DESIGN STAGE EVALUATION TOOLS FOR RESIDENTIAL DEMENTIA CARE ENVIRONMENTS

Abstract

Purpose

The independence and wellbeing of people with dementia can be significantly influenced by the design of physical environments around them. Several assessment tools exist to evaluate the dementia design quality of existing residential care facilities for older people but, to date, none have been formally identified as suitable for use during the process of designing these facilities. This paper examines the feasibility of re-purposing existing post-occupancy tools for use during the design process whilst mapping the influence of design stages on resulting dementia design quality.

Design/Methodology/Approach – Literature searches identified environmental assessment tools suitable for residential care settings. After reliability screening, three tools, the DDAT, the EAT, and the TESS-NH were analysed in depth, mapping their suitability for use during key stages of the design process.

Findings – The study confirmed that existing tools can re-purposed for design stage use and identified that early-stage design has a large influence on resulting dementia design quality.

Research Limitations/Implications – Non-English language publications were not reviewed. Searches may not have identified other existing audit tools for residential care environments.

Practical Implications – The ability to assess design proposals at key stages may help improve the suitability of future residential care environments to support the wellbeing of ever larger numbers of people with dementia.

Originality Value – This is the first known paper to consider formal evaluation of dementia design quality during the design process. It is also the first to identify the influence of key design stages on resulting dementia design quality.

Keywords - Dementia, Design, Residential Care, Environment, Audit Tool, Architecture, Building

Paper Type – Research Paper

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Introduction

The aim of this paper is to test the extent to which existing environmental assessment tools for residential dementia care environments can be repurposed for use during the architectural design process. The paper commences by outlining the increasing international importance of dementia inclusive design in the context of a growing population of older people. Following this, a search of literature identifies existing environmental assessment tools, which are then subjected to two rounds of evaluation. The first round assesses the relative reliability of each tool. The second, more detailed, round establishes the suitability of each tool for undertaking evaluations based on architectural design documentation, such as floorplan drawings. Next the results of the evaluations are presented and discussed. Finally, a conclusion and potential implications are discussed, with recommendations given for future research and development of design stage dementia design evaluation tools.

Background

The global incidence of dementia is expected to double every 20 years to 2050 (Prince *et al.* 2015). This in turn is forecasted to require the construction of an unprecedented volume of residential care settings worldwide. In Australia, for example, the federal government projects that in 2022 a quarter of the country's total provision of residential care for older people will be in environments newly constructed since 2016/17 (ACFA, 2016). The proportion of people living in residential care with a diagnosis of dementia is also increasing (Matthews *et al. 2013)*, having recently risen to above 50 per cent in Australia (AIHW, 2017) and above 60 per cent in the UK (Prince *et al.*, 2014). Functional decline as a result of dementia is now one of the most common causal factors of older people moving into formal residential care (Deary *et al.*, 2009)

There is a significant and long-established body of evidence which identifies environmental characteristics that can improve the wellbeing and experience of people with dementia. Several systematic literature reviews of dementia design research confirm benefits of well-designed environments to include: improved independence and wayfinding; enhanced quality of life; improved behavioural and psychological symptoms of dementia; reduced need for the use of psychotropic drugs; as well as other benefits including reducing the burden on care givers (Fleming and Purandare, 2010; Marquardt, Bueter and Motzek, 2014; Soril *et al.*, 2014; Bowes and Dawson, 2019).

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In studies of dementia design, residential care settings typically fall well short of the environmental conditions evidenced to support the optimal wellbeing of cognitively impaired residents. One of the largest studies of this type (Smith et al., 2012) systematically assessed 56 Australian residential care settings using the Environmental Audit Tool (EAT) (Fleming, 2011) reporting average EAT assessment score of only 57.3 per cent. Furthermore, the 24 environments in the study that were identified as having been designed and built specifically to accommodate people with dementia achieved an average EAT score of 70.1 per cent, suggesting significant room for improvement even amongst the better performing settings.

Several environmental audit tools are available for assessing dementia design quality within existing residential care settings (Moos and Lemke, 1982; Weisman *et al.*, 1996; Sloane *et al.*, 2002; Parker, Barnes, McKee, *et al.*, 2004; Cunningham *et al.*, 2011, 2015; Fleming, 2011). Such assessments can be useful for identifying and prioritising improvements to be considered as part of refurbishment or renovation projects (Schwarz, Chaudhury and Tofle, 2004; Smith, Mathews and Gresham, 2010). However, to date, no tools have been formally identified for use during the design process for new environments, and there are no known published records of the use these tools in this way.

