifications may need to be made in the early stages of dementia to increase acceptance as those with dementia can react with confusion or irritation if changes are made to their usual use of the home.¹⁰⁷

Evidence-based building design guidelines linking universal design and dementia-friendly design have been developed in Ireland.¹⁰⁸ They emphasise attention to the following principles in housing design to ensure a balanced approach between accessibility and the individual needs of people with dementia:

- A participatory design approach involving people with dementia, their family and caregivers.

¹⁰³ Soilemezi (2017).

¹⁰⁴ Calkins et al. (2001).

¹⁰⁵ Kirch et al. (2018); Pierce et al. (2015).

¹⁰⁶ Gabriel et al. (2014); Marquardt et al. (2011a); Powell et al. (2017).

¹⁰⁷ Powell et al. (2017); Soilemezi et al. (2017).

¹⁰⁸ Grey, T., Pierce, M., Cahill, S., and Dyer, M. (2015) *Universal Design Guidelines Dementia Friendly Dwellings for People with Dementia, their Families and Carers* Dublin: Centre for Excellence in Universal Design; Pierce et al. (2015).

- Familiar design with recognisable features consistent with the user's expectations.
- Personalisation of the environment.
- The environment is easy to interpret and is calm, with reduced acoustic and visual disturbances.
- There is good visual access, inside and outside.
- Safety measures are unobtrusive.
- There are distinct spaces for different activities, and the meaning of those spaces is legible and memorable.

Overall, despite some reservations expressed in the literature, studies also point to clear benefits of home modifications and universal design for people with dementia, including enhanced safety and ease of movement, and the ability to adapt to the individual's changing needs. Home modifications and universal design features may obviate the need to move because the home is no longer suitable.

5.7 Safety

Safety issues are a common thread in dementia-friendly building design, and have been touched on in previous sub-sections, particularly in regard to regulating access, spatial orientation, behavioural disturbances, home modifications and universal design. Safety in the home is a particular concern for people with dementia as they have a reduced ability to interpret their environment, and may be unable to make decisions about their safety or appropriately assess risk.¹⁰⁹

While the literature identified more design solutions concerned with safety compared to any other area, safety is not an uncontested domain. The literature identified a tension between safety and comfort, privacy and creating a familiar environment. There is also tension between managing risk and supporting independence.¹¹⁰ Some studies have linked the prioritisation of safety measures over interventions to enhance the person's independence and control over their environment, to lower quality of life and harmful behaviours. Overall the evidence supports the use of unobtrusive safety features, while cautioning against over-emphasising safety.¹¹¹

Both formal and informal caregivers report being particularly concerned about safety, but they are sometimes not well informed or equipped to address problems.¹¹² Carers' responses to safety problems may worsen risk or result in changed behaviour for the person with dementia. Strategies used by carers can comprise comfort and independence, such as blocking access to specific areas or exits, and controlling use of appliances, water and heating.¹¹³

¹⁰⁹ Calkins et al. (2001); Pierce et al. (2015).

¹¹⁰ Evans et al. (2018); Gabriel et al. (2015); Pierce et al. (2015); Soilemezi et al. (2017).

¹¹¹ Fleming et al. (2008); Pierce et al. (2015); Torrington (2006).

¹¹² Marquardt et al. (2011a); Struckmeyer and Pickens (2016).

¹¹³ Soilemezi et al. (2017).

Specific building design solutions identified as effective for people with dementia are:¹¹⁴

- Universal design features such as non-slip flooring, level entrances, walk-in shower, lever handles and taps.
- Sufficient lockable storage for potentially dangerous items.
- Ability to regulate access to potentially dangerous areas such as the kitchen.
- Appropriate lighting.
- Safe heating systems.
- Systems with devices to monitor or shut off gas or water to prevent accidents.

A building design solution that supports both the safety of the person with dementia and the caregiver is to ensure there is sufficient space around the toilet and shower.¹¹⁵

In addition, some solutions involve non-building interventions such as equipment aids, fall sensors, de-cluttering, removing breakables, and repositioning of furniture.¹¹⁶

¹¹⁴ Pierce et al. (2015); Thoma-Lurken et al. (2017); van Hoof and Kort (2009).

¹¹⁵ Calkins et al. (2001).

¹¹⁶ Andrews and Molyneux (2015); Hodges et al. (2007); Pierce et al. (2015); Soilemezi (2017); Thoma-Lurken et al. (2017).

6 Research Quality and Gaps

Not all literature considered in this review reported on the quality of research on building design solutions. Assessment of quality was more common in the literature reviews and systematic reviews.

Overall, there are two important limitations identified in the literature reviewed for this report. The first limitation is the lack of research that considers the efficacy of dementia-friendly building design solutions for housing in the community, as opposed to residential care.

The second limitation is patchy evidence for the efficacy of specific building design interventions, regardless of residential setting, and their expected outcomes. Studies have noted the difficulties of distinguishing the effects of specific building design interventions or modifications on people with dementia, as compared to other factors in their environment.¹¹⁷ There are contradictory or inconclusive findings about light levels, the use of colours and contrasting materials, familiar vs new surroundings, the design needs of those with both dementia and visual impairments, the impacts of universal design for people with dementia, and efficacy of building design to enhance performance of daily activities.¹¹⁸

Those studies that assessed the quality of research reported varying levels of quality, due to theoretical, conceptual and methods limitations. Issues of research quality that were identified included:

- The complexity of subject matter and wide range of variables involved.¹¹⁹
- Lack of conceptual frameworks to span and connect the research fields of dementia, care, housing and construction.¹²⁰
- Inconsistent and varying use of terminology, particularly between health sciences such as nursing and occupational therapy, and architecture and other building sciences.¹²¹
- Lack of qualitative data focusing on the lived experiences of people with dementia, their behaviour in and use of the home and their responses to particular design interventions.¹²²
- Limitations posed by small sample sizes and absence of adequate control groups, as well as inappropriate use of randomised controls.¹²³
- Reliance on expert and practitioner opinion rather than research evidence.¹²⁴

¹¹⁷ Fleming, R. and Bennett, K. (2017) *Environmental Design Resources* Dementia Training Australia.

