Optimizing the Physical & Social Environment Within Hospitals for Patients with Dementia: a Systematic Review

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ABSTRACT

Background

As the population ages, the number of individuals living with dementia is increasing. This has implications for the health-care system, as people living with dementia are hospitalized more frequently and for longer periods. Because patients living with dementia are at increased risk for adverse events during admission, understanding how the acute care physical and social environments influence their outcomes is imperative. Thus, the objective of this review was to identify studies that modified the physical and/or social environment in acute care in order to improve care for hospitalized patients living with dementia.

Methods

MEDLINE, Embase, and CINAHL databases were used to search for articles up to and including June 2021. PRISMA guidelines were followed. Two independent reviewers assessed citations and full texts against the following inclusion criteria: patients living with dementia/cognitive impairment, presence of a control group, and evidence of clinical or health systems outcomes. All published English-language articles meeting inclusion criteria were retrieved.

Results

Following the database search, 12,901 citations were retrieved with 11,334 remaining after duplication removal. Of these, 15 papers met inclusion criteria. Seven studies evaluated the physical environment (e.g., addition of electronic sensor alarms and environmental cues). The remaining studies evaluated specific programs (e.g., art, music, exercise, volunteer engagement, and virtual reality). The majority of studies were low to very low quality; only three studies were RCTs. Environmental cues may initially improve wayfinding, and exercise may reduce neuropsychiatric symptoms.

Conclusions

Although there are several interventions, there is a lack of high-quality evidence available to determine what exactly needs to be incorporated into acute care settings to reduce adverse outcomes for patients with dementia.

Key words: systematic review, physical environment, social environment, acute care hospital, dementia

INTRODUCTION

As the population ages, the number of people living with dementia is increasing. Every year in Canada alone, it is estimated that 76,000 people are diagnosed with dementia, many of whom are over the age of 65.(1) This rise in the number of people living with dementia has major implications for health-care systems across the country. Dementia is associated with increased rates of hospitalization, longer hospital stays, and poorer health-care outcomes such as delirium and functional decline during admission.(2,3)

There is increasing recognition that both the physical and social environment plays a role in the health-care outcomes of patients hospitalized with dementia.(4) Given the higher risk of adverse events occurring during admission, there is a need to better understand the complex interaction between the acute care environment and the manifestations of dementia itself.(4) To address this, interventions have been designed and implemented with the aim of creating more dementia-friendly environments in hospital. The objective of this review was to identify published intervention studies that modified the physical and/or social environment within acute care, and evaluate their effectiveness in improving care as evidenced by better clinical or health systems outcomes for hospitalized patients living with dementia.

METHODS

Purpose

The purpose of this systematic review was to deliver a summary of the available research on the effectiveness of interventions that modified the hospital environment in order to improve outcomes for hospitalized patients living with dementia. Specifically, all intervention studies that made changes to the physical and/or social environment in an acute care setting and evaluated the outcome for patients living with dementia were included. Physical interventions included any modification to the physical environment, while social interventions were broadly defined to include a variety of programs such as behavioural therapy, social visits, virtual reality, and creative and therapeutic activities. This systematic review is reported in accordance with Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA).[5]

Literature Search Strategy

A structured literature search using MEDLINE, Embase, and CINAHL was conducted to identify any experimental and quasi-experimental trial, with either a parallel comparison group or a pre-post–intervention design, identifiable up to and including June 2021. The following search protocol was written prior to starting the literature search. The search strategy used keywords and text words within the domains of population, setting, and possible interventions (see Appendix A). Search terms were adapted for use with other bibliographic databases, and terms were expanded to include related terms and synonyms to ensure integrity. No date restrictions were implemented during the search.

Eligibility and Study Selection

Eligibility criteria for inclusion were defined before conducting the literature search using the PICO (population, intervention, control, and outcomes) framework. Inclusion criteria consisted of: 1) English language articles, 2) study interventions involving modification of the environment (physical and/or social) within acute care, 3) a control or comparison condition, which could include the same population as occurs in a before-after intervention, 4) participants having a diagnosis of dementia and/or cognitive impairment, and 5) report of relevant clinical or health systems outcome data. All titles and abstracts were independently screened by two investigators. If there was disagreement, the full text article was obtained. A secondary review process for full text articles was similarly conducted independently by two investigators. Disagreements were resolved by discussion or a third reviewer. DistillerSR systematic review management software[6] was utilized to organize the citation and article review process.

Data Extraction and Quality Assessment

Data were extracted from included studies by one investigator using a standardized data extraction form developed a priori, and reviewed by a second investigator. Study design, setting, duration, participant characteristics, intervention details, and clinical/heath systems outcomes were recorded. Given the diversity of study designs included, two reviewers assessed the quality of the articles based on characteristics identified as important by the GRADE group (Grading of Recommendations, Assessment, Development and Evaluations), including study design, potential risk of bias, imprecision, inconsistency, indirectness, and publication bias present in the article.[7] Due to the variability of study design, interventions, and outcomes, a meta-analysis was not conducted. Instead, a qualitative summary of the literature is presented.