Although there are likely to be many factors that have prevented existing settings from achieving high quality dementia design, this paper posits that a key cause of this is likely to be the failure to consider dementia design sufficiently early in the design process – with late adoption prohibiting design improvement through both administrative and financial means. As various legal and administrative milestones, such as planning, building consents, construction, and building occupation, all sequentially limit extent of design changes that is possible compared to preceding stages. Linked to this, the costs of design changes increase progressively from inception through each stage of the design process peaking as the environment reaches full occupancy.

As there has been no known prior research to quantify the influence of different stages of the design process on resulting dementia design quality, evaluations that formally establish this could help to inform the value of, and need for, dementia design assessments at different stages of design.

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Methodology I: Literature Review

A scoping review of existing dementia design evaluation tools was undertaken through conducting online database searches using combinations of search terms, including 'dementia' 'design*', 'environment*', 'assess*', 'audit', 'evaluat*', 'tool' and 'survey'. Initial full text searches through *Web of Science*, *Scopus*, *Science Direct,* and *Google Scholar* returned over thirty thousand results. However, after further rounds of search refinements, including limiting search terms to titles, abstracts, and author-defined keywords, the citation information for 456 publication records, were downloaded for review.

Titles were screened for the purpose of removing any publications not related to either the design or assessment of physical environments for people with dementia. The abstracts from the resulting list of 97 papers were then reviewed with a similar objective. This process produced a list of 27 papers relevant to the objects of the present paper. These 27 full-text papers were then downloaded, and their contents reviewed for the inclusion of, or reference to, dementia-related environmental assessment tools. In many cases, assessment tools were referenced but not described in detail. Accordingly, further focussed literature searches were undertaken to obtain copies of original assessment instruments. These further ad-hoc searches added another 14 full-text publications to the overall review. This search and review process is outlined in Figure I.

The searches identified a total of 19 dementia design assessment tools. 6 of these were unable to be retrieved, or the available information about them was insufficient to allow detailed review. 5 of the identified audit tools related to other environments types besides residential care settings. Examples included, Hospitals , Outdoor Spaces, Public Spaces, and Housing. Finally, sufficient information was retrieved to evaluate eight design assessment tools intended for residential care settings intended to be occupied by people living with dementia.

There were two main limitations in these literature searches. Firstly, publications written in languages other than English were excluded. Secondly, some instances full text versions of publications could not be retrieved via available internet sources, or academic inter-library services.

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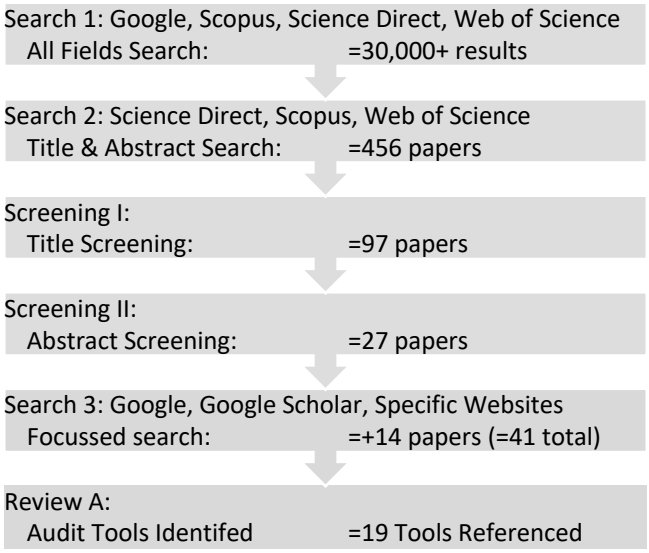

Figure I: Literature search and screening process

Review of existing dementia design assessment tools

Literature searches lead to the retrival sufficient information for robust review of eight design assessment tools suited for use in residential care environments for older people. This stage of review was focssed on evaluating the relative reliability of each of the tools as part of the process of gauging their overall usefulness for carrying out desing assessment. Criteria for assessment included aspects likely to affect reliability including publication date (or age), inter-rater consistency, and the results of any validity testing (see Table I).

