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# A review of the empirical studies on the effectiveness of Assistive Technology in the care of people with dementia



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Translating dementia research into practice

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## ***Important notice***

The views expressed in this work are the views of its author(s) and not necessarily those of the Commonwealth of Australia. The reader needs to be aware that the information contained in this work is not necessarily endorsed, and its contents may not have been approved or reviewed by the Australian Government Department of Health and Ageing.

## ***Introduction***

A number of definitions of assistive technology relevant to people receiving aged care services have been developed. In the UK the Royal Commission on Long-Term Care (HMSO 1999) defined assistive technology as

*‘an umbrella term for any device or system that allows an individual to perform a task they would otherwise be unable to do or increases the ease and safety with which the task can be performed’.*

This is a very generic description of assistive technology and clearly includes such items as handrails. A slightly more specific definition offered by Marshall (Marshall 1997) in the context of the care of people with dementia is

*‘any item, piece of equipment, product or system, whether acquired commercially, off-the-shelf, modified or customised, that is used to increase, maintain or improve functional capabilities of individuals with cognitive, physical or communication disabilities’.*

Both of these definitions have an exclusive focus on function, limiting acknowledgement of the significant contribution assistive technologies make to quality of life, by improving the emotional and cognitive state of the person with dementia. The following definition from the Dementia Resources Guide (DoHA 2008) addresses this to some extent in the definition outlined below

*The term “assistive technology” refers to any product, equipment or device that helps people with disabilities to maintain their independence or improve their quality of life. Such devices can support both the person with dementia and their families and carers by:*

- *Supporting independence in daily living tasks. For example, grab rails can assist the person to maintain balance whilst in the shower.*
- *Enhancing communication. For example, augmentative devices can help both the person with dementia and their family and carers to more effectively be understood*
- *Increasing sense of wellbeing. For example, feeling that one can contribute to the household and continue to participate in self care tasks.*
- *Reducing risk of harm. For example, water temperature controls can reduce the risk of burns*
- *Reducing family and carer stress. For example, less vigilance may be required during tasks such as bathing if the person with dementia cannot burn themselves.*

This definition brings in the concept of wellbeing but again places it in the context of contributing to the household or to self care tasks.

This review of the literature will explore the ways in which technology has been applied to more than helping people with dementia carry out tasks and how it may be making a contribution to the wellbeing of these people by reducing their behavioural problems and improving their emotional state.

This review will take the Dementia Resources Guide (DoHA 2008) definition as a starting point for the definition of assistive technology but modify it slightly:

*The term “assistive technology” refers to a product, equipment or device, usually electronic or mechanical in nature, which helps people with disabilities to maintain their independence or improve their quality of life. Assistive technology can support the person with dementia or their families or carers by:*

- *Supporting independence in daily living tasks. For example, a device providing prompts may help a person with dementia wash their hands.*
- *Enhancing communication. For example, a simplified telephone may help a person with dementia initiate a call to a family member.*
- *Increasing sense of wellbeing. For example, simulated presence of family members or the provision of multi sensory stimulation may improve the mood of a person with dementia*
- *Reducing risk of harm. For example, provide alerts to services or carers to manage risks.*
- *Reducing family and carer stress. For example, a Passive Infra Red device to notify a carer of night time wandering.*

The objective of undertaking the review was

- To assess the empirical support for the use of assistive technology as an intervention to improve independence, safety, communication, wellbeing and carer support.

## A comment on expectations

If there is a tendency to look to technology as a quick fix for the problems encountered by people with dementia it can be countered by looking at two publications. In a detailed account of the design processes required to develop a device to assist with the use of public transport (Carmien, Dawe et al. 2005) Carmien et al describe how a carer might use a 'Script Creator' to programme a hand held device that would guide a person with cognitive impairment through a journey on public transport, (Figure 1)

**Figure 1: Script Creator for travelling on public transport**



A look at the prompts being developed and a consideration of the number and specificity that would be needed gives an immediate appreciation of the complexity of the problem, a point that is made by the authors. A trial of the Script Creator was undertaken by developing prompts for the making of cookies. Forty two steps were required. As far as can be determined there has not yet been a trial of the development of the prompts required for a bus journey.

A trial of the feasibility of training people with dementia to use a mobile phone (Lekeu, Wojtasik et al. 2002) broke the process down to 9 steps which were described on a card stuck to the back of the phone. Two patients with probable Alzheimer's disease and MMSE scores of 21 and 22 took

part in the trial. One patient was able to use the prompt card in the first week of training the second took 9 weeks to use the card unprompted. Training was provided in 45 minute sessions once or twice per week. Both patients were able to make a call, without the use of the prompt card, after 3 months of training.

The contrast between the reality of the time and effort required to help a person with relatively mild dementia make a telephone call in the safety of a clinic and the hope that people with dementia can be prompted to use public transport with all of the attendant distractions, over stimulation and danger, illustrates the gap between expectations and actuality that characterises the literature on assistive technology.

### ***Methods for Selection of studies***

In order to meet the objective screening criteria were established to identify potentially relevant articles that met minimum methodological standards for acceptance as objective assessments of the impact of assistive technology devices. These were modelled on the examples of reviews of the literature on psycho-social interventions for people with dementia (Forbes 1998) (Opie, Rosewarne et al. 1999; O'Connor 2007) as a step towards the consideration of assistive technology as part of the armamentarium of clinicians, managers and direct care staff.

Inclusion criteria:

1. Studies published after 1995
2. Incorporated a control group, pretest-posttest, cross sectional or survey design.

Type of interventions

3. Evaluated an intervention utilising an assistive technology

Types of participants

4. Focused on the care of people with dementia over 50 years of age



## **Search methods for identification of studies**

The following databases were searched Medline, Cinahl, PsycInfo, ProQuest, Google, Scholar Google, and Cochrane for articles published between 1995 and 2008. The following journals were searched manually: Dementia, International Journal of Technology and Aging, Journal of Gerontological Nursing, The Gerontologist, and Journal of Gerontology. The reference lists in earlier reviews and related published articles were checked to identify articles not located in the other searches and experts in the field were asked to identify papers that they considered to be significant.

The search terms used were 'dementia', 'Alzheimer disease', 'home', 'nursing home', 'assisted living', 'day care', 'hospital', 'residential care', 'public places', 'resident room', 'SCU', 'assistive technology', 'technology', 'smart home', 'telecare', 'telemedicine', 'telecommunication', 'community alarm systems', 'computers', 'telephones', 'intercoms', 'low-level technology', 'carbon monoxide sensors', 'light and motion sensitive night-lighting', 'anti-flood devices', 'safety', 'security', 'flood and fall detectors', 'activity monitors', 'alarm and pagers', 'tracking devices', 'alarm bracelets', 'automatic day/date calendar', 'signs modifications', 'universal remote controls', 'reminiscence', 'robot' and 'bed alarms'.

## **Selection of studies**

The titles, key words, abstracts and where necessary the methodology, discussions and/or conclusions of the papers identified by the electronic and hand searches were screened for potential relevance by one of two researchers. This was an over inclusive process designed to eliminate only papers that were obviously irrelevant.

A total of 178 papers were identified as potentially relevant. These were assessed for relevance by both researchers. This process resulted in the elimination of 142 papers because they did not meet the criteria listed above. While this resulted in the exclusion of many poor quality papers it also excluded important papers such as the Cochrane reviews (Martin, Kelly et al. 2008,).

## **Evaluation of the strength of the research**

The 36 papers that remained after the screening process were subjected to an assessment of their validity using the model provided by Forbes (Forbes 1998), 8 articles were considered as strong, 9 moderate and 19 weak. The 35 reviewed papers are listed at the end of this report.

The Forbes approach to the validation of the papers was chosen in the absence of any well accepted alternative contender. The most recent comprehensive review of the assistive technology literature (Cash 2003) did not attempt any systematic validation while in the area of psycho-social research the Forbes approach has been used in recent reviews (Opie, Rosewarne et al. 1999) (O'Connor 2007). The Forbes approach involves an assessment of external validity (design, inclusion, attrition), internal validity and statistical validity. While the Forbes approach is not finely tuned to the methodologies used in the assistive technology literature an adaptation of it was used in the Cochrane review on bright light therapy (Forbes, Morgan et al. 2004) and its use provides an opportunity for a comparison between the strength of the environmental design literature and the psychosocial intervention literature. In practice the Forbes approach required a great deal of discussion between the two raters to come to a consensus so the ratings are therefore offered with a degree of caution.

The quality of the assistive technology literature on the whole is not high. There is not an extensive literature on this subject. It was therefore decided to report on the weak papers included in the final 35 while putting them in the context of the stronger articles to allow the readers to form their own opinion on how much credibility to put on the findings and therefore whether or not to apply them to their situation. This strategy protects the heuristic value of some of the studies that would be lost if they were not discussed as a contribution to an emerging literature and recognises the uncertainty around some of the Forbes ratings.

## ***Organisation of the literature***

There are many ways that the literature could be organised. For the purposes of making this review useful in the Australian context we have adopted the headings used by Baptist Community Services in their Department of Health and Ageing funded work on the provision of advice and product descriptions for people contemplating the use of assistive technology in the care of people with dementia (BCS 2008). This list has been extended to include literature that deals with the use of assistive technology as an aid to communication, carer support and as a therapeutic tool.

The review is therefore organised around the following topics:

1. Independence, prompts and reminders;
2. Safety and security;
3. Communication;
4. Leisure and lifestyle; and
5. Carer support.
6. Therapeutic Interventions

### ***Independence, prompts and reminders***

Everyone with dementia experiences a decline in memory and cognition. In most cases this will progress to the point where the person can no longer look after himself or herself and part of this process involves the loss of the ability to sequence the events that must take place to complete a task. The availability of a device that could compensate for this decline would make a significant difference to the quality of life of a person with dementia. The feasibility of providing such an electronic memory aid has been assessed in a methodologically strong, but laboratory rather than real life based, pilot study (Oriani, Moniz-Cook et al. 2003) (Forbes rating = strong). Five people with mild to moderate Alzheimer's disease were required to carry out seven tasks during a 45 minute period. In a free recall condition they were simply provided with spoken and written instructions on what tasks were to be done and when to do them, e.g. 10.15am - take a felt pen, 10.50am - take a sheet of paper from the table, and then left to carry them out. In the second condition the written list of instructions was left with them and in the third condition they were provided with an electronic memory aid (EMA). The EMA is an electronic device which allows the vocal recording of tasks which can then be pre-programmed by date and time. At the time the task is required to be carried out the EMA sounds an alarm which the user responds to by pressing a central button. The EMA then provides a verbal prompt describing the task to be carried out.

The performance of the tasks was scored on a 4 point scale, 0 = forgot the task, 1 = remembered the task but not at the right time, remembered the time but not the task, 2 = remembered the task and time but did not carry out the task, and 4 completed the task at the right time. Statistical analysis showed a significant difference ( $p=0.001$ ) for EMA in comparison with the other two conditions. Interestingly there was no significant difference between the no memory aid and the written list condition. The written list only helped 1 of the 5 subjects. The authors concluded that the study demonstrates that it is possible to train a person with mild to moderate dementia to use an EMA to remember to do tasks at certain times.

This approach has been elaborated by the addition of audio visual prompts and applied to the task of hand washing (Labelle and Mihailidis 2006) (Forbes rating = moderate). Eight people with moderate to severe dementia (7 men) and who required assistance with hand washing were observed going through the hand washing sequence of (a) turn on the water; (b) wet hands; (c) use the soap dispenser; (d) rinse soap; (e) turn off the water; and (f) dry hands with the towel by a carer during the baseline measurement. During the intervention phases a research assistant remotely issued the same prompts, when the person was having difficulties, using a computer, stereo speakers and a television monitor. The experimental conditions comprised verbal prompting, consisting of an unfamiliar male voice addressing each participant by name and providing a simple instruction and audio visual prompting consisting of the same verbal prompts supplemented with a short video demonstration of the step shown on the television monitor mounted above the sink.

