

Subjective barriers to prevent wandering of cognitively impaired people (Review)

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[Intervention Review]

Subjective barriers to prevent wandering of cognitively impaired people

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Editorial group: Cochrane Dementia and Cognitive Improvement Group.

Publication status and date: New search for studies and content updated (no change to conclusions), published in Issue 3, 2009.

Review content assessed as up-to-date: 23 March 2009.

Citation: Price JD, Hermans D, Grimley Evans J. Subjective barriers to prevent wandering of cognitively impaired people. *Cochrane Database of Systematic Reviews* 2001, Issue 1. Art. No.: CD001932. DOI: 10.1002/14651858.CD001932.

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ABSTRACT

Background

People with dementia often wander, at times putting themselves at risk and presenting challenges to carers and institutional staff. Traditional interventions to prevent wandering include restraint, drugs and locked doors. Cognitively impaired people may respond to environmental stimuli (sounds, images, smells) in ways distinct from healthy people. This has led to trials of visual and other selective barriers (such as mirrors, camouflage, grids/stripes of tape) that may reduce wandering.

Objectives

We assess the effect of subjective exit modifications on the wandering behaviour of cognitively impaired people. The second objective is to inform the direction and methods of future research.

Search methods

The trials were identified from a searches of the Specialized Register of the Cochrane Dementia and Cognitive Improvement Group, *The Cochrane Library*, MEDLINE, EMBASE, PsycINFO, CINAHL, LILACS, clinical trials registries and grey literature sources on 9 March 2009 using the terms: exit*, wander*, camouflage, bars, stripe*, grid*, floor*, door*, barrier*, elopement, ambulat*

Selection criteria

Randomized controlled trials (RCTs) and controlled trials provide the highest quality evidence, but interrupted time series are also considered as they may contribute useful information.

Participants are people with dementia or cognitive impairment who wander, of any age, and in any care environment - hospital, other institution, or their own home.

Interventions comprise exit modifications that aim to function as subjective barriers to prevent the wandering of cognitively impaired people. Locks, physical restraints, electronic tagging and other types of barrier are not included.

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Data collection and analysis

The criteria for inclusion or exclusion of studies are applied independently by two reviewers. All outcomes that are meaningful to people making decisions about the care of wanderers are recorded. These include the number of exits or carer interventions, resource use, acceptability of the intervention and the effects on carer and wanderer (anxiety or distress). Heterogeneity of clinical area, of study design and of intervention was substantial.

Main results

No RCTs or controlled trials were found. The other experimental studies that we identified were unsatisfactory. Most were vulnerable to bias, particularly performance bias; most did not classify patients according to type or severity of dementia; in all studies, outcomes were measured only in terms of wandering frequency rather than more broadly in terms of quality of life, resource use, anxiety and distress; no studies included patients with delirium; no studies were based in patients' homes.

Authors' conclusions

There is no evidence that subjective barriers prevent wandering by cognitively impaired people.

PLAIN LANGUAGE SUMMARY

No evidence that subjective barriers prevent wandering of cognitively impaired people

Cognitive impairment is part of the clinical syndrome of dementia which is due to brain disorder, often progressive and irreversible. Wandering of cognitively impaired people presents risks, and places additional demands on carers. Traditional measures to reduce wandering include drugs, restraints, locked doors and other barriers, but these can be harmful. Subjective barriers (that appear as an obstruction only to those who are cognitively impaired) may provide an inexpensive, safe, effective and ethical alternative. They include mirrors, floor stripes and camouflage of door furniture. The review found no evidence so far that subjective barriers prevent wandering and could not exclude the possibility that such barriers cause psychological harm.