Publication date was an important element of relability screening, as older tools may be less likely to reflect subsequent advances in the dementia design evidence base, whilst newer tools still may lack field testing. Inter-rater consistency was important as a measure of how likely different auditors will conclude similar assessment outcomes for a given environments. Finally, validity studies include assessment content against the research evidence base. Validity can also be tested by comparing assessment outcomes from two or more design assessment tools on the same physical environments

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Table I: Summary characteristics of existing dementia design assessment instruments

Instrument	Environment Type /#Qs /#Domains	Strengths	Limitations / Weaknesses
Dementia Design Audit Tool (DDAT) (2011) Cunningham et al. University of Stirling (UK)	Care Homes and supported living. 345 queries; 11 Domains (10 space types)	Good inter-rater reliability of individual questions (79.4%) and overall score (95%)(Fleming and Purandare, 2010). Validity tested against the EAT (97%) and the TESS-NH (89%). Formally based on a large systematic review of dementia design research literature (Fleming et al. 2008). High number of questions permits very detailed feedback. Linked to a formal dementia design accreditation program.	Assessments are time-consuming to undertake (Fleming, 2010a). Formal training required prior to use. The tool omits some types of spaces (e.g. kitchens). Score calculation is more complicated than other tools.
Design Smart (DS) (2015) Cunningham et al. Hammond Care (UK/Australia)	All residential care settings. 609 queries.	Extensively list of questions allowing highly detailed design feedback. Shares some co-authors with the DDAT.	No known inter-rater reliability or validity tests. Authors state it is not a research tool.
Environmental Audit Tool (EAT) (2011) Fleming, R. University of Wollongong (Australia)	Home-like environments for people living with dementia. 72 queries; 10 domains	Developed from a well-tested earlier tool (Fleming et al., 2003). Simple questions and scoring meaning assessment of existing settings can be undertaken in around 15 minutes (Fleming, 2010a). Instrument content supported by evidence from several literature reviews. Very high inter-rater reliability (87.1%-97%) (Fleming, 2010a). Very little training required for users. Validity tested versus the TESS-NH (86.8%) and the DDAT (Fleming, 2010a). Assessment domains align with established dementia design principles.	Less detailed than some other tools.
Enhancing the Healing Environment (EHE) (2014) The Kings Fund University of Worcester (UK)	Care Homes (1 of 5 versions). 59 queries; 7 domains	Refined using extensive user testing of a previous version for hospital wards. Fair inter-rater reliability (68.7%). Widely used in the UK. User friendly, with simple	No known validity tests. No known publication of evaluation outcomes for use in residential aged care.

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		questions linked to clear dementia design principles.	
Multi-phasic Environmental Assessment Protocol (MEAP) (1982) **Moos and Lemke** **Stanford University (USA)**	Large scale residential care. 9 domains	Good inter-rater reliability (c.70%). Used in multiple published studies.	Older tool now rarely used (Fleming, 2010a). Based on a clinical model of long-term residential care. Scoring is positively biased towards larger facilities (Moos and Lemke, 1984). Not suitable for non-researchers.
Professional Environmental Assessment Protocol (PEAP) (1996) **Weisman et al.** **University of Wisconsin (USA)**	Special care units for people with dementia. 5-point ratings of 9 domains.	Used in at least six studies. Correlates well with TESS-NH (Weisman et al., 1996; Norris-Baker et al., 1999). Good inter-rater reliability (69%-85%).	Auditors are required to have substantial knowledge of the topic. Assessment can take several hours to complete (Sloane et al., 2002). Declining in use.
Sheffield Care Environment Assessment Matrix (SCEAM) (2004) **Parker et al.** **University of Sheffield (UK)**	All social care environments. 318 queries; 11 domains (Incl. 1 on staff)	Highly detailed assessment. Subjective questions are validated against objective measures (e.g. lighting lux levels).	Large number of queries may be time-consuming to undertake. No validation studies known.
Therapeutic Environment Screening Survey for Nursing Homes (TESS-NH) (1990) **Sloane et al.** **University of North Carolina (USA)**	Long-term residential care facilities. 84 queries; 13 domains	Relatively easy to use, and assessments can be undertaken in 15-20 minutes (Fleming, 2010). Extensively tested and validated against other instruments (Sloane et al, 2002; Weisman et al. 1996; Fleming, 2011; Smith et al. 2012; Fleming and Bennett, 2015). High levels of Inter-rater agreement of 84.4% (Fleming, 2010b) to 86.7% (Sloane et al., 2002) and 93% for the SCUEQS subscale. High levels of validity including against other tools. Used in at least five published field studies. Considered the 'Gold Standard' of evaluation by some experts.	. The primary weakness is that an overall assessment score using the full set of queries is not formally available Only a summary score is available using limited subset of 18 questions. Less detailed than some other tools.

