

Assessing cost effects of nursing-home-based geriatric nurse practitioners

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Employment of geriatric nurse practitioners (GNPs) is one strategy to improve nursing home care. The effects of GNPs on costs and profitability of nursing homes and on costs of patient medical service use outside the nursing home are examined. Employment of GNPs does not adversely affect nursing home costs or significantly affect

profits. There is some evidence of cost savings in medical service use for newly admitted patients but no evidence of savings for continuing residents. GNPs reduce the use of hospital services for both groups, and the reduction is statistically significant for newly admitted patients.

Introduction

As recent demographic changes have increased the population requiring long-term care for chronic illness, nursing home care—especially the rapid increase in nursing home expenditures and the poor quality of care—has been the subject of considerable concern.

Evidence of the extent of the Nation's concern about nursing home care comes from the 1986 Institute of Medicine Committee on Nursing Home Regulation's final report. As one means to improve nursing home care, the Committee encouraged nursing homes to "employ specialty-trained gerontological nurses and encourage currently employed nurses to seek training in gerontological nursing" (Institute of Medicine, 1986). Difficulties in obtaining sufficient physician attention to nursing home patients were found in studies by Mitchell and Hewes (1986) and Willemain and Mark (1980). These findings suggest that more highly trained nursing professionals can make important contributions to improving conditions in nursing homes. The unwillingness of many physicians to visit nursing home patients is of particular concern as the average age of patients increases and the functional status of the nursing home population continues to decline (Institute of Medicine, 1986). Without proper medical attention, treatments for ongoing medical conditions may go unmonitored and new conditions may go untreated, possibly causing unnecessary hospitalizations or mortality.

One effort to improve the care provided in nursing homes and make that care more cost effective is the introduction of new health professionals to serve as intermediaries between physicians and nursing homes. One such program has involved the training and employment of geriatric nurse practitioners (GNPs).

In 1975, the Mountain States Health Corporation (MSHC) initiated a program to select and train as GNPs current nursing home employees who were registered nurses but did not necessarily have a bachelor's degree. In return for partial support during the training phase, GNPs committed to remain in the nursing home for at

least 18 months after the completion of training. The MSHC GNP education program included a 4-month didactic section completed at a participating university and an 8-month preceptor period completed under the supervision of an approved physician, usually at the sponsoring nursing home.

A multidimensional, quasi-experimental approach was employed to evaluate the project. The RAND Corporation and the University of Minnesota School of Public Health undertook an evaluation of the MSHC GNP program. RAND performed the cost and use analyses, and the University of Minnesota was responsible for the analysis of quality of care and GNP employment issues. MSHC secured the participation of the nursing homes used in the evaluation and supervised data collection efforts in the field. The evaluation covered eight Western States and included data from the period 1977-86. Results from the cost component of that evaluation are reported here. Other parts of the evaluation show:

- Modest improvements in some measures of process of care (Kane et al., 1989).
- No consistent changes in health outcomes (Kane et al., 1989; Garrard et al., 1989).
- Higher satisfaction among families of patients in nursing homes with GNPs (Skay et al., 1988).
- A commitment by MSHC GNPs to careers in long-term care (Radosevich et al., 1990).

In a study of the patient management process, significant improvements for the GNP homes were found for six of eight tracer conditions; this is the most notable benefit of the program. Patients in GNP homes were also somewhat less likely than others to have been discharged to a hospital by the end of the study. In addition, limited positive effects were observed on 2 of 8 functional status measures, on 2 of 6 drug therapies, and on 5 of 18 nursing therapies (Kane et al., 1989).

An important part of the cost component of the study is an attempt to determine who benefits from this new program and who currently pays its costs. Nursing homes typically employ GNPs primarily to improve care to patients. Better patient care benefits nursing homes if they become more attractive, particularly to private-pay patients. However, this incentive has limited appeal unless nursing homes can increase the proportion of private patients relative to public patients, because occupancy rates in most nursing homes are already high. In theory, the additional training that GNPs receive may increase employment costs to these nursing homes, and the added costs may not be offset by the resultant increase in private-pay patients.

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The benefits of better patient care within nursing homes may actually accrue more to third-party payers than directly to the nursing homes. If better patient care within nursing homes reduces the need for and use of medical services outside nursing homes, it may be appropriate for third-party payers to bear some of the costs of employing these new providers. At present, most third-party payers do not reimburse for patient care services delivered by GNPs working as nursing home employees. The Omnibus Budget Reconciliation Act of 1989 contains yet to be implemented provisions for the Medicare reimbursement of nurse practitioners working in collaboration with physicians to treat nursing home patients.

Because of the importance of identifying who benefits from the program and who pays, we have chosen to conduct our analysis on two levels. In the first, we look at the effects of the program at the nursing home level, analyzing nursing home costs and revenues to determine whether the nursing home benefits from this program. In the second level, we look at the effects of the program on the individual patient in order to determine whether GNPs can indeed reduce the need for and use of services outside the nursing home. The utilization results are analyzed to determine which third-party payers are most likely to benefit.

