Available online at www.sciencedirect.com
SCIENCE DIRECT®
ELSEVIER
Archives of Gerontology and Geriatrics 39 (2004) 245–254
ARCHIVES OF GERONTOLOGY AND GERIATRICS
www.elsevier.com/locate/archger

The influence of outpatient comprehensive geriatric assessment on survival: a meta-analysis

Hsu-Ko Kuo [a,b,c,d,*], Karen Glasser Scandrett [a,b,c], Jatin Dave [a,b,c], Susan L. Mitchell [a,b,c]

[a] *Hebrew Rehabilitation Center for Aged, Research and Training Institute, 1200 Centre Street, Boston, MA 02131, USA*
[b] *The Department of Medicine of Beth Israel Deaconess Medical Center, 330 Brookline Avenue, Boston, MA 02115, USA*
[c] *Division on Aging, Harvard Medical School, 164 Longwood Avenue, Boston, MA 02115, USA*
[d] *Department of Medicine, National Taiwan University Hospital, 7 Chung-Shan S. Road, Taipei, Taiwan*

Received 21 October 2003; received in revised form 18 March 2004; accepted 31 March 2004
Available online 19 June 2004

Abstract

Although outpatient Comprehensive Geriatric Assessment (CGA) has shown certain benefits in functional status and quality of life by many randomized controlled trials, no survival benefit has been reported. We hypothesized that the lack of survival benefit may be due to insufficient power of individual trials. In order to assess the influence of outpatient CGA on survival of older persons, we performed a meta-analysis of all randomized controlled trials of outpatient CGA. Nine studies consisting of 3750 subjects fulfilled the predetermined eligible criteria and were included in the meta-analysis. Combined mortality risk ratio with outpatient CGA intervention compared to usual care group was 0.95 (95% confidence interval, CI 0.82–1.12, $P = 0.62$). Treatment effects were homogeneous across the trials. This meta-analysis did not demonstrate survival benefit for outpatient CGA. Inadequate statistical power is unlikely to explain the results. Future researches of outpatient CGA should focus on coordinated and standardized measurement of outcomes related to functional status, institutionalization rate, and quality of life.

Keywords: Randomized clinical trial; Comprehensive geriatric assessment; Geriatric evaluation and management; Outpatient; Mortality

* Corresponding author. Tel.: +1 617 3638327; fax: +1 617 3638929.
E-mail addresses: hkuo@post.harvard.edu, hkuo@bidmc.harvard.edu (H.-K. Kuo).

0167-4943/$ – see front matter © 2004 Elsevier Ireland Ltd. All rights reserved.
doi:10.1016/j.archger.2004.03.009

1. Introduction

The Comprehensive Geriatric Assessment (CGA) emerged during the1980s as an important strategy to improve care for elders with complex medical, psychosocial, and functional problems (Epstein et al., 1987). CGA is more effective when performed on specialized hospital units than in other settings. The more intensive the CGA intervention and the more control the intervening team has over patient care, the more likely CGA will have a beneficial effect on outcomes (Applegate and Burns, 1996). Focus of recent investigations has been shifted to outpatient CGA due to high costs of inpatient care (Boult et al., 2001). However, the studies of outpatient CGA are impeded by low statistical power, non-uniform eligibility or targeting of patients, and heterogeneous outcomes measures (Applegate et al., 1991; Boult et al., 2001), its benefits are not consistently demonstrated.

Survival is one of the most commonly reported outcomes in clinical studies. Stuck et al. (1993) reported in a meta-analysis that outpatient CGA did not improve survival compared to usual care despite significant survival benefit was observed in inpatient and home-based CGA. However, two of the four trials of outpatient CGA included in this meta-analysis were criticized because the subjects were relatively healthy and not targeted as being at high risk for decline. Since the publication of that meta-analysis, additional studies of outpatient CGA were conducted with greater attention to targeting frail subjects. These studies showed that the intervention improved various outcomes in older persons including mental health (Rubin et al., 1993; Burns et al., 1995, 2000; Reuben et al., 1999; Boult et al., 2001; Cohen et al., 2002) and functional status (Rubin et al., 1993; Reuben et al., 1999; Boult et al., 2001) at no increased cost (Rubin et al., 1993; Toseland et al., 1997; Boult et al., 2001; Cohen et al., 2002). In addition, more than half of these trials about outpatient CGA demonstrated a trend to improve survival (Epstein et al., 1990; Silverman et al., 1995; Toseland et al., 1997; Reuben et al., 1999; Burns et al., 2000; Boult et al., 2001) although no one showed a significant survival benefit.

