# Acute Hospital Use, Nursing Home Placement, and Mortality in a Frail Community-Dwelling Cohort Managed with Primary Integrated Interdisciplinary Elder Care at Home

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**OBJECTIVES:** To evaluate the effect of medical Primary Integrated Interdisciplinary Elder Care at Home (PIECH) on acute hospital use and mortality in a frail elderly population.

**DESIGN:** Comparison of acute hospital care use for the year before entering the practice (pre-entry) with the most-recent 12-month period (May 1, 2010–April 30, 2011, postentry) for active and discharged patients.

**SETTING:** Community.

**PARTICIPANTS:** All 248 frail elderly adults enrolled in the practice for at least 12 months who were living in the community and not in nursing homes in Victoria, British Columbia.

**INTERVENTION:** Primary geriatric care provided by a physician, nurse, and physiotherapist in participants' homes.

**MEASUREMENTS:** Acute hospital admissions, emergency department (ED) contacts that did not lead to admission, reason for leaving practice, and site of death.

**RESULTS:** There was a 39.7% (116 vs 70; *P* = .004) reduction in hospital admissions, 37.6% (1,700 vs 1,061; *P* = .04) reduction in hospital days, and 20% (120 vs 95; *P* = .20) reduction in ED contacts after entering the practice. Fifty participants were discharged from the practice, 64% (n = 32) of whom died, 20% (n = 10) moved, and 16% (n = 8) were admitted to nursing homes. Fifteen (46.9%) deaths occurred at home.

**CONCLUSION:** Primary Integrated Interdisciplinary Elder Care at Home may reduce acute hospital admissions and facilitate home deaths. **J Am Geriatr Soc 2012.**

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**Key words:** frail elderly; in-home primary care; house calls

Healthcare expenditures for individuals aged 65 and older represented 42.7% of total health expenditures in Canada in 2000–01, where seniors aged 65 and older accounted for 12.5% of the total population.[1] In the United States, it is estimated that 20% to 26% of all healthcare dollars are spent for Medicare recipients aged 65 and older during the last year of life and that half of this is spent in the last 1 to 2 months of life.[2–5] A large proportion of the decedents are frail elderly adults,[6–8] who have been variably described as having multiple comorbidities, dependency in function (activities of daily living and mobility), and less physiological reserve.[9,10] Even a minor deterioration in their health status (e.g., an acute illness, fall, or adverse drug reaction) can result in severe decompensation in their function, leading to hospitalization, prolonged convalescence, permanent functional decline, nursing home placement, and death.[9–12] Frail individuals have a much higher absolute and relative risk of transitioning from no or minor disability to severe disability than well older adults and a lower chance of recovering to baseline after hospitalization.[11] Therefore, any effort to reduce hospitalization may protect this vulnerable population, as well as reduce healthcare costs.

Studies evaluating geriatric assessment programs have shown mixed results with respect to the effect on hospital use, function, and mortality.[13–21] Some of the limitations of this model may be that it is consultative, with less follow-up than ongoing management programs and primary care. In Canada, for frail elderly adults living in the community, family physicians provide the majority of primary care in a clinic setting without access to an integrated team of professionals. Many of these people cannot get to a

physician's office without difficulty, and the majority of physicians do not make house calls for ongoing care. In the last decade, there have been reports of programs that provide exclusively home-based primary care for frail seniors that have resulted in improvements in patient and caregiver satisfaction and quality of life and variable effects on hospital use.[22–25] This article reports on a Canadian initiative to evaluate the effect of Primary Interdisciplinary Elder Care at Home (PIECH) on acute hospital use and mortality.

## METHODS

### Study Population

Individuals in this PIECH practice resided in Victoria, British Columbia (BC). This was a unique practice in this region that was started in November 2003. Most individuals were referred to this practice from community nurses or case managers, hospitalists, and others (word of mouth). Three hundred six people living in the community were enrolled in the practice between May 1, 2010, and April 30, 2011. For the purposes of analysis and establishing a 12-month period for comparing hospital use before and after entry into the PIECH practice, only the 248 (81%) individuals who had been enrolled in the practice for at least 1 year between May 1, 2009, and April 30, 2010, were included in the evaluation. The 58 (19%) patients enrolled for less than 1 year were not included in the analysis.