The provision of the verbal prompts increased the mean number of handwashing steps completed without a caregiver from the baseline mean of 3.3 to 4.5. The audiovisual prompts increased the mean number of steps completed without intervention by the carer from 3.6 to 4.6. No statistical significance is reported. This suggests that in practice technology using this approach is likely to be capable of assisting people with moderate to severe dementia to get to rinsing the soap off their hands before requiring the assistance of a carer to turn off the water and dry their hands. It must be noted that this pilot study did not actually use automated technology. The prompts were issued by the research assistant playing the relevant prompt by manually activating a computer. The automated technology was being developed to the prototype stage at the time of publication of this report. A description of automated technology designed to assist with handwashing had been provided in an earlier paper written by the second author of this paper (Mihailidis, Fernie et al. 2000) (Forbes rating = weak). The single subject design greatly limits the generalisability of the findings but the study did demonstrate that the technology assisted a person with dementia to wash their hands by increasing the successful completion of sub-tasks from 13 out of 54 to 26 out of 54.

The Enabling Technologies for People with Dementia project (ENABLE) (Gilliard and Hagen 2004) (Topo and Saarikalle 2004) funded by the European Commission under the “Quality of Life and Management of Living Resources” programme provided an opportunity to assess the impact of the provision of a range of devices with the potential to aid memory and increase independence. They were:

- Night-and-day calendar,
- Locator for lost objects
- Pre-programmable telephone

- Automatic bedroom light
- “Do-it-yourself” picture gramophone
- Medicine reminder
- Cooker monitor – for gas cookers
- Remote day planner – a remotely programmed device to remind the user of the day’s activities

The study took place in Lithuania, Finland, England, Ireland and Norway, involving a total of 155 people with dementia. While there was an intention to assess changes in the quality of life of the people with dementia and carer burden the high drop out rate renders the conclusions very tentative. Quality of life was reported as showing no change between the baseline measurement and the final measurement although there was some improvement shown in the intermediate measures. However the results are reported only as aggregates, not broken down into results relevant to each gadget. The results which are reported for each gadget relate to usefulness.

**Table 1: Usefulness of devices and numbers dropping out of trials (compiled from (Gilliard and Hagen 2004; Topo and Saarikalle 2004))**

	Person with dementia self reporting				Family Carer reports				Total of completers	Total of drop-outs	% of drop-outs
	I have used the product		I find it useful to me		Person with dementia has used the product		I find it useful for him/her				
	Number	% of completers	Number	% of completers	Number	% of completers	Number	% of completers			
Calendar	26	68%	32	84%	34	89%	29	76%	38	13	25%
Lamp	4	80%	5	100%	4	80%	3	60%	5	9	64%
Cooker	1	100%	1	100%	1	100%	1	100%	1	6	86%
Locator	13	72%	11	61%	11	61%	11	61%	18	18	50%
Phone	10	77%	11	85%	11	85%	11	85%	13	0	0%
Medicine reminder	3	60%	4	80%	4	80%	5	100%	5	1	17%
Gramophone	Results not reported in this format								21	7	25%
Day planner	No results reported										

## Night-and-day calendar

Many people with dementia cannot keep track of the day or the time. Some do not know whether it is night or day, and may go out or phone relatives in the middle of the night. Carers are also often stressed by frequent questions as to what day or time it is. This can be very irritating and have a negative effect on the relationship between the carer and the person with dementia. The Night- and-Day Calendar has a display, which shows the day, the date and ‘Morning’, ‘Afternoon’, ‘Evening’ and ‘Night’. At midnight, the day and date change automatically. Similarly, the sign

shifts from 'Morning' to 'Afternoon' and so on, at set times. The device is set in a picture frame and plugged into the mains electricity.

Table 1 indicates that 25% of people supplied with the calendar dropped out of the study, 68% of people remaining said they used it and, a surprising, 84% of people remaining in the study said they found it useful. The family carers also found it useful.

The calendar was found to be easy to install however some calendars were faulty, showing squares instead of letters and numbers. They were exchanged and no further maintenance problems were encountered.

Suggestions for improvement included bigger text, improve contrast, use non-reflective glass. The authors commented that

*“The Night and Day calendar was one of the most popular products. This suggests in part that time orientation, particularly to date, day and stage of day was important to the person and the carer, leading to negative relations and increased stress when frequent questions about day and time of day, and carer is becoming increasingly frustrated. For those living alone, time disorientation often meant a great deal of anxiety, and phone calls to carers who may live some distance away, and who were concerned at the distress experienced by the person who is not orientated to time, stage of day.” (Pages 21-22)*

## **Automatic bedroom lamp**

The lamp was tested by 5 persons in three countries: Ireland, UK and Finland. The lamp was expected to prevent falls at night and to facilitate orientation and to reduce anxiety by turning on the light when the person got out of bed, and switching off when the person was back in bed.

Table 1 indicates that 64% of people supplied with the lamp dropped out of the study; 80% of people remaining said they used it and, again surprisingly, 100% of people remaining in the study said they found it useful. The family carers were a little less inclined to describe it as useful.

The installation of the light involved placing a sensor under one of the legs of the bed. This proved to be unreliable and was modified to placing sensors under two legs. The installation was relatively simple.

The authors describe the reliability of the lamps :

*“Initially the lamps worked well. However, after a period of time all the lamps failed to register the person getting into the bed, thus each had to be turned off manually. Another problem for some respondents was that the lamp flashed on and off for no reason during the night, or when moving in the bed. In one case the sensor pads slipped against the carpet and caused that the person fell.*

*The researchers became uncertain of recommending the product due to flaws. Also, respondents tended to withdraw from the trial because of disappointment with the product.” (Page 24)*

Suggestions for improvement included modifying the sensor pads so that they do not slide off casters.

## **The gas cooker monitor**

The gas cooker monitor was selected for optional testing by Ireland (3 respondents), England (3 respondents) and Lithuania (2 respondents). The gas cooker monitor aimed at preventing incidents like burnt pans or fire due to people forgetting to turn off the cooker which may cause burnt food and pans and even a fire. The control turns off the gas when the food being cooked reaches a certain temperature.

Table 1 indicates that 86% of people supplied with the gas cooker monitor dropped out of the study leaving only one person who completed the trial. S/he, and his/her carers, found it useful.

The installation of the gas cooker monitor proved to be complicated, involving two technicians and taking ‘a few hours’. When operating the cooker is fitted with sensors which detect pan overheating and also reacts to gas leakage and smoke. However there were many technical problems with the monitor switches. This was the cause of the drop outs and the disappointment reported by the professionals and carers.

## **Locator for lost items**

The locator for lost items was tested in Lithuania (5 respondents), Ireland (11 respondents), Norway (4 respondents), Finland (11 respondents), UK (5 respondents). The locator device is aimed at enabling people who have mislaid objects in their homes to locate them. The device has a series of touch panels on the front, onto which can be glued pictures of objects to be located. The tags can be mounted on key rings, pension books etc, or put inside purses, glasses cases etc. When the user touches the picture they initiate a sound from tags attached to the lost object so that it can be found. It can be used by both the person with dementia and their carers.

Table 1 indicates that 50% of people supplied with the locator dropped out of the study, 72% of people remaining said they used it and 61% said they found it useful. The family carers agreed with the rating of usefulness.

The locator is installed by placing it on a wall and plugging it in. A good location has to be found, presumably by trial and error. Tags are attached to the items that are commonly lost. The author notes that 'the product requires ability to learn new routines' and suggests that help from someone living with the person with dementia may be necessary.

Problems were found in operating the locator. The buttons did not always respond even when a lot of pressure was exerted. The tags did not always stop ringing when the object was found. The ringing could not always be heard and the batteries in the tags ran out quickly.

## **Picture telephone**

The picture telephone was tested in four countries: Ireland, UK, Finland and Norway, by 13 respondents. The telephone had nine big keys for putting in photos or names of persons to call. These keys were pre-programmed, which made it possible to dial a person by pressing one key and wait for the answer. In addition the phone had a normal keyboard below the picture keys. It was expected that it would be easier to dial not having to remember a row of numbers, but only by pressing one key.

Table 1 indicates that nobody dropped out of this trial. 77% of people supplied with the phone said they used it and 85% said they found it useful. The family carers agreed with the rating of usefulness made by the care recipient .



The phones had to be installed with a tone and pulse facility in Ireland to ensure that they could be used in all locations but elsewhere there were no problems with the installation. The pre-programming of the numbers was demonstrated to the carers with no problems. There were no particular maintenance problems and 'all respondents with dementia using the phone found it easy...' (Page 30) despite the fact that learning a new routine was required to operate the phone.

Suggestions for improvement included making the keys even bigger, having more keys (pictures) available and better contrast of numbers on the ordinary keyboard.

## **Medicine reminder**

The medicine reminder was tested in Norway and five respondents completed the trial. The purpose of the medicine reminder was to dispense medications at the correct time. Its twenty-eight chambers allowing drugs to be provided for four weeks if medication was given once a day, and two weeks if medication was provided twice a day. The medicine reminder was programmed with a pre-set alarm for the correct time for medication. Once the alarm started, the dispenser chamber opened. Turning it up-side-down to pour out the tablets switched the alarm off.

Table 1 indicates that 17% of people supplied with the dispenser dropped out of the study, 60% of people remaining said they used it and 80% of people remaining in the study said they found it useful. All of the family carers described it as useful.

The dispenser was battery operated so no installation was necessary. Family carers were trained how to set the alarms and change the batteries. The reliability of the dispenser was described:-

*"The medicine reminder was reliable, the alarm went off at set time. However, there were experienced problems in battery change and in adjusting the alarm times for summer and winter-time. A need for the public health nurses to know how the medicine reminder worked was identified, however, they did not seem to be interested." (Page 31)*

## **Picture gramophone**

The evaluation of the picture gramophone (PG) was published separately from the other ENABLE products (Topo and Saarikalle 2004). The PG is dissimilar from the other Enable products in that it offers support with reminiscence and entertainment rather than independence and memory loss.

It is reported in this section because of the strong methodological links with the review of other products.

The picture gramophone multimedia program, developed in Finland in the 1990s by Outi Mäki, was designed to be used by people with dementia, to stimulate them and give them pleasure. The PG plays music that has been compiled onto a CD by the use of a purpose designed editing programme, 'Editor'. The 'Editor' was designed to be fairly simple to use so that people with little experience of word processing and the use of Windows could use it with a manual. The Editor program is intended to be used by people other than those with dementia, but the context of each PG should be based on the preferences of individual users.

The Editor includes three tools: a songbook for saving the written lyrics, a timer for making the lyrics to follow the played music and the photo storage where new photos can be saved for further use. The user writes the lyrics as a Word document and uses the timer when adding the parts of lyrics needed in one screen shown for the user with dementia in a ready Picture Gramophone. The photographs, paintings or drawings are used to illustrate either the artists or names or themes of the songs. They are added to the ready made selection of the songs. The final individual Picture Gramophone product includes three screens: first one showing that the Player is in use, the second one showing the first selection which could be for example selection of five artists, the third one is showing the selection of songs of the artist chosen in the second screen. After chosen the song one the fourth screen will start showing the lyrics.

The user can select from a list of artists or groups of, two to six themes or types of music they would like to listen to. Then they can choose the song they prefer from a list of two to six. Text and pictures or photographs supporting the user appear on the screen, e.g. the user sees the names of the songs and photographs associated with them. When the song begins to play, the lyrics are seen on the screen and they are timed to scroll according to the music.

The picture gramophone was assessed in Finland, Ireland, England and Norway. Table 1 indicates that 25% of people provided with access to it dropped out before completing the trial.