We hypothesized that the lack of demonstrated association between outpatient CGA and reduced mortality may be due to the sample size limitations of these individual trials. To test this hypothesis, we conducted a meta-analysis of all randomized, controlled trials of outpatient CGA, to determine whether the collective statistical power of these studies would demonstrate survival benefit for older patients.

2. Methods

2.1. Study identification

We searched the MEDLINE electronic database (1966 to March 2003) using the following Medical Subject Headings: geriatric assessment, geriatrics, health services for the aged, outpatient, ambulatory care, ambulatory care facilities, family practice, and primary health care. The search also included the following key words: randomized clinical trial, geriatric evaluation and management and comprehensive geriatric assessment. Additional references were found by reviewing bibliographies from original communications and review articles.

2.2. Study selection criteria

Three investigators (H.K., K.G.S, J.D.) independently reviewed all potential studies derived from the MEDLINE search. Individual studies had to meet the following pre-determined criteria in order to be included in the meta-analysis: (1) randomized trial of outpatient CGA versus usual care, (2) methods section described appropriate targeting strategies to recruit frail older people at risk for functional decline, excluding those who are either very healthy or terminally ill, (3) CGA included a multidisciplinary team approach, (4) a physician was included in the CGA team who had formal geriatric training or extensive experience in the care of older persons, and (5) death was reported as an outcome measure. If multiple reports were published from the same trial, only the most recent publication was included in the analysis. Discrepancies regarding the eligibility of any article were adjudicated by a fourth investigator (S.L.M.).

2.3. Data abstraction

Using a standardized data abstraction form, two investigators (H.K., K.G.S.) independently abstracted the following data from each eligible study: (1) year of publication, (2) whether or not the study was set within a Veterans Administration (VA) system, (3) sample size, (4) mean age of subjects (years), (5) duration of follow-up (months), (6) type of intervention (primary care versus consultation only), and (7) mortality data. We contacted the studies' investigators where necessary to clarify the published data. Primary care refers to an intervention that included assessment and management of the subjects. Consultation refers to an intervention that included assessment only with recommendations passed on to another primary care provider to implement. Only one study reported mortality data using survival analysis (Toseland et al., 1997). Therefore, we analyzed mortality in terms of the proportion of subjects who were either alive or dead at the end of the studies' follow-up period.

2.4. Analysis

Data management and analysis were performed using STATA 7.0 software (STATA Corporation, College Station, TX). Mortality rate was the primary outcome of this meta-analysis. A combined mortality ratio was used to compare survival between subjects randomized to receive CGA to those who received usual care in all studies.

Yates correction (Sahai and Khurshid, 1995) was used if the number of deaths was zero in either group. We used both fixed-effects and DerSimonian and Laird random-effects models (Deeks et al., 2001) to calculate the pooled risk ratio across the trials. Chi-squared tests were used to check for heterogeneity among the trials. The influence of individual trials on the combined mortality risk ratio was examined by omitting one trial at a time, and calculating a pooled mortality risk ratio with each omission. A visual examination of funnel plots was conducted for evidence of publication bias. To explore potential sources of heterogeneity, we performed sensitivity analysis by doing stratified subgroup analyses for mortality according to: (1) number of subjects (<200, 200–400, >400), (2) type of intervention (ongoing geriatric clinical care versus one-time consultation only), (3) whether

the study was conducted in VA setting or not, (4) starting date for data collection, and (5) duration of management following CGA (<6, 6–12, >12 months).

3. Results

3.1. Eligible studies

One hundred and sixty-nine potentially relevant studies were identified from the MEDLINE search. One hundred and thirty-nine articles were excluded based on abstract review. The remaining 30 potentially eligible reports were retrieved for full-text review. Fig. 1 illustrates the flow of the selection process of included studies. Nine randomized controlled trials met full eligibility criteria and were included in this meta-analysis. The characteristics of the nine studies are summarized in Table 1.