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The reliability screening of the eight identified, as summarised in Table I, concluded that the three most reliable tools are the *Dementia Design Audit Tool* (DDAT) (Cunningham *et al.*, 2011), the *Environmental Audit Tool* (EAT) (Fleming, 2011), and the *Therapeutic Environmental Screening Survey for Nursing Homes* (TESS-NH) (Sloane *et al.,* 2002). All three had been assessed in previous research as having very good inter-rater consistency and positive validation scores. All three also fared well when compared directly against each other (Fleming, 2010).

The other five, of eight, tools were deemed less reliable. No validity studies or published inter-rater tests could be identified for either *Design Smart* (Cunningham *et al.*, 2015) or the *Sheffield Care Environment Assessment Matrix* (SCEAM) (Parker, Barnes, Mckee, *et al.*, 2004). The *Enhancing the Healing Environment* (EHE) tool (The King's Fund, 2014) was identified as having fair inter-rater reliability. Also, despite reported widespread use in the UK, no validation studies for the EHE were identified. Finally, both the *Multiphasic Environmental Assessment Procedure* (MEAP) (Moos and Lemke, 1982) and *Professional Environmental Assessment Protocol* (PEAP) (Weisman *et al.*, 1996) had good validity and inter-rater test results, but their reliability was considered slightly reduced due to the age of tools and their associated evaluation studies.

Fleming's study (2010) undertook a three-way comparison of the DDAT, EAT, and TESS. This involved two trained auditors making independent use of the three tools across the same set of 30 residential care settings. Fleming found similar levels of absolute agreement between auditors on individual audit items, returning 79.4 per cent for the DDAT, 86.8 per cent for the EAT, and 84.4 per cent for the TESS-NH. The study determined high inter-rater reliability for total scores, using the Intra Class Correlation Coefficient (Fleiss and Cohen, 1973; Shrout and Fleiss, 1979), of 0.95 for the DDAT, 0.97 for the EAT, and slightly lower at 0.87 for the TESS-NH.

Fleming's (2009) study also identified several specific audit items where there was more likely to be reduced or even negative correlation between the two auditors. Examples of such query items include "*cisterns are traditional in appearance*" from the DDAT, "*artificial lighting is bright enough*" from the. EAT, and "*doors to the rest of the facility disguised*" from the TESS-NH. A separate review, of the longer list of these items (Author 1, 2019) found that a high proportion

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of audit items with reduced inter-rater correlation, as identified by Fleming, tend to have greater reliance on the subjective judgement of the auditors.

The present study took each of the DDAT, EAT, and TESS-NH into a second round of review, which follows below. As each of the three tools is addressed in turn, an overview of the background and structure of each is provided before presenting an assessment of the score structures of the three tools as a means of understanding variation in emphases or hierarchies within and/or between audit domains, space types, or dementia design principles. This exercise helped the development of a more nuanced understanding of strengths and weaknesses of each tool informing a better sense of both the suitability and reliability of each tool during key stages of the design process.

The Dementia Design Audit Tool

The *Dementia Design Audit Tool* (DDAT) (Cunningham *et al.,* 2011) published by the University of Stirling's Dementia Services Development Centre (DSDC), contains 345 scored audit questions divided into eleven 'units' organised around nine named space types commonly found in residential care settings (e.g., Bedroom, Assisted Bathroom, Garden, Hairdresser etc.) plus a further two units covering broader topics (*Meaningful Activity* and *General Principles*). Although DDAT assessments take around three times longer than either the EAT or TESS-NH (Fleming, 2010) the tool provides a much deeper, technical, review than either of the other two. DDAT users are generally expected to have some prior knowledge of dementia design, and training is recommended prior to using the tool. The DDAT query items are categorised as either *Essential* or *Recommended,* with 100 per cent of 'essential' items required as a minimum for any form of recognition under the associated dementia design accreditation program. Beyond this, the three grades of award, *Gold, Silver*, and *Bronze*, are based on the overall percentage score achieved across the complete and combined set of *Essential* and *Recommended* items.

Whilst the DDAT is officially based on a systematic literature review by Fleming *et al.* (2008) a large proportion of DDAT queries go beyond the spread of research evidence identified by Fleming. Furthermore, the present authors were able to identify several *Essential* query items for which no formal evidence could be identified in Fleming's review. Conversely, the present authors were able to identify several *Recommended* query items where available supporting research evidence was deemed 'high quality' by Fleming's review. The present authors

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therefore postulate that Cunningham *et al.* relied on a mix of formal and informal evidence when constructing the DDAT question set, as well as being influenced the professional experience of multi-disciplinary co-authors.