RESULTS

Of the 12,901 articles retrieved, 11,334 citations remained after removal of duplicates. Three hundred and ninety-seven full-text articles were retrieved and 15 were included in the study through duplicate independent review (Figure 1). The characteristics of the included studies and summary of the interventions are presented in Table 1 and Table 2.

Description of Studies

The 15 articles included in the review described a total of 12 different interventions (6 studies reported on three similar interventions) that addressed the care for hospitalized patients living with dementia. Eight studies were carried out in the United Kingdom; the other studies were from Germany, USA, Japan, Canada, and Sweden. The majority of the studies were non-randomized, pre-post–intervention studies; three were randomized controlled trials (RCT).

INTERVENTIONS TYPES

Modifications to the Physical Environment

i) Single Rooms Vs. Multi-Bed Wards

Two studies looked at the impact of single rooms versus multi-bed wards on the clinical outcomes of patients living with dementia. Knight and Singh[8] (N = 100) found that patients admitted to single rooms at one hospital were at increased risk of recurrent inpatient falls, when compared to those on multi-bed wards at a second hospital. The mean number of falls per inpatient who fell in single rooms was more than two times (3.3 ± 2.75) that in multi-bed wards (1.5 ± 0.83; $p = .035$). However, the total number of patients who sustained an inpatient fall at each of the two sites was similar (32% patients in single rooms and 30% in multi-bed wards [$p = .83$]). Additionally, the overall length of stay (LoS) in single rooms for all patients, including those who experienced an inpatient fall, was significantly higher than those admitted to multi-bed wards (39.7 ± 30.8 days vs. 21.8 ± 17.0 days, $p = .001$).

A subsequent study by Young *et al*.[9] at the same sites revealed similar results with regard to greater LoS among those admitted to single rooms; however, they found no significant difference in the number of recurrent fallers between the two hospitals. In this study, patients in single rooms had significantly better pre-admission levels of independence as measured by the Barthel Index ADLs ($p = .05$).

ii) Electronic Sensor Alarms

Shee *et al*.[10] evaluated the effectiveness of electronic sensor alarms in reducing falls and fall-related injuries among patients (N = 34) with cognitive impairment (mean Mini-Mental Status Examination (MMSE) score of 12.2 ± 7.4). This repeated-measures single cohort design found a significant decrease in fall rate among all participants when the electronic sensor alarms were being used. For the subgroup of participants who were included in all three phases of the study (19/35), there were 3.18 falls/21 bed days in the pre-intervention period compared to 1.66 falls/21 bed days during the intervention period.

iii) Environmental Cues and Architectural Ward Changes

In two studies, several aspects of the physical environment were changed. Mazzei *et al*.[11] studied the influence of the physical environment on the behaviour of six geriatric psychiatry patients (mean age = 74.5 years) who were transferred from a traditional wing to a purpose-built wing. The major design changes on the purpose-built wing were camouflaging exit doorways, having a circular wandering path, private bedrooms with adjoining bathrooms, and an outdoor patio. Clocks, memory boards, and individual photos in bedrooms or entries to bedrooms were also incorporated, and hallways were kept clutter-free. The results suggest that the new environment had an overall effect on reducing door testing behaviours, as defined as either personal attempts at opening doors, waiting for someone to walk out of the door and then attempting to exit themselves, or using the help of other patients to open doors. In terms of congregation patterns, patients spent 24% less time in the nursing station area. There were slightly more seclusions and the amount of time that individuals paced increased slightly, with the exception of one patient. On a case-by-case basis, none of the patients exhibited a clear downward trend in all of the observed behaviours.