All of the studies were conducted in the United States and published in English. The sample sizes ranged size from 117 to 1388 subjects, with a total of 3750 subjects in all nine studies. Among these subjects, 1885 were assigned to receive CGA and 1865 to usual care. Three of the studies were performed in a VA facility setting and two investigations were multi-centered trials. CGA was performed as a single consultation in three studies. In six studies, the intervention comprised CGA followed by geriatric management. The age of subjects in each trial ranged from 71 to 79 years and the mean age for the nine studies combined was 75.1 ± (S.D.) 2.2 years. The follow-up duration ranged from 12 to 24 months with a mean 15.7 ± (S.D.) 8.1 months. Six of the studies found a trend towards improved survival with CGA, but none reported a statistically significant reduction in mortality.

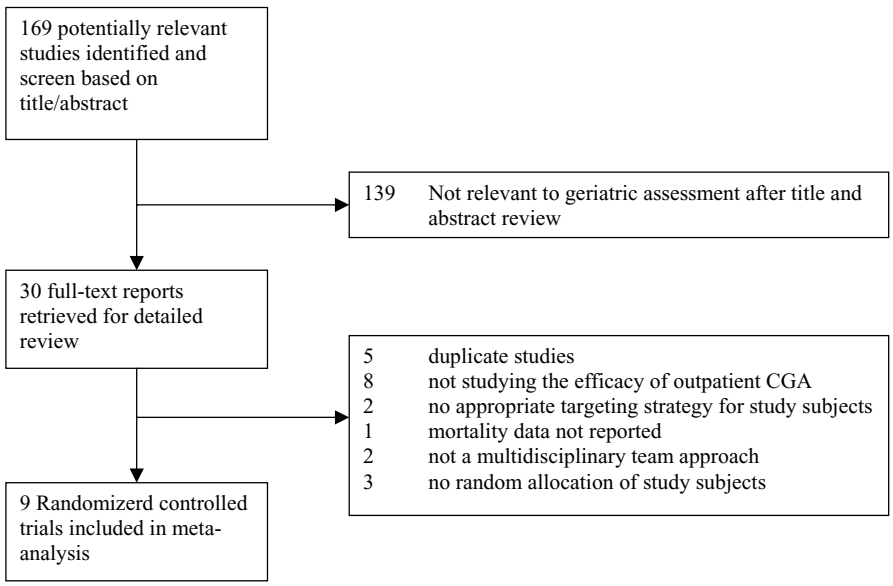

Fig. 1. Flow chart of literature selection and review for eligibility.

Table 1
Characteristics of trials of outpatient comprehensive geriatric assessment meeting inclusion criteria

Study (year)	VA[a] setting	Number of subjects total (CGA/UC[b])	Mean age (years)	Mean follow-up (months)	CGA team member[c]	Model of care	Mortality risk ratio (95% CI)
Williams et al. (1987)	No	117 (58/59)	76.5	12	MD, Psych; N; SW; Nu	Primary care	1.02 (0.31, 3.33)
Epstein et al. (1990)	No	390 (185/205)	76.8	12	MD, NP, SW	Consultation	0.85 (0.38, 1.90)
Rubin et al. (1993)	No	194 (97/97)	76.7	12	MD; Psych, NP, SW	Primary care	1.07 (0.69, 1.67)
Silverman et al. (1995)	No	442 (239/203)	71.9	12	MD, N, SW	Consultation	0.59 (0.23, 1.53)
Toseland et al. (1997)	Yes	160 (80/80)	74.6	24	MD, NP, SW	Primary care	0.67 (0.34, 1.29)
Reuben et al. (1999)	No	363 (180/183)	75.6	15	MD, NP, SW, PT	Consultation	0.09 (0.01, 1.66)
Burns et al. (2000)	Yes	128 (60/68)	71.2	24	MD, NP, SW, Psy, Pharm	Primary care	0.66 (0.34, 1.26)
Boult et al. (2001)	No	568 (294/274)	78.8	18	MD, NP, N, SW	Primary care	0.93 (0.57, 1.53)
Cohen et al. (2002)	Yes	1388 (692/696)	74.2	12	MD, N, SW	Primary care	1.05 (0.86, 1.29)

[a] VA: Veterans affair medical center.
[b] UC: usual care.
[c] CGA team member: MD: medical doctor; N: nurse; NP: nurse practitioner; Nu: nutritionist; Pharm: pharmacist; Psy: psychologist; Psych: psychiatrist; PT: physical therapist; SW: social worker.