Evaluation design and methods

Thirty matched pairs of nursing homes, one with a GNP and the other without, participated in the evaluation. The 30 GNP homes were selected from approximately 100 homes with GNPs trained in the MSHC program. Home selection was based on the availability of a suitably matched control home and the willingness of both homes to participate in the evaluation. Homes were matched on the following characteristics, shown in order of their importance in the matching process: State (because of Medicaid regulations and issues of resource availability); facility size (including the proportion of skilled- and intermediate-level beds); ownership (private, nonprofit, or public, and chain or individual); hospital affiliation; occupancy rate; proportion Medicare; and proportion Medicaid. Given this set of targeted conditions for matching, candidate homes were contacted sequentially until the requisite number of matches was obtained. Recognizing that there might be substantial variation among nursing homes, we used a pre-GNP, post-GNP design to control for differences not removed in our initial selection process; that is, the 1-year period before introduction of GNPs (pre-period) is examined separately from the 2-year period following the completion of their training (post-period).

Within each period, stratified sampling was used to distinguish patients who were nursing home residents at the beginning of the study from those who were admitted during the study period, because it was hypothesized that GNPs might have differing effects on the two sets of patients. We initially thought that improvements in the quality of care from use of GNPs would be most likely to affect newly admitted patients, slowing their decline and possibly enabling them to return to the community.

To enhance our ability to detect real differences, new admissions were oversampled. In the construction of the

study sampling frame, patients with multiple nursing home admissions (generally the result of interim hospitalizations) were eligible for sampling only at the first observed admission. Sampled patients were then followed throughout the study (including interim hospitalizations) or until final discharge, whichever came sooner. For most but not all admissions, the first observed admission was the patient's original admission to the nursing home. For each pre-GNP year, 60 records were randomly selected for abstraction: 20 records of patients who were resident on the first day of the study period and 40 admissions who remained in the facility for at least 6 weeks. For the 2-year post-GNP period, 120 records were selected: 24 patients who were resident on the first day of the study period and 96 admissions (48 from each year). Approximately 9,500 medical records were abstracted for the evaluation. Annual Medicaid Cost Reports, supplemented by a questionnaire completed by the nursing home administrators, were the primary sources of data on nursing home costs.

Case study interviews conducted early in the evaluation revealed that, in 4 of the 30 nursing homes in the treatment group, the GNP role was not implemented (Kane et al., 1988). In these homes, the newly trained GNP was actually employed full time as either the nursing home administrator or the director of nursing. As a result, observations from these homes were treated separately in the analysis.

Using ordinary least-squares regression, we developed analysis of covariance (ANOCOVA) models to study the effects of GNPs on both per diem operating costs and the imputed cost of medical services used per patient day at risk. Our inferences about GNP effects follow from comparing results across the six cells of the design: period (pre, post) crossed with treatment status (control, implemented GNP, nonimplemented GNP). ANOCOVA models allowed us to adjust for differences among cells that were explained by nursing home and patient characteristics.

Independent covariates

In both the home- and patient-level analyses, we controlled for nursing home characteristics and patient characteristics. These are summarized briefly in the following sections.

Nursing-home-level analyses

Our work draws from earlier studies on nursing home cost functions in which the researchers controlled for structural, service intensity, and patient case-mix characteristics (Walsh, 1979; Meiners, 1982; Bishop, 1979; Lee and Birnbaum, 1979; Bishop, 1980; Jensen and Birnbaum, 1979; Holahan, Cohen, and Scanlon, 1983; Menemeyer, 1979; Schlenker and Shaughnessy, 1984). Structural variables are used to describe the type and location of the nursing home. They include facility size, occupancy rate, facility ownership, membership in a chain, certified level of care, whether hospital based or freestanding, State, and urban or rural setting. Service intensity variables relate to the types of services and frequency with which they are provided to nursing home residents. Patient case-mix variables capture patient

