Effectiveness of preventive primary care outreach interventions aimed at older people

Meta-analysis of randomized controlled trials

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Christopher Patterson, MD, FRCPC  Christopher Sigouin, MSC  Mary Gauld

ABSTRACT

OBJECTIVE To determine the effectiveness of preventive primary care outreach interventions aimed at older people. Knowing whether such interventions are effective could help busy family physicians make choices about which preventive care services to provide.

DATA SOURCES We searched MEDLINE, CINAHL, AgeLine, Cochrane Controlled Trials Register, and EMBASE databases and reviewed the reference lists of retrieved articles.

STUDY SELECTION We included studies of preventive primary care interventions aimed at patients 65 years and older if the studies were randomized controlled trials and if any of the following outcomes was reported: mortality, living in the community, admission to acute care hospitals, and admission to long-term care. We defined preventive primary care outreach as proactive, provider-initiated care, which can be provided by nurses, physicians, other professionals, or volunteers, that is in addition to usual care and is provided in primary care settings. Such care can be provided through home visits, office visits, telephone contacts, or a combination of these methods.

SYNTHESIS We assessed the quality of studies and extracted descriptive information on study populations, interventions, and outcomes for 19 trials involving 14,911 patients. Summary odds ratios were estimated for each outcome using a random effects model.

CONCLUSION This review showed that studies of preventive primary care outreach interventions aimed at older people were associated with a 17% reduction of mortality and a 23% increased likelihood of continuing to live in the community.

EDITOR’S KEY POINTS

• Results of studies evaluating the efficacy of preventive primary care interventions aimed at elderly people living in the community are inconclusive.
• This meta-analysis of 19 randomized controlled trials showed that interventions decreased risk of mortality, and that 36 older people would have to be exposed to such interventions to prevent one death. As a comparison, 63 older people with hypertension would have to be treated for 5 years to prevent one death.
• An increased likelihood of being able to continue to live in the community was also observed among people receiving these interventions.

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As the percentage of older adults in the Canadian population increases,¹ the complexity of care required to support those who choose to remain in the community has increased also.² This situation can create challenges for patients, caregivers, their family physicians, and community agencies.

Several studies conducted over the past decade have evaluated specialty-based models designed to anticipate and detect early health problems in community-dwelling older adults and interventions to improve health outcomes.³ We know that individual preventive actions can be effective for older adults,⁴ but it has been less clear whether proactive models anchored in the primary care sector of the health care system are effective at improving older adults’ health outcomes.

Innovative approaches to patient care in the community that address the growing challenge of providing high-quality comprehensive care for older adults require evaluation. This paper reviews the evidence for one such approach, preventive primary care outreach (PPCO). We define PPCO as proactive, provider-initiated care that is in addition to demand-led usual care, is provided in community primary care settings, and is linked to the usual care system. Its goal is to identify unrecognized problems and people at increased risk and to link those people to appropriate health and social care and support. Family physicians, nurses, or other professionals and volunteers can provide PPCO through home visits, office visits, telephone contacts, or a combination of these methods. Some

**Definitions of terms:** Pooling of results of primary studies in a meta-analysis can be done using either a fixed-effects model or a random-effects model.

**Fixed-effects model:** This model restricts inferences to the set of studies included in the meta-analysis and assumes that a single true value underlies all the study results. It takes into account variability within studies, but does not take into account variability between studies.

**Random-effects model:** This model assumes that the studies included are a random sample of a population of studies addressing the question posed in the meta-analysis. It takes into account variability within studies and variability between studies.

**Weighting studies:** Results from smaller studies are more subject to the play of chance. By incorporating a weighting scheme, we can reduce the effect of studies with more uncertainty on the final summary estimate of effect.

**Heterogeneity:** The extent to which results differ from study to study.

**Fitted-cell frequencies:** The values we would expect in a two-by-two table if all the studies had similar levels of the covariates for which we adjusted.

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reports suggest that a preventive approach based on screening those at risk and providing early inter-
vention could help prevent functional decline, pro-
mote independence, and control social and health costs.5,6 Knowing whether PPCO is an effective
approach is important for family physicians as they
make choices about which preventive care services
to provide in a busy practice.

Results of primary studies of PPCO interven-
tions for older people have been mixed. Only some
studies demonstrate benefits that are both clinically
important and statistically significant. Previous sys-
tematic reviews have examined preventive home
visits to older people,7,8 home-based support for
older people,9 comprehensive geriatric assessment,3
and health assessments of older people.10 These
reviews included interventions not consistent with
our definition of PPCO (eg, studies used resources
not readily available in primary care settings, such
as consultation with geriatricians) or studies that
did not meet our inclusion criteria (eg, non-ran-
domized trials, or studies of patients after hospital
discharge).