Individuals remaining in the practice for the entire year between May 1, 2010, and April 30, 2011, were deemed active. Those who died, entered a nursing home, or moved out of the catchment area at any point during this same time period were deemed discharged.

### Intervention

#### Team

Table 1 describes the goals, eligibility criteria, team members, interventions, and costs for the practice. All assessments and care by the team were done in individuals' homes. All individuals received a comprehensive geriatric assessment from the primary care physician and nurse when enrolled that included a medical history and examination, functional review, standardized scales, and comprehensive laboratory testing. Healthcare directives were discussed and documented with most individuals. The regional laboratory performed laboratory monitoring, including electrocardiograms, in the home for people who were unable to get out. On average, a nurse saw stable individuals routinely in their homes monthly to monitor their health status and medication administration, and the physician saw them every 2 to 3 months. The nurse or the doctor assessed anyone needing to be seen at home within 1 working day. Community care nurses from the regional long-term care program provides long-term procedural services (e.g., skin ulcer treatment).

The physician referred individuals to the physical therapist (PT) on as-needed basis. The majority (89%) of patients saw the PT at least once. The number of treatments and duration of therapy was left to the discretion of the PT. Some people with acute problems were seen daily until they improved, some received maintenance therapy every 2 to 3 weeks, and most who required active therapy were seen one to three times per week for 4 to 6 weeks.

Team members recommended home support services. Patients purchased these services from private agencies unrelated to the PIECH service, or the regional health authority provided them after referral to a community case-manager. Decisions regarding public nursing home placement rested with the case manager.

A group of family doctors from local clinics provided after-hours telephone coverage as part of a regional call service. On-call physicians provided telephone advice but did not routinely see individuals in their homes. Individuals were free to go to walk-in clinics and treatment centers, but few used this form of episodic care.

### Hospital Care

All individuals received publically funded hospital care through the Regional Health Care Authority in three hospitals with a centralized electronic record. Individuals and caregivers were encouraged to call the office before going to the emergency department (ED). A summary of their health history including drugs started and stopped was sent by facsimile to the hospital as soon as the transfer was known about. Hospitalists and medical specialists provided hospital care. The PIECH physician made weekly hospital visits to provide supportive care and assist with discharge planning. Intravenous therapy was not provided in the home.

## FUNDING

The provincial government publically funded all direct medical (primary and specialty care) and hospital care. Physicians are paid on a fee-for-service basis. Individuals paid for noninsured health services (e.g., telephone advice and e-mail contact with the physician, family meetings, nursing services, and physiotherapy) that were considered necessary for the success of this practice as they used these services or paid for them as an all-inclusive annual practice fee ($CDN 1,500/patient per year).

## OBSERVATIONAL BEFORE-AND-AFTER DESIGN

### Analysis

Demographic and clinical patient data were entered into an EPI-Info database (Centers for Disease Control and Prevention, Atlanta, GA). The author manually abstracted hospital usage data including acute care admissions and ED contacts that did not lead to admission for the year before entry into the practice and the most recent year (May 1, 2010–April 30, 2011) from the regional electronic hospital chart. An ED contact that was part of a hospital admission was included as a day of the overall admission and not reported as a separate ED contact. Two-sample $t$-tests were used to compare means between groups, and chi-square