Table 1

Definitions of nursing home and patient variables

Type of variable	Definition
Nursing home	
OPCPDAY	Operating cost per patient day
PROFPDAY	Profit per patient day
GNP	GNP role implemented
NIGNP	GNP but role not implemented
POST	Post-period
GNP*POST	Post-period, GNP role implemented
NIGNP*POST	Post-period, GNP but role not implemented
PROFIT	For-profit
LICMCSNF	Licensed for Medicare skilled nursing care
LICSNF	Licensed for skilled care but not Medicare certified
BEDLT75	Less than 75 beds
BED150PL	150 beds or more
SMCHAIN	Part of small chain
LGCHAIN	Part of large chain
NHPLUSCR	Has residential apartments or day care program
NHPLUSHO	Has formal hospital association
RURAL	Rural
CAL	California
COLO	Colorado (omitted group)
IDAHO	Idaho
MONT	Montana
NMEX	New Mexico
OREGON	Oregon
WASH	Washington
ARIZ	Arizona
VA	Veterans Administration
ADMIT	Share of patient days for new admissions
ADMHOSP	Share of days for patients admitted from hospital
ADMITHSP	Share of days for new admissions directly from hospital
MEDICAID	Share of days for patients covered by Medicaid at admission
NTHERAPY	Weighted average number of special nursing therapies
Patient	
AGELT65	Patients under 65 years
AGE6574	Patients 65-74 years (omitted group)
AGE7584	Patients 75-84 years
AGE8594	Patients 85-94 years
AGE95PL	Patients 95 years or over
ADMHOSP	Patients admitted directly from hospital
ADMSKILL	Patients admitted to skilled care
MEDICAID	Patients covered by Medicaid at admission
NTHERAPY	Number of special nursing therapies in first 2 weeks
LOSYSR	Patient's length of stay since beginning of study period
Y1DAYS	Number of days patient in study—up to 365
Y2DAYS	Number of days patient in study—beyond 365

NOTE: GNP is geriatric nurse practitioner.

SOURCE: The RAND Corporation: Data from the Mountain States Project file.

characteristics and the need for nursing services.

Variables used in the cost function estimation are defined in Table 1. Means and standard deviations for GNP and control homes for the variables in our sample are given in Table 2. Approximately 58 percent of the facilities in the sample were for-profit nursing homes; 69 percent were licensed for Medicare skilled nursing care, and another 9 percent for Medicaid skilled care. One-quarter of the homes were small (less than 75 beds), and another one-quarter had 150 beds or more. Forty-two percent were part of a chain: 23 percent were in small

Table 2

Means and standard deviations of nursing home variables for nursing homes with geriatric nurse practitioners (GNPs) and control homes: Selected Western States, 1977-86

Variable	Homes with GNPs		Control homes	
	Mean	Standard deviation	Mean	Standard deviation
OPCPDAY in dollars ¹	52.62	13.73	52.08	11.87
PROFPDAY in dollars ¹	5.39	5.72	6.01	4.33
PROFIT	.54	.50	.64	.48
LICMCSNF	.70	.46	.67	.47
LICSNF	.09	.29	.09	.28
BEDLT75	.28	.45	.22	.42
BED150PL	.22	.42	.25	.43
SMCHAIN	.18	.39	.28	.45
LGCHAIN	.21	.41	.17	.38
NHPLUSCR	.31	.47	.36	.48
NHPLUSHO	.18	.39	.12	.32
RURAL	.42	.50	.23	.43
CAL	.36	.48	.39	.49
IDAHO	.04	.21	.04	.21
MONT	.03	.17	.03	.17
NMEX	.03	.17	.03	.17
WASH	.27	.45	.30	.46
ARIZ	.04	.21	.00	.00
VA	.04	.21	.04	.21
ADMIT	.24	.07	.25	.09
ADMHOSP	.54	.20	.59	.17
ADMITHSP	.14	.08	.15	.09
MEDICAID	.40	.26	.38	.23
NTHERAPY	2.39	.88	2.76	.93

¹1986 constant dollars.

NOTES: Definitions of variables are given in Table 1. Data from both period before GNP added to staff and since GNP added are included. The unit of observation is the nursing home fiscal year.

SOURCE: The RAND Corporation: Data from the Mountain States Project file.

chains of less than five homes and the remaining 19 percent were part of larger chains. One-third of the facilities in the sample had some kind of residential apartments or day care programs run in conjunction with the nursing home, and 15 percent had a formal hospital affiliation. One-third of the sample was located in a rural area (that is, outside metropolitan statistical areas). The only significant difference in nursing home characteristics between the GNP and control nursing homes was that GNP homes were more likely to be in rural areas.

Indicator variables were used to control for differences among States, with Colorado as the omitted group. We expected State to relate to costs because the various State Medicaid programs differ markedly in services covered and level of payments. Medicare and Medicaid policies would not affect Veterans Administration homes significantly. Therefore, the only pair of Veterans Administration facilities is indicated separately, as if it were in a State of its own.

A number of case-mix measures were constructed from the patient-level data. For the home-level analyses, we are interested in case-mix measures that represent the average patient day within the sampled home and study year. To convert the patient measures to measures for the average patient day, we weighted patient measures by estimated sample weights for new admissions and continuing residents and by the study period length-of-stay data. These variables should be interpreted as the

share of patient days associated with patients with the trait in question.

We hypothesized that newly admitted patients (ADMIT) might affect nursing home per diem operating costs differently than longer term, continuing nursing home residents do. Approximately 25 percent of the annual patient days were for patients newly admitted into the nursing home during the course of the study year. Patients who were admitted directly from the hospital (ADMHOSP), whether new admissions or continuing residents, were expected to be sicker and to have higher nursing needs than patients admitted from the community. Newly admitted patients coming directly from the hospital (ADMITHSP) were expected to have higher costs than continuing residents who were originally admitted from the hospital. Patients who were Medicaid eligible at admission accounted for 39 percent of the patient days, and nursing homes that admit more Medicaid patients typically have lower per diem costs.