¹¹⁸ Bowes et al. (2014); Calkins et al. (2001); Fleming et al. (2008); Fleiming and Bennett (2017); Kirch et al. (2018); Marquardt et al. (2014); Marquardt et al. (2011b); Pierce et al. (2015); Soilemezi (2017); Soilemezi et al. (2017); van Hoof, Kort, van Waarde and Blom (2010).

¹¹⁹ Fleming et al. (2008).

¹²⁰ O'Malley and Croucher (2005); van Hoof, Kort, Duijnsteet et al. (2010).

¹²¹ Pierce et al. (2015); van Hoof, Kort, Duijnsteet et al. (2010); van Steenwinkel (2015).

¹²² O'Malley and Croucher (2005); Powell et al. (2017).

¹²³ Fleming et al. (2008); Marquardt et al. (2014); O'Malley and Croucher (2005); Pierce et al. (2015); Soilemezi et al. (2017); Struckmeyer and Pickens (2016).

A wide range of research gaps were identified, in part due to the quality issues noted above, and also as a consequence of the strong focus on institutional settings in most of the research concerning dementia-friendly building design. A lack of research into specific building design solutions was identified, as well as knowledge gaps.

6.1 Building Design Solutions Research Gaps

The following building design solutions research gaps were identified in the literature included in this review:

- Memory support interventions.¹²⁵
- Orientation interventions.¹²⁶
- Wayfinding interventions, including the qualities of visual cues that make them helpful in later stages of dementia.¹²⁷
- Personal care and dressing interventions.¹²⁸
- Lighting design.¹²⁹
- Reduction of noise and acoustic management.¹³⁰
- Benefits and disadvantages of open-plan design.¹³¹
- Air quality, ventilation and odour elimination.¹³²
- Appropriate and effective home modifications for people with dementia.¹³³
- The use of assistive technologies in association with building design.¹³⁴

6.2 Knowledge Gaps

The literature included in this review identified a range of knowledge gaps. Those are mainly concerned with understanding more about how people with dementia experience their home environment, their views about particular design interventions and the differing needs for and access to interventions, depending on health status, social circumstances, cultural background and other factors.

Knowledge gaps were also identified in relation to: formal and informal caregivers; the interrelationship between housing typology and design; the application of research evidence to assessment, guidelines and regulation; and barriers to take-up of design solutions.

¹²⁴ Hodges et al. (2007); Pierce et al. (2015); Torrington (2006).

¹²⁵ van Hoof, Kort, van Waarde and Blom (2010).

¹²⁶ van Hoof, Kort, van Waarde and Blom (2010).

¹²⁷ Davis and Weisbeck (2016).

¹²⁸ van Hoof, Kort, van Waarde and Blom (2010).

¹²⁹ Torrington and Tregenza (2007).

¹³⁰ van Hoof, Kort, Duijnstee et al. (2010).

¹³¹ Pierce et al. (2015).

¹³² van Hoof, Kort, Duijnstee et al. (2010).

¹³³ Gabriel et al. (2015); Marquardt et al. (2011a); Powell et al. (2017); Struckmeyer and Pickens (2016).

¹³⁴ van Hoof and Kort (2009).

People with dementia experiencing their home environment

Key knowledge gaps identified are:

- Design preferences and choices of people with dementia.¹³⁵
- Design solutions for people at different stages of dementia (early, moderate and late) and how design can meet changing needs.¹³⁶
- Understanding the altered sensitivity to environmental conditions that many people with dementia have, how that relates to behavioural symptoms and appropriate design solutions.¹³⁷
- Design solutions for people with dementia living alone.¹³⁸
- Design to assist people with both dementia and visual impairments.¹³⁹
- Access and barriers to design solutions for people with dementia living in rental accommodation.¹⁴⁰
- Design solutions for people with Downs Syndrome who develop Alzheimers.¹⁴¹
- Understanding how the individual's physical, social and cultural environments interact.¹⁴²
- Designing for people of different ethnic and cultural backgrounds, and for indigenous peoples, including how cultural preferences and requirements connect with dementia-related needs.¹⁴³
- Several references noted that people with dementia and those who care for them develop their own strategies for navigating dementia; those strategies, and how they can be incorporated into design, need to be better understood.¹⁴⁴

The experiences of formal and informal caregivers and the provision of care

Three areas of research in relation to the provision of care are identified:

- Design solutions that suit both the person with dementia and their caregiver.¹⁴⁵
- The interaction between design features and care provided in the home and how that impacts on efficacy of design.¹⁴⁶
- Understanding how caregivers perceive design interventions, and prioritise the person with dementia's needs related to the physical environment.¹⁴⁷

¹³⁵ O'Malley and Croucher (2005); van Steenwinkel et al. (2017).

¹³⁶ Fleming et al. (2008); O'Malley and Croucher (2005); Pierce et al. (2015); Struckmeyer and Pickens (2016); van Hoof and Kort (2009).

¹³⁷ van Hoof, Kort, Duijnsteet et al. (2010).

¹³⁸ O'Malley and Croucher (2005); Struckmeyer and Pickens (2016).

¹³⁹ Marquardt et al. (2014).

¹⁴⁰ Gabriel et al. (2015); Gabriel et al. (2014); Pierce et al. (2015); Soilemezi (2017).

¹⁴¹ Fleming et al. (2008).

¹⁴² Fleming et al. (2008); van Steenwinkel et al. (2017).

¹⁴³ Fleming et al. (2008); Gabriel et al. (2015); Lipman and Manthorpe (2018); Pierce et al. (2015); Soilemezi et al. (2017).

¹⁴⁴ Calkins et al. (2001); Gabriel et al. (2015); Pierce et al. (2015); Soilemezi (2017); Struckmeyer and Pickens (2016).

¹⁴⁵ O'Malley and Croucher (2005); Powell et al. (2017); Struckmeyer and Pickens (2016).

¹⁴⁶ Fleming et al. (2008); O'Malley and Croucher (2005).