This systematic review aimed to determine the
effectiveness of PPCO interventions for commu-
nity-dwelling older people. We were interested in
assessing a model of preventive primary care that
used only primary care resources and was consist-
ten with current approaches to primary care in the
developed world. Our inclusion criteria were care-
fully developed to ensure commonality of studies
in the meta-analysis.

Methods

Data sources. We searched MEDLINE from
January 1966 to July 2001, CINAHL from January
1982 to July 2001, AgeLine from January 1978 to
July 2001, the Cochrane Controlled Trials Register
up to July 2001, and EMBASE from January 1988
to July 2001 for reports of primary research, using
the indexing terms “aged” combined with “geriat-
ric assessment” or “preventive medicine” or “home
care services” or “risk assessment” and “random-
ized controlled trial.” Articles were limited to “age
65 and over” and “English language.” Searches were
calculated using methods described by Fleiss.12 Two-by-
two tables were constructed for each outcome in

Study selection. Two investigators reviewed
the searches and the reference lists of all articles
retrieved. The complete texts of all potentially rele-
vant articles were reviewed using the inclusion and
exclusion criteria listed in Table 1. Teams of two
investigators independently abstracted data from all
studies that met the eligibility criteria. We attempted
to contact authors when data were missing. The
methodologic quality of each study was indepen-
dently assessed by two investigators using the Jadad
et al scale, which has demonstrated validity.11 The
Jadad et al scale is scored by awarding 1 point for
each “yes” response to the following items: ran-
domization is reported; method of randomization
is described; double blinding is reported; method
used to double blind is described; and withdrawals
and drop-outs for each arm are described. A point
is subtracted for each “no” response to the following
items: randomization method is appropriate; and
double-blinding method was appropriate.

Table 1. Inclusion and exclusion criteria

<table>
<thead>
<tr>
<th>INCLUSION CRITERIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Most patients were 65 and older</td>
</tr>
<tr>
<td>Patients were community dwelling (not living in residential care or nursing homes)</td>
</tr>
<tr>
<td>The intervention, preventive primary care outreach, was defined as proactive, provider-initiated care (not in response to a patient health problem or event, such as hospitalization or a fall) that is in addition to usual care</td>
</tr>
<tr>
<td>The intervention was provided in an ambulatory primary care community setting</td>
</tr>
<tr>
<td>The study design was a randomized trial</td>
</tr>
<tr>
<td>At least one of the following patient outcomes was reported: mortality, living in the community, admission to an acute care hospital, and admission to long-term care</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>EXCLUSION CRITERIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients were selected on the basis of a specific existing condition (eg, dementia or a history of falls)</td>
</tr>
<tr>
<td>Patients were part of a posthospital program</td>
</tr>
<tr>
<td>The intervention used resources generally available only in secondary care (eg, consultations with geriatricians)</td>
</tr>
</tbody>
</table>
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each study for which data were available. A value of 0.5 was added to each cell of the two-by-two table to adjust for zero cell frequencies.\textsuperscript{13} Summary estimates of effect were calculated by combining individual trial estimates weighted by the inverse of their variances. Both fixed and random effects\textsuperscript{14} estimates were calculated. Heterogeneity was assessed using the Q statistic, which follows a chi-square distribution with N-1 degrees of freedom, where N is the number of trials.\textsuperscript{12} We defined statistical heterogeneity as \( P < .10.\)

For each outcome, we analyzed data from the final follow-up assessment period. The denominator used to calculate effect sizes for outcomes was the number of subjects randomized. We also examined the effect of duration of follow up on mortality by calculating summary ORs at 6, 12, 24, 36, and 48 months separately using all possible data. In an exploratory analysis, we examined seven methodologic, patient population, and intervention characteristics that might modify the effect of PPCO (Table 2). To test whether differences in these characteristics influenced the magnitude of treatment effect in studies, we divided the trials into two specified categories for each variable. We used the \( z \) score to test for a difference in effect size between the two groups by dividing the difference of the summary log relative risk from both groups by the standard error of the difference.

We used a logistic regression method to adjust for all seven covariates simultaneously.\textsuperscript{15} Fitted-cell frequencies were estimated for each study using logistic regression. These adjusted cell frequencies were then used as input for the standard meta-analysis program to estimate an adjusted summary OR.