From the medical record abstracts, we obtained information about patients' receipt of specific nursing therapies during the first 2 weeks after admission. The list of nursing therapies included decubitus care, Foley catheter care, bladder training, bowel training, dressing changes, gait training, intravenous fluid use, tube feeding, ostomy care, restorative nursing, oral suction, fracture care, tracheostomy care, oxygen use, prosthesis care, range-of-motion exercises, pureed diets, and soft restraints. We used a count of the number of therapies a patient received during this time period (N THERAPY) as a measure of patient severity. The weighted average number of nursing therapies per patient day was 2.6. Patients in GNP homes used somewhat fewer therapies at admission than patients in control homes did.

Patient-level analyses

Characteristics of nursing homes may systematically influence the use of medical services by individual patients, either directly through incentives and policies or indirectly through case mix and the type of patients admitted. For example, we hypothesized that patients in for-profit homes (PROFIT) might receive fewer than average services, particularly services that were not clearly profitmakers for the nursing homes. We assumed that homes that were licensed for skilled care (LICSNF) would treat patients with higher than average needs and therefore have higher imputed daily costs. We also hypothesized that the size of the nursing home might affect the use of services. Very small homes might use fewer than average services because services were less available, and very large ones might also use fewer services because individual patients would receive somewhat less attention. We used three size groupings for these categorizations: less than 75 beds (BEDLT75), 75-149 beds (omitted group), and 150 beds or more (BED150PL).

Patient characteristics were also expected to predict use. To see how patient age affected use of services, we used five age groupings: under 65 years (AGELT65), 65-74 years (the omitted group), 75-84 years (AGE7584), 85-94 years (AGE8594), and 95 years or over (AGE95PL). Our initial hypothesis was that older patients would receive fewer services.

Patients who were admitted directly from the hospital (ADMHOSP) were expected to use more services than average, as were patients who were admitted to skilled care (ADMSKILL). We hypothesized that patients who were covered by Medicaid at admission would receive fewer services.

To control for the different patterns of use over the course of nursing home stays, we introduced several variables. For patients who were continuing residents at the beginning of the study period, we controlled for length of stay as of the beginning of the study period. For both new admissions and continuing residents, we introduced two variables to control for the length of the study observation period. The first (Y1DAYS) is the number of days up to 365 in the study observation period. The second (Y2DAYS) is the number of days beyond 365 in the study observation period. These variables were introduced after residual plots on our initial models revealed that per diem costs declined more rapidly in the first year than in the second year of the observation period.

Patient characteristics in the pre- and post-GNP periods for patients in both GNP and control homes are compared in Table 3. These comparisons are made separately for new admissions and for the longer staying, resident group. GNP patients were younger than control patients by one-half of a year, but the difference was statistically significant only in the post-period, new-admission group. No differences were found in the percentage of patients who were covered by Medicaid at admission. However, patients in GNP homes in both the pre- and post-periods were less likely to be admitted from the hospital and were less likely to have required skilled nursing care at admission. These differences were usually statistically significant, suggesting a somewhat lighter case mix in GNP homes than in control homes.

We also looked at functional status as measured by ability to perform six activities of daily living (ADLs). Out of 24 comparisons (6 ADLs in each of 4 sets of tests), only 5 had statistically significant differences. In four of the five differences, patients from GNP homes were more independent at admission than those from control homes, although the differences were not large.

Patients from GNP and control homes appear to be similar on mental and behavioral status measures. The only significant difference was found in the pre-period, resident group, and again patients from GNP homes were more independent.

Finally, we looked at patient case mix as measured by the use of nursing therapies at admission. In the pre-period, control homes had more patients (both new admissions and continuing residents) receiving gait training and range-of-motion exercises, as well as more new admissions on pureed diets. In the post-period, patients in control homes continued to receive more range-of-motion exercises, but they received relatively less gait training. In the post-period, on the other hand, new admissions in GNP homes received more fracture care, more restorative nursing, more gait training, and more bowel and bladder training than those in control homes; fewer GNP patients used Foley catheters or soft restraints. Fewer differences were found for continuing residents than for new admissions in the post-period.

