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A randomized trial of comprehensive geriatric assessment and home intervention in the care of hospitalized patients

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Abstract

Objective: to prove the effectiveness of geriatric evaluation and management for elderly, hospitalized patients, combined with post-discharge home intervention by an interdisciplinary team.
Design: randomized controlled trial with outcome and costs assessed for 12 months after the date of admission.
Setting: university-affiliated geriatric hospital and the homes of elderly patients.
Subjects: 545 patients with acute illnesses admitted from home to the geriatric hospital.
Interventions: patients were randomly assigned to receive either comprehensive geriatric assessment and post-discharge home intervention (intervention), comprehensive geriatric assessment alone (assessment) or usual care (control).
Main outcome measures: survival, functional status, rehospitalization, nursing home placement and direct costs over 12 months.
Results: the intervention group showed a significant reduction in length of hospital stay (33.49 days *vs* 40.7 days in the assessment group and 42.7 days in the control group; $P < 0.05$) and rate of immediate nursing home placement (4.4% *vs* 7.3% and 8.1%; $P < 0.05$). There was no difference in survival, acute care hospital readmissions or new admissions to nursing homes but the intervention group had significantly shorter hospital readmissions (22.2 days *vs* 34.2 days and 35.7 days; $P < 0.05$) and nursing home placements (114.7 days *vs* 161.6 days and 170.0 days; $P < 0.05$). Direct costs were lower in the intervention group [about DM 7000 (US $4000) per person per year]. Functional capacities were significantly better in the intervention group.
Conclusions: comprehensive geriatric assessment in combination with post-discharge home intervention does not improve survival, but does improve functional status and can reduce the length of the initial hospital stay and of subsequent readmissions. It can reduce the rate of immediate nursing home admissions and delay permanent nursing home placement. It may also substantially reduce direct costs of hospitalized patients.

Keywords: *comprehensive geriatric assessment, functional status, home intervention, nursing home placement, rehospitalization*

Introduction

The effectiveness of comprehensive geriatric assessment in improving the outcome of frail, elderly people is still in question. Some studies of acutely ill older patients have had disappointing results [1, 2], while others show benefits from this approach in improved health, better function, improved survival, greater likelihood of living at home [3, 4] and lower costs. The lack of success in some studies has, in part, been attributed to poor implementation of the recommendations that arose from the assessment process, either because primary care physicians ignored assessment results or because there were insufficient hospital or home care resources to carry them out.

Comprehensive geriatric assessment was not implemented in the Bethanien Geriatric Hospital until 1991, and patients received more traditional medical intervention and discharge planning. Because of this, we were able to test the effectiveness of in-hospital

comprehensive geriatric assessment alone and in combination with an extended treatment by an interdisciplinary home intervention team.

Methods

The rationale and design of the study have already been described [5].

Patients over 65 with acute disease are usually referred to the geriatric centre at the University Hospital of Heidelberg. They are either referred directly by their general practitioner or admitted from the emergency wards of the departments of internal medicine, neurology and surgery.

Elderly subjects who lived at home before admission, had multiple chronic conditions or functional deterioration after convalescence or were at risk for nursing home placement met our inclusion criteria. Those with terminal illness or severe dementia were excluded. Patients who lived too far away (>15 km) for the home intervention team to make regular visits were also excluded. Thirty-one (5.7%) of the eligible patients refused to participate.

The patients included had a higher mean age (81.4 years), more dependency (Barthel score 71.0) and a longer length of stay than hospital patients overall. Women made up 73.4% of the group; 27.2% lived with spouse or partner.

After giving informed consent, patients were randomly assigned to (i) comprehensive geriatric assessment and additional in-hospital and post-discharge follow-up treatment by an interdisciplinary home intervention team, (ii) comprehensive geriatric assessment with recommendations, followed by usual care at home or (iii) assessment of activities of daily living and cognition, followed by usual care in hospital and at home. The randomization was carried out by means of sealed envelopes containing group assignments using a random number sequence.