Housing typology

Two areas of research are identified in relation to housing typology:

- Efficacy of design features in different housing typologies, for example, stand-alone housing, apartments, duplexes, townhouses.¹⁴⁸
- The potential for translating design from residential care settings to housing in the community.¹⁴⁹

Assessment, guidelines and regulations

Key knowledge gaps identified are:

- Standardised assessment tools to determine intervention needs and design solution outcomes.¹⁵⁰
- Understanding of environmental quality as perceived and experienced by people with dementia and the implications for measures, guidelines and regulations.¹⁵¹

Barriers to take-up

There are two suggestions for research on barriers to take-up of design solutions:

- How to increase acceptance of building design solutions by those with dementia, those who care for them and the wider community.¹⁵²
- Reasons why specific design solutions are successfully or not successfully implemented.¹⁵³

¹⁴⁷ Marquardt et al. (2011a); Pierce et al. (2015).

¹⁴⁸ O'Malley and Croucher (2005).

¹⁴⁹ Fleming et al. (2008); Struckmeyer and Pickens (2016); van Hoof, Kort, van Waarde and Blom (2010).

¹⁵⁰ Struckmeyer and Pickens (2016).

¹⁵¹ Marquardt et al. (2011b); van Hoof, Kort, Duijnsteet et al. (2010).

¹⁵² Marquardt et al. (2011a).

¹⁵³ Fleming et al. (2008); O'Malley and Croucher (2005); van Steenwinkel (2015).

7 Dementia-friendly Design Guidelines

Eleven dementia-friendly building design guidelines are summarised in Appendix 2. Developed in Australia, the United Kingdom, Ireland and New Zealand, these have been selected because they mainly focus on building solutions for people with dementia living in their own homes. Some also include design information for supported housing or residential care. Only one publication, the New Zealand Ministry of Health guideline, is solely concerned with secure residential dementia care design. It has been included because it acknowledges the importance of incorporating a 'New Zealand' perspective in design, referring to homelike surroundings, a garden, community links and cultural identity. Along with the IHC Checklist, these were the only New Zealand dementia-friendly building design guides found.

The guidelines do not provide detailed building and technical guidance. Instead, most provide examples, practical tips, case studies, checklists, floorplans and other information. A few provide design standards, although those are often country-specific and linked to legal requirements particular to that country. Most guides combine building design guidance with other guidance, e.g., concerning equipment and aids, furnishings and signage.

Several guidelines include general design principles for dementia-friendly housing. A typical set of internationally-tested principles is presented by Fleming and Bennett (2017), based on their review of the literature. They advocate for applying principles in design, rather than reliance on rules, so as to take account of the uniqueness of each person's living environment and their needs.

Evidence underpinning the development of building design principles is largely based on residential care settings and requirements, not on the needs of people with dementia living in their own homes. Furthermore, those design principles are not generated from indigenous worldviews and they have not been widely tested in different cultural and ethnic communities, although Australian dementia-friendly design guides have tested the principles in Aboriginal communities.¹⁵⁴

General dementia-friendly design principles, based on Fleming and Bennett (2017), are set out in Infobox 6, with examples of both building design solutions and other design solutions.

¹⁵⁴ James, B. (2019) *Home, Space and Place: A Review of Māori and Indigenous literature contributing to dementia-friendly housing design*. Report prepared for Building Solutions Project. Wellington: Building Better Homes Towns and Cities National Science Challenge.

Principle	Building design solutions	Other solutions
Unobtrusively reduce risk	Appropriate lighting Level access Home modifications Attention to repairs and maintenance	Reposition furniture Remove loose floor coverings
Provide a human scale	Size and configuration of spaces	Furniture and furnishings Décor
Allow people to see and be seen	Clear sight lines (visual access) to different rooms and functional areas Delineation of functions of areas (zones)	Reposition furniture Reduce clutter
Reduce unhelpful stimulation	Appropriate lighting Acoustic materials Avoid temperature extremes	Reduce clutter
Optimise helpful stimulation	Use of colour and contrast Adequate lighting	Use of appropriate signage and aids to assist wayfinding Use of familiar objects
Support movement and engagement	Access to nature Size and configuration of spaces Design of corridors	Garden design, planting, furniture
Create a familiar place	Access to kitchen Use of familiar fixtures and fittings Spaces and storage for personal possessions	Furniture and furnishings Décor
Provide a variety of places to be alone or with others in the living environment	Size and configuration of spaces Private spaces Delineation of functions of areas (zones)	Furniture and furnishings
Provide a variety of places to be alone or with others in the community	Space for entertaining and for visitors to stay	Furniture and furnishings
Design in response to vision for way of life	Provision of spaces for meaningful activities	Familiar objects Furniture and furnishings Décor

Infobox 6: Design Principles and Examples of Solutions

8 Conclusions and Implications of Review Findings

This review of research on dementia-friendly building design solutions has found that much of the literature is concerned with either design principles and goals on the one hand, or with practice guidelines on the other. There is not a large body of research assessing specific building design solutions. Considerable limitations of the available research were identified in the literature. As a consequence, the literature suggests further research into the efficacy of specific design solutions, as well as research to fill knowledge gaps. In particular, more research is needed about the lived experience of people with dementia and their informal caregivers, their activities and behaviour in their homes and their experiences and preferences concerning different building solutions.

A fundamental constraint on developing accepted and effective dementia-friendly design approaches for residential buildings is that research has primarily focused on the design of residential care facilities, despite the majority of people with dementia living in their own homes. Recommendations for home design have evolved from this research, and while many design features in institutional settings may be useful, there is a lack of research assessing the applicability, transferability and efficacy of those designs to housing in the community.

Another limitation of the literature is that many building solutions have not been well studied as to efficacy. There is good-to-strong evidence for some specific building solutions, but evidence about other solutions is inconclusive or contradictory. No reference was found that compared the cost-effectiveness of alternative solutions.