The findings on functional status suggest that new

Table 3

Patient characteristics of new admissions and continuing residents in nursing homes with geriatric nurse practitioners (GNPs) and in control homes, by period: Selected Western States, 1977-86

Patient characteristic	New admissions				Continuing residents			
	Pre-period		Post-period		Pre-period		Post-period	
	Control homes	Homes with GNPs	Control homes	Homes with GNPs	Control homes	Homes with GNPs	Control homes	Homes with GNPs
Age in years	79.6	79.1	79.2	*78.5	81.9	81.1	82.4	81.9
Percent admitted from hospital	62	58	62	*60	60	*51	61	*56
Percent covered by Medicaid at admission	36	34	27	29	44	47	40	40
Percent receiving skilled care at admission	76	*70	79	*75	80	*77	76	*73
Functional status at admission: ¹								
Ambulation	3.0	3.0	2.8	*2.9	3.1	3.2	3.0	3.0
Transferring	2.6	2.6	2.5	*2.6	2.7	*2.8	2.6	2.7
Feeding	3.6	3.5	3.5	3.5	3.6	3.5	3.5	3.5
Toileting—bladder	2.9	2.9	2.8	2.9	2.9	*3.0	2.8	2.9
Toileting—bowel	3.2	*3.1	3.2	3.1	3.2	3.2	3.1	3.1
Dressing	2.5	2.5	2.4	2.4	2.5	2.6	2.5	2.5
Mental and behavioral status at admission: ¹								
Mental status	3.2	3.1	3.2	3.2	3.0	*3.2	3.1	3.0
Behavior	3.6	3.5	3.6	3.6	3.5	3.6	3.5	3.5
Percent using nursing therapies at admission:								
Decubitus care	14	11	16	16	11	11	15	*12
Foley catheter	19	18	22	*18	15	14	18	17
Bladder training	17	19	17	*20	18	14	18	18
Bowel training	8	9	9	*13	11	10	11	10
Dressing changes	10	12	12	13	8	7	9	10
Gait training	28	*20	20	*23	18	*14	18	17
Intravenous fluids	1	0	1	1	0	0	0	1
Tube feeding	3	2	4	4	1	2	2	3
Ostomy care	2	2	2	2	1	1	1	1
Restorative care	73	71	68	*82	72	67	69	*74
Oral suction	2	1	2	2	1	1	1	1
Fracture care	6	7	8	*10	5	4	6	*8
Tracheostomy	0	0	0	1	0	0	0	0
Oxygen	6	7	9	8	3	3	5	4
Prosthesis care	2	1	2	2	1	1	2	1
Range-of-motion exercises	32	*22	35	*27	29	*20	30	*22
Pureed diets	10	*7	10	*8	12	10	11	9
Soft restraints	37	38	41	*36	37	36	41	*37

*Statistically significant differences at the 5-percent level on two-tailed t-tests.
¹Scaled from 1-4; higher scores indicate fewer problems or more independence.

NOTE: Pre-period is period before GNP added to staff; post-period is period since GNP added.

SOURCE: The RAND Corporation: Data from the Mountain States Project file.

admissions to GNP homes in the post-period were more independent than their control counterparts in ambulation and transferring (getting into or out of a bed or chair) but did not differ in their degree of independence in toileting. Thus, it is difficult to know whether the observed differences in the use of bowel and bladder training therapies reflect real differences in case mix or merely a greater emphasis on patient training in GNP homes as a result of the introduction of these newly trained health professionals. To some extent, certain nursing therapies may be substituting for others. For example, bladder training may substitute for the use of Foley catheters, and restorative nursing may substitute for range-of-motion exercises. Our use of a count of the number of nursing therapies allows for this substitution.

Nursing home costs and profits

We analyzed per diem operating costs for the nursing homes in this study. We performed the same analysis using patient care costs rather than operating costs and

obtained similar results. However, operating rather than patient care costs are presented here because they are a more complete measure of potential GNP impact. We initially hypothesized that GNPs could affect dietary costs through improved nutritional programs, laundry costs through improved continence training programs, and other nonpatient care costs that are captured only in the more general measure of operating costs.

Operating costs were calculated by deducting property-related expenses from the total nursing home costs reported in Medicaid Cost Reports. In a small number of cases, Medicaid Cost Reports were unavailable and data from a questionnaire were substituted. As our focus is on pre-post differences, we required that a consistent data source be used in each home throughout the study timeframe so as not to bias results. Total profits were computed as revenues less operating costs. Per diem figures were obtained by dividing totals by the number of patient days of care delivered during the year.

The unit of observation for this analysis is the nursing home study year. For each of the 60 participating nursing

homes, data for up to 3 years—1 pre-year and 1 or 2 post-years—were collected, limiting our potential sample size to 180 observations. Problems concerning data availability further limited the actual sample size. Three homes did not file cost reports and refused to complete the cost questionnaire; six homes with pre-periods in the mid-1970s no longer retained cost data; one home changed from a hospital-based facility to a freestanding unit and was consequently eliminated from the study. During the second post-year, four GNPs resigned and a GNP was found to be working in a control facility; these problems limited data collection in the affected homes and their matched pairs to 1 pre- and 1 post-year.