Two quotations capture the essence of the results of the evaluation.

*“The results from all the four countries were similar: there were many problems in use of the Editor and in getting the Picture Gramophones ready. But when ready most users were satisfied with the end product. It was also obvious that when more time than expected was needed to get the Picture gramophones ready this decreased the*

*motivation to continue the use. It also may have affected on how the users assessed those Picture gramophones they made and for sure it was associated with the quite low ranking of the Editor in the question about whether the result was worth to effort.”*

*“Even though staff members reported that every second user had some problems using the PG, all except two were said to have benefited from using it. In Finland only every third user had problems but in Norway everyone experienced difficulties at some time. According to both the responses of staff members and the users' own comments, the oldest users and users with severe dementia had more problems with using the PG than the other participants but the difference was not statistically significant.” (Page 44)*

Summarising the 4 empirical studies on the use of assistive technologies for increasing independence and compensating for memory problems it seems fair to say that once the evaluation moves from the laboratory significant practical and methodological problems emerge. These are reflected in very small samples, high drop out rates, very basic statistical analyses and poor performance of the technology itself. In general the use of the technology reported to date makes little difference to practical outcomes.

## ***Safety and security***

No methodologically robust evaluations of the use of assistive technology to improve the safety and/or security of people with dementia were found. Two weak studies, as assessed using the Forbes criteria, investigated the impact of the introduction of a package of assistive technologies including general and individualised passage alarms, sensor-activated night time illumination and fall detectors on staff and relatives associated with a cluster of small residential units for people with dementia. (Engström, Ljunggren et al. 2005; Engstrom, Lindqvist et al. 2006) The authors concluded that staff members' job satisfaction and perceived quality of care improved in comparison with a control group and that the relatives' opinions of IT support were positive and improved during the implementation of the support package. No attempt to assess the impact on residents through direct measurement was reported.

One of the most critical safety concerns encountered in the care of people with dementia is that of ensuring that the person with dementia is safe when they attempt to leave the building in which they live. A range of interventions are used to address this issue ranging from physical and chemical restraints, the locking of doors and windows, environmental modifications, e.g. placing visual barriers on or in front of doors (Namazi, Rosner et al. 1989; Dickinson, McLain-Kark et al.

1995) through to constant supervision. There is a strong desire to replace these draconian and/or labour intensive interventions with technology based approaches that maximise individual freedom while providing safety from getting lost. However, to date, there is no methodologically robust investigation of any technological device that might assist with this issue. Given that 40% of patients with dementia get lost at some point in their illness and 5% get lost repeatedly over many months (McShane, Gedling et al. 1998a) this issue is of such importance that the results of 4 studies that are classified as poor by the use of the Forbes criteria will be described.

The earliest investigation dealt with the issue of finding a person with dementia who has wandered away from home (McShane, Gedling et al. 1998b). A telephone survey of 99 carers suggested that 20% of a sample of people with dementia living at home with the help of community psychiatric nurses were at continuing risk of traffic accidents and 45% of getting lost. The use of a tracking device involving wearing a transmitter on a belt was described to the carers, 7% said that it was likely to be of benefit at the time of the interview and a further 11% said it could have been of benefit at an earlier stage.

A study designed to assess the feasibility of using the tracking device in practice was carried out on 24 patients referred by psychogeriatricians and community psychiatric nurses. Seventeen were male, 5 had never been lost before but were regarded as being at risk, 14 had been lost on up to 5 occasions. Following the initial assessment the transmitter was worn by 13 patients of whom 8 were living at home. The reasons for the exclusion of 11 of the patients initially referred were one or more of the following: increased disability leading to reduced mobility (9 cases), no carer available to use the receiving device (7 cases) and carer thought it unlikely that the patient would tolerate wearing the transmitter (6 cases). The transmitter was the size of match box, had a 15 cm aerial and could be worn on a belt, wrist, as a pendant or attached to clothing.

In practice the transmitter was worn for no more than a few days in 4 cases, up to 3 months in 3 cases and for 3-8 months in 6 cases. The primary reason for the early drop outs was lack of willingness of the patient to wear the transmitter. The device was used in a search 4 times and was instrumental in finding the person on 2 occasions.

The device used in this study was, by current standards, clumsy, especially the receiver which was similar to a small television aerial and gave only an approximate indication of the direction in which the person lay. The availability of GPS technology integrated with a mobile phone promises much greater accuracy and ease of use. The first report on the use of this technology was published in 2005 (Miskelly 2005). GPS equipped mobile phones were provided to 11 patients with dementia (no details of type or severity of dementia provided) for a total of 84 patient weeks.

The relative/carer was responsible for ensuring that the phone was 'worn' by the patient every day. The person with dementia was 'sent out to walk randomly .... In an attempt to simulate the walk of a lost elderly person.' (Page 497) To confirm that the tracking was accurate the participant's location on the central computer was compared with either the information given by the relative/carer during the preliminary interview where a description of the regular activities of the participant had been obtained or with a description given by the carer over the phone. The location was correctly identified by the GPS system more than 90% of the time. However 5 of the 11 participants dropped out of the study because of 'usability or comfort issues'. The author concluded that 'a simpler phone that is easier to use and more comfortable to wear may be necessary. When compliance is high, however, the system works well enough to be used as a reliable tracking device for dementia patients.'

A simpler phone was used in the most recently reported investigation of the use of GPS tracking of people with dementia (Rasquin, Willems et al. 2007). This phone had only 3 buttons, one to switch it on and off, one to send an alarm call to a service centre and one to dial a pre-programmed number. This type of phone combines a tracking function, which is of particular use to a carer, with a function that assists the person with dementia to make contact in an emergency. The authors caution that the GPS technology is not accurate or reliable if the signal is not stable/ or identifiable because of environmental factors for example, if the person is in a steep valley, inside a building or under trees. In good circumstances it provides a location to an accuracy of 4 to 10 metres when interrogated by remote calling to the phone.

Seven participants were selected for inclusion in the study. Selection criteria included being in an early stage of dementia, living at home with an informal caregiver, able to go for a walk outside and able to have basic communication. By the time the field trial began "four patients were too ... deteriorated in cognitive functioning, and going outside alone was not possible anymore. The fifth couple was willing to participate. However, when the researchers explained the use of the technology they decided that it was too complicated for them. For the sixth couple the informal caregiver would participate, but the patient with dementia refused to participate. The seventh couple agreed to participate." (Page 117) ( The investigation continued with one subject. This person was described as having had dementia for 3 years, being mildly demented with word finding and short term memory problems and likely to get lost in an unknown environment.

The results of the field trial are described:-

"The informal caregiver made a telephone call. This went how it should be, the person with dementia picked up the telephone, but had some problems in remembering the

correct button. Localisation of the person with dementia was not accurate, due to technical problems. The caregiver asked the location of the person with dementia via the service centre. The wrong location was given (the streets that were located were three blocks further away than the actual location of the patient).” (Rasquin, Willems et al. 2007) (Page 118)

Leaving aside the technical problems that resulted in the wrong location being provided the authors concluded that ...

“...using technological devices to increase the possibility of going outside alone for the person with dementia depends on a lot of prerequisite constraints, which should be specified before broad implementation of technological devices in health care is decided on. More specific information is needed to define the typology of the user group, before implementation of technology can be started.” (Rasquin, Willems et al. 2007)(Page 119)

It is clear that in the area of mobility outside of a home there are major technical problems and issues of user acceptance and ability to operate the technology that remain unsolved, or if they have been solved no sound assessment of the solution has yet made its way into the literature. The provision of a safer environment within a home provides another opportunity for technology to be of assistance. Tagging systems are widely used for monitoring prisoners in Europe. The prisoner wears a bracelet which is a small radio transmitter. One or more monitoring stations detect the signal from the transmitter and this identifies which zone the prisoner is in. If the prisoner is in the wrong zone then a warning is transmitted to a pager worn by a staff member. This technology has been adapted for use in residential care.

“Residents wearing a bracelet are able to move freely around the facility, or can be restricted to certain zones within that facility. The system can vary the conditions of warning depending on time of day so that, for instance, the resident’s presence in the garden may be acceptable during the day but not at night. The advantages of the system are that no permanent wiring is required making it easy to install and it only generates an alarm when wearers of the bracelet approach a pre-determined area of risk.” (Miskelly 2004) (Page 304)(Forbes rating =weak)

It was tested on 4 residents (no details supplied) living in a 39 bed, 3 storey residential home for an unspecified but apparently prolonged period. Two episodes of wandering outside the building were detected by the system and attended to by staff. A daily average of 15 events involving wandering into an internal ‘at risk’ area were detected. False alarms were few. As the bracelet is

designed to require two hands for its removal it was difficult for the residents to remove it; however one of the four was successful and this was detected as an alert by the system.

The author concludes that the system was successful in preventing dangerous situations from developing and reports that staff and relatives felt reassured by being alerted to every wandering event. He also notes that "Only the use of a Control Group in a Randomised Control Trial (without the ability to intervene) would allow us to estimate the true benefit of the equipment" (Page 305) and recommends that large-scale trials be undertaken.

In general it must be concluded that the evidence for the effective use of assistive technology to improve the safety and security of people with dementia is, as yet, very weak. The common problems associated with lack of acceptance by the user, difficulties with use and technical reliability are evident. The need for careful assessment to determine the likely benefit of the technology to an individual is also clear, one size does not fit all and there is a strong suggestion that the window of opportunity for the successful application of technology is quite small.

## ***Communication***

Approximately 24% of people with dementia living in the community live alone (AIHW 2006). The availability of a reliable method of communication could, potentially, support them in maintaining their social networks, performing daily activities and in getting help when needed. The telephone is perhaps the most commonly used and reliable method of communication used by people living by themselves so the question arises can the telephone be used by people with dementia to assist them maintain their independence, interdependence, health and safety.

The introduction of a 'simple-to use' telephone into the homes of people with dementia who were accustomed to using a telephone was evaluated in 6 homes in Finland (Topo, Jylha et al. 2002) (Forbes rating = weak). The initial sample of 11 was reduced by five - one person had a heart attack, the phone disturbed one person with dementia who had hallucinations and three people described the phone as unnecessary. The remaining 6 people were aged 55 to 90 and having either mild or moderately severe dementia according to the Clinical Dementia Rating Scale (Hughes, Berg et al. 1982).

The telephones had 12 keys with clear plastic covers under which a photograph or written information could be displayed. The use of the telephones was explained to the people with dementia and their carers, most of whom were cohabitant, and then monitored for 2 months by inviting the carers to complete a questionnaire on the use of the phone on 10 occasions and by follow up interview. Three of the people with dementia showed an improvement in their use of the

phone by moving from 'Answers telephone but does not dial' to 'Dials a few well known numbers'. One improved from 'Does not use telephone at all' to 'Answers telephone but does not dial'. The authors concluded that 'Most of the problems that the people with dementia had with phone use in general did not disappear with the use of the new phone. In most cases it did not help the person to remember whom he called and when'. However carers found the phones easier to use and purchased them for use after the study. Most of the carers commented that the phone may have been more useful at an earlier stage in the dementia.

An alternative strategy of training people with dementia to use their existing phones, in this case a mobile phone, has also been evaluated (Lekeu, Wojtasik et al. 2002) (Forbes rating = weak). Two people with mild Alzheimer's disease were trained for 45 minutes 1 or 2 days per week for 3 months. Each training session was divided into 2 parts. In the first part the spaced retrieval technique was used to promote the consultation of a card pasted on the back of the phone. The card described each stage of making a call. In the second part calling exercises were repeated many times using errorless learning principles, e.g. trainer anticipation of an error and intervention with correct response to avoid the memorising of an incorrect response. One person was able to make a call without using the card as a prompt after 11 weeks of training and the other after 14 weeks.