Although *Essential* queries are formally deemed more important than *Recommended* queries under the DDAT, the repetition of some queries give them more meaningful impact on the overall assessment outcome. For example, the *Recommended* query item '*The skirting contrasts with both the floor and walls'* occurs a total of eight times across as many assessment units; whereas the *Essential* query item '*The colour and tone of the toilet doors should contrast clearly with adjacent walls'* occurs only once (in query number 11.08).

Similarly the number of audit items per unit determines its relative influence on overall DDAT score. On this basis the three most important DDAT units per the DDAT scoring system, as illustrated in Table II, would appear to be: Unit 10: *External Area*, containing 64 of 345 audit questions (or 18.6 per cent of the maximum overall DDAT score); Unit 1: *Entrance, corridors, wayfinding and lift* containing 56 queries (16.2 per cent); and Unit 9: *Communal Toilets/Bathrooms* containing 39 questions (11.3 per cent). The primary importance of outdoor space is further reinforced by the finding that the relevant assessment unit, *External Area*s, contains 31 of 118 (or 26.3 per cent) of all *Essential* DDAT query items.

The absence of an assessment unit for Kitchens is a curious omission from the DDAT, since Fleming's (2008) literature review had identified that several studies showing the important practical and therapeutic value of providing resident access to kitchens in residential care settings. This point is further reinforced by the inclusion of kitchen assessment questions in other high profile audit tools that pre-date the DDAT (Sloane *et al.*, 2002; Fleming, Forbes and Bennett, 2003). There has since been a further increase in the volume of new research evidencing the functional social and therapeutic benefits of resident access to kitchens, and other ordinary domestic facilities (Hishida, Matsumoto and Ueno, 2010; Barnes *et al.*, 2012; Chau *et al.*, 2018).

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Table II: The Dementia Design Audit Tool scoring system

		Available points		Contribution to overall score		
	Assessment Unit	E	R	E%	R%	Total%
Unit 1:	Entrance, corridors, wayfinding, and lift	14	42	4.1%	12.2%	16.2%
Unit 2:	Lounge area	4	25	1.2%	7.2%	8.4%
Unit 3:	Dining room	7	20	2.0%	5.8%	7.8%
Unit 4:	Meaningful occupation	1	8	0.3%	2.3%	2.6%
Unit 5:	Examination room	3	16	0.9%	4.6%	5.5%
Unit 6:	Hairdressing room	3	13	0.9%	3.8%	4.6%
Unit 7:	Bedrooms*	8	29	2.3%	8.4%	10.7%
Unit 8:	En-suite provision*	20	18	5.8%	5.2%	11.0%
Unit 9:	Communal toilets/bathrooms	17	22	4.9%	6.4%	11.3%
Unit 10:	External areas	31	33	9.0%	9.6%	18.6%
Unit 11:	General principles	2	9	0.6%	2.6%	3.2%
Total		*110	*235	32%	68%	100%

E= Essential items, R= Recommended items, T= Total

*** The DDAT allows the assessment units for spaces that repeat, such as bedrooms, to be duplicated.**

Where this occurs the relative score values will vary slightly from this table.

The Therapeutic Environmental Screening Survey

The *Therapeutic Environment Screening Survey for Nursing Homes* (TESS-NH) (Sloane *et al.*, 2002) was developed by the *Cecil G. Sheps Center for Health Services Research*, University of North Carolina. It contains a total of around 91 queries organised around 13 themes (e.g. *Outdoor Access, Privacy, Safety* etc), plus a separate 'global' rating. The relatively short list of questions means that full assessments can be undertaken in 15-20 minutes (Fleming, 2010). However, it is recommended that auditors undertake a day of training prior to using the tool. It was developed from the earlier *Therapeutic Environment Screening Survey (Sloane et al.* 1990) through a process that included extensive field testing amongst dementia design experts (*Sloane et al.* 2002). The revised version has significantly improved validity and inter-rater test results compared to the original (Weisman *et al.*, 1996; Sloane *et al.*, 2002).

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Where other tools offer a complete assessment score combining the sub-scores from all domains, the TESS-NH does not. A formal overall score is available through the *Special Care Unit Environmental Quality Scale* (SCUEQS), a subset of the TESS-NH comprising just 18 queries. The SCUEQS questions have shown high inter-rater consistency (Sloane *et al.*, 2002) and cover a cross section of key assessment topics; including *Maintenance, Cleanliness, Safety, Lighting, Physical Appearance/Homelikeness, Orientation/Cueing, and Noise*. However, the incomplete basis of this summary score makes it less valuable for design evaluation compared to other tools. Although, the TESS-NH contains a section named '*Overall Physical Environment',* this only captures the assessor's personal, subjective, experience of the environment using a Likert scale of 1-10.