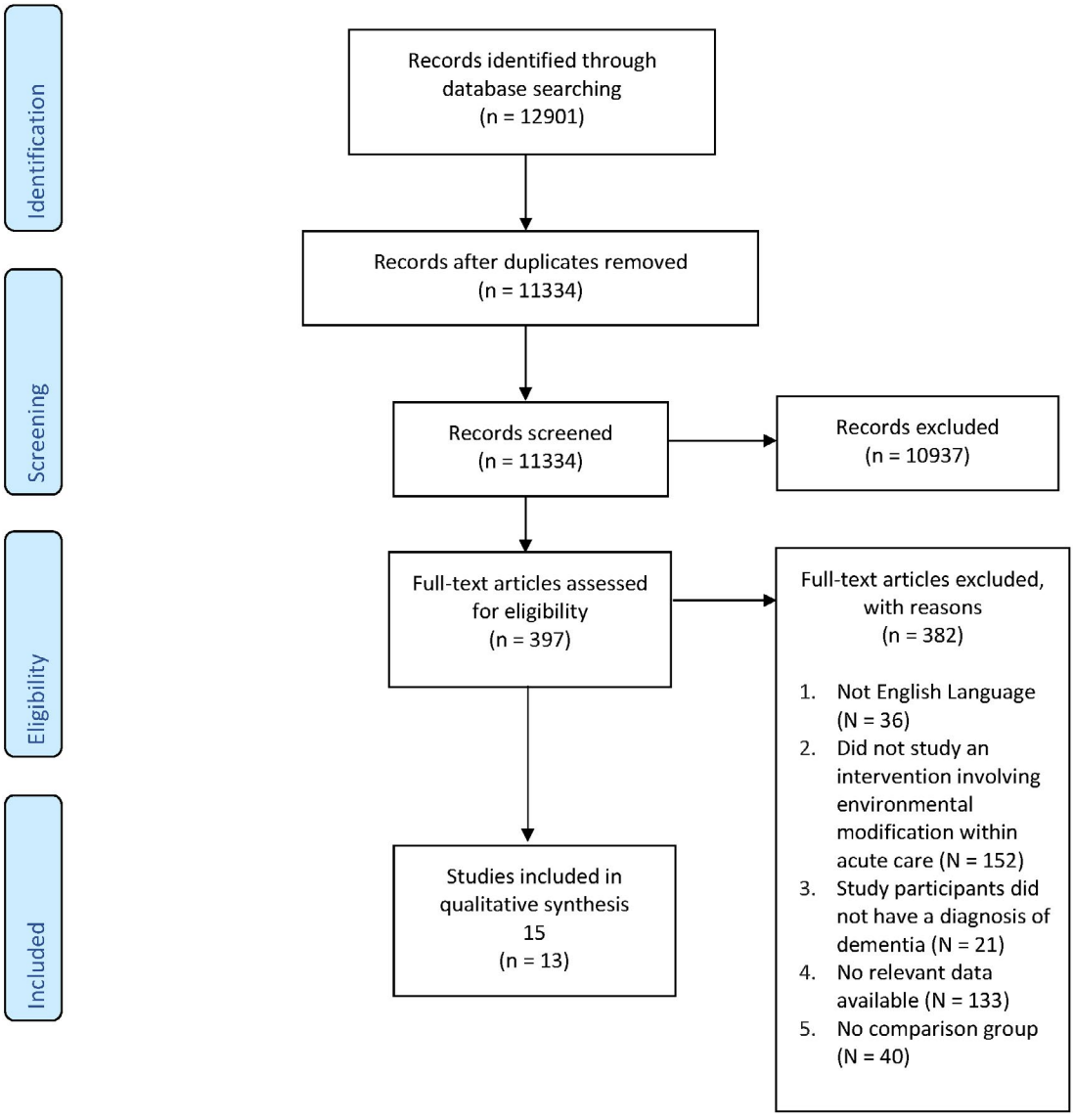

FIGURE 1. PRISMA flow diagram

TABLE 1.
Description of studies that modified the physical environment

Author, Year and Country	*Study Design*	*Sample Size and Setting*	*Intervention*	*Outcomes Measured*	*Results*	*Study Quality*
Knight *et al.*[8] (2016) UK	Prospective observational study	N=100 2 general hospitals	Single rooms vs. multi-bed wards	In-patient falls (IF), fall-related adverse outcomes (injury, hip fracture), LoS, in-patient mortality, 30-day post-discharge mortality	Total number of patients who sustained an IF was similar at both sites (p=.83). Single rooms were associated with more IF and recurrent fallers (p=.035). Overall LoS was also significantly greater in single rooms (p=.001).	Very low No control for confounding.
Young *et al.*[9] (2017) UK	Prospective observational study	N=100 2 general hospitals	Single rooms vs. multi-bed wards	LoS, discharge destination, in-patient mortality, 30-day readmission, IF and associated fracture	The same number of patients fell at each site. There was no significant difference in the number of recurrent fallers (p=.629), in-patient mortality (p=.21), or 30-day readmission rates (p=.335). Mean LoS was significantly greater for patients discharged from single rooms (p=.027). The majority of patients were discharged from hospital.	Very low No control for confounding.
Shee *et al.*[10] (2014) Australia	Repeated measures cohort design	N=34 Geriatric subacute ward in a large regional hospital	Electronic sensor bed/chair alarms	Fall rate	The intervention had a significant decrease on the fall ID for all participants (1.86 falls/21 bed days vs. 2.92 falls/21 bed days in pre-intervention, z = 2.239, p=.025) and for the subgroup of participants included in all 3 phases (n = 19) (1.66 falls/21 bed days vs. 3.18 falls/21 bed days in pre-intervention, z = 2.579, p=.010). There was no significant difference between the fall rate in the intervention period and post-intervention period (2.50 falls/21 bed days, z = -1.795, p=.072), nor the pre-intervention and post-intervention periods (z = 1.005, p=.317).	Very low No control for confounding.
Mazzei *et al.*[11] (2014) Canada	Qualitative case study	N= 6 Acute geriatric psychiatry care unit	Purpose-built dementia care environment with several design changes	Congregations, pacing, door-testing, and seclusions	Purpose-built wing influenced the spatial behaviours of the residents but not always in predictable linear ways.	Very low No control for confounding and no statistical comparison.
Motzek *et al.*[13] (2016) Germany	Longitudinal non-blinded, quasi-experimental design	N=42 Geriatric ward acute care hospital	Environmental cues used to label beds and wardrobes in double occupancy rooms	Wardrobe and bed finding abilities assessed by nurses	Intervention was most effective from the 3rd to the 5th day after admission. Patients in intervention rooms (n = 14) had significantly fewer problems identifying their wardrobe than patients in control rooms (7% vs. 43%; p = 0.028). At 10-12 days, the abilities of patients to identify their wardrobes decreased; more patients in intervention rooms had identification problems (54% vs. 29% in control rooms; p = 0.168).	Very low No blinding, and under-matched controls.