The interrelated impacts of building design solutions on the multiple needs of people with dementia are often missing in research or only cursorily considered. The literature identified a lack of synergy and potential conflicts between dementia-friendly design and accessible and universal design. Designing for safety can also conflict with dementia-friendly design. Consideration of the needs of those with visual impairments must be included in dementia-friendly design, yet there is some evidence of contradictions between the emphasis on independence in design for sight loss, compared to the emphasis on control of behaviours in some dementia design. There is also a need for research on building design that supports both the person with dementia and their partner or family caregiver, especially if the carer has health issues requiring home modifications.

Most of the design research that has been done in the home environment has been carried out with people in earlier stages of dementia. There needs to be more understanding of the needs and experiences of people in the later stages of dementia and their care needs, if design is to support people with dementia to stay longer in their home as their condition changes.

Despite the limitations of the research, the literature reviewed does highlight building solutions where there is evidence of efficacy. Those areas include:

- Regulating access, through camouflage, placement of locks and limiting the number of entrance/exit points.
- The use of colour and different materials to distinguish between different spaces and functions, and to enhance visibility.
- Simple, easy to understand layout and avoidance of long corridors.
- Direct visual sightlines to relevant and important places and spaces.
- Ensuring that spaces have an unambiguous and unique character and function, which do not give confusing messages.
- Ensuring natural and artificial lighting is appropriate to the space and specific tasks, and glare is reduced.
- Appropriate siting and sizing of windows.
- Controlling unnecessary sensory stimuli such as light and noise.
- Ensuring thermal comfort.
- Universal design features such as non-slip flooring, level entrances, walk-in shower, lever handles and taps.
- Use of systems with safety features that monitor or shut off gas or water if required.

Furthermore, there is a body of evidence-based dementia-friendly design guides targeted to housing in the community. Those include practical information and advice including floor plans, case studies and tips.

Despite the availability of design guides, the literature clearly identifies barriers to take-up of dementia design solutions. Poor understanding of dementia among building and design professionals leads to a disconnection between design and the person with dementia's needs, capabilities and preferences. The profusion of design guides, many of which are focused on residential facilities, coupled with the lack of easy-to-use information about effective home interventions, can contribute to confusion and poor design choices, or even inaction. Good information about design costs and benefits would also assist take-up as there is some evidence that costs are misunderstood. Take-up is also affected by resistance to design interventions due to stigma about dementia. Design has a role to play in combatting stigma by including aspirational and aesthetic elements.¹⁵⁵

A key barrier to design take-up evident in the international research is the dearth of policy and regulation to support dementia-friendly design principles and standards. This is also the case in New Zealand. It is notable that, even though New Zealand's *Framework for Dementia Care* aims to increase the ability of people with dementia to live at home, its focus is on improving care services, rather than on promoting building design features that would support people with dementia to age-in-place in their homes and communities.¹⁵⁶ The only New Zealand guide for dementia-friendly building design is for secure institutional care, not

¹⁵⁵ Hodges et al. (2007); Kirch et al. (2016).

¹⁵⁶ Ministry of Health (2014). *Improving the Lives of People with Dementia*. Wellington: Ministry of Health; Ministry of Health (2013). *New Zealand Framework for Dementia Care*. Wellington: Ministry of Health.

for housing.¹⁵⁷ New Zealand has no requirements in the Building Code for level entry and other basic accessibility standards in residential buildings.¹⁵⁸ This compromises good building design practice around entry/exit and safety for people with dementia, as well as for other people with physical disabilities.

New Zealand lacks a strong research platform for developing evidence-based building design solutions for people with dementia and those who care for them. We know almost nothing about the extent to which New Zealand's housing stock caters for their needs. To build on the international evidence base discussed in this report, the following research gaps should be addressed:

- The physical condition, functionality, affordability, security and adequacy of dwellings in which people with dementia live.
- The extent to which the dwelling includes design features to support the independence and wellbeing of people with dementia.
- The extent of needs for home modifications among people with dementia, and whether those needs are addressed.
- Whether building design elements support in-home care.
- The housing tenure of people with dementia, and the impacts of tenure on their ability to access design features that support their independence and wellbeing.
- The building design preferences of people with dementia, and their experiences of particular design interventions.

¹⁵⁷ See Appendix 2: Ministry of Health (2016). *Secure Dementia Care Home Design: Information Resource* Wellington: Ministry of Health.

¹⁵⁸ James et al. (2018).

APPENDIX 1:

Annotated Bibliography: Dementia-Friendly Building Design Solutions

Andrews, J. and Molyneux, P. (2013). *Dementia: Finding housing solutions*. London: National Housing Federation.

Case studies of housing associations and home improvement agencies concerning support provided to people with dementia. Appropriate housing can: reduce or delay demand for health and social care; improve the rate of diagnosis for dementia; deliver improved health and social outcomes at reduced cost. Design interventions include: self-navigation, visual, cues, lighting, spatial orientation, safety, home modifications, acoustics.

Bakker, R. (2003). Sensory Loss, Dementia and Environments. *Generations*, 27(1): 46-51.

Explores the ways in which Alzheimers and related dementias influence how people interpret what they see, hear, taste, feel, and smell and environmental elements that encourage healthy interaction between people, spaces and objects.

Bowes, A., McCabe, L., Dawson, A., and Greasley-Adams, C. (2014). *Good practice in the design of homes and living spaces for people living with dementia and sight loss* Research Findings No. 42. London: Thomas Pocklington Trust.

A systematic review of the evidence base on ways in which home environments can be modified to enable people with dementia and sight loss to enjoy better quality of life. The evidence base for design recommendations was found to be variable. This research was used to develop the guidelines *Good practice in the design of homes and living spaces for people with dementia and sight loss* (see Appendix 2).

Calkins, M., Sanford, J. and M. Proffitt (2001). "Design for dementia: Challenges and Lessons for Universal Design." In Preiser, W. and E. Ostroff (eds), *Universal Design Handbook 1E*. New York: McGraw-Hill Professional.

Explores principles for creating supportive environments for people with dementia and whether they are consistent or contradictory to universal design (UD) principles. Aims to provide guidelines to expand the usefulness of UD principles to people with deteriorating cognitive conditions. Covers self-navigation, visual cues, safety, ability to carry out daily tasks, independence, privacy, controlling access.