This study illustrates the level of sophisticated effort required to maintain the abilities of a person with dementia to use technology with which they are already familiar. If it is impractical to enable the person with dementia to initiate communication perhaps technology can assist with health and safety issues by providing easier access to prompts and assistance from a remote carer.

The possibility of providing cognitive assessment and an intervention aimed at improving cognitive performance via a videoconferencing system was investigated in a sample of 22 people randomly allocated to videoconferencing or face to face contact. (Poon, Hui et al. 2005) (Forbes rating = moderate). The mean score of the whole sample on the Cantonese version of the Mini-Mental State Examination (Chiu, Lee et al. 1994) was 18.5, indicating significant cognitive impairment, and there was no significant difference between the two groups of 11 after random allocation. A total of 12 sessions were conducted over 6 weeks via either videoconferencing or face to face without their being any major modifications in the assessment and training methods for either group. (No details are provided on the training methods). Both groups improved significantly ( $p < 0.001$ ) in the areas of attention and memory, calculation and language with the face to face group also improving in spatial construction ( $p < 0.001$ ). Ten of the eleven people in the videoconferencing group were satisfied with the audio and visual quality of the



videoconferencing system and the majority of this group expressed a preference for this mode of delivery as it saved the time and cost of travelling.

While drawing attention to the small sample size and short follow up period the authors concluded that telemedicine is a feasible and acceptable means of providing cognitive assessments and interventions to older people with mild cognitive deficits. However an investigation of the use of a similar system to monitor and prompt the taking of medications has also been carried out (Smith, Lunde et al. 2007) (Forbes rating = weak). This project involved 14 people with mild dementia who lived alone, 8 of whom received video monitoring and/or a 'plain ordinary telephone service' (POTS) monitoring service. The video and telephone monitoring services involved a call from a nursing assistant timed to coincide with the time to take a medication. So if the client required medications in the morning, at noon and at bedtime he or she was contacted at that time, if medications were only prescribed once per day the client was only contacted once per day. Medication compliance was assessed over a two year period and compared with 6 people who received standard care, defined as 'whatever the family might independently arrange'. During this time more than 4,000 telemedicine contacts were conducted. Over time, the video-monitored group remained stable in their compliance while the other groups declined. The rate of change between video and no monitoring was significantly different ( $P < .05$ ), as was the difference in compliance at the end of the evaluation period ( $P < .05$ ), with values of 81%, 80%, and 62%, for video, phone, and no monitoring, respectively. There were no significant differences between the video and phone monitoring services. The authors concluded that :-

“... our small study provides encouraging results for the ability of a home telehealth application to positively affect mild dementia patients. It provides another example of use of telemedicine applications to avoid the need for home health care visits. Video and possibly simple phone monitoring may help stabilise medication compliance in such patients who live alone and may be at risk for premature relocation out of their homes.”  
(Page 26)

A much broader use of telemedicine for people with dementia and their family and professional carers is reported in an earlier study (Lee, Kim et al. 2000) (Forbes rating = weak) which describes the experience of a telemedicine system operated from Seoul National University for dementia patients in a nursing home and a medical centre. The service, which included assessment, diagnosis, counselling and staff education, reached 140 patients, 680 family carers and 140 care staff over a two year period.

The results of assessment of the severity of dementia obtained via the telemedicine link and from resident specialists were identical in 76% of the medical centre patients and 89% of the nursing home patients and the diagnosis of dementia was agreed to 100% of the time. The education provided through the telemedicine system was preferred by the care staff over traditional face to face education and the telemedicine interactions between clinicians and patients were well accepted by the patients.

In general the literature seems not to support the use of technology (in its current form) to enhance communication initiated by the person with dementia but it provides some promise that remote carer initiated communication can be used for assessment and simple therapeutic interventions. However the studies are not methodologically strong.

### ***Leisure & lifestyle***

No methodologically strong studies investigating the impact of technology on the leisure and lifestyle of people with dementia were found.

### ***Carer support***

Family caregivers have been described as the 'second victims' in dementia care (Ory, Hoffman et al. 1999; Winter and Gitlin 2006). They tend to under-utilise existing services (Brodaty, Thomson et al. 2005) while being at risk of stress, depression, sleep deprivation, mortality and social isolation (Schulz and Beach 1999). Factors that contribute to depression include the behaviour problems of the persons with dementia being cared for, the carers' perception of their own lack of mastery of the skills needed and isolation (Ory, Yee et al. 2000).

Support and education have proven to be effective in alleviating some of the consequences of providing prolonged care to a family member with dementia (Brodaty and Gresham 1997; Brodaty, Green et al. 2003). The contribution of technology to these interventions has been investigated in methodologically sophisticated studies.

The reduction of caregiver stress by the provision of an interactive voice response (IVR) system providing the following functions has been investigated:(Mahoney, Tarlow et al. 2003) (Forbes rating = strong)

Weekly caregiver's conversation – an automated IVR conversation monitoring the caregiver's stress levels and providing information on how to manage the care recipient's behavioural problems

Personal mailbox – provided caregivers with the opportunity to anonymously send and receive confidential voice mail between themselves or to communicate with a clinical nurse specialist who answered or forwarded questions to a multidisciplinary professional panel of dementia experts.

Bulletin Board - an in-home telephone support group that provided personal and caregiver group voice mail, similar to a computer chat group.

Activity-Respite Conversation - an automated, personalised conversation designed to reduce disruptive behaviours and to provide caregivers with respite time. When initiated by the carer, this module offered the care recipient a personalised pleasant conversation designed to engage the listener in a safe, comforting, and non-demanding activity. The conversation lasted 18 min and would repeat once if not disconnected.

The IVR system was designed to be available 24 hours per day without the need for human intervention.

People with dementia (MMSE <24) and their caregivers were randomly allocated to an intervention group and a control group. The 49 dyads in the intervention group were given 12 months access to the IVR system via their own telephone and a brief training session. The 51 dyads assigned to the control condition were given a booklet containing advice on care similar to that provided by accessing the caregiver's conversation in the IVR system. There were no significant differences in characteristics between the control and intervention groups for either the caregivers or the care recipients at baseline. All participants were interviewed at 6, 12 and 18 months post baseline. Assessments of the 'bothersome nature of the care recipient's disruptive behaviours', anxiety and depression were made during these interviews.

The overall results did not support the hypothesis that this type of intervention would reduce caregiver stress. Bother, depression and anxiety scores did not differ significantly between groups at any assessment point. However more detailed analysis revealed a significant effect in all 3 measures for those caregivers who scored in the low-mid range of the Caregiver Mastery scale, a measure of the extent to which the participant regarded his or her life chances as being under his or her own control (Pearlin and Schooler 1978). At 18 months the significance of the differences were as follows: bother ( $p = .04$ ), anxiety ( $p = .01$ ), and depression ( $p = .007$ ).

The authors concluded that the significant improvement in this group highlighted the need to target technological interventions to those who have the potential to benefit from them. A conclusion supported by the wide range of use made of the IVR system during the project. On average, usage was concentrated to the first 4 months and amounted to 55 min/user (SD = 78 min) over the 1-year period (range 1-318 min), with calls numbering between 1 and 45 (11 on average) and lasting 3 min and 40 seconds per call. Clearly some participants in the study made very little use of the service.

The benefits of a fully automatic support system appear to be limited to a particular group of people with a low sense of their ability to manage the situation. The use of telephone based support where the discussions and support are facilitated by trained social workers interacting with a small group of caregivers has been investigated in a randomized controlled study on 103 female caregivers (Winter and Gitlin 2006) (Forbes rating = strong). The 58 caregivers randomised to the intervention group were provided with the opportunity to take part in weekly, 1 hour support groups via telephone from their own home. On average participants took part in 14.8 of the 26 available sessions. The groups were conducted on traditional lines with an initial focus on group cohesion leading on to disclosure and discussion of intimate problems with caregivers expressing emotion and sharing coping strategies. Depression, caregiver burden and 'gains through involvement' were assessed at baseline and 6 months post baseline.

There were no significant or large differences between the intervention and control groups at 6 months but there was some indication that older participants gained more benefit. The authors concluded that 'Overall, these results argue for minimal benefits of support group participation ...' (Winter and Gitlin 2006).

The benefits of using technology, in the form of the telephone, as an adjunct to psychosocial therapy so that it supplements an intervention based on human contact rather than being the only medium through which contact is made has been investigated in a methodologically sophisticated study weakened by a high attrition rate (Eisdorfer, Czaja et al. 2003) (Forbes rating = weak). A sample of 225 people caring for people with dementia (MMSE<24) for at least 4 hours per day was randomly divided into groups receiving family therapy, family therapy plus access via telephone to a computer aided information network and a minimal support control group.

The 26 family therapy contacts usually took place in the home of the caregiver. The control group received bi-weekly supportive telephone calls for the first 6 months and monthly calls for the next 6 months. The computer supported information system was designed to augment the family

therapy by providing the caregiver with enhanced access to resources including the ability to talk with up to 6 others at a time of their choosing, to engage in weekly discussion groups, send voicemail to family members and/or the therapist, receive reminders from therapists, access resources from the Alzheimer Association Resource Guide.

Overall the family therapy plus access to the information network intervention was effective in lowering caregiver depression scores relative to the control group, measured by the CES-D (Radloff 1977), at 6 months ( $p=0.036$ ) but at 18 months the reduction, though apparent, was no longer statistically significant. The family therapy alone intervention did not have a significant effect on depressive symptoms for most of the caregivers. The authors explain the advantages of the technologically augmented family therapy:

“The unique feature of the more successful combined therapy and technology intervention was that, in addition to receiving in home family therapy, caregivers were able to access local resources and participate in family conferences and online support groups by using simple, readily accessible, computer-telephone technology. The technology may have facilitated the ability of the caregivers to receive additional needed individualised support without having to leave their homes. Caregivers were also able to control the type and amount of support they received. They were able to access resource information and participate in online discussion groups as frequently as they wished. The system may have also helped caregivers to resolve family conflicts that may have arisen during the therapy sessions ...” (Page 529)

In summary the limited literature available provides some support for the use of assistive technology to facilitate communication and access to support and information for caregivers of people with dementia. However the benefits are small as is the uptake of opportunities to use the technologically supported systems. The best results appear to come when the technology is used by people who consider that they lack mastery over their situation and when used to augment face to face contact. (Brignell, Wootton et al. 2007)

## ***Therapeutic interventions***

### **Bright light**

There is a growing interest in the potentially beneficial effects of increasing light levels to overcome the exceptionally low exposure to bright light experienced by many people with dementia living in institutions (Ancoli-Israel, Clopton et al. 1997) which lead to sleep disturbance. A methodologically robust RCT, marred only by lack of information on participation rate, (Ancoli-Israel, Gehrman et al. 2003) (Forbes rating = weak) involving ninety-two patients randomly

assigned to morning bright light, morning dim red light, or evening bright light, (mean of 105 minutes exposure to 2,500 lux) showed that:

“...the effect of light treatment on sleep and circadian activity rhythms in patients with AD suggest that increased bright light exposure, whether in the morning or in the evening, consolidates night-time sleep by lengthening the maximum sleep bouts during the night. There was, however, neither an effect of light treatment on total sleep time nor on wake time during the night or day. In other words, sleep was consolidated but overall time asleep did not change as there were longer but fewer sleep bouts. The magnitude of this effect was also clinically meaningful. Morning light increased the maximum sleep bout length by over 30 min while evening light increased the maximum sleep bout length by over 20 min.” (Page 31)

These findings are generally consistent with those found in a small study (Koyama, Matsubara et al. 1999) (Forbes rating = weak) in which 4 of the 6 nursing home patients with dementia showed less waking during the ‘lights out period’ ( $p < 0.05$ ) and 2 showed less sleeping during the day ( $p < 0.05$ )

However these results were challenged by a randomised control trial, (Lyketsos, Lindell et al. 1999) (Forbes rating = moderate), weakened by a high attrition rate resulting in a small sample, which found no significant improvement in nocturnal sleep or agitated behaviour in a group of patients in a dementia specific, chronic care facility who were exposed to 10,000 lux at a distance of 3 feet daily for 4 weeks.