BACKGROUND

Wandering by people with dementia and cognitive impairment is common (Hope 1997). A clear definition is lacking although several typologies have been suggested. Wandering is not a single, simple behaviour and wanderers are not all alike (Hope 1994); people may wander for different reasons, in different ways and with differing results. Wandering may be problematic to both carer and patient, to the carer alone or to the patient alone. Wanderers may stray and be at risk of harm or death through injury, exposure or omitted treatments. This may cause anxiety and distress in both carer and wanderer. Problem wandering by people living in their own home may lead to placement in institutional care. However, wandering may be beneficial to the patient (meeting a need to spend time alone, or to relieve boredom) and to the carer (for example daytime wandering may reduce nocturnal wandering).

Traditional responses to wandering include human restraint, physical restraints (Buxton chairs, tethers), drugs, alarms, and the lock-

ing of doors. Frequency and method of restraint vary between nations, but there are trends towards minimising their use. Physical restraint and drugs are associated with higher risk of pressure sores, infection, sedation, falls and psychological consequences such as agitation, anxiety and violence. Closure of doors, with or without locking, is often unacceptable because of fire risk or the need for unimpeded access or exit. Exit alarms are disruptive and may be distressing; false alarms are wasteful of staff time. Furthermore, traditional responses have high direct and indirect financial costs. None of these traditional responses are satisfactory. An ideal barrier would not limit other non-problematic behaviour of the wanderer, would involve little staff monitoring or training, would allow a range of motion to occur, would be relatively inexpensive and not harmful to the wanderer or others (Hussian 1987). In addition, it would not lead to anxiety or distress amongst wanderers or others who wish to exit, and supervised passage of the wanderer (for example in an emergency) would be unimpeded, as would passage of the occasional visitor.

Cognitively impaired people may respond to modification of exits differently from those who are unimpaired. Visual, thermal or other stimuli may be perceived as absolute or relatively stronger barriers to exit than is rationally the case. Specifically, it has been claimed that visual agnosia may result in the interpretation of two-dimensional floor grids or bars as three-dimensional and therefore representing a physical barrier to exit (Hussian 1987), and that superficial modifications to doors, such as the concealment of door handles, may selectively disguise exits. This review examines systematically the evidence supporting these interventions.

Exit modification should form part of a holistic approach to problem wandering. This may include the identification and definition of other problems in the individual case, preventative activities such as exercise classes or occupational therapies and improved communication between carer and wanderer (Rader 1987).

OBJECTIVES

This review assesses the effects of exit-modifying interventions designed to function as selective barriers to prevent the wandering of cognitive impaired people.

METHODS

Criteria for considering studies for this review

Types of studies

Randomized controlled trials (RCTs), controlled trials and interrupted time series (ITS) of subjective barriers are included in this review (see the Cochrane Effective Practice and Organisation of Care Group (EPOC), Editorial Information for the definition of ITS).

Types of participants

Participants are people with acquired cognitive impairment who wander, including people:

1. with dementia, either unclassified or classified according to the major subtypes of vascular, Alzheimer's, mixed (vascular and Alzheimer's) and Lewy Body, as well as people who are chronically cognitively impaired but do not fulfil the accepted criteria for the classification of dementia.
2. with a syndrome of acute cognitive impairment (delirium), whether or not there is evidence of pre-existing chronic cognitive impairment.

Studies are considered if diagnostic criteria such as DSM (DSM IV) or ICD (ICD 10) or equivalents are rigorously applied or, less

adequately, where a description of patient assessment clearly indicates the presence of acquired cognitive impairment. Studies applying the operational definitions 'cerebral insufficiency' or 'cerebral or senile deterioration', present in the literature during the 1960s and 1970s, are considered if they meet these criteria.

There is no consensus in the literature about what wandering is or how to measure it. Some authors have divided wandering into a number of subcategories (for example Hope 1994). The problem remains, however, that categories overlap and that wandering is a complicated and multifaceted phenomenon. In this review rigorous definition and characterisation of participants' wandering behaviour(s) is not required. However, this is an area meriting further research, and later reviews may apply more demanding criteria. Studies are not excluded on the grounds of participants' age or care environment (hospital, residential home or nursing home).

Types of interventions

Trials are considered for inclusion if the intervention comprises subjective exit modification.