The authors of the TESS-NH do not formally state that any question or domain is any more or less important than others. However the variation in point score values suggests that this is at least partly the case. The SCUEQS is scored out of a maximum of 40 points calculated as a sum of the point values of the 18 individual items, which range in value from 1 to three points. In a notional extension of this logic, per the analysis in Table III, the domains of *Lighting* (21 points=12.8 per cent) and *Noise* (18 points=11.0 per cent) would appear to be the most important domains. Meanwhile *Privacy* (1 point=0.6 per cent), *Maintenance* (8 points=4.9 per cent), and *Access to Outdoors* (9 points=5.5 per cent) are, on this basis, the least important. This apparent lack of importance of outdoor space sits in somewhat stark contrast with the DDAT – where outdoor space is the most important domain by score contribution.

Table III: Query Numbers and Scoring of TESS-NH themes per Sloane et al. (2002)

Domain	Non-Scoring Items	Scoring Items	Max Points	Share O/A Points
Unit Autonomy	-	9	16	9.8%
Exit Control	2	10	12	7.3%
Maintenance	-	4	8	4.9%
Cleanliness	-	6	12	7.3%
Safety	-	6	12	7.3%
Lighting	-	9	21	12.8%
Space/Seating	1	4	7	4.3%
Personal./Familiarity/Homelikeness	-	5	13	7.9%
Visual/Tactile Stimulation	-	4	12	7.3%
Access to Outdoors	-	3	9	5.5%
Orientation/Cueing	-	13	13	7.9%
Privacy	-	1	1	0.6%
Noise	-	7	18	11.0%
Overall Physical Environment	-	1	10	6.1%

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The Environmental Audit Tool

The Environmental Audit Tool (EAT) (Fleming, 2011; Bennett and Fleming, 2013) is published by the University of Wollongong. It contains a list of 72 query items organised under ten established Dementia Design Principles (DDPs). Assessments can be undertaken in around 15 minutes (Fleming, 2010). The simple format and accessible language mean that users do not need to have extensive training nor care sector experience to make use of the tool. The EAT question set originated in a New South Wales Ministry of Health publication *Adapting the Ward for People with Dementia* (Fleming, Forbes, and Bennett 2003). Subsequent development and refinement were informed by the findings of at least two major systematic literature reviews (Fleming *et al.*, 2008; Fleming and Purandare 2010) both the largest of their kind at their respective dates of publication. As identified in the preceding section, and detailed in Table I, the EAT has been extensively tested, and validated against other dementia design assessment tools including the TESS and the DDAT (Fleming, 2011; Innes, Kelly and Dincarslan, 2011; Smith *et al.*, 2012; Fleming and Bennett, 2015) returning high levels of inter-rater reliability, with scoring consistency amongst even novice evaluators reported at 97 per cent (Fleming, 2011) and individual item consistency averaging 86.8 per cent - an outcome similar to the TESS-NH.

Each of the EAT's ten DDPs is allocated an equal ten per cent share of the overall assessment score – suggesting that Fleming *et al.* consider all ten DDPs to be of broadly of equal merit. However, with DDPs containing between 1 to 14 queries, and individual question values range from 1 to 4 points (see Table IV) the merit of individual physical attributes can vary significantly. For example, six of the fourteen questions under DDP#1 *Safety* (Q1.08 to 1.12, and 1.14) each contribute only 0.45 per cent to the overall EAT score. By contrast, the single question under DDP#3 Size and Scale of "*How many people live in the unit?"* represents ten per cent of the overall EAT score, making it by far the single most important design criteria in the EAT.