The application of this approach in a more naturalistic way, i.e. avoiding the restrictions inherent in getting people with dementia to sit beside light boxes for extended periods by providing elevated light levels in public areas, has been well investigated (Sloane, Christianna et al. 2007) (Forbes rating = strong).

“Analyses of data from this cluster-unit intervention trial of persons with dementia in two care facilities indicate that high-intensity ambient light therapy in the morning or throughout the day resulted in a small but statistically significant increase in night-time sleep minutes and inconsistent effects on night-time sleep consolidation and daytime sleepiness. ...The study also demonstrated that bright light was well tolerated and was not associated with adverse effects. The light delivery method used in this study involved remodelling the activity and dining areas of institutional settings, thereby providing passive light exposure. Data on intervention fidelity indicate that this method produced

median light intensities close to the target level of 2,500 lux. Furthermore, mean participant exposure was comfortably above the target of 1 to 2 hours per treatment day, and more than 85% of participants received at least 1.5 hours of exposure regardless of treatment. ...These results suggest that environmental modification may be superior to light boxes, the current therapeutic standard, as a light delivery method. Although statistically significant, the clinical significance of the finding that total sleep time was 11 minutes longer under morning or all-day light is unclear.” (Page 1531)

These results had been anticipated to some extent in a study involving bright light treatment for 22-demented patients that avoided the use of light boxes and the need for restraining patients to one location by installing bright lights into the living rooms of severely demented patients on a psychogeriatric ward. (Van Someren, Kessler et al. 1997) (Forbes rating = weak) Rest-activity rhythm was assessed two weeks before baseline (average light intensity 436 lux), three weeks after installation of the light (average light intensity 1136 lux), and then four weeks after the removal of the light (average light intensity 372 lux). Results showed that during increased illumination the rest-activity rhythm increased in patients with intact vision, but not in significantly visually impaired patients, suggesting that the change was not due to a placebo effect.

Sloane et al go on to provide a standard by which the significance of these changes can be assessed.

“To better gauge the clinical significance of this finding, the results were compared with those of published clinical trials of commonly prescribed sleep medications. Zolpidem and temazepam, the most commonly prescribed sleep medications in 2005, produce approximately 30 minutes of additional sleep in young adults and healthy elderly volunteers, but the favorable effect of hypnotic medication appears attenuated in older persons. One randomized trial in 72 elderly persons with chronic insomnia, for example, reported only 4.4 more minutes of sleep with temazepam than with placebo. Furthermore, in long-term care populations, the risks of (adverse effects from) sedative–hypnotic medications are particularly high”. (Sloane, Christianna et al. 2007)

Unlike the light box therapy approach this approach does not appear to involve any additional staff resident interactions. The positive results are therefore more likely to be due to the increase in light levels than to the beneficial effects of spending time with staff.

Further supportive evidence comes from a study (Rheume, Manning et al. 1998) (Forbes rating = weak) where residents with difficulty in sleeping were exposed to intense light (2,500 lux at eye

level) in a pleasant room when residents had difficulty in sleeping. Outcomes, which were positive in 3 case studies of people with dementia, were not statistically analysed.

In addition to beneficial effects on sleep patterns the provision of very high light levels (10,000 lux) during a 30 minute breakfast period has been shown to have positive effects on behavioural disturbance as measured by the Cohen Mansfield Agitation Index in a sample of 16 demented residents ages 60 to 89 using a repeated measures ABA design (Thorpe, Middleton et al. 2000) (Forbes rating = moderate). The brightness of this illumination may be gauged by comparing it to the 1000 lux which is approximately equivalent to being outside on a cloudy day.

The provision of simulated dawn/dusk variations in light produced similar consolidation in sleeping patterns (Gasio, Kräuchia et al. 2003) (Forbes rating = weak). Significant improvement in MMSE scores ( $p=0.0012$ ) was obtained in a group of 9 nursing home residents with either Alzheimer's disease or vascular dementia given 2 hours of bright light therapy (3,000 lux) each day for 10 days. No improvement was observed in the randomly allocated control group. (Graf, Wallner et al. 2001) (Forbes rating = weak because of high attrition rate).

In summary there is good evidence to show that the use of technology to provide periods of relatively high intensity lighting helps residents with dementia sleep better and reduces behavioural disturbances. These results may be particularly important for residents of aged care facilities in high latitudes or cloudy climates where access to sunlight is limited. The application of artificial light in the Australian context, where there is a great deal of natural sunlight, may be redundant if staff are encouraged to help residents access outside areas for safe periods of time.

## **Multi-sensory environments**

Over the last 15 years there has been steady interest shown in the possibility that exposure to multi sensory stimulation (MSS) may have beneficial effects on the well being of people with dementia (Chung and Lai 2002). The term Snoezelen has become synonymous with this approach. It is a Dutch neologism bringing together the idea of exploring stimuli and being in a state of pleasant relaxation. A typical Snoezelan room will contain a bubble tube, a large tube filled with water, backlit by coloured bulbs to enhance the effect of the bubbles rising in it; sprays of fibre optic cables which change colours in a rhythmical manner; a CD player to provide a musical background; a projector for the projection of abstract or representational images onto the walls; a disco ball that reflects light into moving or stationary patterns; and a range of tactile materials such as soft balls. The inclusion of some basic technological devices, e.g. projector, fibre optics brings this approach to stimulation into relevance here and, more subtly, so does the



substitution of artificial stimulation for natural stimulation, e.g. sunlight, clouds moving, birds singing.

The effects of enriching the environment by providing multi-sensory stimulation in a Snoezelen room and through activity therapy have been investigated in a carefully described RCT (Baker, Bell et al. 2001) (Forbes rating = strong). Fifty patients with diagnoses of moderate to severe dementia were randomized to either MSS or Activity groups. Patients participated in eight 30-minute sessions over a 4-week period. Both methods of increasing the level of stimulation were effective. Immediately after MSS and Activity sessions patients talked more spontaneously, related better to others, did more of their own initiative, were less bored/inactive and were more happy, active or alert. Both groups were more attentive to their environment than before, with a significantly greater improvement from the MSS group. Members of the activity group interacted more appropriately with the objects around them than those in the MSS group ( $p=0.001$ ), the only significant difference between the groups when differences in baseline assessments were statistically controlled. The effects evident during the sessions were not detected at the 1 month follow up.

A replication of this approach in a multi-centre study (Baker, Holloway et al. 2003) (Forbes rating=strong) failed to show any significant difference between an MSS group and a credible control group after providing 8 x 30 minute sessions of either MSS or activities such as playing cards, looking at photographs. Both interventions produced improvements in relationships between residents and boredom measured after the sessions finished. However this improvement was lost at 1 month follow up.

Short term improvements in mood and activity were reported in an early evaluation of exposure to MSS in a Snoezelen room (Hope 1998) (Forbes rating = weak). Data were collected on 29 patients with dementia in a department of old age psychiatry over an 8 month period. The statistical analysis was limited to percentage change and no significance levels were reported. The author noted that, while the experience was predominantly positive, some patients responded negatively and suggested that further research is required to identify the groups that benefit. She also noted that the room was under-utilised, perhaps because staff were unfamiliar with it and its use had not been well integrated into the treatments programme on the ward.

Much longer lasting effects were observed when Snoezelen sensory stimulation techniques were integrated into a 24 hour, individualised, person centred care inspired intervention (van Weert, van Dulmen et al. 2005) (Forbes rating = strong) This intervention involved the use of detailed

social histories, the identification of preferences of the various sensory stimulation modalities available within the Snoezelen approach, extensive training of staff and 18 months of intervention.

Twelve psychogeriatric wards of six nursing homes, spread over the Netherlands took part. The wards were randomly allocated to the intervention and control groups. Sixty two residents with moderate to severe dementia received the intervention and 63 were allocated to the control group. Assessments of depression, agitation and emotional responses were made at baseline and 18 months later. While most ratings in the control group showed negative changes, the intervention group had significant positive changes ( $p < 0.05$ ) for distorted consciousness, rebellious behaviours and depression. No negative changes or side effects were found in the intervention sample.

This study involved a very complex set of inter-related changes in the intervention nursing homes. The authors concluded that:

“The actual effective ingredient(s) of the *snoeze/en* intervention still remain indeterminate. The combination of individualised, person-centred care and a 24-hour comprehensive care plan integrating multisensory stimulation might contribute to the success, although additional scientific research is needed to gain more insight into the underlying mechanisms.” (van Weert, van Dulmen et al. 2005) (Page 31)

It is not clear that the study involved the use of the usual technological devices found in Snoezelen rooms, e.g. disco balls, audio/visual devices. It may have used the approach to Snoezelen adopted in a trial comparing it with one-on-one activity in a psychogeriatric ward where the multi-sensory activities involved only manipulating beads, puzzles and feeling different types of cloth (Staal, Sacks et al. 2007). The integration of these into a behavioural therapy approach was associated with significant improvement in activities of daily living, agitation and apathy as measured with the Pittsburgh Agitation Scale and the Scale for the Assessment of Negative Symptoms in Alzheimers Disease ( $p = 0.05$ )

The relative benefits of providing stimulation via artificial and natural environments has been investigated (Cox, Burns et al. 2004) (Forbes rating = moderate). This two-stage project examined how effective two types of multi sensory environments were in improving the well-being of older individuals with dementia. The two multi sensory environments were a Snoezelen room and a landscaped garden. These environments were compared to the experience of the normal living environment. The observed response of 24 residents with dementia in a nursing home was measured during time spent in the Snoezelen room, in the garden, and in the living room. In the

second part of the project, face-to-face interviews were conducted with six caregivers and six visitors to obtain their responses to the multisensory environments. Both the Snoezelen room and the garden decreased the signs of sadness, ( $p=0.05$ ) as measured by the Affect Rating Scale (Lawton, Van Haitsma et al. 1996) shown by residents in comparison with the living room. However there was a significant increase in pleasure in the three environments when the residents were approached by staff. The authors concluded that

‘in terms of the relative effectiveness of each environment in improving well-being of participants, the quantitative data indicate few differences between them. Qualitative data obtained by interviewing staff and caregivers indicated that ‘No matter which of the three environments was being spoken of, it was the opportunities of a one-to-one relationship, quality time, and to feel closer, that were valued...’ (Page 43)

In summary it must be said that there is little in the way of convincing evidence to support the use of Snoezelen technology over the use of other activities to improve the well being of people with dementia. This conclusion is shared by other reviewers (Chung, Lai et al. 2002)

## **Audio technology**

Technology for recording and reproducing sound has been around for a long time and is continuously developing, from records to cassettes, CDs and MP3 files. Results of a well controlled trial of music played through a cassette player suggests that this use of technology has a contribution to make (Clark, Lipe et al. 1998) (Forbes rating = strong). The purpose of this study was to examine the effects of recorded, preferred music in decreasing occurrences of aggressive behaviour during bathing among 18 individuals with Alzheimer's type dementia, aged 55 to 95, with severe levels of cognitive impairment. They were randomly scheduled for observation during bath time under either a control (no music) condition or an experimental condition in which recorded selections of preferred music were played via audiotape recorder during bathing. Following a 2-week (10 episode) observation period, conditions were reversed. A total of 20 observations were recorded for each individual. Results indicated that while the music was being played, decreases occurred in 12 of 15 identified aggressive behaviours. Decreases were significant ( $p < 0.05$ ) for the total number of observed behaviours and for hitting behaviours. During the music, caregivers frequently reported improved affect and a general increase in cooperation with the bathing task.