Effects on nursing home costs

Although we were careful to select a set of non-GNP, or control, homes that matched the GNP facilities on dimensions that affect nursing home behavior, we also collected extensive pre-period data to allow us to control directly for behavioral differences between the two sets of nursing homes. Our regression models (Table 4) were formulated with additive effects for GNP, post-period, and the interaction of GNP and post-period all measured relative to the pre-period control group. (We also estimated cost functions on the logarithm of per diem operating costs and found that this transformation did not perform as well as the raw measure.) GNP homes in which the GNP role was not implemented were distinguished in both the pre- and post-periods. Small positive coefficients on the GNP variable indicate that there were no real pre-period differences in per diem operating costs between the two groups of nursing homes. The larger negative coefficient in the post-period variable is significant. It may in part be an artifact of our inflation adjustment methods, if medical care costs actually rose faster than nursing home costs during this time period. The small, positive, statistically insignificant coefficient on the interaction term for GNP and post-period (GNP*POST) indicates that GNPs did not significantly affect nursing home operating costs. The estimated GNP effect is \$0.22 per patient day, and a 95-percent confidence interval for this estimate runs from -\$4.80 to \$5.20. The size of the confidence interval reflects the large observed variability found in most cost data.

Many of the home-level variables were not statistically significant, but the signs on the coefficients were consistent with our expectations and with previous findings reported in the literature. Relative to the omitted group, for-profit homes had lower costs and homes licensed for skilled care (Medicare or Medicaid) had somewhat higher costs. Larger homes and those that were part of large chains had lower costs. Multilevel facilities tended to have higher costs: Costs were somewhat higher for homes associated with residential apartments and/or adult day care programs and much higher for those with formal hospital affiliations.

Our findings with respect to the case-mix measures constructed from the patient-level variables were mixed. As expected, a larger share of days associated with patients who were covered by Medicaid at admission predicts lower per diem operating costs, and a larger share of days for newly admitted patients predicts higher costs. The negative coefficients on the share of days

Table 4
Coefficients of per diem operating costs and profits from nursing-home-level regression models: Selected Western States, 1977-86

Variable	Per diem operating cost	Per diem profit
GNP	0.260	-0.944
NIGNP	-8.730	5.419
POST	** -3.936	-0.126
GNP*POST	0.215	0.975
NIGNP*POST	7.503	* -5.670
RURAL	-3.605	-1.468
CAL	5.861	-2.977
IDAHO	-0.745	-2.338
MONT	-1.502	* -6.564
NMEX	10.138	-3.968
WASH	3.809	-2.466
ARIZ	** 36.033	4.128
VA	12.880	-1.812
LICMCSNF	1.834	1.709
LICSNF	2.781	-1.191
PROFIT	-4.076	* 3.051
BEDLT75	-0.641	0.011
BED150PL	-3.805	* 2.930
SMCHAIN	1.275	0.732
LGCHAIN	-2.073	0.464
NHPLUSCR	3.955	-0.376
NHPLUSHO	11.126	-1.773
MEDICAID	*** -20.661	-1.197
ADMIT	33.412	-1.442
ADMHOSP	-1.954	-4.558
ADMITHSP	-4.638	-1.084
N THERAPY	0.003	1.212
Intercept	*** 51.845	5.538
Sample size	137	134
R ²	0.785	0.486

* Statistically significant at the 10-percent level.

** Statistically significant at the 5-percent level.

*** Statistically significant at the 1-percent level.

NOTES: Definitions of variables are given in Table 1. Two-sided *p* values are used.

SOURCE: The RAND Corporation; Data from the Mountain States Project file.

associated with new admissions from the hospital and on all hospital admissions were unexpected.

Effects on nursing home profits

Because we anticipated that the presence of GNPs might increase nursing home revenues by attracting more private-pay patients or through the introduction of new revenue-producing day care programs, we estimated nursing home profit equations. The results of this regression, also shown in Table 4, indicate that GNP homes began with somewhat lower profits than control homes but achieved somewhat higher profits after GNPs were introduced. However, these differences were not statistically significant.

Relative to the omitted group, homes that were licensed for Medicare skilled nursing care were more profitable, but homes licensed for only Medicaid skilled care were less profitable. Not surprisingly, proprietary homes were more profitable than not-for-profit homes. Large homes were more profitable than medium or small homes. Being part of a chain had no effect on profitability. Homes that were part of multilevel

complexes, especially those associated with hospitals, appear to have been less profitable.

Not unexpectedly, a larger share of days associated with Medicaid admissions had a negative impact on profits. Larger shares of days for new admissions and patients admitted directly from the hospital were also associated with lower profits.

Patient-level analyses: Imputed expenditures

The dependent variable for the patient-level regressions was the natural logarithm of imputed medical services expenditures per day. To avoid letting a few cases with small expenditures (less than \$1 per day) have too much influence, we added \$1 to each value before taking the logarithm. Relative prices were imputed for the following services: physician, podiatry, dental, therapy and emergency room visits, laboratory and radiology services, hospital days, and prescriptions.