These include the following:

- pattern(s) on floor or door (for example, a grid or lines or bars)
- mirror(s) on door
- camouflage of door or doorknob
- concealment of view through door window

The above list is not considered exclusive. Trials of combinations of two or more of the above interventions are also considered acceptable.

Trials assessing the following interventions are not included:

- pharmaceuticals
- physical restraints (ropes, locks, chains)
- combination locks
- electronic tagging

Types of outcome measures

We include all reported outcomes likely to be meaningful to people making a decision about the care of cognitively impaired people who wander. Outcomes of interest identified include the following:

- number of attempted exits
- number of successful exits
- global impression of change by carer
- number of carer interventions
- carer anxiety or distress
- patient anxiety or distress
- cost of care (for example supervision, drugs)
- dependency (such as institutionalisation)
- use of services
- acceptability of intervention

Search methods for identification of studies

See [Cochrane Dementia and Cognitive Improvement Group](#) methods used in reviews.

The Specialized Register of the Cochrane Dementia and Cognitive Improvement Group (CDCIG) was searched on 9 March 2009. This register contains records from the following major healthcare databases *The Cochrane Library*, MEDLINE, EMBASE, PsycINFO, CINAHL and LILACS, and many ongoing trial databases and other grey literature sources. The following search terms were used: exit*, wander*, camouflage, bars, stripe*, grid*, floor*, door*, barrier*, elopement, ambulat*.

The Cochrane Library, MEDLINE, EMBASE, PsycINFO, CINAHL, many ongoing trial databases and other grey literature sources were searched separately on 9 March 2009 for the latest records. The search terms used to identify relevant controlled trials on dementia, Alzheimer's disease and mild cognitive impairment for the Group's Specialized Register can be found in the Group's module on *The Cochrane Library*. These search terms were combined with the following search terms and adapted for each database, where appropriate: exit*, wander*, camouflage, bars, stripe*, grid*, floor*, door*, barrier*, elopement, ambulat*. See Appendix 1 for the sources searched and numbers of hits retrieved.

The search strategies used to identify relevant records in MEDLINE, EMBASE, PsycINFO, CINAHL and LILACS can be found in the Group's module.

In addition MEDLINE, PsycLIT, EMBASE, CINAHL, British Nursing Index, OMNI (Organising Medical Networked Information) and SIGLE were searched again for the update using the following thesaurus and free text word terms to identify relevant reports of an interrupted time series design:

Set 1: cognitive impairment:

[cognit* or memory*) and (declin* or impair*)

delir*

confus*

dement*

Alzheimer*

Pick*

Huntington*

Creutzfeldt*

JCD*

Binswanger*

Korsakoff*

Wernicke*

Set 2: wandering or intervention to prevent wandering:

exit*

wander*

camouflage

bars

stripe*

grid*

floor

door

barrier*

elopement

ambulat*

Set 3: methodology:

ITS or "interrupted time series" or "time series"

baseline

experiment*

washout

Additional sources:

Personal contact with specialists in the field. Unpublished data and 'grey literature' were sought through personal communication with researchers and others with an interest in the field. When relevant studies were identified, first named authors were contacted and requested to provide details of other (unpublished) trials.

Data collection and analysis

The search for trials was performed by one reviewer (DH). Both JDP and DH read the abstracts (or title if abstract not available) of all trials and reviews and discarded irrelevant publications to create a pool of relevant articles. The pools were merged and these articles obtained. After the potential trials are retrieved, two reviewers (JDP and DH) independently apply the inclusion/exclusion criteria to the full report. The reviewers are not blinded to the names of the authors, institutions or journal of publication. Disagreements about study inclusion are resolved by discussion. The criteria used to assess the methodological quality of studies are those used by the Cochrane EPOC group (see Group Editorial information). Assessment of articles using these criteria provides a score indicating the methodological quality of each trial. The total score is intended to give a rapid indication of the methodological quality, provide a guide to the shortcomings of the studies and to assist in making recommendations about future research. Study quality is assessed independently by two reviewers (JDP and DH). Differences are resolved by discussion. Studies that are seriously compromised by weaknesses in design, conduct or analysis are excluded. Details of these excluded studies are reported in the excluded trials table and discussed in the narrative section of the review.