A reduction in agitated behaviours has also been demonstrated when songs ‘characterised by an upbeat rhythm and gay lyrics’ are played through a CD player as background music (Ziv, Granot

et al. 2007) (Forbes rating = moderate). This study examined the effect of background music on both positive and negative behaviours, during a time in which patients with Alzheimer's disease, MMSE scores of less than 11, were not occupied with any structured activity. Twenty eight participants were observed both with and without the stimulative, familiar background music. Results showed both a significant increase in positive social behaviours and a significant decrease in negative behaviours related to agitation when music is played (both changes  $p=0.001$ ).

Perhaps the most disruptive and, in the long run, disturbing behaviour is repetitive calling out, screaming or moaning. A technological alternative to pharmacotherapy was explored by Burgio et al (Burgio, Scilley et al. 1996) (Forbes rating = moderate) who investigated the efficacy of two environmental "white noise" audiotapes for the treatment of verbal agitation in severely demented nursing home residents. In addition to using technology, in the form of audiotapes of 'environmental white noise', the investigators used a computer-assisted real-time observational system to assess both the frequency of verbal agitation and the actual use of the intervention on the nursing units (treatment fidelity). The environmental white noise was the sound of gentle ocean waves and mountain streams. Results indicate a 23% reduction in verbal agitation ( $p=0.001$ ) as measured by a staff rating of type and severity of verbal agitation. These results were obtained even though treatment fidelity data showed that the audiotapes were used during only 51% of the observations. The authors discuss the need for formal staff management procedures for increasing staff compliance with treatment and provide details of their computerised monitoring system.

In summary there is good evidence to suggest that simple audio technology has a place in the management of disruptive behaviour but even here there appears to be some resistance to its use.

## **Simulated presence therapy**

The original form of Simulated Presence Therapy (SPT) involves playing an audiotape to a person with dementia over a personal stereo of his or her carer's voice. It was first described by Woods and Ashley (Woods and Ashley 1995) who used this intervention with 27 people with dementia living in a nursing home. They reported that SPT was successful in alleviating 'problem behaviours' such as social isolation, verbal aggression or agitation on at least 89 per cent of the occasions that it was used. A systematic attempt to assess its efficacy by comparing it to usual care and the opportunity to listen to a favourite music tape involved six nursing home residents with a diagnosis of Alzheimer's disease or another form of dementia resulting in moderate to severe cognitive impairment and high levels of anxiety (Cheston, Thorne et al. 2007) (Forbes

rating = moderate). In total, 21 periods of intervention and baseline conditions were carried out with the six participants, with six further sessions being offered, but declined by participants. Although each participant was offered a music tape to listen to, on each occasion they chose to listen to the SPT tapes. However the acceptance of the SPT tape reduced across time, participants were less likely to give consent for their tape to be played with successive presentations.

A one-factor repeated measures ANOVA was used to analyse the data for both distressed and pro-social behaviour. It showed a significant change in levels of distressed behaviour across the three conditions ( $p=.025$ ). Specifically SPT was more effective for participants asking or seeking to go home. The reduction in distressed behaviour did not generalise beyond the end of the tape. There was no significant change in pro-social behaviours, e.g. talking calmly.

The authors concluded with an important statement:

“One abiding, albeit anecdotal, impression from this study is of the chronically low levels of stimulation and the dearth of emotionally sustaining relationships available to participants when their relatives were not present. The response of the participants reminds us that we should not view SPT as a replacement for real contact with attachment figures. SPT is not a magical tool that somehow does away with the effects of separation from loved ones, and if the needs of nursing home residents for intimacy, friendship and security are to be met consistently, then this can only be if care staff make sustained and informed efforts to establish such relationships. SPT may be a partial means of meeting these needs, but it cannot, on its own, be the complete answer.” (Page 448)

A randomised, single blind study has been carried out comparing SPT and preferred music (Garland, Beer et al. 2007) (Forbes rating = weak). The careful design of the study was marred by the exclusion of a large number of residents who refused to wear headphones or whose relatives refused permission for participation. Thirty nursing home residents with frequent, severe behavioural disturbances were observed by research staff before, during, and after multiple, randomised, single-blind exposures to 15-minute audiotapes of simulated family presence (a conversation prepared by a family member about positive experiences from the past), music preferred by the resident in earlier life and a placebo condition of a reading from a horticultural text. Physically aggressive agitation, physically non-aggressive agitation, verbally aggressive agitation and verbally non aggressive agitation were recorded by trained observers at 2 minute

intervals before, during and after the interventions. Treatments were applied once a day for 3 days per week for 3 weeks. All three treatment conditions were compared with usual care.

Simulated presence and preferred music both proved effective in reducing counts of physically agitated behaviours ( $p=0.003$  and  $0.039$  respectively). Simulated presence, but not music, resulted in significantly reduced counts of verbally agitated behaviours ( $p=0.037$ ).

Analysis of the effect of the interventions on individual residents resulted in the surprising finding that 43% and 50% of participants respectively showed a marked reduction in agitation counts in response to SPT and music. The modest size of the statistical significance was due to the polarisation of the effects. Some participants became engrossed in the SPT tapes and others became more agitated and threw the headphones away.

The authors note that of the two treatments, individually tailored music tapes were easier to make and were clearly helpful in many instances. By contrast, family members often struggled to recall enough happy memories to compile a simulated presence tape.

The lack of advantage of simulated presence therapy over other forms of activity was illustrated in a study aimed at reducing verbally disruptive behaviour (Cohen-Mansfield and Werner 1997), (Forbes rating = weak). The careful design of this study was marred by a high attrition rate. Thirty-two nursing home residents suffering from dementia and manifesting verbally disruptive behaviour were observed before, during, and after the interventions. The interventions were presentation of a videotape of a family member talking to the older person, in vivo social interaction, and the use of music. Behaviours decreased by 56% during the social interaction, 46% during the videotape, 31% during the music, and 16% during the no-intervention. The effects of the interventions were clinically and statistically significant, indicating the importance of providing stimulating activities and a richer environment to cognitively impaired nursing home residents but not providing any support for an enhanced effect from simulated presence therapy.

Another technological approach to increasing stimulation and providing emotionally satisfying relationships has been explored through the provision of robotic pets (Libin and Cohen-Mansfield 2004) (Forbes rating = moderate). Traditional pet therapy has been shown to enhance individual wellbeing (Churchill, Safaoui et al. 1999). However, the authors contend, there are situations where a substitute artificial companion (i.e., robotic pet) may serve as a better alternative because of insufficient available resources to care for a real pet, allergic responses to pets or other difficulties. They compared the benefits of a robotic cat and a plush toy cat as interventions for 9 women with moderate dementia in a nursing home. The mean age of the residents was 90.

The design of the robotic cat, NeCoRo, was based upon the concept of an emotional communication robot (Shibata, Tashima et al. 1999; Ogata, Matsuyama et al. 2000) Enhanced artificial intelligence and built-in sensors provide for a variety of responses during interactions, which can be either verbal (meow, purr, or hiss) or nonverbal (stretching paws, wagging tail, opening and closing eyes, turning head and spreading ears, and sitting or lying down). Both cats were covered with soft synthetic gray fur of different shades. The plush cat was lighter and softer than the robotic cat.

The plush cat produced a significant lowering of agitation as measured on the Agitated Behaviours Mapping Instrument (Cohen-Mansfield, Werner et al. 1989)( $p=0.04$ ); there was no significant effect for the robotic cat. The robotic cat significantly increased the amount of pleasure and interest expressed ( $p=0.007$  and  $0.028$  respectively), there was no significant effect for the plush cat. Only 22% of participants held the robotic cat during the sessions while 78% of the residents held the plush cat. In summary the robotic cat had no significant advantage over the plush cat.

Similar results were obtained in a comparison between a motor-driven toy dog and AIBO, a 'metal entertainment robot' that looked like a dog and responded to 75 spoken commands (Tamura, Yonemitsu et al. 2004) (Forbes rating = weak). The participants in this study were 1 man and 12 women with a mean age of 84 years and severe dementia living in a geriatric health care facility. The toy dog and AIBO were introduced to the residents in 5 minute sessions over 4 days. The interactions were videotaped and classified into 5 categories: watching, talking, clapping hands, touching and caring. The total number of interactions was 985 for the toy dog and 608 for AIBO. The toy dog elicited more responses in every category.

The metallic appearance and feel of AIBO was counteracted in a second experiment during which AIBO wore a plush suit. There was no significant change in the results. 'Very few of the participants touched AIBO, regardless of whether it was clothed'.

In summary the effects of simulated presence therapy appear to be modest and short lived. There is a substantial level of resistance to it and it does not have any advantage over simpler approaches to providing comfort.

## Summary and conclusion

The literature exploring the use of assistive technologies for increasing independence and compensating for memory problems illustrate the problems of moving from the laboratory to real life. This is reflected in very small samples, high drop out rates, very basic statistical analyses, lack of adjustment for multiple comparisons and poor performance of the technology itself. In general the use of the technology reported on to date makes little difference to practical outcomes.

**Table 2: Articles arranged by AT device**

Article	Forbe's rating	AT device
<b>Audio devices</b>		
Clark, ME, Lipe, AW, Bilbrey, M (1998). Use of music to decrease aggressive behaviors in people with dementia. <i>J Gerontol Nurs.</i> 24 (7), 10-17.	Strong	Music therapy - from a tape recorder.
Burgio, L., et al., Environmental "white noise": an intervention for verbally agitated nursing home residents. <i>Journals of Gerontology Series B-Psychological Sciences &amp; Social Sciences</i> , 1996. 51(6): p. P364-73.	Moderate	Audiotapes
Ziv, Naomi, et al, (2007). The Effect of Background Stimulative Music on Behavior in Alzheimer's Patients. <i>Journal of Music Therapy</i> , 44 (4). 329	Moderate	Background music
<b>Bright Light Devices</b>		
Sloane, P. D., P. Christianna, et al. (2007). "High-Intensity Environmental Light in Dementia: Effect on Sleep and Activity." <i>Journal of the American Geriatrics Society</i> 55(10): 1524.	Strong	Bright light
Lyketsos, C. G., L. Lindell, et al. (1999). "A randomized, controlled trial of bright light therapy for agitated behaviors in dementia patients residing in long-term care." <i>International Journal of Geriatric Psychiatry</i> 14(7): 520-525.	Moderate	Bright light
Thorpe, L., J. Middleton, et al. (2000). "Bright light therapy for demented nursing home patients with behavioral disturbance." <i>American Journal of Alzheimer's Disease and Other Dementias</i> 15(1): 18-26.	Moderate	Bright Light
Ancoli-Israeli, S., et al (2003), Effect of light on agitation in institutionalized patients with severe Alzheimer disease. <i>American Journal of Geriatric Psychiatry</i> , 11(2): 194-203.	Weak	Bright light
Gasio, P. F., K. Kräuchia, et al. (2003). "Dawn–dusk simulation light therapy of disturbed circadian rest–activity cycles in demented elderly." <i>Experimental Gerontology</i> 38(1-2): 207-216. 38(1-2): 207-16.	Weak	Bright light
Graf, A., C. Wallner, et al. (2001). "The effects of light therapy on mini-mental state examination scores in demented patients." <i>Biological Psychiatry</i> 50(9): 725-7.	Weak	Bright light
Koyama, E., H. Matsubara, et al. (1999). "Bright light treatment for sleep-wake disturbances in aged individuals with dementia." <i>Psychiatry and Clinical Neurosciences</i> 53(2): 227-229.	Weak	Bright light
Rheaume, Y. L., B. C. Manning, et al. (1998). "Effect of light therapy upon disturbed behaviors in Alzheimer patients." <i>American Journal of Alzheimer's Disease and Other Dementias</i> 13(6): 291-295.	Weak	Bright light
Van Someren, E. J., A. Kessler, et al. (1997). "Indirect bright light improves circadian rest-activity rhythm disturbances in demented patients." <i>Biological Psychiatry</i> 41(9): 955-63.	Weak	Bright light
<b>Multi-sensory stimulation</b>		