Synthesis

The study selection process (Figure 1) yielded 1030 citations. Twenty-two reports of 19 studies met our inclusion criteria.\textsuperscript{16-36} In 14 studies, samples were selected from primary care practice populations using sampling frames such as practice registries\textsuperscript{17,19-21,23,26-30,32,34-36}; in the other five studies, samples were selected from general population bases using sampling frames such as census lists or health insurance lists.\textsuperscript{22,24,25,31,33} Descriptive details of these 19 studies are shown in Table 3.\textsuperscript{16-36}

Typically, interventions involved an initial health and social assessment or screening of subjects by a professional or volunteer. Subjects in the intervention group received one or more home, telephone, or office contacts by family physicians, nurses, social workers, or volunteers. Interventions included education about health-related matters and referrals to relevant community agencies for health and social services (eg, nursing visits, Meals on Wheels, homemaking), and to family physicians. The frequency of follow-up contacts varied, as did the duration of the intervention (12 to 60 months).\textsuperscript{16-36} Table 3 lists outcomes assessed in the 19 trials included in the meta-analysis.

Mortality (19 studies). The summary OR was 0.83 (95% confidence interval [CI] 0.75 to 0.91), a 17% reduction in mortality (Table 4).\textsuperscript{16-36} In all but three studies,\textsuperscript{19,21} the intervention was associated with a reduction in mortality, with exact ORs ranging from 0.25 to 0.91. Heterogeneity of study results was not statistically significant (\( P = .39 \)). Assuming a mortality rate in the absence of intervention equivalent to the overall mortality rate in the control arms of the studies included in our review, PPCO would prevent one death for every 36 elderly people targeted for intervention.

Because the study by Burton et al\textsuperscript{16-18} accounted for 28% of the summary estimate, we conducted a sensitivity analysis to determine the effect of this

<table>
<thead>
<tr>
<th>Table 2. Methodologic, patient population, and intervention characteristics that could modify the effect of a preventive primary care outreach intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Methodologic Characteristic</strong></td>
</tr>
<tr>
<td>Methodologic quality (score of ( \leq 2 ) vs ( \geq 3 ))</td>
</tr>
<tr>
<td><strong>Patient Population Characteristics</strong></td>
</tr>
<tr>
<td>Source of sample (practice-based vs population-based)</td>
</tr>
<tr>
<td>Age (mean or median age &lt; 75 years vs ( \geq 75 ) years)</td>
</tr>
<tr>
<td>Targeting a high-risk group (targeting vs not targeting)</td>
</tr>
<tr>
<td>Geographic area (Canada vs other countries)</td>
</tr>
<tr>
<td><strong>Intervention Characteristics</strong></td>
</tr>
<tr>
<td>Frequency of contacts (once or less per year vs twice or more per year)</td>
</tr>
<tr>
<td>Length of follow up (( \leq 24 ) months vs ( \geq 36 ) months)</td>
</tr>
</tbody>
</table>
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Figure 1. Study Flow

Potentially relevant RCTs identified and screened for retrieval (n=242)

RCTs excluded
• Ineligible patient population (n=119)
• Ineligible intervention (n=33)

RCTs retrieved for more detailed evaluation (n=90)

RCTs excluded
• Ineligible patient population (n=26)
• Ineligible intervention (n=35)
• Ineligible outcomes (n=10)

RCTs included in the meta-analysis (n=19)

Table 3. Randomized controlled trials that evaluated preventive primary care outreach interventions for older people