## Table 1.  Description of Primary Integrated Interdisciplinary Elder Care at Home Program

| Goals | 1. Improve quality of life<br>2. Reduce caregiver burden<br>3. Prevent and delay nursing home placement<br>4. Improve and maintain functional status<br>5. Prevent hospitalization<br>6. Facilitate home deaths.<br>7. Improve access to primary care for frail people<br>8. Allow informed choices about intensity of medical interventions<br>9. Teach medical students and residents care of the elderly in a home environment | | |
|---|---|---|---|
| Entry criteria | Aged $\geq$ 75, difficulty getting to physician's office, complex medical or functional problems, live in geographic catchment area, transfer primary medical care | | |
| Capacity and scheduling | 300 active patients. Patients scheduled/day:<br>Doctor, n = 9 (up to 5 added)<br>Registered nurses (1.5 EFT), n = 13 scheduled (up to 3 added)<br>Physical therapy, n = 4–6<br>Patients told morning (9:00–12:30) or afternoon (1:00–4:00), with no fixed appointment time. | | |
| Staffing (%) patients seen/year | Discipline | Equivalent Full Time (EFT) | Percentage of Patients Seen | Average Number of Visits per Patient/Year |
| | Physician | 0.86 | 100 | 5.8 |
| | Registered nurse | 1.50 | 100 | 9.1 |
| Computer support-contracted | Physical therapist | 0.60 | | 4.6 |
| | Office manager | 1.00 | | |
| Standardized tests | Mini-Mental State Examination,[34] Clock Drawing,[35] Montreal Cognitive Assessment –MOCA[36] for MCI, 5-point Geriatric Depression Scale,[37] self-reported health status,[38] Timed Up and Go Test,[39] and Berg Balance Scale[40] (by physical therapist) | | |
| Interventions Doctor | Comprehensive Geriatric Assessment, clinical case management, primary medical care, joint injection, cryotherapy, skin biopsies, long-term planning, 1–2× weekly supportive acute hospital care and discharge planning | | |
| Nurse | Bowel and bladder care (including catheterization), wound care including modified Una boots, suture and staple removal, immunization (rates: 89% influenza and 68% Pneumococcus), ear syringing, assessment of acute illnesses, chronic disease management[32] (e.g., diabetes mellitus, congestive heart failure, chronic obstructive pulmonary disease, and hypertension with BPTru machine), clinical scales, monitoring medications and response to treatment, supportive care, digital weights, PFT, oximetry, glucometer, mobilization of community resources | | |
| Physical therapist | Assessment and management of acute injuries, joint mobilization, massage, trigger point relief, acupuncture, exercise, balance training and reconditioning, equipment assessment (e.g., bars, rails, walkers, wheel chairs, power mobility splints, orthoses, footwear), other physical therapy | | |
| Communication | Tablet PC, virtual private network, integrated electronic health record, virtual daily team meetings (share and comment on progress notes by e-mail), quarterly business and planning team meetings, direct, e-mail and cellular telephone contact, liaison with patients, families, case managers, community nurses and aides, pharmacists) Summary of health history sent by facsimile to hospital at admission, transitional care, and discharge planning. | | |
| Clinical teaching | Medical school Year 1—lecture; medical school Year 2—two afternoon house calls focused on care of elderly adults; medical school Year 4—2-week elective. Family medicine—2-week elective, family medicine third-year residency—supervise fellowship for Diploma in Care of the Elderly, nurse practitioner electives | | |
| Average cost/patient per year, CDN$[a] | Primary medical care (fee for service)—753<br>Medical specialists (fee for service)—355<br>Laboratory and X-ray (fee for service)—233<br>Practice fee (paid by patients)— 1,500<br>Total—2,841 | | |

[a]Source: Patterns of Practice Mini-Profile 2010, for Dr. Theodore Rosenberg, British Columbia Medical Association. (does not include hospital, drug, and direct and indirect home support costs). MCI = mild cognitive impairment; BP = blood pressure; PFT = pulmonary function test; PC = personal computer.

tests were used to compare categorical data. Fisher exact tests were used only if the number of observations was fewer than six. Two-sided paired $t$-tests were used to compare hospital usage before and after entry into the practice, and multiple regression analyses were done using NCSS (329 North 1000 East, Kaysville, UT). $P < .05$ was considered statistically significant.

## RESULTS

Table 2 lists the demographic and clinical characteristics of patients on April 30, 2011, or at the time of discharge. There were 198 active patients and 50 patients discharged during the study period. Discharged patients were significantly older (2.3 years) and frailer (70.0%

Table 2. Demographic and Clinical Characteristics on April 30, 2011, or at Discharge