Descriptive characteristics and quantitative data on the outcomes of interest are extracted independently by two reviewers (JDP and DH) without masking of study site or author. All outcomes that are meaningful to people making decisions about the care of wanderers are extracted (see Types of outcome measures, above).

RESULTS

Description of studies

See: [Characteristics of excluded studies](#); [Characteristics of ongoing studies](#).

A total of 39 studies were identified during the initial search. Of these none were RCTs or CCTs. Thirty-one articles were not experimental studies. Eight reports of trials (of which two were reports of the same trial) described interrupted time series and were considered suitable for further consideration. Owing to important weaknesses in design and/or implementation, none of these was subsequently deemed appropriate for inclusion. From the search in March 2009, there were 15 results. Of these, four studies were excluded, one study has been added to the ongoing studies section. The remaining results were discarded as irrelevant or review articles.

Risk of bias in included studies

No studies were found to be suitable for inclusion.

Effects of interventions

No studies were found to be suitable for inclusion.

DISCUSSION

There is no evidence to resolve whether subjective barriers prevent wandering by cognitively impaired people.

Visual and other barriers tested in the excluded studies included contrasting tape (grid or stripes) applied to door ([Namazi 1989](#)) or floor ([Chafetz 1990](#); [Hewawasam 1996a](#); [Hewawasam 1996b](#); [Hussian 1987](#); [Namazi 1989](#)), mirrors ([Mayer 1991](#); [Roberts 1996](#)) and cloth panels (to conceal door or doorknob: [Dickinson 1995](#); [Roberts 1996](#)). Many studies examined more than one intervention simultaneously (for example, [Dickinson 1998](#) used a blind and a cloth barrier). Others studied a sequence of single interventions with no assessment of the magnitude of learning effects. For example, [Hussian 1987](#) used progressively increasing numbers of floor stripes in different orientations. The description of the methods was at times unclear or incomplete (for example [Hussian 1987](#)).

These experimental studies were forms of interrupted time series, and all were of unsatisfactory quality. Studies were vulnerable to bias, particularly performance bias. All studies were small (between 4 and 30 participants) and the interventions were heterogeneous. Most studies did not classify patients according to type or severity of dementia. Participants' characteristics were poorly described and/or evaluated. Age, sex, type and severity of dementia and diagnostic method were often not specified. Only one study examined for presence of specific cognitive impairment such as visual

agnosia ([Namazi 1989](#)). No studies included patients with delirium. All studies took place in an institutional environment (care home or hospital). Definitions of wandering were omitted and some studies included non-wandering patients ([Chafetz 1990](#)).

Outcomes were described narrowly in terms of increased or decreased number of exits. No study attempted a broader assessment to include quality of life issues, psychological aspects (anxiety or depression) or carer focused outcomes (time, stress, placement decision making) or cost evaluation. All outcomes were assessed in the short term only (days or a few weeks). Longer term evaluations would permit an assessment of whether efficacy reduces as the patient becomes more familiar with the device. None of the studies evaluated the effects on non-cognitively impaired people, particularly those unfamiliar with the barrier such as hospital visitors.

In institutions as well as at home, the availability of financial and human resources may be important concerns. Subjective barriers, if proven to be effective and safe, could help to reduce the resources committed to management of wandering, with potential benefits to patient and carer. However, subjective barriers, even if effective, may not be the intervention of choice. For example, other interventions such as occupational therapies may be both effective and enjoyable. Furthermore, ethical issues related to subjective barriers must be considered. Very few authors discuss the possible positive, therapeutic aspect of wandering: patients may need privacy, may want to move because of boredom or discomfort, and exercise may deliver physical, emotional and other benefits (for example improved sleep at night). Subjective barriers may cause fear, anxiety or bemusement.