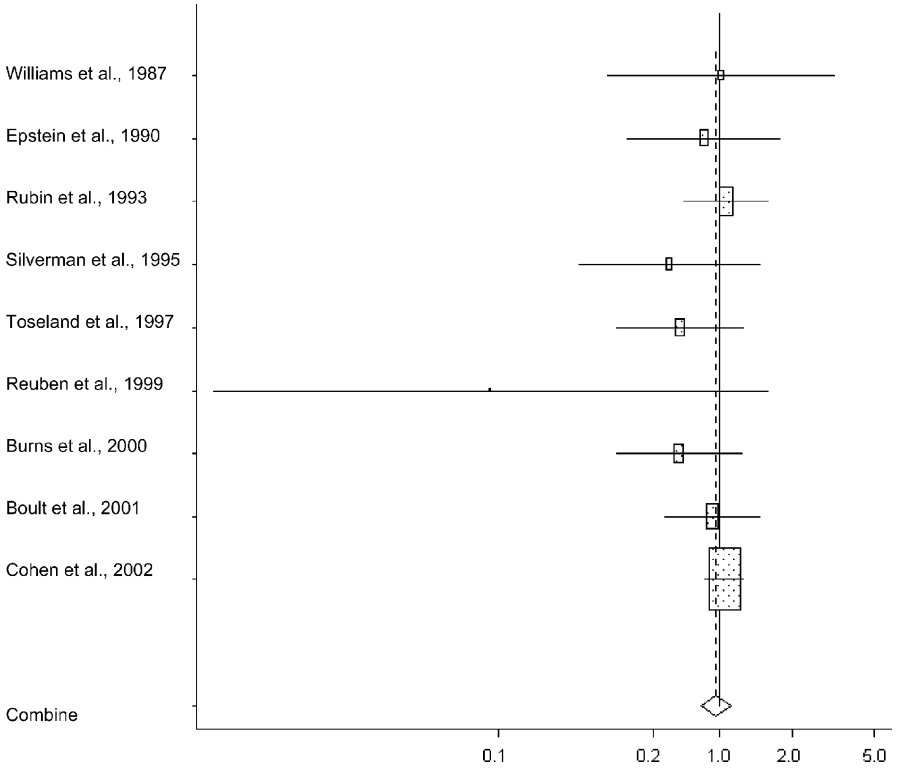

Fig. 2. The impact of CGA intervention on mortality. Mortality risk ratios are displayed on the horizontal axis. The squares represent the mortality risk ratios for each trial. The size of each square is proportional to the reciprocal of the variance of the corresponding trial, with 95% confidence intervals indicated by solid horizontal lines. The diamond indicates the summary mortality risk ratio, with width corresponding to its 95% confidence interval. The vertical dashed line displays the summary mortality risk ratio of 0.96.

3.2. Effect of outpatient CGA on mortality

After combining the mortality data for the nine studies using meta-analytic techniques, outpatient CGA was not shown to improve the survival of frail older persons compared to usual care (Fig. 2). The summary risk ratio for mortality in patients receiving outpatient CGA intervention, compared with patients receiving usual care, was 0.95 (95% confidence interval, CI 0.82–1.12). Test for heterogeneity using a chi-squared-test showed a Q test statistics $= 7.15$ with 8 degrees of freedom ($P = 0.52$) indicating a homogenous risk ratio among studies. Therefore, results are presented using a fixed-effects model.

3.3. Sensitivity analysis and publication bias

Sensitivity analysis was conducted according to the following variables: number of subjects, type of intervention, length of management, whether or not the care was delivered in