| Characteristic | Active, n = 198 | Discharged, n = 50 | P-Value |
|---|---|---|---|
| Age, mean ± SD | 86.7 ± 6.4 | 89.2 ± 6.4 | .01 |
| Sex, n (%) | | | |
| Female | 142 (71.7) | 36 (72.0) | .06 |
| Male | 56 (28.3) | 14 (28.0) | |
| Marital status, n (%) | | | |
| Widowed | 128 (64.6) | 26 (52.0) | .43 |
| Married | 47 (23.7) | 14 (28.0) | |
| Divorced or separated | 18 (9.1) | 7 (14.0) | |
| Never married | 5 (2.5) | 3 (6.0) | |
| Years of education, n (%) | | | |
| Postsecondary | 103 (55.7) | 27 (57.4) | .93 |
| 10–12 years | 68 (36.8) | 16 (34.0) | |
| <10 years | 14 (7.6) | 4 (8.5) | |
| Housing, n (%) | | | |
| House or apartment, no family | 58 (29.3) | 10 (20.0) | .21 |
| House or apartment, with family | 49 (24.7) | 18 (38.0) | |
| Retirement home | 52 (26.3) | 14 (28.0) | |
| Assisted living | 39 (19.7) | 8 (16.0) | |
| Average length of stay in practice, months, mean ± SD | 46.3 ± 25.2 | 36.0 ± 26.1 | .01 |
| Canadian Study on Health and Aging Clinical Frailty Scale | | | |
| Mean ± SD | 5.4 ± 0.75 | 5.8 ± 0.81 | .001 |
| 3, n (%) | 1 (0.5) | 1 (2.0) | |
| 4, n (%) | 17 (8.6) | 1 (2.0) | |
| 5, n (%) | 96 (48.5) | 13 (26.0) | |
| 6, n (%) | 72 (36.4) | 26 (54.0) | |
| 7, n (%) | 12 (6.1) | 8 (16.0) | |
| Clinical characteristics, n (%) | | | |
| Dementia | 67 (33.8) | 24 (48.0) | .06 |
| Depression on medications | 94 (47.5) | 23 (46.0) | .85 |
| Antipsychotic drugs | 12 (6.1) | 6 (12.0) | .15 |
| Stroke or cerebrovascular disease | 86 (43.4) | 24 (48.0) | .56 |
| Chronic obstructive pulmonary disease | 69 (34.9) | 17 (34.0) | .70 |
| Ischemic heart disease | 60 (30.3) | 20 (40.0) | .19 |
| Congestive heart failure | 46 (23.2) | 15 (30.0) | .32 |
| Atrial fibrillation | 46 (23.2) | 11 (22.0) | .85 |
| Hypertension | 121 (61.1) | 33 (66.0) | .52 |
| Diabetes mellitus | 27 (13.6) | 8 (16.0) | .67 |
| Osteoarthritis | 123 (62.1) | 34 (68.0) | .44 |
| Osteoporotic fracture | 64 (32.2) | 18 (36.0) | .62 |
| Hip fracture | 16 (8.1) | 1 (2.0) | .11 |
| Chronic pain on narcotic | 46 (23.2) | 13 (26.0) | .68 |
| Hemoglobin <120 g/L | 39 (19.9) | 17 (42.5) | .03 |
| Glomerular filtration rate <60 mL/min | 92 (46.7) | 17 (43.6) | .72 |

SD = standard deviation.

having Canadian Study of Health and Aging Clinical Frailty Scale[9] Scores ≥6 vs 42.5% of active patients), had a shorter average length of stay in the practice (10.3 months) and a 26% greater frequency of anemia than active patients.

Table 3 compares the acute care use of patients for the year before entering the practice (pre-entry) with the most-recent 12-month period between May 1, 2010, and April 30, 2011 (postentry). For all patients, there was a 39.7% reduction in hospital admissions (P = .004), a 37.6% reduction in hospital days (P = .04), and a 20.8% reduction in ED contacts (P = .20). For active patients, there was a 59.5% reduction in hospital admissions (P < .001), a 61.7% reduction in hospital days (P = .004), and a 9.8% reduction in ED contacts (90 pre-entry and 82 postentry, P = .66). For discharged patients, the corre-

sponding results were a 12.5% increase in hospital admissions (P = .68), a 19.7% increase in hospital days (P = .58), and a 57% reduction in ED contacts (P = .02).

Discharged patients had a significantly higher risk of hospitalization during the pre-entry period (odds ratio (OR) = 2.41, 95% confidence interval (CI) = 1.27–4.59) and postentry period (OR = 12.4, 95% CI = 6.04–25.47) than active patients. Discharged patients had a higher risk of pre-entry ED use (OR = 1.80, 95% CI = 0.96–3.38) and a significantly lower postentry risk (OR = 0.50, 95% CI = 0.25–0.99).