An increasing elderly population - and increases in the number of cognitively impaired people - and the realities of restricted health resources suggest that we should continue to develop and evaluate subjective barriers as methods to prevent wandering at home or in institutions. Subjective barriers may be preferable to more traditional solutions in spite of the drawbacks mentioned above. To that end new studies, properly designed and executed, should be performed.

AUTHORS' CONCLUSIONS

Implications for practice

There is no evidence so far that subjective barriers reduce wandering, and the possibility of harm (particularly psychological distress) cannot be excluded. If used, then subjective barriers should form part of a diverse approach to problem wandering, which may include the identification and definition of the problem in the individual, preventative activities such as exercise classes or occupational therapies, and improved communication between carer and wanderer.

Implications for research

Fundamental and applied research in this area needs to be developed. Anecdotal evidence, a number of case studies and a few small experimental studies of modest quality have been published by a number of authors from many countries to suggest the topic is worth pursuing further.

There is a need for high quality trials of subjective barriers. Randomized controlled trials (RCTs) provide the highest quality of evidence. In the home setting these are feasible but have not been done. However, within institutions randomization of individuals would be costly and impractical; cluster randomization (of wards or institutions) is a realistic but currently unexplored alternative. Where - perhaps for local reasons - RCTs are impractical, useful evidence may be obtained from well designed and implemented non-randomized studies. These include controlled trials and time series. Controlled trials are prone to selection bias. Time series are straightforward to implement, and most of the experimental studies so far performed are of this design. However, this study type is vulnerable to bias. Assessment of outcome should be objective and if possible observers should be blinded to the nature of the intervention; the presence of observers or monitoring equipment should be obscured if possible (as this may alter behaviour); changes in behaviour of carers and/or other staff in response to the intervention should be measured and reported; disease progression during the study should be monitored; other changes - in patients, staff or care environment - should be avoided where possible; serial interventions may result in learning effects which should be measured (for example by a second baseline period).

Studies have been small, heterogeneous and have examined mul-

iple hypotheses. Future studies should examine single interventions, including sufficient participants to enable confident conclusions to be drawn. Multiple interventions should be evaluated only if the size of the study justifies this and bias due to learning effects is minimised and its magnitude assessed. Power calculations should be performed early in the planning stage. Assessment at the point of enrolment should include type and severity of cognitive impairment. Studies should state the diagnostic criteria and process.

Researchers must be sensitive to the possibility of harm (for example anxiety and distress) and should consider assessing broad carer and patient-focused outcomes (cost of care, acceptability of intervention and quality of life). Studies should measure longer term outcomes, as learning effects may reduce the effectiveness of barriers over time.

It is hoped that updates of this review will be able to report more conclusive evidence of the efficacy of subjective barriers and the basic science underlying them.

ACKNOWLEDGEMENTS

Four consumers have put considerable effort into shaping this review. Their vigour, experience and dedication have benefited both the review and the reviewers. We would like to thank Margaret Clarke, Christine Derrick, U Hla Htay and Joyce MacFarlen and hope their involvement with the Group will continue. We also acknowledge the help of Julia Cream from the Alzheimer's Society who initiated consumer involvement, organised meetings and helped where necessary.

REFERENCES

References to studies excluded from this review

Bass 2008 *{published data only}*

Bass E, Rowe MA, Moreno M, McKenzie B. Expanding participation in Alzheimer's Association Safe Return by improving enrollment. *American Journal of Alzheimer's Disease & Other Dementias* 2008;**23**(5):447-50.

Chafetz 1990 *{published data only}*

Chafetz PK. Two-dimensional grid is ineffective against demented patients' exiting through glass doors. *Psychology and Aging* 1990;**5**(1):146-7.

Chen 2007 *{published data only}*

Chen D, Bharucha AJ, Wactlar HD. Intelligent video monitoring to improve safety of older persons. *Conf Proc IEEE Eng Med Biol Soc* 2007:3814-7.