Patients had to be in a stable medical condition before a comprehensive geriatric assessment was carried out. The members of the assessment team were blinded as to whether a subject had been assigned to assessment and intervention or assessment alone until the assessment was completed.

Activities of daily living were assessed by the Barthel index [6] and Lawton–Brody questionnaire [7], cognition by the Mini-Mental-State Examination [8]. To assess social situation we evaluated social contacts and support, activities, economic situation and housing conditions using a standardized questionnaire [9]. Finally, we used a simple ranking scale (very good, good, average, bad, very bad) to discover the patient's own perception of their state of health and quality of life.

The home intervention team consisted of three nurses, a physiotherapist, an occupational therapist, a social worker and a secretary. The team worked closely with hospital staff and the primary care physician. While the patient was in hospital the team gave them additional treatment (such as additional training in washing, eating, dressing and/or walking). One home visit was carried out during the hospital stay to evaluate the patient's home (e.g. for safety hazards) and to prescribe technical aids, when necessary. After discharge, the team provided treatment (such as physiotherapy/occupational therapy according to the Bobath concept) which home services could not or could not immediately provide for as long as necessary (twice a week, up to twice a day, for a minimum of 30 min).

The mean treatment period was 7.6 days (range 1–41 days). At least one home visit was carried out within 3 days of discharge. Three months after discharge, a follow-up visit was made to check whether recommendations were being implemented, home care continued and technical aids used, and to identify any new problems.

One year after randomization, follow-up data were obtained by telephone. Subjects who did not have a telephone were asked to complete a postal questionnaire. To confirm these data, home visits were carried out and additional information obtained from the patients' general practitioners. All follow-up data were collected by a trained interviewer who was not a member of the home intervention team.

The approximate annual costs of the home intervention programme were derived from the costs of staff (3×0.5 full-time equivalent nurse, 0.5 full-time equivalent physiotherapist, 0.5 full-time equivalent occupational therapist and 0.5 full-time equivalent social worker), use of community services (frequency and duration of health care visits, type of health care services), number of visits to physicians and hospital, and nursing home days.

One year after randomization, 30 subjects were lost to follow-up (eight from the intervention group, 10 from the assessment group and 12 from the control group). No data were available from the nine subjects who had moved house, five subjects refused to answer and in the remaining 16 cases data were either incomplete or inconsistent. Baseline characteristics of these subjects were comparable to those of the whole study sample.

Statistics

The main outcome variables (survival, functional status, hospital readmission, nursing home placement and direct costs) were compared using an intention-to-treat approach. The required sample size was calculated using data derived from similar trials [10–12].

We used the Wilcoxon rank-sum test to examine

differences in continuous variables and the χ^2 test for categorical variables (e.g. Barthel score, Mini-Mental-State Examination, life satisfaction), with the modification for linear trend when appropriate. The effects of intervention on the number of hospital readmissions, nursing home placement and visits to physicians were based on multivariate Poisson regression analyses. Differences between the study groups in functional status were examined by repeated-measures analysis of variance. To adjust for multiple comparisons we used the Bonferroni correction.

Survival was measured both as a 1-year mortality rate and in terms of time lived during one study year. Group comparisons were performed with the χ^2 and log-rank tests, respectively [13]. Survival curves were constructed by Kaplan–Meier analysis (not shown).

To deal with any baseline differences between groups not eliminated through randomization, we adjusted baseline characteristics [14].

All *P* values were based on two-sided tests, and a *P* value of <0.05 was considered to be statistically significant.

Results

The baseline characteristics of the people in the intervention, assessment and control groups were similar.

Although they had a significantly shorter length of hospital stay, patients in the intervention group had a similar functional status at discharge to patients in both other groups. Discharge to a nursing home was also significantly less common in the intervention group (Table 1).

Follow-up characteristics of the survivors at 12 months showed the intervention group to have better functional capacities ($P = 0.03$) and a higher score of self-perceived health ($P = 0.04$) and life satisfaction ($P = 0.04$; Table 2).