Thirty-two (64%) discharged patients died, 10 (20%) moved out of the catchment area and eight (16%) were admitted to nursing homes. Fifteen (46.9%) deaths occurred at home, 14 (43.8%) in the hospital, two (6.3%) in hospice, and one (3.1%) in a nursing home.

Table 3.  Acute Care Use

| Use | Active, n = 198 | Discharged, n = 50 | Total, N = 248 |
|---|---|---|---|
| Hospital admission | | | |
| Pre-entry, n[a] | 84 | 32 | 116 |
| Postentry, n[b] | 34 | 36 | 70 |
| Change,% | −59.5 | 12.5 | −39.7 |
| P-value | <.001 | .68 | .004 |
| Hospital days | | | |
| Pre-entry, n[a] | 1,197 | 503 | 1,700 |
| Postentry, n[b] | 459 | 602 | 1,061 |
| Change,% | −61.7 | 19.7 | −37.6 |
| P-value | .004 | .58 | .04 |
| Average length of stay, days | | | |
| Pre-entry, n[a] | 14.3 | 15.7 | 14.7 |
| Postentry, n[b] | 13.5 | 16.7 | 15.2 |
| Change,% | −5.3 | 6.4 | 3.4 |
| Emergency department contacts | | | |
| Pre-entry, n[a] | 90 | 30 | 120 |
| Postentry, n[b] | 82 | 13 | 95 |
| Change,% | −9.8 | −56.7 | −20.8 |
| P-value | .66 | .02 | .20 |

[a] Twelve-month period before entering the practice.
[b] May 1, 2010–April 30, 2011.

A multiple regression model was performed using age, status as active or discharged, and Canadian Study of Health and Aging score as independent variables and pre- and postpractice differences in the number of admissions, hospital days, and ED contacts as the dependent variables. None of the models or regression coefficients were statistically significant.

## DISCUSSION

This PIECH model has several potential advantages. By going to individuals' homes, it improves access to care for people who may have difficulty getting to a physician's office. An integrated team combines different skills to provide a larger spectrum of services than provided in routine medical care. Individuals have choices about the intensity of care, as well as the option of dying at home. It offers a chance to comprehensively assess individuals in their own environment and better assess their function, individual needs, and choices and subtle changes in their health status. PIECH is responsive to healthcare needs and has the flexibility to provide services and follow-up in a timely manner until a condition has stabilized. Similar models have also reported reductions in caregiver burden.[23,24]

This article demonstrates that this model of care may also reduce some of the costs in the acute hospital care system and that, for active patients, there can be a significant reduction in acute hospital admissions and hospital days, as well as a smaller reduction in ED use. This may be a conservative estimate of the effect on acute care because individuals were on average 4 years older and presumably frailer during the postentry period than in the pre-entry period. Others have found short-term reductions in acute care use after enrollment in a house-call program.[23,25]

Discharged patients were older and frailer than active patients, had a shorter length of stay in the practice, were

more anemic, and used greater amounts of acute care before entering the practice. This high level of pre-entry hospitalization may be a risk marker of future hospitalization, nursing home placement, and death.

Eight of the 10 people who moved outside of Victoria did so because they needed to be closer to family for more support and supervision. The people who were admitted to nursing homes had significant dementia or physical frailty that exceeded the capacity of their caregivers to look after them.

Because of the scarcity of long-term care beds, the majority of people going into nursing home in Victoria are admitted through hospitals, where they have to wait for placement. For all of the people discharged, the eight (16% of all discharges) who went to nursing homes were responsible for 27.8% of the postentry admissions and 47.3% of postentry hospital days. More-rapid transfer to nursing homes from acute care may further reduce acute care use.

There was a nonsignificant reduction in ED use, although the number of the 95 ED contacts was small in comparison with the 639 acute care days saved. Therefore the main effect of care seems to be preventing hospital admission. Because of limited resources, this practice operated during regular business hours and did not provide around-the-clock coverage for direct contact by the regular physician and team. It is possible that around-the-clock coverage could lead to further reductions in ED contacts and hospital admissions.

A substantial percentage of the decedents were able to die in their own homes: a positive outcome for individuals, families, and the healthcare system.