Dickinson 1995 *{published data only}*

Dickinson JI, McLain-Kark J, Marshall-Baker A. The effects of visual barriers on exiting behavior in a dementia care unit. *Gerontologist* 1995;**35**(1):127-30.

Dickinson 1998 *{published data only}*

Dickinson JI, McLain-Kark J. Wandering behaviour and attempted exits among residents diagnosed with dementia-related illnesses: a qualitative approach. *Journal of Women and Aging* 1998;**10**(2):23-4.

Graff 2008 *{published data only}*

Graff MJ, Adang EM, Vernooij-Dassen MJ, Dekker J, Jönsson L, Thijssen M, et al. Community occupational therapy for older patients with dementia and their care givers: cost effectiveness study. *BMJ (Clinical Research Ed.)* 2008;**336**(7636):134-8.

Hewawasam 1996a *{published data only}*

Hewawasam L. Floor patterns limit wandering of people with Alzheimer's. *Nursing Times* 1996;**92**(22):41–4.

Hewawasam 1996b *{published data only}*

Hewawasam L. The use of two-dimensional grid patterns to limit hazardous ambulation in elderly patients with Alzheimer's disease. *NT Research* 1996;**1**(3):217–28.

Hussian 1987 *{published data only}*

Hussian Richard A. Use of two-dimensional grid patterns to limit hazardous ambulation in demented patients. *Journal Of Gerontology* 1987;**42**(5):558–560.

Mayer 1991 *{published data only}*

Mayer R, Darby SJ. Does a mirror deter wandering in demented old people?. *Int. J. of Geriatric Psychiatry* 1991;**6**: 607–9.

Miskelly 2005 *{published data only}*

Miskelly F. Electronic tracking of patients with dementia and wandering using mobile phone technology. *Age and ageing* 2005;**34**(5):497–9.

Namazi 1989 *{published data only}*

Namazi KH, Rosner TT, Calkins MP. Visual barriers to prevent ambulatory Alzheimer's patients from exiting through an emergency door. *Gerontologist* 1989;**29**(5): 699–702.

Thomas 2006 *{published data only}*

Thomas DW, Glogoski C, Johnson J. The effect of a supervised walking program on wandering among residents with dementia. *Activities, Adaptation & Aging* 2006;**30**(4): 1–13.

References to ongoing studies

Moore 2008 *{unpublished data only}*

Moore DH. Home Evaluation of Visual Exit Barriers in Dementia-Related Wandering. <http://clinicaltrials.gov/show/NCT00797355> 2008.

Additional references

DSM IV

American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders. *American Psychiatric Association*. 4th Edition. Washington DC: APA, 1994.

Hope 1994

Hope T, Tilling KM, Gedling K, Keene JM. The structure of wandering in dementia. *International Journal of Geriatric Psychiatry* 1994;**9**(2):149–55.

Hope 1997

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ICD 10

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Rader 1987

Rader J. A comprehensive staff approach to problem wandering. *Gerontologist* 1987;**27**:756–60.

Roberts 1996

Roberts C. The management of wandering in older people with dementia. *Journal of Psychiatric Mental Health Nursing* 1996;**3**(2):138–9.

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Price 2001

Price JD, Hermans DG, Grimley Evans J. Subjective barriers to prevent wandering of cognitively impaired people. *Cochrane Database of Systematic Reviews* 2001, Issue 1.[Art. No.: CD001932. DOI: 10.1002/14651858.CD001932]