Davis, R. and Weisbeck, C. (2016). Creating a Supportive Environment using Cues for Wayfinding in Dementia *Journal of Gerontological Nursing* 42(3):36-44.

Literature review on the qualities of environmental cues that affect wayfinding. Includes studies of older adults with and without dementia living in residential care, supported housing, and in housing in the community. Only eight relevant studies were found.

Dementia Care (2015) *Housing Options for People with Dementia: Discussion Paper*, September 2015, Brunswick Village, Newcastle upon Tyne.

Discusses housing options available for people with dementia and the need for alternative options to residential care for people in the later stages of dementia. Outlines Dementia Care model of housing (independent supported living) and longitudinal study into residents' capacity to continue independently performing Activities of Daily Living.

Evans, S., Atkinson, T., Cameron, A., Johnson, E., Smith, R., Darton, R., Porteus, J. and Lloyd, L. (2018). Can extra care housing support the changing needs of older people living with dementia? *Dementia*, doi: [10.1177/1471301218801743](https://doi.org/10.1177/1471301218801743).

Longitudinal project exploring capacity of extra care housing to respond to the changing social needs of residents including those with dementia. Investigates how residents make decisions about the changing nature of their care needs and negotiate these needs with providers. Covers safety, independence, activities of daily living, enjoyment of home.

Fleming, R., Cookes, P. and Sum, S. (2008). *A Review of the empirical literature on the design of the physical environment for people with dementia*. Faculty of Health and Behavioural Sciences, University of Wollongong, Australia.

Systematic review of environmental design literature that has formed the basis of much of the guidance on dementia-friendly design in residential care. Found the literature is not extensive, nor is the quality high. There is strong evidence for: unobtrusive safety features, a variety of spaces, enhancement of visual access and optimisation of levels of stimulation. Knowledge gaps are also identified.

Gabriel, M., Faulkner, D. and Stirling, C. (2015). *Housing priorities of people with dementia: security, continuity and support*. AHURI Final Report No.242. Melbourne: Australian Housing and Urban Research Institute.

Through interviews with people with dementia, their carers, housing providers and community care providers, investigates: support for people with dementia across a range of housing settings, housing and care pathways, policy responses and measures to better support practitioners, housing providers and family carers to respond effectively to the future housing and support needs of people with dementia. The study highlighted a range of areas for policy reform and innovation.

Gabriel, M., Stirling, C., Faulkner, D. and Lloyd, B. (2014) *Future housing and support needs of people with dementia*, AHURI Positioning Paper No. 159, Melbourne: Australian Housing and Urban Research Institute.

Overview of academic literature and policy papers on the housing and support needs of people with dementia. Focuses on housing in the community and residential care. Covers: spatial orientation, independence, activities of daily living, home modifications.

Hadjri, K., Rooney, C. and Faith, R. (2015) Housing Choices and Care Home Design for People with Dementia, *Health Environments Research and Design Journal*, 8(3), 80-95

Explores housing options available to older people with dementia and identifies issues in the design of supported housing and residential care homes. Covers visual cues, spatial orientation, safety, behavioural issues, home ambience.

Hodges, L., Bridge, C., Donnelly, M., and Chaudhary, K. (2007) *Designing Home environments for people who experience problems with cognition and who display aggressive or self-injurious behaviour*. Evidence Based Practice Reviews, The Home Modification: Information Clearinghouse Project.

Systematic review of physical design features of the home environment that would impact aggressive or self-injurious behaviour in people with cognitive deficits. Covers: self-navigation, home ambience, behavioural issues, home modifications. Nine design guidelines were identified from the literature: reduction of known stressors; implication of the environment; optimising stimulation; use of preventive and reactive support strategies; flexibility and opportunities for choice and control; physical safety; durability of features and materials; accommodating family and staff support; design aesthetics.

Kirch, J., Marquardt, G. and K. Bueter (2018). "Breaking Down Barriers: Promoting a New Look at Dementia-Friendly Design." pp. 125-133 in: Langdon P., Lazar J., Heylighen, A. and H. Dong (eds) *Breaking Down Barriers*. London: Springer-Verlag.

Examines barriers to conception and implementation of dementia-friendly design. Covers: spatial orientation, safety, independence, home modifications, enjoyment and ambience of the home. A wide range of barriers are identified, including: lack of design standards and regulations, patchy evidence on efficacy of design solutions, narrow range of guidance, research gaps, stigmatising of dementia.

Lipman, V. and Manthorpe, J. (2018). *Gearing Up; housing associations' responses to tenants with dementia from black and minority ethnic groups*. London: Age UK

Explores how housing providers meet the needs of people with dementia from black and minority ethnic groups. Covers: visual cues, safety, enjoyment and ambience of the home, behavioural issues, home modifications. Notes the lack of policy and practice around adaptations for dementia compared to physical adaptations, and issues with the costs of adapting housing.

Marquardt, G., Johnston, D., Black, B., Morrison, A., Rosenblatt, A., Lyketsos, C. and Samus, Q. (2011a). A Descriptive Study of Home Modifications for People with Dementia and Barriers for Implementation. *Journal of Housing for the Elderly*, 1:25(3): 258-273.

Through interviews with people with dementia and their caregivers, explores the adaptation of home environments and barriers to implementation. Covers a range of design solutions for entry/exit, self-navigation, spatial orientation, safety, home

modifications, and behavioural issues. Found that physical obstacles and lack of accessibility are common issues in the homes of people with dementia. Also found that caregiver perception of what interventions are necessary or useful is a barrier to implementation.

Marquardt, G., Johnston, D., Black, B., Morrison, A., Rosenblatt, A., Lyketsos, C. and Samus, Q. (2011b). Association of the Spatial Layout of the Home and ADL Abilities Among Older Adults With Dementia. *American Journal of Alzheimer's Disease & Other Dementias* 26(1): 51-57.

