Effectiveness of assistive technology and environmental interventions in maintaining independence and reducing home care costs for the frail elderly: a randomized controlled trial

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Record Status
This is a critical abstract of an economic evaluation that meets the criteria for inclusion on NHS EED. Each abstract contains a brief summary of the methods, the results and conclusions followed by a detailed critical assessment on the reliability of the study and the conclusions drawn.

Health technology
Assistive technology (AT) and home environmental interventions (EIs), used for increasing independence for community-based frail elderly persons. AT consisted of such things as canes, walkers and bath benches, whilst EI included the addition of ramps, lowering of cabinets and removal of throw rugs.

Type of intervention
Treatment; Rehabilitation.

Economic study type
Cost-effectiveness analysis.

Study population
The study population consisted of home-based, frail, elderly patients living in western New York. Only elderly patients with scores greater than 23 on the Mini-Mental State Examination were included in the investigation.

Setting
The setting was community. The economic study was conducted in New York, USA.

Dates to which data relate
The year to which effectiveness, resources and price data related was not stated. The study was accepted for publication in 1998.

Source of effectiveness data
Effectiveness data were derived from a single study.

Link between effectiveness and cost data
Costing was undertaken prospectively on the same patient sample as that used in the effectiveness analysis.

Study sample
104 home-based frail elderly people were randomised: 52 patients each to the AT-EI and the standard care control groups. For adequate statistical power, the authors considered that they would require 90 elderly people at the end of the follow-up. Based on a medium effect size (d = 0.50), power was assumed to be 0.80 with an alpha level of 0.05. Baseline characteristics were reported to allow comparisons with the study population. These were: mean age, 73 years; mean number of children, 2.7; percentage female, 70.2%; education less than high school, 31.4%; high school and some
college education, 52.9%; college education and above, 15.7%; income less than $10,000, 56.8%; income greater than $20,000, 23.2%; married, 32.7%; widowed, 47.1%; other marital status, 20.2%; living alone, 52.9%; living with someone, 47.1%.

Study design
The study took the form of a randomised controlled trial. Randomisation was performed by means of a computer-generated table of random numbers. This was a multicentre trial, with participants being referred by the Community Alternative Systems Strategy, the hospital physical medicine and rehabilitation programmes providing short-term rehabilitation, and the Western New York Visiting Nursing Association, serving both Medicare and Medicaid patients. Duration of follow-up was 1.5 years, with 4 participants being lost from the treatment group (4 died) and 10 from the control group (6 died and 4 withdrew from the study). A project research associate who was unaware of the patients' original group assignment administered the follow-up assessments in the patients' homes. However, blinding was difficult to maintain as the research assistant was sometimes aware that subjects received AT-EIs due to their comments or observation of devices and home changes.

Analysis of effectiveness
The analysis of the clinical study was based on intention to treat. The primary health outcomes used in the analysis were functional independence measurements, carried out using the Functional Independence Instrument (FIM), including two subsections - cognitive and motor; the Older Americans Research and Services Centre Instrument (OARS-IADL), the Mini-Mental State examination (MMSE) and the Craig Handicap Assessment and Reporting Technique (CHART), including 4 subsections - physical independence, mobility, occupation and social integration. Pain indicators were also considered and were measured using the Functional Status Index (FSI). Groups were shown to be comparable at analysis in terms of age, sex, marital status, living status and education. The treatment group had fewer children (2.2 versus 3.3). Results of tests and point estimates were given.

Effectiveness results
For every measure used, the control group (standard care) declined more than the treatment group (AT-EI), with the smallest mean difference between the two groups being 2.7 for CHART mobility and the largest difference being 13.3 for CHART physical independence.

Significant differences between the two groups were found for the results shown below.

FIM TOTAL SCORE
initial score (mean (SD)): treatment 108.8 (14.3), control 109.4 (13.5); and
score at 18 months: treatment 104.8 (16.7), control 97.9 (23.2), (p=0.01).

FIM MOTOR SCORE
initial score: treatment 74.1 (14.2), control 75.0 (13.4); and
score at 18 months: treatment 71.6 (16.2), control 66.4 (19.1),(p=0.01).

FSI PAIN SCALE
initial score: treatment 28.8 (1.7), control 16.1 (5.5); and
score at 18 months: treatment 14.6 (5.8), control 18.2 (8.6), (p=0.04).

Clinical conclusions
It was noted that both groups declined in functional status over time, with the decline being greater for the control
group. The control group declined more than the treatment group on every measure considered.

**Measure of benefits used in the economic analysis**
The authors did not provide a summary measure of benefits and, as such, a cost-consequences analysis was performed.