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Table IV: The Environmental Audit Tool scoring system

DDP No.	Dementia design principle (DDP)	No. Qs.	Points	Overall EAT Value	Avg. value per Qs.
DDP#1	Safety	14	22	10%	0.71%
DDP#2	Size and scale	1	3	10%	10.0%
DDP#3	Visual access	10	19	10%	1.00%
DDP#4	Stimulus reduction	8	8	10%	1.25%
DDP#5	Useful stimuli	9	9	10%	1.11%
DDP#6	Movement and engagement	9	9	10%	1.11%
DDP#7	Familiarity	6	12	10%	1.67%
DDP#8	Privacy and social interaction	5	12	10%	2.00%
DDP#9	Community links	2	2	10%	5.00%
DDP#10	Domestic activity	8	16	10%	1.25%
	Totals	72	112	100%	

Methodology II: Design Stage Assesment Feasability

The full sets of assessment queries from the DDAT, EAT, and TESS-NH were sorted into three categories depending on the type(s) of design document that could be used to answer each query item. The three categories, labelled *Plan*, *Detail*, and *Manage,* represent three key stages of design for dementia care environments, outlined as follows:

Plan: Layout planning is the dominant aspect of the early stages of design. Although the floorplan drawings that capture layout planning can be revised and refined at later stages of design, they are predominantly synonymous with early stages of design. So, for the purposes of this research, dementia design assessment queries that could be answered using information from architectural floor-plan drawings were categorised against this key stage of design.

Detail: Detailed design follows layout planning. It tends to be a more intensive process, resulting in more types, volume, and complexity of design documentation. Assessment queries that can be answered using information from detailed drawings, schedules, and specifications (but not floorplans) are associated with this key stage of design.

Manage: Conventionally the design process is considered to come to an end once construction has been completed. However, this outdated mindset fails to acknowledge that the ability of a physical setting to function as designed requires ongoing management and maintenance. This is particularly important in dementia care setting where changeable

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elements, such as access control, lighting, noise etc can have significant effects on occupant wellbeing. Managing the designed environment is therefore, in this context, considered a key stage of design. For the purposes of the present research dementia design assessment queries placed in this category are those that require information contained in operational management and maintenance documents or require a post-occupancy visit to building to observe management and use.

Where a design assessment tool query was deemed capable of being answered using information from documents in than one category or design stage, then it was allocated against the earlier stage in the design process. For example, the query *Can the dining room be seen into from the lounge room?* (EAT query 3.05) could be answered using either a floor plan ('Plan') or a section drawing ('Detail') so would be placed in the 'Plan' stage. This process of categorisation along with associated justification notes produced by the first author were subsequently reviewed by co-authors. The subsets of assessment queries form each tool, as categories under each of the three design stages could then be used to form assessment tools specific to the relevant stage of design.

Results

Despite all previously recorded formal use of the DDAT, EAT, and TESS-NH being limited to post occupancy evaluations of existing residential care settings, this simple process quickly confirmed their potential for design-stage use. The results , shown in Table V, and Figure II, indicate that the vast majority of query items (DDAT=321/345, EAT=63/72, TESS-NH=58/82) are suitable for use during the design stages that precede occupation. When considered according to scoring structures the applicable queries convert to indicate that a convincing 93.0 per cent of the overall DDAT and 88.3 per cent of the overall EAT total scores can potentially be determined prior to commencing construction. Meanwhile up to 72.1 per cent of a theoretical overall score can be determined for the TESS-NH up the same point.

The most significant outcome of this analysis was finding that early stages of design – especially layout planning - can play a significant role in determining the dementia design quality of a new residential care setting, with results (see Table V and Figure II) suggesting that 22.1 per cent of the total score value of the TESS-NH, 28.1 per cent of the DDAT, and as much as 59.9 per cent of the EAT, being determinable through building layout design alone.

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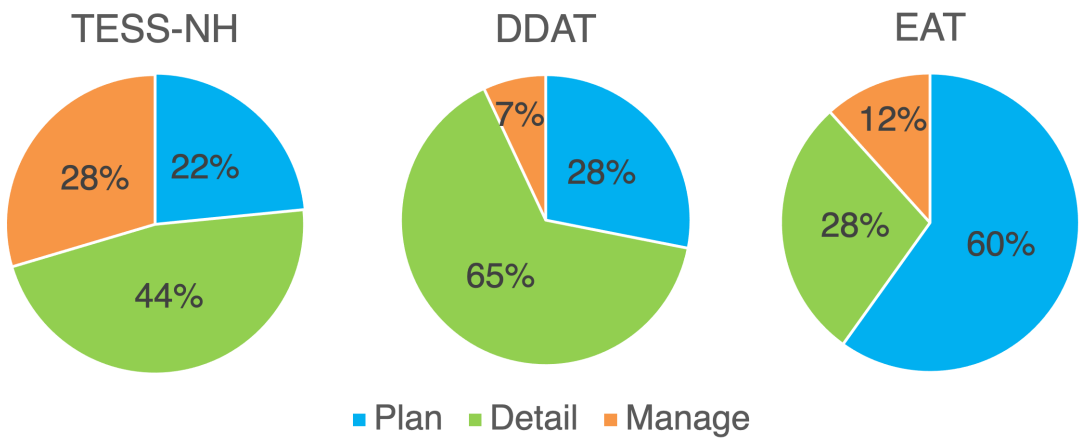