Investigated the relationship between spatial layout and activities of daily living, with 303 people with dementia living in the community. Involved detailed mapping of spatial layout of participants' homes and measurement of integration, intelligibility and relationships of spaces. Also assessed participants on measures of activities of daily living, and their perceptions of spatial layout. The study found that enclosed rooms with a clearly legible meaning and function were associated with participants' higher functionality and independence.

Marquardt, G., Büter, K. and T. Motzek (2014). "Impact of the Design of the Built Environment on People with Dementia: An Evidence-Based Review." *Health Environments Research and Design Journal*, 8(1): 127-157.

Systematic review of literature on the impact of design on people with dementia in long-term care settings. Covers a range of design solutions for entry/exit, self-navigation, spatial orientation, visual cues, activities of daily living, home ambience, behavioural issues. Found the quality of evidence was variable, and more research on some interventions is required due to conflicting evidence.

O'Malley, L. and K. Croucher (2005). Housing and Dementia Care – A Scoping Review of the Literature. *Health and Social Care in the Community*, 13(6): 570-577.

This literature review found very few studies of dementia design for housing. Concluded that dementia is a peripheral issue in the evidence base for the nexus between housing and care provision for older people.

Pierce, M., Cahill, S., Grey, T. and M. Dyer (2015). *Research for Dementia and Home Design in Ireland Looking at New Build and Retro-Fit Housing from a Universal Design Approach: Key Findings and Recommendations*. Report prepared for the National Disability Authority Centre of Excellence in Universal Design, Dublin, Ireland: NDA.

The study, consisting of a literature review, case studies of supported housing and interviews and workshops with older people, carers, architects/designers and stakeholder organisations, underpinned the development of Irish national guidelines *Universal Design Guidelines Dementia Friendly Dwellings for People with Dementia, their Families and Carers* (see Appendix 2). Covers a range of building design solutions for entry/exit, self-navigation, spatial orientation, visual cues, activities of

daily living, independence, home ambience, behavioural issues, home modifications, UD, enhancement of carer support.

Powell, J., Macintosh, S., Bird, E., Ige, J., Garrett, H., and Roys, M. (2017). *The role of home adaptations in improving later life* Centre for Ageing Better, University of the West of England, Bristol.

Systematic review explores the effectiveness of minor and major adaptations for enhancing usability, accommodating disability and age related impairments, supporting better outcomes in health and functionality, and increasing independence in later life. The authors review existing peer reviewed literature and professional and practitioner-led grey literature, including two randomised control trial studies of people with dementia, to assess the importance of adaptations, explore potential cost saving implications and make recommendations for policy, service design and practice.

Soilemezi, D. (2017). Living Well with Dementia at Home: Understanding the Role of the Home Environment. *Presidents Award for Research 2016*, 1-37.

Systematic review of international qualitative literature to explore the ways people with dementia and their carers experience their home environment, the meanings and tensions of home and the design/environmental strategies viewed as useful and acceptable. Interviews with caregivers were conducted and used to inform an understanding of the barriers and facilitators to dementia care at home, changing perceptions, nature and challenges of the home environment and strategies that can support people with dementia and their carers as symptoms progress. Key themes include risk vs. independence; care vs. safety; familiarity vs. adaption; the needs of people with dementia vs. the needs of carers; medicalisation vs. comfort and self-expression.

Soilemezi, D., Drahota, A., Crossland, J. and Stores, R. (2017). The role of the home environment in dementia care and support: Systematic review of qualitative research. *Dementia*. <https://doi.org/10.1177/1471301217692130>

Systematic review using thematic synthesis of qualitative studies exploring the perceptions and experiences of people with dementia and their caregivers living in the community and the methods employed to address challenges. Identified three key themes: “home as a paradox”; “no magic formula”; and “adapting the physical space, objects and behaviour”, which were validated in a workshop with people with dementia, caregivers, researchers and practitioners. Covers: accessibility; size; layout of the home; space for retreat; adequate lighting; windows; single level; aesthetics; individuation; ongoing assessment and adaption; and professional support.

Struckmeyer, L. and N. Pickens (2016). “Home Modifications for People with Alzheimer’s Disease: A Scoping Review.” *The American Journal of Occupational Therapy*, 70(1): 1-9.

Literature review of research published between 1994 and 2014 on the role of home modifications in reducing caregiver stress and supporting people with Alzheimer's to age in place. Identification of: gaps in the existing literature, strategies and modifications most commonly employed by caregivers at different stages of the disease. Major findings: the need to recognise modification as an ongoing process, due to the progressive nature of the disease; the importance of caregiver education and training; the importance of a client-centred approach to intervention; and the importance of integrating a variety of social, physical and cognitive interventions to enhance functionality and safety.

Thoma-Lurken, T., Bleijlevens, Michel, H., Lexis, M. and De Witte, L. (2017). Facilitating aging in place: A qualitative study of practical problems preventing people with dementia from living at home. [*Geriatric Nursing*](#), 39(1): 29-38.

Uses focus groups and interviews with formal and informal care providers, health professionals and assistive technology experts to gain insight into the most common practical issues preventing people with dementia from ageing at home. Factors included: declines in self-reliance; safety; social networks and informal care; behaviour; formal care provision; and cognitive function. Discuss the ways in which these factors interact to compound the risk of institutionalisation, as well as potential management strategies and supports for caregivers.

Torrington, J. (2006) What has architecture got to do with dementia care? Explorations of the relationship between quality of life and building design in two EQUAL projects, *Quality in ageing: policy, practice and research* 7(1): 34-48, March 2006.

Explores how the built environment and assistive technologies can be designed and implemented to support engagement, activity, pleasure and quality of life for people with dementia through observation of two dementia-design projects. Identifies enabling and disabling factors and discusses the implication of interventions for the cognitive meaning of space. The importance of considering interactions between people, support networks, place technology and culture when designing tools and spaces is stressed.