There was no difference in the rate of new admissions to nursing homes in any of the groups. Thirty subjects in the intervention group (21.4 %), 35 in the assessment group (25.2%) and 42 in the control group (29.1%) were living in nursing homes at the 1-year follow-up. Patients in the intervention group spent about one-third fewer days in nursing homes than those in the other groups. This was due to delays in moving to nursing homes. All residents in nursing homes were dependent in basic activities of daily living.

Mortality in all groups was similar, with 33 deaths in the intervention group (18.2%), 30 in the assessment group (16.8%) and 32 in the control group (17.3%). There was no difference in the survival curves between the groups.

The rate of hospital readmissions did not differ between the groups, but the length of stay was significantly shorter in the intervention group (Tables 2 and 3). This was mainly due to a reduction in the length of hospital stay of patients readmitted to our study centre. The difference between the intervention and the other two groups was highly significant ($P = 0.007$). The intervention had no effect on the length of stay of admissions to other hospitals (Table 2).

There was no difference in the mean number of visits to primary care physicians in any of the groups over 1 year of follow-up (Table 3). In all groups, only 4% of subjects made no visits to a physician.

Only 54 subjects in the intervention group (38.6%) needed help with instrumental activities of daily living (Table 3) compared with 70 (50.4%) of the assessment group and 67 (47.5%) of the control group. The difference between the intervention and assessment groups was significant (adjusted relative risk 0.5; 95% confidence interval 0.3–0.9; $P = 0.04$).

The use of community services was higher in the intervention group (Table 4).

The cost of staff, increased use of community services and marginally increased number of visits to physicians in the intervention group, on the one hand,

Table 1. Length of hospital stay, functional status at hospital discharge and discharge destination of subjects

	Home intervention ($n = 181$)	Assessment ($n = 179$)	Control ($n = 185$)
Length of hospital stay, days[a]	33.5 (30.4–36.5)[b]	40.7 (37.7–44.8)	42.7 (39.8–45.6)
Activities of daily living score[a]			
Basic	91.8 (89.7–93.9)	92.6 (90.5–94.7)	91.1 (89.3–93.9)
Instrumental	5.7 (5.4–6.0)	5.5 (5.3–5.7)	5.5 (5.3–5.7)
Discharge destination, no. (%) of subjects			
Private home	173 (95.6)	166 (92.7)	170 (91.9)
Long-term care institution	8 (4.4)[b]	13 (7.3)	15 (8.1)

[a]Mean and range.
[b]$P < 0.05$ for comparison between study groups.

Table 2. Follow-up characteristics of the surviving participants at 12-month follow-up

	Home intervention ($n = 140$)	Assessment ($n = 139$)	Control ($n = 141$)
No. of medications[a]	4.3 (4.1–4.5)	4.3 (4.0–4.6)	4.1 (3.8–4.4)
Activities of daily living score[a]			
Basic	81.2 (77.8–84.6)	82.3 (80.0–84.7)	80.9 (78.1–83.8)
Instrumental	5.6 (5.4–5.8)[b]	4.1 (3.9–4.3)	4.3 (4.1–4.5)
Self-perceived health score[a]	3.7 (3.4–4.0)[b]	3.0 (2.6–3.4)	3.0 (2.8–3.2)
Life satisfaction score[a]	3.9 (3.6–4.2)[b]	3.2 (2.9–3.6)	3.2 (2.9–3.4)
Living location, no. (%) of subjects			
Private home	110 (78.6)	104 (74.8)	99 (70.9)
Long-term care institution[c]	22 (15.7)	20 (14.4)	27 (19.1)
Length of stay, days[a]	114.7 (101.6–127.9)[b]	161.6 (139.8–183.5)	170.0 (147.9–192.2)
Rehospitalization			
No. (%) of subjects	43 (30.7)	43 (30.9)	45 (31.9)
Length of stay, days[a]	22.2 (18.0–26.4)[b]	34.2 (29.9–38.5)	35.7 (31.1–40.4)
Geriatric hospital			
No. of admissions	38	39	38
No. (%) of subjects	34 (24.3)	37 (26.6)	36 (25.5)
Length of stay, days[a]	15.3 (12.4–18.3)[b]	32.3 (28.7–36.0)	34.0 (29.8–38.1)
Other hospitals			
No. of admissions	21	25	27
No. (%) of subjects	20 (14.3)	23 (16.5)	25 (17.7)
Length of stay, days[a]	34.7 (31.5–37.9)	37.2 (33.7–40.7)	38.1 (34.3–41.9)