<table>
<thead>
<tr>
<th>Study</th>
<th>Sample size and characteristics</th>
<th>Intervention</th>
<th>Intervenors</th>
<th>Duration of follow up (mo)</th>
<th>Outcomes assessed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burton et al 1995&lt;sup&gt;16&lt;/sup&gt; and 1997&lt;sup&gt;17&lt;/sup&gt;; German et al 1995&lt;sup&gt;18&lt;/sup&gt; (USA)</td>
<td>4195 people ≥65 y from 102 solo or partnership practices, 12 community group practices, and three medical clinics; 63% women*</td>
<td>Preventive services each year for 2 years that included physical examination, laboratory screening for cancer, immunizations, and counseling for health risks†</td>
<td>Physicians, nurse practitioners, physicians’ assistants, osteopaths</td>
<td>48</td>
<td>a,c,d,m,n</td>
</tr>
<tr>
<td>Carpenter and Demopoulos 1990&lt;sup&gt;19&lt;/sup&gt; (UK)</td>
<td>539 people ≥75 y from two general practices: 87% 75-84 y, 13% ≥85 y; 65% women*‡§</td>
<td>Visits over 3 years to complete questionnaire on activities of daily living; if no disability, visits every 6 mo; if some or severe disability, visits every 3 mo†</td>
<td>Volunteers</td>
<td>36</td>
<td>a,c,d,e,g,j,k</td>
</tr>
<tr>
<td>Clarke et al 1992&lt;sup&gt;20&lt;/sup&gt; (UK)</td>
<td>523 people ≥75 y living alone from a large group practice of 12 family practitioners*‡§</td>
<td>Visits for 1.25-2 y; minimum of 3 visits in first year. Assistance, tailored to personal requests, included social, financial, housing, nursing and medical services†</td>
<td>Lay community workers</td>
<td>42</td>
<td>a,b,e,l,m</td>
</tr>
<tr>
<td>Dalby et al 2000&lt;sup&gt;21&lt;/sup&gt; (Canada)</td>
<td>142 people ≥70 y at risk of functional decline on roster of two family physicians; mean age 79 y; 67% women*‡§</td>
<td>Visiting nurse developed care plan with physician, patient, family; follow-up visits and phone calls as needed over 14 months to promote health, provide support, make referrals†</td>
<td>Nurses</td>
<td>14</td>
<td>a,c,m</td>
</tr>
<tr>
<td>Hall et al 1992&lt;sup&gt;22&lt;/sup&gt; (Canada)</td>
<td>167 people ≥65 y receiving personal care at home; mean age 78 y; 78% women‡§</td>
<td>Home visits, development of personal health plan, and referral. Frequency of visits varied: average of 4-12 h/y per client†</td>
<td>Nurse</td>
<td>36</td>
<td>a,b,c</td>
</tr>
</tbody>
</table>

Continued on next page
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<table>
<thead>
<tr>
<th>STUDY</th>
<th>SAMPLE SIZE AND CHARACTERISTICS</th>
<th>INTERVENTION</th>
<th>INTERVENORS</th>
<th>DURATION OF FOLLOW UP (MO)</th>
<th>OUTCOMES ASSESSED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hay et al 1998 (Canada)</td>
<td>619 people ≥65 y listed on a practice roster who screened positive for health concerns or risks; mean age 74; 58% women*§</td>
<td>Referral for follow-up care for issues identified on screening form; such care provided by physician, nurse practitioner, social worker, chiroprist, optometrist, and nurse responsible for giving influenza vaccine</td>
<td>Physicians</td>
<td>24</td>
<td>a,c,e,m,n</td>
</tr>
<tr>
<td>Hébert et al 2001 (Canada)</td>
<td>494 people ≥75 y listed on the Quebec health insurance plan identified through mailed questionnaire at risk of functional decline; mean age 80; 64% women§</td>
<td>Assessment by nurse who sent results to GP; referral to specialized resources and contact with GP; monthly contact with clients for 1 y†</td>
<td>Nurse</td>
<td>12</td>
<td>a,c,h</td>
</tr>
<tr>
<td>Hendriksen et al 1984 (Denmark)</td>
<td>600 people ≥75 y listed on a register of municipal social welfare authorities; median age 78; 62% women#</td>
<td>Home visits every 3 mo for 3 y; Intervenor visited subjects, conducted assessment, offered referral to and coordination of community services; subjects could telephone to request additional visits†</td>
<td>Medical resident, home nurses</td>
<td>36</td>
<td>a,b,c,d,j,k,m,n</td>
</tr>
<tr>
<td>Leveille et al 1998 (USA)</td>
<td>201 people ≥70 y registered in two HMOs and being treated for at least one chronic condition excluding dementia or terminal disease; mean age 77; 56% women‡§</td>
<td>Targeted multicomponent disability prevention and disease management program at a senior centre for 1 y; nurse met each person to develop health management plan to address risk factors for disability; follow-up visits (average of three) and telephone calls (average of nine); peer support; referral†</td>
<td>Geriatric nurse practitioner, volunteer mentors</td>
<td>12</td>
<td>a,d,f,h,m,n</td>
</tr>
<tr>
<td>McEwan et al 1990 (UK)</td>
<td>296 people ≥75 y registered in a general practice§</td>
<td>One home visit to complete assessment, give health advice, and make referrals</td>
<td>District nurses</td>
<td>20</td>
<td>a,e,m</td>
</tr>
<tr>
<td>Newbury et al 2001 (Australia)</td>
<td>100 people ≥75 y registered in six general practices; median age 79; 63% women‡</td>
<td>One health assessment in home</td>
<td>Nurse</td>
<td>12</td>
<td>a,c,f,g,h,l</td>
</tr>
<tr>
<td>Pathy et al 1992 (UK)</td>
<td>725 people ≥65 y registered with a general practice; mean age 73; 60% women‡§</td>
<td>GP mailed questionnaire yearly for 3 y. If responses indicated problems, health visitor made visit to give practical advice, health education, or make referrals</td>
<td>Health visitor</td>
<td>36</td>
<td>a,b,c,d,j,k,m,n</td>
</tr>
<tr>
<td>Schraeder et al 2001 (USA)</td>
<td>941 people ≥65 y with at least one risk factor registered with one of 32 family practice or 19 internal medicine physicians; mean age 76; 73% women‡§</td>
<td>Home assessment by nurse. Collaborative team generated plan of care. Case assistant provided telephone monitoring, education, health promotion, referral to and coordination of supportive services. Team provided flexible home or office visits over 2 y†</td>
<td>Physicians, nurses, and case assistants</td>
<td>24</td>
<td>a,d,n</td>
</tr>
<tr>
<td>Sorensen and Sivertsen 1988 (Denmark)</td>
<td>1554 people aged 75, 80, and 85 drawn from the Central National Register; 49% women in intervention group†</td>
<td>One home visit by social worker and physician. Social worker conducted assessment, referred patients to social services. Physician conducted medical examination</td>
<td>Social worker and physician</td>
<td>60</td>
<td>a,b,c,e,i,l,m</td>
</tr>
<tr>
<td>Tulloch and Moore 1979 (UK)</td>
<td>295 people ≥70 from a general practice register; 46% women‡</td>
<td>Letter sent with medical questionnaire and offer of physical examination (at office or home if required). Patients monitored regularly for 2 y at clinic run by GP, practice nurses, and health visitors</td>
<td>GP, practice nurses, and health visitors</td>
<td>24</td>
<td>a,d,m</td>
</tr>
<tr>
<td>van Rossum et al 1993 (Netherlands)</td>
<td>580 people aged 75-84 y; 58% women§</td>
<td>Home visits by nurses four times yearly for 3 y with extra visits if necessary; telephone contact; nurses discussed health topics, gave information and advice, and made referrals†</td>
<td>Nurses</td>
<td>36</td>
<td>a,b,c,d,h,l,m,n</td>
</tr>
</tbody>
</table>