TABLE 1.
(Continued)

Author, Year and Country	*Study Design*	*Sample Size and Setting*	*Intervention*	*Outcomes Measured*	*Results*	*Study Quality*
Goldberg *et al.*[13] (2013) UK	Randomized controlled trial	N=600 General hospital	Specialist medical & mental health unit	1° = # days spent at home over 90 days after randomization, death, time spent in hospital, readmissions, in-patient rehabilitation or intermediate care, or new placement in a care home. 2° = mood and engagement scores, activity, noise, and staff interactions	Intervention had no significant effect on primary outcomes measured after adjustment for baseline variables, though trends towards reduced mortality (22% vs. 25%; 95% CI: −9% - 4%), readmission (32% vs. 35%; 95% CI: −10% - 5%), and new admission to care home (20% vs. 28%; 95% CI: −16% - 0%) were observed. Patients on specialist units had significantly higher quality of hospital experience, were more often in a positive mood or engaged (79% vs. 68%, 95% CI: 2% - 20%; p = 0.03) and experienced more staff interactions that met emotional and psychological needs (p < 0.001).	High
Goto *et al.* [14] (2017) Japan	Quasi-experimental	N=25 General hospital	Japanese garden	Attention and behaviour during observation of the garden	Viewing the Japanese garden had no significant effect on subjects, however a general tend towards improved attention (p < 0.08) was observed.	Very low No control for confounding.

Motzek *et al.*[12] studied the effectiveness of environmental cues on patients' abilities to identify their beds and wardrobes on an acute geriatric ward (N = 42). They labeled patients' beds and wardrobes with the environmental cues ''colour'' and ''number''. Patients living with dementia were assigned to control or intervention rooms depending on bed availability. The results show that environmental cues can help patients living with dementia identify their wardrobes for the first three-to-five days after admission (n = 22; 7% vs. 43%; $p = .028$); however, by the tenth to twelfth day, no difference was seen between groups. Of note, there was a positive correlation with a moderate relationship between the ability to identify their own wardrobe and being allocated to an intervention room (r = 39; $p = .022$). With respect to the ability to identify the bed, patients in the intervention rooms had a non-significant trend towards fewer problems between both the third and fifth days (14% vs. 38%; $p = .252$) and the tenth and twelfth days (15% vs. 29%; $p = .444$). There were no differences in neuropsychiatric symptoms, ADLs, or caregiver distress.

iv) A Specialized Care Unit

Goldberg *et al.*[13] randomized 600 patients identified as "confused" on admission to either a specialist medical and mental health unit or to a standard care ward. Features of the specialist unit included joint staffing by medical and mental health professionals, enhanced staff training in delirium and dementia, organized activities, environmental modifications, delirium prevention, and an inclusive approach to family caregivers. When comparing the specialist medical and mental health unit with standard care, groups were generally well-matched, but there were imbalances at baseline in some important variables: previous residence in care home (28% vs. 21%), presence of delirium (53% vs. 62%), history of hip fracture (14% vs. 7%), and hemiparesis (4% vs. 10%). Specialist unit patients were not significantly more likely to return home from hospital (74% vs. 70%, $p = .54$); among those who returned home, the number of days at home was similar (median 70.5 vs. 71 days, $p = .51$). Mortality in hospital was also similar (29 (9%) vs. 22 (8%)). Specialist unit patients were slightly more likely to survive to 90 days (78% vs. 75%, 95% CI for difference −4% to 9%), less likely to move to a care home (20% vs. 28%, $p = .30$), or be readmitted (32% vs. 35%, $p = .31$). However, none of these differences were significant after adjustment for baseline variables. There was a non-significant trend towards more inpatient falls on the specialist unit (30/110 (27%) vs. 17/95 (18%), $p = .10$).

Structured non-participant observations showed that patients randomized to the specialist unit were more often in a positive mood or engaged (median 79% vs. 68%; $p = .03$; equivalent to an additional 40 minutes per six-hour observation), active (82% vs. 74%; $p = .10$), or engaged in social interactions (47% vs. 39% $p = .06$), and less often in a negative mood (11% vs. 20%; $p = .05$). Patients on the specialist unit experienced more staff interactions that met psychological and emotional needs (median 4 vs. 1 per observation; $p < .001$).