Figure II: Share of Audit Scoring by Design Stage

This finding, suggests that the EAT is the most suitable of the three tools for use in the early stages of design, as layout planning is the dominant aspect of early design. On a similar basis the DDAT is the most suitable for assessing the *Detail* phase of design. This phase alone represents 64.9 percent of the overall scoring in the DDAT, versus 28.4 per cent for the EAT and 50.0 per cent for the TESS-NH. However, considering design assessment at *Detail* sage is likely to include cumulative scores for both the *Plan* and *Detail* stages, there is only a small difference between the DDAT and EAT. Whilst the DDAT takes a slight advantage with a cumulative (*Plan + Detail)* score of 93.0 per cent, versus a slightly lower 88.3 per cent for the EAT.

Table V: Comparison of TESS-NH, DDAT, and EAT scoring across design stages.

	TESS-NH*		**DDAT****		**EAT**	
	Phase	Cumulat. Total	Phase	Cumulat Total	Phase	Cumulat Total
Total No Qs.	82 (+3*)		345		72	
No. of 'Plan' Qs	19		95		39	
No. of 'Detail' Qs	39	58	226	321	24	63
No. of 'Manage' Qs	23	82	24	345	9	72
'Plan' Points Total	34		95		62	
'Detail' Points Total	77	111	226	321	33	95
'Manage' Points Total	43	154	24	345	17	112
'Plan' Share of Score	22.1%		28.1%		59.9%	59.9%
'Detail' Share of Score	50%	72.1%	64.9%	93.0%	28.4%	88.3%
'Manage' Share of Score	27.9%	100%	7.0%	100%	11.7%	100%

***Only scoring queries are counted. The TESS-NH (2002) has three non-scoring queries**
**** The DDAT uses a minor numerical conversion to determine % values indicated here.**
The percentage share of score values are based on share of point totals for the tool.

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Discussion and Conclusions

This research found that both the DDAT and EAT are well merited for use during the design process. The choice of which of the two tools seems likely to come down to the preferences and needs of the user. Some may prefer the more detailed assessment of the DDAT, whilst others may prefer the simplicity and reduced time required to use the EAT.

Whilst this research showed that the TESS-NH is also capable of being used for design stage assessment, its greater emphasis on the post-occupancy (*Manage)* stage (DDAT=7.0 per cent, EAT=11.7 per cent, TESS-NH=27.9 per cent) reduces its suitability for design stage assessment. Technical issues identified earlier in the paper, also affect the reliability of the TESS-NH these purposes.

Although design review has the potential to be helpful at any stage of the design process, the results of this research indicate that the earlier stages of design may have greater influence on the resulting dementia design quality than previously conceived. This implies that design evaluation in advance of proposals being 'locked in' by key milestones such as planning consents, building permits, or construction contracts, has the potential to catalyse a high degree of improvement in dementia design quality in the resulting residential care environment. The availability of design stage assessment tools could, therefore, help those involved in the design of new residential care settings to identify, protect, and improve dementia design quality, resulting in enhancing the quality of life and wellbeing of residents with cognitive impairment, whilst also potentially minimising both the time and financial costs of bringing about these improvements.

This research concluded that the *Environmental Audit Tool* (Fleming, 2011; Bennett and Fleming, 2013) is particularly well suited for assessing dementia design quality during the earlier stages of design. It also concluded that the highly detailed *Dementia Design Audit Tool* (Cunningham et al. 2011) is best suited for use at the later, more detailed, stages of the design process. On the basis of this research we can also conclude that it is likely that other existing post occupancy environmental audit tools may also suited to modification for use during the design process.

The outcomes of this research have been partly dependent on categorizing standard architectural design document types into key design stages. However, in design practice there

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may often be overlap of documents between stages. A floor plan developed in early stages may for example be revised or refined during later stages. Whilst this does not undermine the broad thrust of these research outcomes, nor their potential impact on practice, it suggests the need for some flexibility how and when design stage assessment tools are used.

This paper identifies an important gap in industry-relevant dementia design literature, identifying that a large proportion of assessment questions within established post-occupancy audit tools can be answered at early stages of design. In doing so it provides justification for the development of formal dementia design tools suited for use at various stages of the architectural design process.

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