* Indicates the major publication for the study

CHARACTERISTICS OF STUDIES

Characteristics of excluded studies *[ordered by study ID]*

Study	Reason for exclusion
Bass 2008	The intervention is a program which assesses finding people when they get lost
Chafetz 1990	Only half of all participants were fully mobile; staff were not blinded to the intervention; insufficient data points; significant change in medication during study
Chen 2007	The intervention is a monitoring system
Dickinson 1995	Serial interventions with no assessment of magnitude of learning effect; insufficient data points; observers not blinded to interventions
Dickinson 1998	Later report of Dickinson 1995 (duplicate publication). Similar justification of exclusion
Graff 2008	The intervention is occupational therapy
Hewawasam 1996a	Serial interventions but no assessment of learning effect; observers not blinded to interventions; insufficient data points
Hewawasam 1996b	Later report of Hewawasam 1996a (duplicate publication). Similar justification of exclusion
Hussian 1987	Serial interventions but no assessment of learning effect; insufficient data points; observers not blinded to the intervention
Mayer 1991	Serial interventions but no assessment of learning effect; insufficient data points; observers not blinded to the interventions
Miskelly 2005	RCT of electronic tagging, not subjective barrier
Namazi 1989	Serial interventions with evidence of learning effect; observers not blinded to the interventions; insufficient data points
Thomas 2006	The intervention is a walking program

Characteristics of ongoing studies *[ordered by study ID]*

Moore 2008

Trial name or title	Home Evaluation of Visual Exit Barriers in Dementia-Related Wandering
Methods	Treatment, Randomized, Single Blind (Outcomes Assessor), Crossover Assignment
Participants	Veterans over age 60 with an Alzheimer's-like dementia diagnosis
Interventions	Device: door mat and door camouflage subjective exit barriers
Outcomes	Primary: decrease in pre-elopement (exit door shadowing and lingering) behavior Secondary: reduction in caregiver burden; increase in pre-elopement behaviours occurring in proximity to other potential exit doors and windows within the same area; increase in persons with dementia agitation
Starting date	January 2009
Contact information	Name: Dorothy Helen Moore, Email: Dorothy.Moore4@va.gov, Tel: 001 813 558-3931. Address: James A Haley VA Hospital
Notes	

DATA AND ANALYSES

This review has no analyses.

WHAT'S NEW

Last assessed as up-to-date: 23 March 2009.

Date	Event	Description
24 March 2009	New search has been performed	Update searches of 9 March 2009 retrieved new studies for consideration by the authors. No new studies have been included; five studies have been excluded and one study added to the ongoing studies section

HISTORY

Protocol first published: Issue 4, 1999

Review first published: Issue 4, 2000

Date	Event	Description
7 November 2008	Amended	Converted to new review format.
24 January 2007	New search has been performed	January 2007: This is a minor update: no new studies were found in the search. The search strategy sections were updated
13 May 2005	New search has been performed	May 2005: This is a minor update: no new studies were found in the search. The search strategy sections were updated
5 September 2000	New citation required and conclusions have changed	Substantive amendment

CONTRIBUTIONS OF AUTHORS

-James Price:

Reading all abstracts; application of inclusion/exclusion criteria to articles obtained; data extraction; data synthesis; data analysis; writing of review

-Dymphna Hermans:

Search strategy; obtaining of hard copy; reading all abstracts; application of inclusion/exclusion criteria to articles obtained; data extraction; data synthesis; data analysis; writing of review; organising and coordinating consumer input; updating

-John Grimley Evans:

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Assistance with data synthesis, analysis and writing of review; checking the update of 2009.

DH did the update search in 2005 and 2007 and updated the review accordingly. Vittoria Lutje conducted the update search in 2009

Consumer editors: U Hla Htay, Joyce McFarlane, Christine Derrick and Margaret Clarke.

DECLARATIONS OF INTEREST

None known.

SOURCES OF SUPPORT

Internal sources

- Division of Clinical Geratology, Nuffield Department of Clinical Medicine, University of Oxford, UK.

External sources

- NHS R&D Executive, UK.

INDEX TERMS

Medical Subject Headings (MeSH)

*Architectural Accessibility; Caregivers [psychology]; Cognition Disorders [*psychology]; Dementia [*psychology]; Floors and Floor-coverings; Orientation; Walking

MeSH check words

Aged; Humans