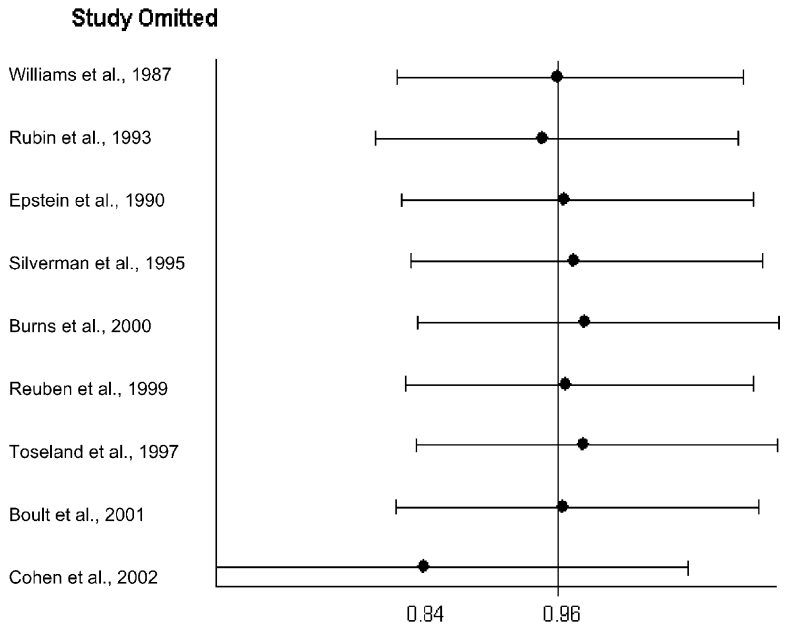

Fig. 3. The relative influence of individual trial. Mortality risk ratios are displayed on the horizontal axis. Studies omitted are displayed on the vertical axis. Solid dot and horizontal bar means point estimate of mortality risk ratio and its 95% confidence interval with omission of certain study. Vertical line displays the summary mortality risk ratio of 0.96. Cohen et al. shows greatest influence on overall result, deviating summary mortality risk ratio from 0.96 to 0.84 with its omission.

the VA setting, and year in which data collection began. The resulting mortality risk ratios were not statistically significant in any of these subgroup analyses.

The relative influence of each study was examined by sequentially omitting each study and recalculating the combined mortality risk ratio (Fig. 3). With a large sample size, Cohen et al. (2002) demonstrated the greatest influence over the results. Excluding this study, the combined mortality risk ratio was 0.84 (95% CI 0.66–1.07). Omission of other studies did not change the combined risk ratio.

We used a funnel plot to ascertain publication bias, graphing the logarithm of trial effect sizes (mortality risk ratio) on the horizontal axis and the number of participants in each trial on the vertical axis. Our results demonstrated a minimal degree of publication bias.

4. Discussion

In this meta-analysis, outpatient CGA has no demonstrable benefit for the survival of older, frail patients compared to usual care. Our findings support and extend the result of an earlier meta-analysis of CGA (Stuck et al., 1993), which also found no improvement in survival with outpatient CGA compared to usual care. However, the interpretation of efficacy of outpatient CGA from this Stuck et al. (1993) was limited because it only included

four trials of outpatient CGA (Tulloch and Moore, 1979; Williams et al., 1987; Yeo et al., 1987; Epstein et al., 1990), two of which (Tulloch and Moore, 1979; Yeo et al., 1987) did not adequately target frail elders. Our meta-analysis is the first one to combine all appropriately targeted, randomized, controlled trials of outpatient CGA conducted through 2002. Therefore, inadequate statistical power is unlikely to explain the lack of survival benefit of outpatient CGA reported to date. Our sensitivity analysis, which failed to identify any subgroup of studies demonstrating significant survival benefit with outpatient CGA, further supports the robustness of this finding. While outpatient CGA may have other benefits for community-dwelling older persons at risk for decline, it is unlikely to result in life prolongation.

CGA delivered in other settings such as inpatient service or home healthcare, however, demonstrates significant survival benefit in several studies (Hendriksen et al., 1984; Vetter et al., 1984; Applegate et al., 1990; Saltvedt et al., 2002) and meta-analyses (Rubenstein et al., 1991; Stuck et al., 1993). The mechanism for the fact that inpatient and home-based CGA have survival benefit while outpatient CGA does not is still unclear. This discrepancy of survival benefit may be explained by some hypothesized features that outpatient CGA does not have, such as intensive rehabilitation and improved patient adherence during hospitalization, *and* frequent and scheduled home visit to monitor treatment effect and patient compliance. In addition, several possible reasons can explain the lack of survival benefit for outpatient CGA. First, it is possible that strength of the interventions in these studies (e.g., the expertise of the CGA team or the implementation of their recommendations) was weak, offering limited benefit over usual care to the extent that survival would be affected (Reuben et al., 1999). Second, the subjects included in these studies were all specifically targeted to be at risk for physical decline. Although the lack of targeting has been a criticism of earlier studies of outpatient CGA, it may be that these subjects were, in fact, too frail for outpatient CGA intervention to impact their survival.