Continued on next page
Table 3. Randomized controlled trials that evaluated preventive primary care outreach interventions for older people

<table>
<thead>
<tr>
<th>STUDY (COUNTRY)</th>
<th>SAMPLE SIZE AND CHARACTERISTICS</th>
<th>INTERVENTION</th>
<th>INTERVENORS</th>
<th>DURATION OF FOLLOW UP (MO)</th>
<th>OUTCOMES ASSESSED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vetter et al 1984 &lt;sup&gt;(UK)&lt;/sup&gt;</td>
<td>1148 people aged 70 y from two general practice registers*</td>
<td>Minimum of one home visit yearly for 2 y to provide health education, preventive counseling, referrals, and follow up</td>
<td>Health visitors</td>
<td>24</td>
<td>a,b,c,f,m</td>
</tr>
<tr>
<td>Wagner et al 1994 &lt;sup&gt;(USA)&lt;/sup&gt;</td>
<td>1539 people ≥65 y enrolled in three group health cooperatives; mean age 72.5; 60% women**</td>
<td>Assessment visit and follow-up interventions targeting risk factors for disability and falls (exercise, alcohol, medication use, hearing or vision). Referrals. One or two follow-up telephone calls; mailed reminders†</td>
<td>Nurses</td>
<td>24</td>
<td>a,g,h</td>
</tr>
<tr>
<td>Wasson et al 1992 &lt;sup&gt;(USA)&lt;/sup&gt;</td>
<td>497 men aged ≥54 attending a primary care clinic; mean age 66*</td>
<td>Clinicians doubled their recommended interval for face-to-face follow up and scheduled three intervening telephone contacts†</td>
<td>Internists, physicians’ assistants, nurse practitioners</td>
<td>24</td>
<td>a,d,m,n</td>
</tr>
</tbody>
</table>

*—mortality, b—living in the community, c—admission to long-term care, d—admission to acute care, e—activities of daily living, f—depression, g—falls, h—physical function, i—quality of life, j—referral to homemaking, k—referral to Meals on Wheels, l—self-rated health, m—use of health services, n—costs of health services.