[a]Mean and range.
[b]$P < 0.05$ for comparison of intervention group with assessment and control group.
[c]New admissions.

and decreased number of days spent in hospitals and nursing homes, on the other hand, resulted in an average net saving of about DM 7000 DM (US $4000) per subject per year in the intervention group (Table 5).

Discussion

In this randomized clinical trial, we found no differences in survival between the groups at 1 year. Many participants had severe illnesses, and some suffered a steady deterioration that was not amenable to the interventions recommended in the comprehensive assessment and carried out by the home intervention team.

Progressive deterioration could also provide an explanation for the fact that the rate of rehospitalization in the intervention group was no different to those in the other two groups. An analysis of factors contributing to new hospital admissions showed the main reasons to be new acute diseases and relapse of chronic illness.

We demonstrated that the length of the initial hospital stay could be considerably shortened by our home intervention team. Patients were given additional treatment in hospital by the home intervention team, resulting in a comparable functional status at discharge to that of patients in the assessment and control group.

Better information exchange between hospital and family doctors, as well as a quicker, more appropriate discharge planning, resulted in a great reduction in the length of stay when patients were readmitted to our hospital. No effect was seen when patients were admitted to other hospitals.

Our programme resulted in a significant reduction in the number of initial nursing home admissions and number of days spent in nursing homes. The rate of nursing home admissions over the year of follow-up were comparable in all groups. These findings support the hypothesis that, while our intervention could not

Table 3. Dependence, hospital and nursing home admissions and visits to physicians by the surviving participants at 12-month follow-up

	Home intervention ($n = 140$)	Assessment ($n = 139$)	RR (and 95% CI) for intervention *vs* assessment	Control ($n = 141$)	RR (and 95% CI) for intervention *vs* control
Dependence on assistance in ADL (no. of subjects)					
Basic	17	16	1.1 (0.7–1.9)	19	0.9 (0.7–1.3)
Instrumental	54	70	0.5 (0.3–0.9)[a]	67	0.6 (0.4–1.0)
Acute care hospital					
No. of readmissions	59	64	0.9 (0.6–1.4)	65	1.0 (0.7–1.4)
No. of days/100 readmissions/year	1652[b]	2497		2566	
Long-term care institution					
No. of people (initial and new)	30	33	0.8 (0.6–1.2)	42	0.7 (0.3–1.0)
No. of days/100 people/year	2458[b]	4069		5065	
Visits to physicians (mean no. of visits/person/month)	1.23	1.11	1.1 (1.0–1.3)	1.08	1.2 (1.0–1.4)

[a]$P < 0.05$ for the comparison between intervention and assessment group; [b]$P < 0.05$ for the comparison of intervention group with assessment and control group.
RR, relative risk; CI, confidence interval; ADL, activities of daily living.

Table 4. Use of community services by participants living at home at 12-month follow-up

	No. (and %) of people using service, by group		
	Home intervention ($n = 110$)	Assessment ($n = 104$)	Control ($n = 99$)
Total	70 (63.6)[a]	52 (50.0)	49 (49.5)
Nursing help (care management)	33 (30.0)	30 (28.8)	31 (31.3)
Household help	14 (12.7)	13 (12.5)	14 (14.1)
Shopping	57 (51.8)[a]	24 (23.1)	25 (25.3)
Meals on wheels	53 (48.2)[a]	27 (26.0)	23 (23.2)
Community centres for senior citizens	27 (24.5)[a]	11 (10.6)	9 (9.1)

[a]$P < 0.05$ for comparison of intervention group with assessment and control group.

prevent admissions to nursing homes, it could delay them. Patients in the intervention group were able to live longer at home. At 1-year follow-up their functional status was better, which is in agreement with the findings of other studies of comprehensive geriatric assessment [15–17].