While survival is the most commonly reported outcome in trials of CGA, the prolongation of life is not necessarily the most relevant goal for many frail elders. All trials included in our meta-analysis examined other important outcome for outpatient CGA, including: functional status (Williams et al., 1987; Epstein et al., 1990; Rubin et al., 1993; Silverman et al., 1995; Toseland et al., 1997; Reuben et al., 1999; Burns et al., 2000; Boult et al., 2001; Cohen et al., 2002), cost (Williams et al., 1987; Rubin et al., 1993; Silverman et al., 1995; Toseland et al., 1997; Boult et al., 2001; Cohen et al., 2002), patient satisfaction (Williams et al., 1987; Epstein et al., 1990; Rubin et al., 1993; Toseland et al., 1997; Reuben et al., 1999; Burns et al., 2000; Boult et al., 2001), rates of institutionalization or hospitalization (Williams et al., 1987; Epstein et al., 1990; Rubin et al., 1993; Silverman et al., 1995; Toseland et al., 1997; Burns et al., 2000; Boult et al., 2001). The efficacy of outpatient CGA in each of these areas is not consistently demonstrated. Unfortunately, these outcomes are not measured in a uniform manner such that data synthesis could be used as valid approach to resolve inconsistencies.

Our study has several limitations. Based on our predetermined eligibility criteria, all nine included studies were conducted within the United States, thereby affecting the generalizability of our results. It is possible that within other health systems, CGA may provide a survival benefit over usual care practices. Publication bias may have affected our results, as

found on our funnel plot. However, we believe that our search strategy was thorough and that this bias was minimal.

While evidence to date does not suggest survival benefit for outpatient CGA, it remains an important approach to deliver health care to this population. Its tenacity may be due, in part, to potential benefits on other important outcomes to older persons, such as delayed institutionalization, reduced costs, and improved quality of life. However, meta-analysis of these outcomes has been impeded by inconsistent measures and incomplete reporting. Future studies of CGA should focus on coordinated and standardized measurement of these outcomes to facilitate comparison of individual study findings and future meta-analytic efforts.

Acknowledgements

Dr. Kuo is supported by the Men's Associates Fellowship of the Hebrew Rehabilitation Center for Aged, Boston, MA, USA. Dr. Scandrett is supported by the Women's Auxiliary of the Hebrew Rehabilitation Center for Aged, Boston, MA, USA. Dr. Mitchell is supported by the NIH-NIA Mentored Patient Research Award K23AG20054-01.

References

Applegate, W.B., Burns, R., 1996. Geriatric medicine. J. Am. Med. Assoc. 275, 1812–1813.

Applegate, W.B., Miller, S.T., Graney, M.J., Elam, J.T., Burns, R., Akins, D.E., 1990. A randomized, controlled trial of a geriatric assessment unit in a community rehabilitation hospital. N. Engl. J. Med. 322, 1572–1578.

Applegate, W., Deyo, R., Kramer, A., Meehan, S., 1991. Geriatric evaluation and management: current status and future research directions. J. Am. Geriatr. Soc. 39, 2S–7S.

Boult, C., Boult, L.B., Morishita, L., Dowd, B., Kane, R.L., Urdangarin, C.F., 2001. A randomized clinical trial of outpatient geriatric evaluation and management. J. Am. Geriatr. Soc. 49, 351–359.

Burns, R., Nichols, L.O., Graney, M.J., Cloar, F.T., 1995. Impact of continued geriatric outpatient management on health outcomes of older veterans. Arch. Intern. Med. 155, 1313–1318.

Burns, R., Nichols, L.O., Martindale-Adams, J., Graney, M.J., 2000. Interdisciplinary geriatric primary care evaluation and management: two-year outcomes. J. Am. Geriatr. Soc. 48, 8–13.

Cohen, H.J., Feussner, J.R., Weinberger, M., Carnes, M., Hamdy, R.C., Hsieh, F., Phibbs, C., Courtney, D., Lyles, K.W., May, C., McMurtry, C., Pennypacker, L., Smith, D.M., Ainslie, N., Hornick, T., Brodkin, K., Lavori, P., 2002. A controlled trial of inpatient and outpatient geriatric evaluation and management. N. Engl. J. Med. 346, 905–912.