Article	Forbe's rating	AT device
Baker, R., S. Bell, et al. (2001). "A randomized controlled trial of the effects of multi-sensory stimulation (MSS) for people with dementia." <i>Br J Clin Psychol.</i> 40(Pt 1): 81-96.	Strong	Multi- Sensory Stimulation, Snoezelen room
Baker, R., J. Holloway, et al. (2003). "Effects of multi-sensory stimulation for people with dementia." <i>Journal of Advanced Nursing</i> 43(5): 465-77.	Strong	Multi-sensory stimulation
Van Weert, J. C. M., A. M. van Dulmen, et al. (2005). "Behavioral and Mood Effects of Snoezelen Integrated into 24-Hour Dementia Care." <i>Journal of the American Geriatrics Society</i> 53(1): 24-33.	Strong	Snoezelen room
Cox, H., I. Burns, et al. (2004). "Multisensory environments for leisure: promoting well-being in nursing home residents with dementia." <i>Journal of Gerontological Nursing</i> 30(2): 37-45.	Moderate	Snoezelen room
Hope, K. (1998). "The effects of multisensory environments on older people with dementia." <i>Journal of Psychiatric &amp; Mental Health Nursing</i> 5: 377-385.	Weak	Multisensory environment, Snoezelen.
<b>Prompting and cueing devices.</b>		
Oriani, M., E. Moniz-Cook, et al. (2003). "An electronic memory aid to support prospective memory in patients in the early stages of Alzheimer's disease: a pilot study." <i>Aging &amp; Mental Health</i> 7(1): 22-27.	Strong	Electronic memory aid
Labelle, K. L. and A. Mihailidis (2006). "The use of automated prompting to facilitate hand washing in persons with dementia. ." <i>American Journal of Occupational Therapy</i> 60: 442-450.	Moderate	Automated prompting system (both verbal and audiovisual prompts) to facilitate hand-washing.
Mihailidis, A., G. Fernie, R. , et al. (2000). "The development of a computerized cueing device to help people with dementia to be more independent." <i>Technology and Disability</i> 13(1): 23-40.	Weak	Computerized cueing device
<b>Robotic pets</b>		
Libin, A. and J. Cohen-Mansfield,(2004) Therapeutic robocat for nursing home residents with dementia: preliminary inquiry. <i>American Journal of Alzheimer's Disease and Other Dementias</i> ,19(2): 111-116.	Moderate	Robot cat
Tamura, T., et al.,( 2004.) "Is an entertainment robot useful in the care of elderly people with severe dementia?" <i>Journals of Gerontology Series A-Biological Sciences &amp; Medical Sciences</i> , 59(1): 83-5.	Weak	Robotic dog
Cheston, R., et al., Simulated presence therapy, attachment and separation amongst people with dementia. <i>Dementia</i> , 2007. 6(3): p. 442-9.	Moderate	Simulated Presence Therapy - an audio tape on a personal stereo of their carers own voice.
Cohen-Mansfield, J., Werner, P. (1997), Management of verbally disruptive behaviors in nursing home residents. <i>J Gerontol A Biol Sci Med Sci</i> , 52 (6), M369-377	Weak	A video of a family member talking and Music.
Garland, K., et al., A comparison of two treatments of agitated behavior in nursing home residents with dementia: simulated family presence and preferred music. <i>American Journal of Geriatric Psychiatry</i> , 2007. 15(6): p. 514-21.	Weak	Cassette player
<b>Tagging devices</b>		
Miskelly, F. (2004). "A novel system of electronic tagging in patients with dementia and wandering." <i>Age Ageing</i> 33(3): 304-306.	Weak	Electronic tagging
<b>Telephony and monitoring devices</b>		
Mahoney, D. F., B. J. Tarlow, et al. (2003). "Effects of an automated telephone support system on caregiver burden and anxiety: findings from the REACH for TLC intervention study." <i>Gerontologist</i> 43(4): 556-67.	Strong	Computer mediated automated Interactive Voice Response telephone system - giving access to weekly care givers conversation, bulletin board, personal mail box, activity-respite conversation.
Winter, L. and L. N. Gitlin (2006). "Evaluation of a telephone-based support group intervention for female caregivers of community-dwelling individuals with dementia." <i>American Journal of Alzheimer's Disease &amp; Other Dementias</i> 21(6): 391-7.	Strong	Telephone

Article	Forbe's rating	AT device
Poon, P., E. Hui, et al. (2005). "Cognitive intervention for community-dwelling older persons with memory problems: telemedicine versus face-to-face treatment." <i>International Journal of Geriatric Psychiatry</i> 20(3): 285-6.	Moderate	Telemedicine (Cognitive intervention program using telemedicine (VC) versus a conventional face-to-face (FTF) method)
Engström, M., B. Ljunggren, et al. (2005). "Staff perceptions of job satisfaction and life situation before and 6 and 12 months after increased information technology support in dementia care." <i>Journal of Telemedicine and Telecare</i> 11(6): 304.	Weak	IT support: general and individualized passage alarms, sensor activated night time illumination, fall detectors and internet communication.
Engstrom, M., R. Lindqvist, et al. (2006). "Relatives' opinions of IT support, perceptions of irritations and life satisfaction in dementia care." <i>Journal of Telemedicine &amp; Telecare</i> 12(5): 246-50.	Weak	General and individualized passage alarms, sensor-activated illumination of the toilet, fall detectors, additional computers for staff, internet homepage describing the group living facility, internet access for the staff and email communication between staff and relatives.
Eisdorfer, C., S. J. Czaja, et al. (2003). "The effect of a family therapy and technology-based intervention on caregiver depression." <i>Gerontologist</i> 43(4): 521-31.	Weak	Computer telephone integrated system
Lee, J. H., J. H. Kim, et al. (2000). "A telemedicine system as a care modality for dementia patients in Korea." <i>Alzheimer Disease &amp; Associated Disorders</i> 14(2): 94-101.	Weak	Telemedicine system- includes a registry, follow up protocol and a daily behaviour checklist for dementia patients.
Lekeu, F., W. V, et al. (2002). "Training early Alzheimer patients to use a mobile phone." <i>Acta Neurol Belg.</i> 102(3): 114-21.	Weak	Mobile phone
Smith, G. E., A. M. Lunde, et al. (2007). "Telehealth home monitoring of solitary persons with mild dementia." <i>American Journal of Alzheimer's Disease &amp; Other Dementias</i> 22(1): 20-6.	Weak	Televideo
Topo, P., M. Jylha, et al. (2002). "Can the telephone-using abilities of people with dementia be promoted? An evaluation of a simple-to-use telephone." <i>Technology and Disability</i> 14: 3-13.	Weak	Telephone

The evidence for the effective use of assistive technology to improve the safety and security of people with dementia and their ability to communicate with others outside of their home is very weak. The common problems associated with lack of acceptance by the user, difficulties with use and technical reliability are evident. The need for careful assessment to determine the likely benefit of the technology to an individual is clear and there is a strong suggestion that there is quite a short span of time during which the person with dementia is able to use the technology.

There is some promise that remote carer initiated communication can be used for assessment and simple therapeutic interventions and there is support for the use of assistive technology to facilitate communication and access to support and information for caregivers of people with dementia. However the benefits are small and the uptake of the opportunity to use this approach to accessing support is limited. The best results appear to come when the technology augments face to face contact.

Support for the use of assistive technology in the provision of 'therapies' is mixed. Using it to provide high levels of illumination appears to have some benefits. The provision of multi-sensory environments by the use of fibre optics, audio stimulation etc is beneficial when it is accompanied by increased contact with staff but the evidence for effectiveness when used in isolation is limited.

The substitution of artificial contact for real contact by the provision of simulated presence through robotic cats, dogs and audio tapes results in modest, short lived changes for a significant proportion of people with dementia, avoidance of the situation by many and an increase in agitation in some.

A number of generalisations can be made on the basis of the literature:

1. The technology studied to date is often unreliable
2. There is marked resistance to the acceptance of most of the technologies available
3. The available technologies are no substitute for supportive human contact
4. The technology should be tailored to the needs of the person
5. The simpler the technology the more likely it is to have a beneficial effect
6. There is a great need for better designed studies with larger samples

It is clear that our attempts at using assistive technologies to aid people with dementia are at an early stage of development. The current status might be likened to the Wright Brothers' attempts to use the contents of their bicycle workshop to build an aeroplane and fly. While they had the vision it required a great deal of time, energy, ingenuity and courage before they were successful. However they were successful and progress accelerated dramatically once the basic problems were solved. The same may happen with assistive technology as the devices improve and the next generation of technologically literate elderly people begin to take it up. Let us hope that our desire to use it for the good of the person with dementia is stronger than the temptation to use it for our own convenience.

## **References**

- AIHW (2006). *Dementia in Australia: National data analysis and development*. Canberra, Australian Institute of Health and Welfare
- Ancoli-Israel, S., P. Clopton, et al. (1997). "Use of wrist activity for monitoring sleep/wake in demented nursing home patients. ." *Sleep* 20: 24-27.
- Ancoli-Israel, S., P. Gehrman, et al. (2003). "Increased light exposure consolidates sleep and strengthens circadian rhythms in severe Alzheimer's disease patients." *Behavioral Sleep Medicine* 1(1): 22-36.
- Baker, R., S. Bell, et al. (2001). "A randomized controlled trial of the effects of multi-sensory stimulation (MSS) for people with dementia." *British Journal of Clinical Psychology* 40(Pt 1): 81-96.
- Baker, R., J. Holloway, et al. (2003). "Effects of multi-sensory stimulation for people with dementia." *Journal of Advanced Nursing* 43(5): 465-77.
- BCS (2008). *Living with dementia: how the environment, technology and you can help*, Baptist Community Services.
- Brignell, M., R. Wootton, et al. (2007). "The application of telemedicine to geriatric medicine." *Age & Ageing* 36(4): 369-74.
- Brody, H., A. Green, et al. (2003). "Meta-analysis of psychosocial interventions for caregivers of people with dementia." *Journal of the American Geriatrics Society* 51(5): 657-64.
- Brody, H. and M. Gresham (1997). "The Prince Henry Hospital Dementia caregivers training programme." *International Journal of Geriatric Psychiatry* 12: 183-192.
- Brody, H., C. Thomson, et al. (2005). "Why caregivers of people with dementia and memory loss don't use services. *Int J Geriatr Psychiatry*. 2005;20:537-546." *International Journal of Geriatric Psychiatry* 20: 537-546.
- Burgio, L., K. Scilley, et al. (1996). "Environmental "white noise": an intervention for verbally agitated nursing home residents." *Journals of Gerontology Series B-Psychological Sciences & Social Sciences* 51(6): P364-73.
- Carmien, S., M. Dawe, et al. (2005). "Socio-technical environments supporting people with cognitive disabilities using public transportation." *ACM Trans. Comput.-Hum. Interact.* 12(2): 233-262.
- Cash, M. (2003). "Assistive technology and people with dementia." *Reviews in Clinical Gerontology* 13(4): 313-9.
- Cheston, R., K. Thorne, et al. (2007). "Simulated presence therapy, attachment and separation amongst people with dementia." *Dementia* 6(3): 442-9.