TABLE 2.
Description of studies that modified the social environment

Author, Year and Country	*Study Design*	*Sample Size and Setting*	*Intervention*	*Outcomes Measured*	*Results*	*Study Quality*
Daykin *et al.*[15] (2018) UK	Mixed methods design	N=85 Acute elderly care service in a hospital	Inclusive participatory music activity	# falls, LoS, use of antipsychotic medications, need for one-to-one attention, scores of happiness, relaxation, distraction, engagement and agitation	The intervention had no significant effect on the outcomes measured. There was a slight reduction in LoS, use of antipsychotic medications (↓4.26%) and reported falls (31 vs. 47), and a slight increase in the number of discharges (↑9.84%) and need for one-to-one attention (2 vs. 1). Observation data during the activity showed consistently positive scores on relaxation, distraction, engagement, and agitation.	Very low No adjusting for confounding, age was significantly different between groups and no statistical comparisons available. Don't report *p* values.
Shroeder *et al.*[16] (2018) USA	Quasi-experimental design	N=41 Geriatric behavioral health inpatient unit at a Midwestern hospital	Individualized music-based intervention	Agitation, mood, resistance to care, # of one-on-one nursing staff interventions # of agitation-related PRN medications	The intervention significantly improved mood and agitation with resulting large effect sizes (d=1.10-1.59), as well as significantly lowered resisting care level with a resulting medium effect size (r= -0.69). Rate of PRN medication prescription for agitation was not statistically different.	Very low No control for confounding.
Windle *et al.*[17] (2018) UK	Mixed-methods longitudinal observational study	N=125 across 3 research settings; N=23 for NHS hospital wards	Visual arts program	Well-being, quality of life (QoL), communication	Results for subgroup analyses for patients in hospital only are not reported for well-being. Proxy-reported QoL improved between baseline and 3-month follow-up (baseline: n=19, mean (SD)=86.7 ± 12.6; 3 months: n=9, mean (SD)=96.3 ± 10.2; 6 months: n=4, mean (SD)=85.5 ± 15.6), but no improvements in QoL were reported by the participants with dementia. Communication deteriorated between baseline and follow-up at 3 months (β=7.49, t=3.62, *p*=.001, 95% CI: 3.21– 11.75) and at 6-months (β=5.63, t=3.38, *p*=.003, 95% CI: 2.17–9.08).	Low Confounding addressed but no statistical comparison available for subgroup of interest.
Staal *et al.*[18] (2007) USA	Randomized controlled single-blinded study	N=24 Acute care psychiatric hospital unit	Multi-sensory behaviour therapy (MSBT)	ADLs, agitation, negative symptoms	Compared to the control group, the MSBT group improved significantly in agitation (F(6, 120)=3.56, *p*=.003) and apathy (F(1, 20)=4.47, *p*=.04) from baseline to session 6 (F(6, 120)=3.15, *p*=.01), as well as levels of ADL independence (F(1, 20)=4.72, *p*=.04). Within the MSBT group, 9 of the 12 participants were on atypical antipsychotic medications and had better agitation scores than the 3 subjects who were not on atypical antipsychotic medications (F(1, 12)=2.80, *p*=.133).	Moderate Risk of selection bias due to convenience sample.

TABLE 2.
(Continued)