Also consistent with the findings of some other studies [11, 12, 18] was the increased use of community services in the intervention group. This seemed to be in contrast to the better functional status in the intervention group than the control group at 1-year follow-up. The services of the home intervention team meant that the intervention group were better informed than controls about possible use of community services. This resulted in a higher use of 'convenience' services (e.g. help with shopping, meals on wheels), while the use of 'essential' services was unaffected. Better information and resource allocation led to greater patient satisfaction and health status perception in the intervention group.

Taking into account the costs for the home intervention team and the increased use of community services, our programme resulted in lower direct costs. The reduced costs for the intervention group were mainly due to fewer days spent in hospital and nursing homes. These findings are consistent with those of other controlled trials [15, 17–19].

Several limitations in our study should be noted. Although not familiar with comprehensive geriatric assessment at the beginning of the study, clinicians may have learned the principles of geriatric assessment because the same doctors were caring for patients in all study groups and could observe the work of the home intervention team. Improved care of control patients could thus have contaminated the in-hospital data. Geriatric assessment technology is unknown to primary care physicians in Germany. It is unlikely that geriatric assessment could have influenced post-discharge treatment of patients, even if the same doctor had cared for patients from different study groups during the follow-up period.

The impracticability of blinding interviewers to the treatment assignments may have biased the reports of outcomes. To obtain as complete reports as possible

Table 5. Direct costs for patients in home intervention, assessment and control groups 12 months after admission to study

	Direct costs in DM (and US $)/100 people/year		
	Home intervention ($n = 140$)	Assessment ($n = 139$)	Control ($n = 141$)
Medical staff[a]	240 000 (137 000)	50 000 (28 600)	–
Community services	330 000 (188 600)	250 000 (142 900)	210 000 (120 000)
Visits to physicians	89 000 (50 900)	80 000 (45 800)	78 000 (44 600)
Hospital costs			
Initial	1 742 000 (995 000)	2 115 000 (1 209 000)	2 223 000 (1 270 000)
Readmissions	669 000 (382 300)	1 000 000 (571 400)	1 026 000 (586 300)
Nursing homes	295 000 (168 600)	488 000 (278 900)	608 000 (347 400)
Total	3 365 000 (1 922 400)	3 983 000 (2 276 600)	4 145 000 (2 368 300)

[a]Home intervention team, assessment, nursing.

about health status and where patients were living, proxy reports were required in some cases, and reports from proxies and patients may differ. We tried to minimize these problems by obtaining additional data from home visits and information from primary care physicians. The interviewers were trained intensively and only valid and reliable test instruments were used.

An important finding was the lack of effect of comprehensive geriatric assessment alone: it did not improve any outcome and was effective only in combination with home intervention team. A recently published meta-analysis of 28 controlled trials supports these findings [20]: programmes with control over medical recommendations and extended post-discharge follow-up were more likely to be effective, and no effects were seen when comprehensive geriatric assessment was carried out with recommendations alone.

Our results support the view that comprehensive geriatric assessment, in combination with a hospital-based post-discharge intervention, may help to improve the health and function of older patients by continuous treatment and care, as well as reducing direct costs. Comprehensive geriatric assessment with recommendations, however, failed to show positive effects.

Key points

- Comprehensive geriatric assessment combined with a home intervention team significantly reduced lengths of hospital stay and immediate nursing home placement. It delayed permanent nursing home placement and improved functional status.
- Survival was not affected by the intervention programme.
- The additional costs of staff were more than balanced by the value of released bed days (in hospital and nursing homes) and resulted in net savings.
- Improved information and resource allocation led to greater patient satisfaction and health status perception in the home intervention group.
- Comprehensive geriatric assessment with recommendations alone did not improve outcome.

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