- Chiu, H. F. K., H. C. B. Lee, et al. (1994). "Reliability and validity of the Cantonese version of the Mini-Mental State Examination: a preliminary study." Hong Kong Journal of Psychiatry **4**: 25-28.
- Chung, J. C., C. K. Lai, et al. (2002). "Snoezelen for dementia." Cochrane Database of Systematic Reviews(4): CD003152.
- Chung, J. C. C. and C. K. Y. Lai (2002). " Snoezelen for dementia. ." Cochrane Database of Systematic Reviews (4).
- Churchill, M., J. Safaoui, et al. (1999). "Using a therapy dog to alleviate the agitation and desocialization of people with Alzheimer's disease. ." J Psychosoc Nurs Ment Health Serv. **37**(4): 16-24.
- Clark, M. E., A. W. Lipe, et al. (1998). "Use of music to decrease aggressive behaviors in people with dementia." Journal of Gerontological Nursing **24**(7): 10-7.
- Cohen-Mansfield, J. and P. Werner (1997). "Management of verbally disruptive behaviors in nursing home residents." Journals of Gerontology Series A-Biological Sciences & Medical Sciences **52**(6): M369-77.
- Cohen-Mansfield, J., P. Werner, et al. (1989). "An observational study of agitation in agitated nursing home residents." Internation Psychogeriatrics **1**(2): 153-165.
- Cox, H., I. Burns, et al. (2004). "Multisensory environments for leisure: promoting well-being in nursing home residents with dementia." Journal of Gerontological Nursing **30**(2): 37-45.
- Dickinson, J. I., J. McLain-Kark, et al. (1995). "The effects of visual barriers on exiting behavior in a dementia care unit." Gerontologist **35**(1): 127-30.
- DoHA (2008). Dementia Resources Guide. D. o. H. a. Ageing, Australian Government.
- Eisdorfer, C., S. J. Czaja, et al. (2003). "The effect of a family therapy and technology-based intervention on caregiver depression." Gerontologist **43**(4): 521-31.
- Engstrom, M., R. Lindqvist, et al. (2006). "Relatives' opinions of IT support, perceptions of irritations and life satisfaction in dementia care." Journal of Telemedicine & Telecare **12**(5): 246-50.
- Engström, M., B. Ljunggren, et al. (2005). "Staff perceptions of job satisfaction and life situation before and 6 and 12 months after increased information technology support in dementia care." Journal of Telemedicine and Telecare **11**(6): 304.
- Forbes, D., D. Morgan, et al. (2004). "Light Therapy for Managing Sleep, Behaviour, and Mood Disturbances in Dementia." Cochrane Databases of Systematic Review(2).
- Forbes, D. A. (1998). "Strategies for managing behavioural symptomatology associated with dementia of the Alzheimer type: a systematic overview." Canadian Journal of Nursing Research **30**(2): 67-86.

- Garland, K., E. Beer, et al. (2007). "A comparison of two treatments of agitated behavior in nursing home residents with dementia: simulated family presence and preferred music." American Journal of Geriatric Psychiatry **15**(6): 514-21.
- Gasio, P. F., K. Kräuchia, et al. (2003). "Dawn–dusk simulation light therapy of disturbed circadian rest–activity cycles in demented elderly." Experimental Gerontology **38**(1-2): 207-216. **38**(1-2): 207-16.
- Gilliard, J. and I. Hagen (2004). Enabling Technologies for People with Dementia; Cross-national analysis report
- Graf, A., C. Wallner, et al. (2001). "The effects of light therapy on mini-mental state examination scores in demented patients." Biological Psychiatry **50**(9): 725-7.
- HMSO (1999). Royal Commission on Long-Term Care. With Respect to Old Age: Long Term Care – Rights and Responsibilities. . London, HMSO.
- Hope, K. (1998). "The effects of multisensory environments on older people with dementia." Journal of Psychiatric & Mental Health Nursing **5**: 377-385.
- Hughes, C., L. Berg, et al. (1982). "A new clinical scale for staging of dementia." British Journal of Psychiatry **140**: 566-572.
- Koyama, E., H. Matsubara, et al. (1999). "Bright light treatment for sleep-wake disturbances in aged individuals with dementia." Psychiatry and Clinical Neurosciences **53**(2): 227-229.
- Labelle, K.-L. and A. Mihailidis (2006). "The use of automated prompting to facilitate handwashing in persons with dementia." American Journal of Occupational Therapy **60**(4): 442-50.
- Lawton, M. P., K. Van Haitsma, et al. (1996). "Observed affect in nursing home resident's with Alzheimer's disease." Journal of Gerontology: Psychosocial Sciences, **51B**: 3-14.
- Lee, J. H., J. H. Kim, et al. (2000). "A telemedicine system as a care modality for dementia patients in Korea." Alzheimer Disease & Associated Disorders **14**(2): 94-101.
- Lekeu, F., V. Wojtasik, et al. (2002). "Training early Alzheimer patients to use a mobile phone." Acta Neurol Belg. **102**(3): 114-21.
- Libin, A. and J. Cohen-Mansfield (2004). "Therapeutic robot for nursing home residents with dementia: preliminary inquiry." American Journal of Alzheimer's Disease and Other Dementias **19**(2): 111-6.
- Lyketsos, C. G., L. Lindell, et al. (1999). "A randomized, controlled trial of bright light therapy for agitated behaviors in dementia patients residing in long-term care." International Journal of Geriatric Psychiatry **14**(7): 520-525.
- Mahoney, D. F., B. J. Tarlow, et al. (2003). "Effects of an automated telephone support system on caregiver burden and anxiety: findings from the REACH for TLC intervention study." Gerontologist **43**(4): 556-67.
- Marshal, M., Ed. (1997). State of the Art in Dementia Care. London, Centre for Policy on Ageing.

- Martin, S., G. Kelly, et al. (2008,). "Smart home technologies for health and social care support." Cochrane Database of Systematic Reviews (4).
- McShane, R., K. Gedling, et al. (1998a). "Getting lost in dementia: a longitudinal study of a behavioral symptom." International Psychogeriatrics **10**(3): 253-60.
- McShane, R., K. Gedling, et al. (1998b). "The feasibility of electronic tracking devices in dementia: a telephone survey and case series." International Journal of Geriatric Psychiatry **13**(8): 556-63.
- Mihailidis, A., G. Fernie, R. , et al. (2000). "The development of a computerized cueing device to help people with dementia to be more independent." Technology and Disability **13**(1): 23-40.
- Miskelly, F. (2004). "A novel system of electronic tagging in patients with dementia and wandering." Age Ageing **33**(3): 304-306.
- Miskelly, F. (2005). "Electronic tracking of patients with dementia and wandering using mobile phone technology." Age Ageing **34**(5): 497-499.
- Namazi, K. H., T. T. Rosner, et al. (1989). "Visual barriers to prevent ambulatory Alzheimer's patients from exiting through an emergency door." Gerontologist **29**(5): 699-702.
- O'Connor, D. (2007). A review of the literature on psycho-social interventions for behavioral and psychological symptoms of dementia. Sydney, Primary Dementia Collaborative Research Centre.
- Ogata, T., Y. Matsuyama, et al. (2000). Development of emotional communication robot: WAMOEBA-2R Experimental evaluation of the emotional communication.. . IEEE International Conference on Intelligent Robots and Systems.
- Opie, J., R. Rosewarne, et al. (1999). "The efficacy of psychosocial approaches to behaviour disorders in dementia: a systematic literature review." Australian & New Zealand Journal of Psychiatry **33**(6): 789-99.
- Opie, J., R. Rosewarne, et al. (1999). "The efficacy of psychosocial approaches to behaviour disorders in dementia: a systematic literature review." Australian and New Zealand Journal of Psychiatry **33**(6): 789-799.
- Oriani, M., E. Moniz-Cook, et al. (2003). "An electronic memory aid to support prospective memory in patients in the early stages of Alzheimer's disease: a pilot study." Aging & Mental Health **7**(1): 22-27.
- Ory, M. G., R. R. I. Hoffman, et al. (1999). "Prevalence and impact of caregiving: a detailed comparison between dementia and nondementia caregivers." Gerontologist **39**: 177-185.
- Ory, M. G., J. L. Yee, et al. (2000). The extent and impact of dementia care: Unique challenges experienced by family caregivers. Handbook on dementia caregiving. R. Schulz. New York, Springer: 1-32.

- Pearlin, L. I. and C. Schooler (1978). "The structure of coping. ." Journal of Health and Social Behavior **19**(1): 2-21.
- Poon, P., E. Hui, et al. (2005). "Cognitive intervention for community-dwelling older persons with memory problems: telemedicine versus face-to-face treatment." International Journal of Geriatric Psychiatry **20**(3): 285-6.
- Radloff, I. S. (1977). "The CES-D scale: A self-report depression scale for research in the general population." Applied Psychological Measures **1**: 385-401.
- Rasquin, S. M. C., C. Willems, et al. (2007). "The use of technical devices to support outdoor mobility of dementia patients." Technology and Disability **19**: 113-120.
- Rheume, Y. L., B. C. Manning, et al. (1998). "Effect of light therapy upon disturbed behaviors in Alzheimer patients." American Journal of Alzheimer's Disease and Other Dementias **13**(6): 291-295.
- Schulz, R. and S. R. Beach (1999). " Caregiving as a risk factor for mortality: the caregiver health effects study. ." Journal of the American Medical Association **282**: 2215-2219.
- Shibata, T., T. Tashima, et al. (1999). Emergence of emotional behavior through physical interaction between human and robot.. IEEE International Conference on Robotics and Automation.
- Sloane, P. D., P. Christianna, et al. (2007). "High-Intensity Environmental Light in Dementia: Effect on Sleep and Activity." Journal of the American Geriatrics Society **55**(10): 1524.
- Smith, G. E., A. M. Lunde, et al. (2007). "Telehealth home monitoring of solitary persons with mild dementia." American Journal of Alzheimer's Disease & Other Dementias **22**(1): 20-6.
- Staal, J. A., A. Sacks, et al. (2007). "The effects of snoezelan (multi-sensory behaviour therapy) and psychiatric care on agitation, apathy, and activities of daily living in dementia patients on a short term geriatric psychiatry inpatient unit." International Journal of Psychiatry in Medicine **37**(4): 357-370.
- Tamura, T., S. Yonemitsu, et al. (2004). "Is an entertainment robot useful in the care of elderly people with severe dementia?" Journals of Gerontology Series A-Biological Sciences & Medical Sciences **59**(1): 83-5.
- Thorpe, L., J. Middleton, et al. (2000). "Bright light therapy for demented nursing home patients with behavioral disturbance." American Journal of Alzheimer's Disease and Other Dementias **15**(1): 18-26.
- Topo, P., M. Jylha, et al. (2002). "Can the telephone-using abilities of people with dementia be promoted? An evaluation of a simple-to-use telephone." Technology and Disability **14**: 3-13.
- Topo, P. and K. Saarikalle (2004). Picture Gramophone assessment: National findings from Finland, Ireland, Norway and UK and cross national results. Enabling Technologies for People with Dementia.



- Van Someren, E. J., A. Kessler, et al. (1997). "Indirect bright light improves circadian rest-activity rhythm disturbances in demented patients." Biological Psychiatry **41**(9): 955-63.
- van Weert, J. C. M., A. M. van Dulmen, et al. (2005). "Behavioral and Mood Effects of Snoezelen Integrated into 24-Hour Dementia Care." Journal of the American Geriatrics Society **53**(1): 24-33.
- Winter, L. and L. N. Gitlin (2006). "Evaluation of a telephone-based support group intervention for female caregivers of community-dwelling individuals with dementia." American Journal of Alzheimer's Disease & Other Dementias **21**(6): 391-7.
- Woods, P. and J. Ashley (1995). " Simulated presence therapy: Using selected memories to manage problem behaviors in Alzheimer's disease patients. ." Geriatric Nursing **16**(1): 9-14.
- Ziv, N., A. Granot, et al. (2007). "The effect of background stimulative music on behavior in Alzheimer's patients." Journal of Music Therapy **44**(4): 329-43.