Author, Year and Country	*Study Design*	*Sample Size and Setting*	*Intervention*	*Outcomes Measured*	*Results*	*Study Quality*
Koike *et al.* [19] (2013) Japan	Quasi-experimental design	N=13 Geriatric hospital	Steam foot spa	Cognitive function and behavioural and psychological symptoms of dementia	The intervention had a significant effect on total MMSE scores ($p<.01$) after 10 days of treatment (mean MMSE before treatment=18.38 ± 3.69 vs. after treatment=22.92 ± 3.97) and a significant improvement in the overall dementia severity items on DMAS (8.54 ± 4.55 vs. 6.92 ± 3.87; $p<.05$).	Very low No control for confounding.
Fleiner *et al.* [20] (2017) Germany	Randomized controlled trial	N=85 Three specialized dementia care wards in the Department of Geriatric Psychiatry	Short-term exercise program	Neuropsychiatric signs and symptoms	The intervention group showed significantly reduced neuropsychiatric signs and symptoms: emotional agitation ($p<.001$), lability ($p<.001$), psychomotor agitation ($p=.01$), and verbal aggression ($p=.04$). There were no between-group differences concerning antipsychotic and benzodiazepine medication.	Moderate Risk of bias from no blinding.
Mashlan *et al.*[21] (2019) UK	Quasi-experimental design	N=16 Shared mental health and medical ward in a district general hospital	Meaningful engagement with students (individual interaction, artwork, music therapy, reminiscence therapy, games/ entertainment)	# falls, use of antipsychotic/anti-agitation medication, need for one-to-one care, sleep/wake cycle problems, discharge destination, unscheduled readmission (within 28 days)	Number of falls was reduced for the intervention group (pre-intervention = 9 falls incidents; post-intervention = 7 falls incidents), as well as total number of falls on the ward post-intervention (pre-intervention = 17 falls incidents; post-intervention = 11 falls incidents). The number of patients requiring anti-agitation medication on an as-needed basis was reduced from pre- to post-intervention (pre-intervention = 13 patients; post-intervention = 5 patients), as well as the number of patients with an identified sleep/wake cycle problem (pre-intervention = 4 patients; post-intervention = 2 patients). Most patients were discharged to residential or nursing homes and all patients who were discharged remained out of hospital for more than 28 days.	Very low No adjusting for confounding, no statistical comparisons available. Don't report *p* values.
Rose *et al.* [22] (2019) UK	Mixed methods design	N = 8 In-patient psychiatric hospital	Head-mounted display virtual reality (HMD-VR)	Overt Aggression Scale-Modified for Neurorehabilitation (OAS-MNR) St Andrews Sexual Behaviour Assessment (SASBA) Observed Emotion Rating Scale (OERS)	There was a significant difference in pleasure before, during, and after HMD-VR exposure (Friedman test: before (Mdn=1.250), during (Mdn=2.000) and after (Mdn=1.750) HMD-VR exposure, χ^2 (2)=8.000, $p=.018$; Wilcoxon signed-rank tests: before (Mdn=1.250), during (Mdn=2.000), Z=-2.060, $p=.039$; before (Mdn=1.250), after (Mdn=1.750), Z= -2.060, $p=.039$). There was no significant difference in anger ($p=1.000$), anxiety/fear ($p=.212$) or sadness ($p=.229$). There was also a significant difference in alertness (before, during, and after: χ^2 (2)=6.300, $p=.043$; before and after via Wilcoxon signed-rank tests: Z= -2.060, $p=.039$). OAS-MNR aggregate aggression scores decreased from 14 prior to HMD-VR to 2.	Very low No control for confounding.

v) Japanese Garden

Goto *et al*.[14] explored how viewing a Japanese garden affected Japanese patients living with dementia. They constructed a Japanese garden on the rooftop of a hospital and assessed the behavior of 25 patients with middle-to-late stage dementia under four different conditions: control, viewing the garden through an open door, viewing the garden through a closed door, and a closed door with chrysanthemum scent. There were non-identical subject groups for each condition, as well as a differing sequence and uneven intervals between conditions. Only six individuals were involved in all four conditions. The average level of attention for these individuals was calculated by dividing their total scores (on a scale of 1 to 5, with 1 being highly attentive and 5 being very un-attentive) by the total number of assessments. The average score for attention increased by 1.6 while viewing the garden through an open door. With the door closed, the positive response dropped, even though it remained more positive than the control. The addition of the floral scent made very little change.

Creative and Activity-based Interventions

i) Music Programs

Through a mixed-methods design, Daykin *et al*.[15] examined the effects of a ten-week music program on the well-being of patients living with dementia. A total of 85 patients living with dementia stayed on the ward during the study period (data were available for 38/59 patients living with dementia pre-intervention and 47/84 during the music program).

During the music program, there was a small reduction in the average LoS (34.68 days vs. 36.90 days), an increase in the overall number of discharges (9.84%), and a decrease in the number of patients prescribed antipsychotic medications (4.26%). Prescribed antipsychotic medications on the day of the week that the music activity took place was markedly decreased (27.72%). The number of patients who did not take their usual antipsychotic medications on the day of the music project was one in the pre-intervention phase and 15 in the music project phase. There was a reduction in the number of falls recorded with the music intervention (31 vs. 47). Structured observational data were available for 20 patients, observed over five music sessions. All mood scores increased by the end of each music session (average 1.6 points), with no decreases recorded. Observed effects on relaxation, distraction, engagement, and agitation were also consistently positive.

Schroeder *et al*.[16] evaluated the impact of an individualized music-based intervention on agitation, mood, cooperation with care, need for one-on-one nursing staff intervention, and need for PRN medication. Participants were admitted to a geriatric behavioural inpatient unit for acute agitation or behavioural disturbance. Participants were divided into two groups based upon which months they were admitted to hospital (usual care [n = 20] or individualized music plus usual care [n = 21]). The music-based intervention group had significantly lower scores on the agitation and negative mood scales, and significantly higher scores on the positive mood scale ($p \leq .01$) with resulting large effect sizes (d = 1.10–1.59). The music-based intervention group also had significantly lower scores on resisting care with a resulting medium effect size (r = –0.69). When only individuals with major neurocognitive disorder were examined, agitation, mood, and resisting care remained significantly different between the study groups, while number of PRN medications administered and number of one-on-one staff interactions was non-significant.