*Sample source classified as practice. †Intervention classified as frequent contact. ‡Sample classified as older (age indeterminate in Vetter et al <sup>†</sup>). †Sample classified as targeted risk group.

Additional data obtained from author.

Table 4. Odds ratios for mortality

<table>
<thead>
<tr>
<th>AUTHOR</th>
<th>INTERVENTION n/N*</th>
<th>CONTROL n/N*</th>
<th>ODDS RATIO 95% CONFIDENCE INTERVAL</th>
<th>WEIGHT %</th>
<th>ODDS RATIO (95% CONFIDENCE LIMITS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Talloch and Moore, 1979 &lt;sup&gt;(UK)&lt;/sup&gt;</td>
<td>1304/7452</td>
<td>1486/7459</td>
<td>0.83 (0.75, 0.91)</td>
<td>0.01</td>
<td>0.1</td>
</tr>
<tr>
<td>Hendrikse et al, 1984 &lt;sup&gt;(UK)&lt;/sup&gt;</td>
<td>24/170</td>
<td>42/169</td>
<td>3.3 (0.76, 1.26)</td>
<td>5.6</td>
<td>0.69 (0.47, 1.02)</td>
</tr>
<tr>
<td>Vetter et al, 1984&lt;sup&gt;(UK)&lt;/sup&gt;</td>
<td>80/577</td>
<td>105/571</td>
<td>5.6 (0.69, 1.02)</td>
<td>5.4</td>
<td>0.63 (0.32, 1.25)</td>
</tr>
</tbody>
</table>

*Sample source classified as practice. †Intervention classified as frequent contact. ‡Sample classified as older (age indeterminate in Vetter et al <sup>†</sup>). †Sample classified as targeted risk group.

Additional data obtained from author.
study on the summary OR and the summary OR’s precision if this study was removed. The summary OR for mortality without this study was 0.82 (95% CI 0.73 to 0.92), which is very similar to the summary OR and 95% CI with this study included.

**Living in the community (seven studies).** In all seven trials, patients receiving PPCO interventions were more likely to be living in the community at the end of the study ([Table 5](#)). Summary OR was 1.23 (95% CI 1.06 to 1.43). Heterogeneity of study results was not statistically significant ($P = .22$).

**Other outcomes.** Summary ORs for admission to long-term care (OR 0.88; 95% CI 0.74 to 1.05) and acute care hospital (OR 1.00; 95% CI 0.85 to 1.16) were not statistically significant (data not shown).

**Length of follow up.** The summary OR for mortality was significant at 12 months (OR 0.80, 95% CI 0.66 to 0.98) and at 24 months (OR 0.78, 95% CI 0.70 to 0.87) ([Table 6](#)).

**Exploratory analyses.** Study quality and intervention characteristics (frequency of contact, length of follow up) did not modify the effect of PPCO on the outcomes of mortality, living in the community, and admission to long-term care or acute care hospitals. Patient population characteristics (source of sample, age, risk status, and geographic area) did not modify the effect of PPCO on mortality or on admission to long-term care or acute care hospitals. For the outcome of proportion of people living in the community, trials conducted among younger people had significantly higher summary ORs than trials conducted among older people (summary ORs 1.68 and 1.13, respectively, $P = .03$). For the outcome of mortality, the summary OR for trials conducted in Canada was 0.75 (95% CI 0.46 to 1.22) compared with the summary OR of 0.83 (95% CI 0.75 to 0.92) for trials conducted in other countries ($P = .39$).

**Adjusted analysis.** When we adjusted for all covariates listed in [Table 2](#), the adjusted summary random effects ORs for the outcomes of mortality,