Deeks, J.J., Altman, D.G., Bradburn, M.J., 2001. Statistical methods for examining heterogeneity and combining results from several studies in meta-analysis. In: Egger, M., Smith, G.D., Altman, D.G. (Eds.), Systematic Reviews in Health Care: Meta-Analysis in Context. BMJ Publishing Group, London, pp. 285–312.

Epstein, A.M., Hall, J.A., Besdine, R., Cumella Jr., E., Feldstein, M., McNeil, B.J., Rowe, J.W., 1987. The emergence of geriatric assessment units. The "new technology of geriatrics". Ann. Intern. Med. 106, 299–303.

Epstein, A.M., Hall, J.A., Fretwell, M., Feldstein, M., DeCiantis, M.L., Tognetti, J., Cutler, C., Constantine, M., Besdine, R., Rowe, J., McNeil, B.J., 1990. Consultative geriatric assessment for ambulatory patients. A randomized trial in a health maintenance organization. J. Am. Med. Assoc. 263, 538–544.

Hendriksen, C., Lund, E., Stromgard, E., 1984. Consequences of assessment and intervention among elderly people: a three year randomised controlled trial. Br. Med. J. (Clin. Res. Ed.) 289, 1522–1524.

Reuben, D.B., Frank, J.C., Hirsch, S.H., McGuigan, K.A., Maly, R.C., 1999. A randomized clinical trial of outpatient comprehensive geriatric assessment coupled with an intervention to increase adherence to recommendations. J. Am. Geriatr. Soc. 47, 269–276.

Rubenstein, L.Z., Stuck, A.E., Siu, A.L., Wieland, D., 1991. Impacts of geriatric evaluation and management programs on defined outcomes: overview of the evidence. J. Am. Geriatr. Soc. 39, 8S–16S, discussion 17S–18S.

Rubin, C.D., Sizemore, M.T., Loftis, P.A., De Mola, N.L., 1993. A randomized, controlled trial of outpatient geriatric evaluation and management in a large public hospital. J. Am. Geriatr. Soc. 41, 1023–1028.

Sahai, H., Khurshid, A., 1995. On analysis of epidemiological data involving a 2×2 contingency table: an overview of Fisher's exact test and Yates' correction for continuity. J. Biopharm. Stat. 5, 43–70.

Saltvedt, I., Mo, E.S., Fayers, P., Kaasa, S., Sletvold, O., 2002. Reduced mortality in treating acutely sick, frail older patients in a geriatric evaluation and management unit. A prospective randomized trial. J. Am. Geriatr. Soc. 50, 792–798.

Silverman, M., Musa, D., Martin, D.C., Lave, J.R., Adams, J., Ricci, E.M., 1995. Evaluation of outpatient geriatric assessment: a randomized multi-site trial. J. Am. Geriatr. Soc. 43, 733–740.

Stuck, A.E., Siu, A.L., Wieland, G.D., Adams, J., Rubenstein, L.Z., 1993. Comprehensive geriatric assessment: a meta-analysis of controlled trials. Lancet 342, 1032–1036.

Toseland, R.W., O'Donnell, J.C., Engelhardt, J.B., Richie, J., Jue, D., Banks, S.M., 1997. Outpatient geriatric evaluation and management: is there an investment effect? Gerontologist 37, 324–332.

Tulloch, A.J., Moore, V., 1979. A randomized controlled trial of geriatric screening and surveillance in general practice. J. R. Coll. Gen. Pract. 29, 733–740.

Vetter, N.J., Jones, D.A., Victor, C.R., 1984. Effect of health visitors working with elderly patients in general practice: a randomised controlled trial. Br. Med. (J. Clin. Res. Ed.) 288, 369–372.

Williams, M.E., Williams, T.F., Zimmer, J.G., Hall, W.J., Podgorski, C.A., 1987. How does the team approach to outpatient geriatric evaluation compare with traditional care: a report of a randomized controlled trial. J. Am. Geriatr. Soc. 35, 1071–1078.

Yeo, G., Ingram, L., Skurnick, J., Crapo, L., 1987. Effects of a geriatric clinic on functional health and well-being of elders. J. Gerontol. 42, 252–258.