Because per diem imputed expenditures are highly skewed, we experimented with alternative transformations and variance-stabilizing weighting schemes to enhance the statistical performance of our models. Transformations of the dependent variable included the natural logarithm, the inverse, and the inverse of the square root. Because these efforts made the estimated coefficients more difficult to interpret and did not change our conclusions regarding the effects of the GNPs, we have opted to present the logarithmic models only. In the logarithmic models, it is assumed that effects are multiplicative, in contrast to the additive nature of the untransformed models. Because the models estimated on the logarithm of imputed expenditures explain considerably more of the variation in expenditures (13-24 percent, compared with 6-7 percent for the untransformed models), we focus our comments on these models. In lieu of the alternative weighting schemes, we have chosen to control directly for differences in patient length of stay.

Nursing-home-level variables included geography, ownership and institutional status of the home, and number and type of patients accepted. Patient-level variables included information about demographic characteristics; admission status (when admitted, place from which admitted, etc.); and function. Consequently, differences arising from nursing home and patient characteristics were not attributed to the GNPs. Variance components models were used to estimate the magnitude of nursing home effects that remained unexplained by the ANOCOVA models. These models provided correct standard errors for GNP effects and other nursing-home-level coefficients.

In a variance components model, the analytic approach that we have chosen, the unexplained variance term is decomposed into the variation attributable to various sources. In our models, we introduced one variance component for nursing home effects and another for an interaction between post-period and home effects. The latter variance component allows for the possibility that nursing home effects differ between periods. Estimates of these random-effects models confirmed that the two hypothesized variance components were significant. The variance components model provides formulas that have

been used to adjust the *t*-statistics for the coefficients of all home-level variables in the tables that follow. Because nursing home effects were fairly stable over time, the adjustment to the coefficients for post-period, post-period with GNP role implemented, and post-period with GNP role not implemented are slight compared with those for other home-level variables.

New admissions

The signs on most of the home-level variables were consistent with our expectations, although it is clear from the adjusted *t*-statistics that most were not significant at the 5-percent level (Table 5). Patients in for-profit homes had lower per diem expenditures, and those in homes licensed for skilled care had higher average expenditures. Patients from very large homes and those from small homes used fewer medical services than those from average-sized homes; patients from small homes were consistently the lowest users. Patients from homes with a formal hospital affiliation used more services, and patients in rural areas used less.

Patient age is a strong predictor of per diem expenditures. Relative to the young elderly (those 65-74 years of age), both the young (under 65 years of age) and old (75 years of age or over) had lower use patterns. Expenditures fell monotonically with age among the elderly, and the lowest use is observed among patients 95 years of age or over. Patients admitted directly from the hospital and those admitted to skilled care used more services; those admitted from the hospital used more than patients who were admitted to skilled care. Patients who were covered by Medicaid at admission had lower service use than non-Medicaid patients. A greater number of nursing therapies used during the first 2 weeks after admission also significantly predicts greater use of other medical services. Expenditures dropped continuously with length of stay, as observed earlier.

Continuing residents

Findings with respect to home-level variables were somewhat less consistent with our expectations for continuing residents than for new admissions, perhaps as a result of the lower sampling ratio for this group. Somewhat unexpectedly, continuing residents in skilled care facilities had lower expenditures in both models, and those in for-profit homes had marginally higher expenditures in one model. Findings with respect to bed size and hospital affiliation were similar to those for new admissions.

As anticipated, increased length of stay prior to the study observation period was a strong predictor of lower use. Longer study observation periods also predict lower use. The effect of age on average expenditures was similar to that found among new admissions, although not as significant: Older patients received fewer services and service use decreased with increasing age.

As expected, variables describing the patient at admission did not have as strong predictive power for continuing residents as for newly admitted patients. Patients admitted directly from the hospital had higher per diem expenditures, but the effect for admission to skilled

Table 5

Coefficients of per diem imputed medical expenditures from patient-level model for new admissions and continuing residents of nursing homes: Selected Western States, 1977-86

Variable	New admissions	Continuing residents
GNP	*0.341	0.155
NIGNP	0.187	-0.047
POST	***0.167	0.061
GNP*POST	*-0.159	-0.034
NIGNP*POST	0.049	0.183
PROFIT	-0.112	0.014
LICSNF	0.071	-0.030
BEDLT75	-0.256	*-0.179
BED150PL	-0.163	-0.016
NHPLUSCR	-0.028	0.031
NHPLUSHO	0.097	0.057
RURAL	-0.114	0.010
CAL	0.126	0.123
IDAHO	0.069	-0.021
MONT	-0.177	**0.451
NMEX	-0.141	-0.106
OREGON	0.073	-0.020
WASH	0.092	-0.096
ARIZ	0.106	0.283
VA	**0.621	**0.533
AGELT65	***-0.149	-0.039
AGE7584	**0.074	-0.040
AGE8594	***-0.191	**0.109
AGE95PL	***-0.289	***-0.211
LOSYS	—	***-0.061
ADMHOSP	***0.292	***0.102
ADMSKILL	***0.111	0.058
MEDICAID	***-0.228	-0.014
N THERAPY	***0.065	0.015
Y1DAYS	***-0.001	***-0.001
Y2DAYS	***-0.001	**0.000
Intercept	***2.082	***2.182
Sample size	6,150	3,283
R ²	0.131	0.113

* Statistically significant at the 10-percent level.