**Direct costs**
Direct health service costs were considered in the analysis, such as: costs of AT-EIs; in-home personnel, including nurses, occupational therapists, physical therapists, speech-language pathologists, case managers and personal care aides; and institutional costs, hospitalisation, nursing home stays. Both equipment costs and personnel costs associated with assessment, training and follow-up were considered for AT-EIs. Personal care aide costs were calculated at $8.16 per hour, nurses at $98 per visit, case managers at $89 per visit, occupational and physical therapists and speech pathologists at $90 per visit, nursing home stays at $86 per day and hospital costs at $877.85 per day, with the corresponding resource quantities being given. Discounting was not carried out due to the short duration of the study. Quantities were presented separately by device supplied, but without corresponding unit costs. Costs were derived using results published by the National Association for Home Care - Basic statistics about home care, 1997. The price year was not stated.

**Statistical analysis of costs**
Mann-Whitney tests were applied to determine differences between health care costs for treatment and control groups.

**Indirect Costs**
Indirect costs were not considered.

**Currency**
US dollars ($).

**Sensitivity analysis**
No sensitivity analysis was performed.

**Estimated benefits used in the economic analysis**
See effectiveness results above.

**Cost results**
The total mean (SD) costs were $14,172 (13,761) for the AT-EI group and $31,610 (42239) for the standard care group, with a large effect size (d=0.56). The difference was stated not to have been statistically significant, with the test statistic, but not the p value or level of significance being presented.

**Synthesis of costs and benefits**
Not applicable.

**Authors’ conclusions**
The authors stated that the frail elderly persons in this trial experienced functional decline over time. The results of the study indicated that the rate of decline can be slowed and institutional, and certain in-home personnel costs, reduced through a systematic approach to providing AT and EIs.
CRD COMMENTARY - Selection of comparators
The reason for the choice of the comparator, standard care for the elderly, was clear, as both AT-EIs technology and standard care for the elderly were used in the settings considered by the authors. You, as a database user, should consider if the same applies to your own setting, especially given the complex nature of the technology, which is difficult to define by professional activity and equipment supplied.

Validity of estimate of measure of effectiveness
The analysis was based on a randomised, multicentre, prospective controlled trial that was appropriate for the study question. A comprehensive list of baseline characteristics was provided in order to assess if the study sample was representative of the study population, with power calculations being used to determine the sample size. Patient groups were shown to be comparable at analysis in their baseline characteristics and extensive statistical analyses were conducted on the effectiveness data. The measures of effectiveness seemed to be validated, appropriate and comprehensive. The main problem with studying this type of technology is that, even given the use of randomisation to avoid selection bias and the performance of power calculations to increase the probability of detecting difference between technologies, each technology is complex. Therefore, in order to try to reproduce these results in another setting, one needs either precise details of the technology or the prognostic value of each of its components.

Validity of estimate of measure of benefit
The authors did not derive a summary measure of health benefit. Therefore, please refer to the effectiveness commentary above.

Validity of estimate of costs
All categories of costs relevant to the perspective adopted were included in the analysis. Unit costs and quantities were reported separately for most categories. Costs were not discounted due to the short duration of the study. Appropriate statistical analyses were conducted on costs, and the total costs per treatment group were calculated. The price year was not stated. When technologies are multifactorial, a comprehensive list of resources used, as given here, is useful in order to know to what effectiveness is attributable.

Other issues
Appropriate comparisons with relevant studies dealing with the same topic were conducted. The issue of generalisability of costs to other settings was not addressed, and no sensitivity analysis was conducted, although effectiveness and cost-consequences were competently presented. The authors did not seem to present their results selectively.

Implications of the study
This study showed that functional decline in "mentally alert" elderly people can be slowed by a complex intervention, which might be difficult to reproduce elsewhere. The authors consider that additional research is needed to confirm the impact of AT-EIs on physically frail, cognitively alert elderly people. The impact of AT and EIs on cognitively impaired elderly people also needs to be investigated.

Source of funding
The Rehabilitation Engineering Research Center on Aging is funded by the National Institute on Disability and Rehabilitation Research of the Department of Education, Washington DC, under grant H133E60006. Research also supported by the Administration on Ageing of the Department of Health and Human Services and the Andrus Foundation of the American Association of Retired Persons, Washington.

Bibliographic details
Mann W C, Ottenbacher K J, Fraas L, Tomita M, Granger C V. Effectiveness of assistive technology and
environmental interventions in maintaining independence and reducing home care costs for the frail elderly: a randomized controlled trial. Archives of Family Medicine 1999; 8(3): 210-217

**PubMedID**
10333815

**Other publications of related interest**

**Indexing Status**
Subject indexing assigned by NLM

**MeSH**
Activities of Daily Living; Aged; Aged, 80 and over; Cost-Benefit Analysis; Female; Frail Elderly; Health Care Costs; Health Services for the Aged /economics; Home Care Services /economics; Humans; Institutionalization /economics; Male; Self-Help Devices

**AccessionNumber**
2199900997

**Date bibliographic record published**
31/03/2002

**Date abstract record published**
31/03/2002