Torrington, J. and Tregenza, P. (2007). Lighting for people with dementia, *Lighting Research and Technology*, 39(1), 81-97

Research on the specific lighting requirements of people with dementia, examined in relation to: the diurnal cycle, a view of nature and the outside world, support for individual and social activities, and recognition of place. Recommendations for lighting are derived from the findings of two research projects (Design in Caring Environments, and Investigating Enabling Environments for People with Dementia) and literature reviews.

Utton, D. (2009). The design of housing for people with dementia. *Journal of Care Services Management*, 3(4): 380-390.

Examines the ways in which two newly completed extra-care and residential care facilities have successfully integrated dementia design principles into their developments to achieve environments that meet internationally accepted standards. Covers design features that can be implemented in ways that are orienting and understandable; compensate for impairment; maximise independence and expression of choice; support self-esteem and confidence; demonstrate care for staff; reinforce personal identity; welcome relatives and the community; and offer control over stimuli.

Van Hoof, J. and Kort, H. (2009). Supportive Living Environments: A first concept of a dwelling designed for older adults with dementia. *Dementia*, 8(2): 293-316.

Addresses how modifications can be implemented in existing homes. Uses professional expertise, existing dementia design literature and focus groups to identify problems commonly experienced by people living with dementia in their homes, develop comprehensive solutions that compensate for sensory and cognitive changes, create a safe, pleasant and (appropriately) stimulating environment and facilitate ageing in place. Modifications in architecture, interior design, technological solutions internal environment management and sensory stimulation are discussed and integrated into a first concept for a “dementia dwelling.”

Van Hoof, J., Kort, H., van Waarde, H. and Blom, M. (2010). Environmental Interventions and the Design of Homes for Older Adults with Dementia: An Overview. *American Journal of Alzheimer's Disease & other Dementias*, 25(3): 202-232.

Outlines design goals and principles for dementia architecture and presents an overview of environmental interventions to support activities of daily living, mitigate abnormal behaviour, compensate for loss of cognitive functions, and alleviate the burden of care provided at home. Explores the extent, potential, timing and acceptance of interventions and barriers to implementation. Research is based on a literature review, professional expertise, focus groups with stakeholder organisations and conversations with people with dementia, their partners, carers and family members.

Van Hoof, J., Kort, H., Duijnste, M., Rutten, P. and Hensen, J. (2010). The indoor environment and the integrated building design of homes for older people with dementia. *Building and Environment*, 45(5): 1244-126.

Literature review of the impacts of air, odours, light, and acoustics have on the experience and wellbeing of people with dementia and sensory impairment. Management of stimuli is discussed in relation to injury/falls, social engagement, orientation and behaviour. Uses the International Classification of Functioning Disability and Health (ICF) and the Model of Integrated Building Design (MIBD) frameworks to assess the relationship between the building and occupant(s) and how well the building supports: physical and psychological wellbeing; activities and functioning; ageing in place; care provision; and compensates for occupant deficits.

Van Steenwinkel, I. (2015). *Offering architectural insights into dementia: Three case studies on orientation in space-time-identity*. (Doctoral Dissertation) University of Leuven, Belgium.

Mixed-method research exploring the potential of the built environment for supporting people with dementia to orientate themselves, engage with others, carry out everyday tasks and activities. Methods include case studies of people with dementia living at home and in residential care facilities, architectural analysis of participants' dwelling, literature reviews, participant observation, discussion with people with dementia, family members, formal caregivers and professionals, interviews with architects involved in dementia design, and fieldwork in residential care facilities.

Van Steenwinkel I., Van Audenhove C. and Heylighen, A. (2017). *Insights into living with dementia: Five implications for architectural design*. Paper presented at the 3rd International Conference on Architecture, Research, Care, Health (Arch 17), Copenhagen, Denmark.

Considers why dementia design principles and scientific evidence are rarely integrated into architectural practice and suggest reasons for this oversight: lack of design knowledge; lack of understanding on the dementia process; inadequate attention to spatial organisation. Uses ethnographic case studies of people with dementia (at home and in residential care), and carer interviews to gain insight into the influence of the architectural context on dwelling activities such as everyday activity, social interaction, decision making. They propose that architectural design for people with dementia should focus more on providing a framework for everyday activity and social integration than countering the disease process.

Verbeek, H., Kane, R., van Rossum, E. and Hamers, J. (2011) Chapter 19 Promoting Resilience in Small-Scale, Homelike Residential Care Settings for Older People with Dementia: Experiences for the Netherlands and the United States, in Resnick *et al.*, (eds), *Resilience in Ageing: Concepts, research and outcomes*, Springer Science + Business Media.

Examples of small-scale "homelike" dementia care developments in the Netherlands and United States, which aim to move from a medical model to person centred care that builds on existing skills, strengths and capabilities to support overall wellbeing. Defines the essential elements of these communities, assesses the extent to which they achieve their stated aims, and compares outcomes for people with dementia, family members and staff to outcomes in traditional residential care facilities.

Wright, C., Zeeman, H. and Whitty, J. (2017) Design Principles for housing people with complex physical and cognitive disability: towards an integrated framework for practice, *Journal of Housing and the Built Environment*, 32:339-360.

Identifies design features that enhance wellness and quality of life and develops an environmental framework to inform the design and construction of residential dwellings that meet and support the needs of people with complex disabilities. Aspects covered include: universal design; the physical environment (independence,

control, safety, privacy); social engagement; the natural environment; symbolic environment; and the care environment.