### Table 5. Odds ratios for living in the community

<table>
<thead>
<tr>
<th>AUTHOR</th>
<th>INTERVENTION n/N*</th>
<th>CONTROL n/N*</th>
<th>ODDS RATIO 95% CONFIDENCE INTERVAL</th>
<th>WEIGHT %</th>
<th>ODDS RATIO (95% CONFIDENCE LIMITS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hendriksen et al, 1984</td>
<td>213/300</td>
<td>206/300</td>
<td></td>
<td>13.6</td>
<td>1.12 (0.79, 1.58)</td>
</tr>
<tr>
<td>Vetter et al, 1984</td>
<td>471/577</td>
<td>443/571</td>
<td></td>
<td>17.8</td>
<td>1.10 (0.96, 1.31)</td>
</tr>
<tr>
<td>Sorensen and Sivertsen, 1988</td>
<td>209/777</td>
<td>271/777</td>
<td></td>
<td>26.4</td>
<td>1.13 (0.90, 1.40)</td>
</tr>
<tr>
<td>Clarke et al, 1992</td>
<td>190/261</td>
<td>189/262</td>
<td></td>
<td>11.8</td>
<td>1.03 (0.70, 1.52)</td>
</tr>
<tr>
<td>Hall et al, 1993</td>
<td>61/81</td>
<td>51/84</td>
<td></td>
<td>4.7</td>
<td>2.07 (1.07, 3.99)</td>
</tr>
<tr>
<td>Poth et al, 1992</td>
<td>291/269</td>
<td>244/256</td>
<td></td>
<td>14.5</td>
<td>1.48 (1.20, 2.35)</td>
</tr>
<tr>
<td>Van Rossum et al, 1993</td>
<td>231/292</td>
<td>223/208</td>
<td></td>
<td>11.3</td>
<td>1.11 (0.74, 1.66)</td>
</tr>
<tr>
<td>Pooled random effects estimate</td>
<td>1745/2657</td>
<td>1627/2640</td>
<td></td>
<td></td>
<td>1.23 (1.04, 1.43)</td>
</tr>
</tbody>
</table>

* $n/N =$ number living in the community/ number studied.
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living in the community, and admission to long-term care or acute care hospitals were very similar to the unadjusted ORs. Two trials with missing data were excluded from these analyses.

Random- vs fixed-effects model. We found minimal to no differences in summary ORs using random-effects or fixed-effects models. For example, the summary OR for mortality using the random-effects model was 0.83 (95% CI 0.75 to 0.91) and using the fixed-effects model was 0.83 (95% CI 0.76 to 0.90).

Discussion

Results of this meta-analysis of 19 randomized controlled trials, most of which were conducted in family practice settings, provide evidence that PPCO interventions substantially reduce risk of mortality and increase the likelihood of continuing to live in the community. Our findings suggest that PPCO interventions can make an important difference in the lives of community-dwelling older people. The effect of PPCO interventions on mortality (OR 0.83, 95% CI 0.75 to 0.91) is comparable to the effect of pharmacotherapy for hypertension in elderly people (OR 0.84, 95% CI 0.75 to 0.94). Using PPCO would prevent one death for every 36 older people targeted for intervention; one death would be prevented for every 63 hypertensive elderly people treated for 5 years with drug therapy.

Unlike evaluation of pharmacologic interventions, assessment of health service interventions usually involves evaluating a package of services or an intervention with multiple components. These interventions are sometimes referred to as “black box” interventions because the effect of their individual components is usually not evident. While this is challenging, it is typical of evaluations of health services interventions. In the absence of further research, how PPCO interventions specifically affect mortality remains somewhat speculative. Plausible explanations include the effect of early identification and management of risks and

Table 6. Mortality summary odds ratio and 95% confidence intervals by length of follow up

<table>
<thead>
<tr>
<th>LENGTH OF FOLLOW UP (M0)</th>
<th>NUMBER OF STUDIES</th>
<th>TOTAL SAMPLE SIZE</th>
<th>HETEROGENEITY P VALUE</th>
<th>SUMMARY ODDS RATIO (95% CONFIDENCE LIMITS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>2</td>
<td>1123</td>
<td>.99</td>
<td>1.00 (0.57, 1.77)</td>
</tr>
<tr>
<td>12</td>
<td>11</td>
<td>5714</td>
<td>.80</td>
<td>0.80 (0.66, 0.98)</td>
</tr>
<tr>
<td>24</td>
<td>11</td>
<td>13 425</td>
<td>.87</td>
<td>0.78 (0.70, 0.87)</td>
</tr>
<tr>
<td>36</td>
<td>7</td>
<td>4498</td>
<td>.20</td>
<td>0.90 (0.75, 1.04)</td>
</tr>
<tr>
<td>48</td>
<td>2</td>
<td>5749</td>
<td>.15</td>
<td>0.90 (0.76, 1.08)</td>
</tr>
</tbody>
</table>
comorbidity and greater attention to personal and health needs.

The findings of our meta-analysis are generally consistent with results of a recent meta-analysis of home visiting programs that offer health promotion and preventive care to older people. That study, which included six of the trials included in our meta-analysis and nine others not meeting our inclusion criteria, found that home visiting was associated with a 24% reduction in mortality among members of the general elderly population and a 28% reduction in mortality among frail older people. That study also found no significant reduction in admission to hospital (OR 0.95, 0.80 to 1.09), but, unlike ours, found a significant reduction in admission to long-term care of 35%.