ii) Visual Arts Program

Windle *et al*.[17] evaluated the impact of a visual arts program on 125 people living with dementia in residential care, hospital, and community. Twenty-three participants were recruited from a county hospital. Across the three sites (residential care, hospital, and community), scores for well-being were significantly better in the art program; subgroup analyses for the patients in hospital are not reported. Proxy-reported QoL improved between baseline and three-month follow-up, but no improvements in QoL were reported by the participants living with dementia. In the hospital setting, communication deteriorated between baseline and follow-up at three months ($p = .001$) and at six months ($p = .003$).

iii) Multi-Sensory Behaviour Therapy

Staal *et al*.[18] recruited 24 geriatric in-patients with moderate-to-severe dementia and associated behavioural disturbances on an acute care geriatric psychiatry unit to participate in a study evaluating multi-sensory behaviour therapy (MSBT). MSBT involves placing participants in environments with personalized auditory, olfactory, and tactile stimuli. Participants were randomized to either receive MSBT or a structured activity (e.g., bead mazes, puzzles, and tactile tasks). At baseline, group overall health (measured by the Multi-level Assessment Instrument) was significantly higher within the MBST group (mean score 4.17 vs. 2.83).

Over the course of six sessions, both the MSBT and control groups had reduced agitation, with greater reduction in agitation observed in the MBST group compared to the control group ($F(6, 120) = 3.56$, $p = .003$). The MBST group also had significantly improved levels of apathy compared to the control group ($F(1, 20) = 4.47$, $p = .04$), and was the only group to demonstrate improvement in apathy from baseline ($F(6, 120) = 3.15$, $p = .01$). The MSBT group had significantly improved levels of independence in ADLs compared to the control group ($F(1, 20) = 4.72$, $p = .04$). Controlling for health status and age, both apathy and agitation scores emerged as statistically significant predictors of ADL performance (0.65 vs. 0.42; $p = .03$). Within the MSBT group, 9 of the 12 participants were on atypical antipsychotic medications and had better agitation scores than the three subjects who were not on atypical antipsychotic medications ($F(1, 12) = 2.80$, $p = .133$).

iv) Steam Foot Spa

Koike *et al*.[19] investigated whether a steam foot spa improves cognitive impairment in geriatric inpatients. Thirteen geriatric inpatients were given a steam foot spa treatment for

20 minutes, five days per week, for two weeks. There was a significant increase in total MMSE scores after 10 days of treatment (18.38 ± 3.69 vs. 22.92 ± 3.97; $p < .01$) and a significant improvement in the overall dementia severity items on the Dementia Mood Assessment Scale (8.54 ± 4.55 vs. 6.92 ± 3.87; $p < .05$).

v) Exercise Program

Fleiner *et al*.[20] conducted a hospital-based RCT on three specialized dementia care wards to study the effects of a short-term exercise program on the neuropsychiatric signs and symptoms of patients living with dementia. Patients who had a minimum length of stay of one week before enrollment into the study were randomly allocated to a two-week exercise program or two-week social stimulation control group; 70 patients completed the study protocol. Results show the intervention group had significantly reduced neuropsychiatric signs and symptoms. The intervention group showed significantly more positive clinical effects on the Alzheimer's Disease Cooperative Study-Clinical Global Impression of Change (ADCS-CGIC) dimensions of emotional agitation ($p < .001$), lability ($p < .001$), psychomotor agitation ($p = .01$), and verbal aggression ($p = .04$). No significant differences were found in the physical aggression dimension ($p = .07$). The analyses on single dimensions of neuropsychiatric signs and symptoms showed significant reductions from baseline to follow-up for both the Neuropsychiatric Inventory (NPI) total score (intervention group change [Δ] = –12 points; control group Δ = –6 points) and the Cohen-Mansfield Agitation Inventory (CMAI) total score (intervention group Δ = –10 points; control group Δ = –6 points). A change of 11 points within the NPI total score and a change of 8 points within the CMAI total score is considered clinically relevant. There were no significant differences between the dosage of antipsychotic and sedative medication between both groups at baseline, during the intervention period, or at follow-up measurement.

vi) Meaningful Engagement with Volunteers

Mashlan *et al*.[21] conducted a pilot project providing school-aged volunteers with opportunities to engage in activities with patients living with dementia on a shared mental health and medicine ward. Activities included individual interaction and group activities such as artwork, music therapy, reminiscence therapy, playing games or providing entertainment. Activities took place one day per week for 2 hours. Sixteen patients with dementia participated, though attendance varied each week from 5 to 7 patients per session. Results show that fall incidents decreased from 9 to 7 among patients who attended the intervention, as well as the total number of falls on the ward (total falls pre-intervention = 17; total falls post-intervention = 11). This was thought to be a result of grouping high-risk patients together during the intervention, so that staff would be caring for fewer patients at a given time. For the intervention group, the use of PRN anti-agitation medication was reduced, as well as the incidence of sleep/wake cycle problems. The need for one-to-one care did not change, but the two patients who required it used less anti-agitation medications.