This study was unable to determine the effects on nursing home placement. This may be one of the important outcomes of this model of care. A previous study found a significant reduction in skilled nursing facility use after people entered a house call program.[25] A meta-analysis found that preventive home visitation reduced nursing home admissions by 34%.[13] This outcome was related to use of comprehensive assessment and frequency of visits and was greatest if there were more than nine visits per year, similar to the PIECH practice.

Other house call programs, using different professional staffing ratios and mixed funding sources and serving varying populations, have been able to increase access to care and have generally found high levels of patient and caregiver satisfaction, lower caregiver burden, and better quality of life, with variable effect on hospital utilization.[22–25]

This model does not increase direct community medical care costs. The provincial government and medical association track practice patterns of all physicians in British Columbia. This PIECH practice was unique in that the same physician provided 78.1% (ranked second of 3,613 GPs in BC) of all medical care, presumably improving continuity of care. Costs for diagnostic services were 5.3% lower, referrals to specialists were 30.9% lower, and total physician costs (primary and specialist) were 4.3% lower than the adjusted provincial mean (unpublished data, Dr. Theodore Rosenberg, British Columbia Medical Association). Data for drug use and home care supports are not routinely available or included in this profile.

The PIECH practice used a mixed model of funding, combining provincially funded fee for service with a private practice fee. This mixed funding model ensured that the practice was financially sustainable and provided the physician with autonomy and flexibility to purchase equipment and hire staff to meet patient needs. This funding model is unusual in Canada, where user fees are uncommon. It is not entirely analogous to concierge medicine in the United States.[26] The practice fee was not for the direct physician costs but was introduced because there was no government or regional support for the team and indirect care, but this model could be entirely publically funded by changing the practice fee to a capitation payment. The significant savings in hospital use (and probable saving in nursing home admissions) should easily offset the $1,500 practice fee.

This PIECH model uses comprehensive geriatric assessment, provision of in-home primary care by an integrated team, electronic records, increased communication with caregivers and patients by e-mail and cellular telephone, audits and reminder systems, and chronic disease and syndrome management protocols that have been considered necessary features of successful care of elderly adults.[27,28] Home visitation, functional assessment, and monitoring by nurses not integrated with primary medical care have not altered hospital use or healthcare costs.[29,30] Clinical case management by nurse–social worker teams who liaise with primary care physicians have shown mixed results on quality of life and healthcare use.[31] More-recent attempts at guided care at home by nurse specialists integrated with office-based general practices have shown greater satisfaction with care[32] but no significant improvement in acute care use and other health outcomes in randomized trials.[33] It is possible that the success of this PIECH practice is because of a primary physician trained in geriatrics going into the home and a highly integrated team that can respond to changes in health status in a timely manner.

This study has several limitations. The absence of a usual-care control group and randomization to this practice make it difficult to determine whether this practice truly reduces hospital use, delays or prevents nursing home placement, affects quality of life, or changes overall survival. Its retrospective design might have led to selection and other biases. It evaluates only one practice with one regular physician using an atypical private–public funding model that may affect the generalizability of the findings. The number of patients is small, which limits the statistical power to detect differences, particularly in the group that was discharged. The truncated follow-up for the 18 people who were discharged alive may underestimate hospital use for this group. The fact that the author, who was not blinded to clinical status of the patients, participated in the data abstraction might have led to observer bias. It is unlikely that there was a misclassification of exposure or outcome because all patient health information and personal identifiers for this practice are kept electronically, and the hospital admissions were abstracted from one central repository that contained identifiers including the unique personal health number of each patient in the practice. There may have been confounding factors such as volume of informal and formal home supports or availability of family caregivers that stabilized people in the community and prevented hospital admission.

Nevertheless, this evaluation is hypothesis generating. At the very least, it appears that PIECH does not increase direct medical or hospital costs, may reduce hospital use, and could be tested in a more-rigorous manner.

## CONCLUSIONS

PIECH has numerous potential features that can make it an attractive model of care for elderly adults, their caregivers, providers, and the healthcare system. This evaluation shows that it may also save a substantial number of acute hospital days and facilitate home deaths. A randomized controlled trial may provide more-definitive answers about the effectiveness and efficiency of PIECH as a viable alternative model of primary care for frail elderly adults.

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