APPENDIX 2:

Dementia-Friendly Design Guidelines

Guidelines	Description	Building design solutions	Other solutions	Examples of information	Country
Ageing Disability and Homecare (2011) <i>At home with dementia: A manual for people with dementia and their carers</i> Department of Family and Community Services, NSW Government.	Solutions to challenges commonly encountered when caring for someone with dementia at home. includes information for both renovation and new housing.	Home modifications Materials Flooring Lighting Use of colour Utilities, heating, ventilation Paths Fencing Universal design	Memory aids Wayfinding aids Clothes Furnishings Managing behaviours Creating a supportive environment Pets	Problem solving tips Checklists Product information Photos Case studies Floor plans	Australia
Alzheimer's Society (2017) <i>Making your home dementia friendly</i> United Kingdom, Alzheimer's Society.	Evidence-based guidelines targeted to people with dementia living in their own homes.	Lighting Flooring	Furniture and furnishings Signage Appliances Aids and equipment Keeping active and engaged Keeping things in order	Practical tips Checklists	United Kingdom
Dementia Australia Help Sheets available from www.dementia.org.au	See Help Sheets: <ul style="list-style-type: none"> Adapting Your Home How can supportive aids help? How to design dementia-friendly care environments 	Lighting Colour and contrast Home modifications Universal design	Memory aids Safety aids Signage and labelling Furniture	Practical tips	Australia

Fleming, R. and Bennett, K. (2017) <i>Environmental Design Resources</i> Dementia Training Australia	A series of evidence-based resources to inform the design of homes, residential and hospital facilities. See particularly Resource 2: <i>Applying the key design principles in environments for people with dementia</i> . This resource sets out key design principles and provides environmental assessment tools to evaluate environments for people with dementia. Five case studies demonstrate the application of design principles.	Home modifications Materials Flooring Lighting Use of colour and contrast Utilities, heating, ventilation Paths Fencing Universal design	Wayfinding aids Furniture and furnishings Appliances	Design principles Environmental assessment tools Case studies 'Before' and 'after' photos Floor plans Planning template	Australia
Greasley-Adams, C., Bowes, A., Dawson, A. and McCabe, L. (2014) <i>Good practice in the design of homes and living spaces for people with dementia and sight loss</i> . University of Stirling, Scotland, UK.	Evidence-based guide for building and adapting homes that are accessible and supportive for people experiencing dementia and/or visual impairment. The guidelines were informed by people with dementia and/or sight loss and their carers to identify the circumstances under which different features are most useful.	Colour and contrast Lighting Fixtures and fittings Kitchen layout and design Bathroom layout and design Cupboards and cabinet design Entrances and exits Design of outdoor spaces Accessibility	Outdoor planting Signage Easy-to-use appliances Furnishings	Assessment of design solutions – readers can see at a glance which solutions help the most people, which help some or a few people, and which should be treated cautiously Photos	United Kingdom

Grey, T., Pierce, M., Cahill, S., and Dyer, M. (2015) <i>Universal Design Guidelines Dementia Friendly Dwellings for People with Dementia, their Families and Carers</i> Dublin: Centre for Excellence in Universal Design.	Evidence-based dementia-specific universal design (UD) guidelines. Covers new builds and retrofitting existing homes, and all scales of intervention, from low-cost, low-impact, to major structural works. The guidelines identify UD dementia-friendly principles and typical features.	Entry, exit and moving about the home Living spaces and layout Materials and finishes Colour, tone and contrast Fixtures and fittings Lighting Ventilation Heating Energy Windows Doors	Signage and labelling Furniture Planting Assistive technology	Room-by-room design Tips and guidelines Floor plans Costs of different design options on a scale of 1-5 Examples (good and bad) Photos	Ireland
Halsall, B. and MacDonald, R. (2015) <i>Design for Dementia Volume 1 – A Guide</i> , Liverpool: Halsall Lloyd Partnership.	Evidence-based guidelines drawing on engagement with people with dementia and their carers to gain their knowledge about building design. Covers both new builds and retrofits.	Entry/exit Visual cues Colour, tone and contrast Windows Doors Lighting Acoustics Interior layout and circulation Universal design Colour and contrast Space for visitors and carers Storage Design of outdoor and garden spaces	Dementia-friendly neighbourhoods	Design principles Photos Practical tips Diagrams Floor plans, including retrofitted bungalow and terraced house Links specific impairments to potential design responses Design standards (statutory and non-statutory)	United Kingdom

IHC New Zealand Ltd (2018) <i>Dementia Design Checklist (Revised)</i> available from https://ihc.org.nz	Adapted from the Dementia Design Checklist (The Dementia Services Development Centre), this checklist can be used in residential care settings and for people wishing to assess their own homes.	Entry/exit Fixtures and fittings Universal design and home modifications Heating Storage space Lighting Internal layout, size of spaces, circulation Exterior design Colour and contrast Flooring	Décor Furniture Wayfinding – landmark objects, signage	Checklist of items for assessment of all rooms, indoor and outdoor areas to determine their suitability for people with dementia, and to identify improvements required	New Zealand
John, A. (2014) <i>Homes for People with Dementia and Sight Loss: A guide to designing and providing safe and accessible environments</i> , Cymru: RNIB.	Design of new and refurbished housing, supported housing and residential care. Addresses discrepancies between best practice guidelines in the fields of visual impairment and dementia.	Spatial orientation, navigation and wayfinding Colour, tone and contrast Surface materials and finishes Lighting Acoustics Fixtures and fittings Stairs Home modifications Universal design	Signage Assistive technology Furnishings	Design standards Practical tips Photos (good and bad examples) Case studies	Wales, United Kingdom

Ministry of Health (2016). <i>Secure Dementia Care Home Design: Information Resource</i> Wellington: Ministry of Health	Evidence-based guidelines for secure care facilities that cover dementia design principles and specific design features for new builds and retrofits.	Scale and density of indoor spaces Layout Colour and contrast Lighting	Cultural identity and appropriateness The therapeutic environment Garden and external environment Memory aids and cues	Design principles Floor plans Lists dementia-friendly design audit tools	New Zealand
The Dementia Services Development Centre (2013) <i>Improving the design of housing to assist people with dementia</i> Stirling: University of Stirling.	Evidence-based guidelines covering owner-occupied and rental housing. Includes case studies of how design can help particular aspects of dementia.	Entry and exit Internal layout Flooring Indoor and outdoor surfaces Lighting Stairs and lifts Use of colour and contrast Sound and acoustic materials Doors Bathroom, kitchen and living areas design	Clocks and calendars Furniture Mirrors Signage Décor Safety devices Aids	Examples Case studies Photos (good and bad examples) Floor plans Implications of designs for new build and refurbishment Top 10 housing adaptations Four priority areas	Scotland, United Kingdom