The summary OR for the four Canadian trials (0.76) was comparable to the summary OR for all the studies included in this review, but was not statistically significant. This is not surprising, given that these four studies’ sample sizes were generally small and that the four trials together accounted for only 4.6% of the total sample on which the summary estimate for mortality is based. The intervention is feasible in the Canadian health care system and the findings of this meta-analysis are highly relevant to policy development in primary care, particularly as it relates to care of older adults. The literature search described earlier was updated to the end of April 2004. We found no studies that met our eligibility criteria.

Our meta-analysis does not include unpublished studies or studies reported in languages other than English. The existence, direction, magnitude, and importance of bias resulting from exclusion of unpublished and non–English-language studies is controversial.

We used a validated scale to determine the quality of studies. Double blinding (one of the scale’s criteria), however, was not applicable to this literature. Given the considerable variability in study quality, we included all studies in the meta-analysis and then did an adjusted analysis that included study quality as a covariate. Some of the randomized controlled trials included in this meta-analysis had noteworthy limitations. Only eight studies described the random allocation procedure used. Many studies provided only a minimal description of the intervention itself.

**Implications for future research.** Some unanswered questions remain. It is possible that PPCO interventions, like geriatric evaluation and management interventions, result in more positive outcomes when targeting specific groups of frail elderly people. Patient characteristics, such as age and degree of functional impairment, might be useful selection criteria for such interventions.

The effect of PPCO on other important outcomes, such as physical functioning or activities of daily living, quality of life, cognitive or mental status, and cost-effectiveness, has not been adequately studied. Well designed and adequately powered intervention studies are clearly needed to address these unanswered questions.

**Conclusion**

Based on a meta-analysis of 19 randomized controlled trials, PPCO interventions appeared to reduce mortality by 17% among community-dwelling older people and to increase the likelihood of their continuing to live in the community by 23%. Our analyses do not indicate that PPCO interventions reduce admissions to long-term care or acute care hospitals. Results of this study have important implications for future research and health services planning.

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**Contributors**

Dr Ploeg contributed substantially to concept and design of the study; to acquisition, analysis, and interpretation of
data; and to writing and revising the paper. Dr Feightner contributed to the conceptual framework and design of the study, to the literature review, and to manuscript revisions, and approved the final version of the paper. Drs Hutchison and Patterson contributed to the conceptual framework and design of the study, to data extraction, to literature evaluation, and to manuscript revisions, and approved the final version of the paper. Mr Siguouin contributed to data analysis and manuscript revisions and approved the final version of the paper. Ms Gauld assisted with the literature search; contributed to development of the data extraction form, data extraction, design and preparation of tables, and manuscript revisions; and approved the final version of the paper.

Competing interests
None declared

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References
1. Statistics Canada. 2001 Census analysis series. Profile of the Canadian popula-
15. Wang MC, Bushman BI. Integrating results through meta-analytic review using SAS soft-
17. Burton LC, German PS, Shapiro S, Johns Hopkins Medicare Preventive Services Demon-
erage for preventive services for the elderly: response and results in a demonstration popu-
20. Clarke M, Clarke SJ, Jagger C. Social intervention and the elderly: a randomized con-
tive home visits by a nurse on the outcomes of frail elderly people in the community: a ran-
24. Helbert R, Robichaud L, Roy P, Braigo V, Voyler L. Efficacy of a nurse-led multidimensional preventive programme for older people at risk of functional decline. A randomized con-
29. Pathy MI, Aver B, Harding K, Dibble A. Randomized trial of case finding and surveil-

31. Soresen KH, Sivertsen J. Follow-up three years after intervention to relieve unmet medi-

32. Talamo SJ, Moore V A. A randomized controlled trial of geriatric screening and surveil-

35. Wagner EH, LaCross AZ, Grothaus L, Leveille SG, Hecht JA, Artz K, et al. Preventing disabil-
39. Grégoire G, Derderian F, Lorier J. Selecting the language of the publications included in a meta-analy-

41. Rubenstein LZ, Goodwin M, Hadley E, Patton SK, Bempushedi VE, Reuben D, et al. Working group recommendations: targeting criteria for geriatric evaluation and manage-

42. Winograd CH. Targeting strategies: an overview of criteria and outcomes. J Am Geriatr


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