vii) Virtual Reality

Rose *et al*.[22] looked at the feasibility of Head Mounted Display-Virtual Reality (HMD-VR) for people with dementia on an inpatient psychiatric unit. They used a mixed-methods design to observe changes in affect and behaviour before, during, and after exposure to 15 minutes of HMD-VR. Six patients with dementia with comorbid psychiatric diagnoses participated. Emotions were rated using the Observed Emotion Rating Scale (OERS) and behaviours using the Overt Aggression Scale-Modified for Neurorehabilitation (OAS-MNR), as well as the St Andrews Sexual Behaviour Assessment (SASBA). Results show a significant difference in ratings of pleasure before (Mdn = 1.250), during (Mdn = 2.000), and after (Mdn = 1.750) HMD-VR exposure, calculated by the Friedman test (χ^2 (2) = 8.000, $p = .018$) and Wilcoxon signed-rank tests revealed a significant increase in pleasure from before (Mdn = 1.250) to during (Mdn = 2.000; Z = –2.060, $p = .039$), and before (Mdn = 1.250) to after (Mdn = 1.750; Z = –2.060, $p = .039$). There was no significant difference in the other observed emotions of anger ($p = 1.000$), anxiety/fear ($p = .212$), or sadness ($p = .229$) with exposure to HMD-VR. There was a significant difference in general alertness before, during, and after (χ^2 (2) = 6.300, $p = .043$) and again, Wilcoxon signed-rank tests demonstrated a significant increase in alertness from before (Mdn = 4.500) to after (Mdn = 5.000) exposure (Z = –2.060, $p = .039$). OAS-MNR aggregate aggression scores decreased from 14 prior to HMD-VR to 2 post-exposure.

DISCUSSION

This review has revealed a sparsity of high-quality evidence to help guide acute care hospital design for older adults living with dementia. In a recent scoping review on dementia-friendly design in acute care settings, Parke *et al*.[4] highlight the need for intervention studies to determine how, and under what conditions, physical design changes can produce a positive impact on hospitalized older adults living with dementia. From our review, we ascertain that modifying the physical environment may have a positive impact on hospitalized older adults living with dementia. Specifically, simple environmental changes, such as door camouflage and environmental cues may, at least initially improve door testing and wayfinding.[11,12]

Commonly used electronic sensor alarms appear to have the potential to decrease the rate of inpatient falls among those living with dementia.[10] However, a much larger single-site study by Shorr *et al*.[23] did not find any statistically or clinically significant effect of bed alarms on fall-related events on surgical and medical units. This may be because this larger study did not limit bed alarm use to only those with cognitive impairment or dementia.

Creative- or activity-based interventions have a potential role in enhancing mood and reducing neuropsychiatric

symptoms. Exercise in particular may help manage neuropsychiatric signs and symptoms.[20] Other successful interventions, including multi-sensory behaviour therapy,[18] music,[14,15] and gaming technology like virtual reality may improve mood and reduce agitation. However, these results should be interpreted with caution given they are based on low quality studies.

Improved patient experience was noted in a department-wide intervention[13] designed to deliver best practice care for people with delirium or dementia. However, the exact contribution of physical design elements and therapeutic activities is not known. This is a common occurrence in the Acute Care for the Elderly (ACE) literature, where the prepared environment is not well-described. A systematic review and meta-analysis performed in 2012 further identified that very few trials have examined the effectiveness of the full ACE model, including the prepared environment.[24]

Limitations

Twelve of the 15 included studies are of low or very low quality, limiting the conclusions that can be drawn from the data and the reliability of the stated outcomes. Additionally, due the lack of homogeneity between study outcomes, it was impossible to conduct a meta-analysis. Finally, this review was complicated by the methodological issues inherent to these kinds of interventions and pragmatic studies.

CONCLUSION

We outline the limited evidence available related to the impact hospital environments (both physical and social) have on hospitalized patients living with dementia. Further high-quality intervention studies are needed in order to better evaluate how the hospital environment can be optimized to improve outcomes for both hospitalized patients living with dementia and the health-care system.

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CONFLICT OF INTEREST DISCLOSURES

We have read and understood the Canadian Geriatrics Journal's policy on conflicts of interest disclosure and declare that there are none.

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APPENDIX A. Search Strategy Keywords and Text Words Within the Three Domains

Population	Dementia, or Multi-Infarct, or AIDS Dementia Complex, or Aphasia, Primary Progressive or, Lewy Bodies, or CADASIL, or Creutzfeldt-Jakob Syndrome, or Cognition, or Memory Disorders, or Cognition Disorders, or Neurodegenerative Diseases, or Huntington Disease, or Alzheimer Disease
Setting	Hospitals, or Critical Care, or Inpatients, or Hospital Departments, or Hospital Medicine, or Hospital Units
Possible Interventions	Environment, or Health Facility Environment, or Built Environment, or Environmental Design, or Social Environment, or Nursing Staff, or Hospital Information System, or "Hospital Design and Construction" or Materials Management, or Lighting, or Architecture, or Color Perception