** Statistically significant at the 5-percent level.

*** Statistically significant at the 1-percent level.

NOTE: Definitions of variables are given in Table 1.

SOURCE: The RAND Corporation: Data from the Mountain States Project file.

care was marginal. Patients who were covered by Medicaid at admission had lower expenditures, as evidenced by consistently negative coefficients, although the coefficients were not statistically significant.

Medical services

For the new-admission sample, the GNP coefficients indicate that patients from GNP homes had higher per diem expenditures than patients from control homes in the pre-period. After adjusting the *t*-statistics to correct for the correlation across observations, this difference is significant at the 5-percent level in the continuing-resident models and at the 10-percent level in the new-admission models. Per diem expenditures for patients from control homes increased significantly during the post-period for new admissions.

Although not conclusive, our results for new admissions in GNP homes suggest that expenditures dropped in the post-period relative to the trend in control homes (GNP*POST coefficient). This relative decline

was statistically significant at the 10-percent level. The retransformed net GNP effect was a change of -\$2.65, or -15 percent. A 95-percent confidence interval for the change is from -28 percent to 1 percent. Other model variations, not shown here, included patient classification systems, Functionally Ranked Explanatory Designations, Katz score, the Minnesota Case-Mix System, resource utilization groups, number of ADL dependencies, and indicators for each ADL dependency. The relative decline attributed to GNPs was statistically significant at the 5-percent level in one of the eight model variations and at the 10-percent level in four more. In the remaining models, the size and sign of the coefficients were consistent with this finding, but the statistical precision needed to achieve significance is lacking. Using these classification systems, no differences in case mix were found between the treatment and control group.

For the continuing-resident group, we found no evidence of either a GNP effect or increased use in the post-period for the control group. Residents from homes where the GNP role was not implemented had marginally higher post-period expenditures in the basic model.

Components of medical service use

An important early hypothesis was that use of GNPs would reduce hospitalization costs. We also anticipated that the use of restorative-type services would increase as GNPs made greater efforts to return patients to higher levels of independent functioning. In part, these conflicting hypotheses led to the development of the imputed cost methodology, because dollars form a convenient metric for combining different services into a single measure. Having observed that costs for patients in GNP homes fell relative to costs in the control group, we would now like to understand what services contributed to the initially higher pre-period costs in GNP homes and how the use of these services changed through time for the two groups. Because patients were followed for different lengths of time, we express these figures as rates of use per study day.

For every type of service, new admissions to GNP homes had higher pre-period use rates than new admissions to control homes. These differences were statistically significant for 6 of the 14 reported measures—physician visits with examination, dental visits, laboratory and radiology orders, occupational therapy, and regular prescription drugs at both admission and discharge (Table 6). In the post-period, the use of these six services remained higher in the GNP group. In addition, the difference in use of physical therapy and emergency room visits increased to statistically significant levels. The drop in costs resulted exclusively from the reduction in hospitalization measures for GNP patients. In the post-period, the admission rate for patients in GNP homes was significantly below the rate in control homes, and the number of inpatient days for both elective and emergency stays fell to levels below those in control homes. The reduction from pre- to post-period was statistically significant for emergency hospital days. Within the control group, hospitalization increased between the two periods.

In the pre-period, relatively fewer real differences are observed between the GNP and control groups within the

Table 6

Unadjusted measures of service use per study day for new admissions and continuing residents in nursing homes with geriatric nurse practitioners (GNPs) and control homes, by period and type of service: Selected Western States, 1977-86

Type of service	New admissions				Continuing residents			
	Pre-period		Post-period		Pre-period		Post-period	
	Control homes	Homes with GNPs	Control homes	Homes with GNPs	Control homes	Homes with GNPs	Control homes	Homes with GNPs
Physician visits with examination	.026	*.030	.027	*.030	.022	*.024	.023	†.027
Physician visits—no examination	.008	.009	†.006	†.006	.010	.010	†.007	†.005
Podiatry visits	.003	.003	†.002	†.002	.002	.002	.002	.003
Dental visits	.001	*.002	.001	*.003	.001	.001	.001	*.001
Laboratory and radiology services	.013	*.018	†.017	*.018	.008	*.009	†.011	†.011
Physical therapy	.075	.091	.085	†.108	.023	.026	†.013	*.029
Occupational therapy	.004	*.024	†.007	*.024	.000	*.008	†.000	*.011
Emergency room visits	.000	.001	†.001	*.002	.001	.000	.001	.000
Emergency room visits (tests only)	.002	.002	.002	.002	.001	.001	.001	.001
Regular prescriptions at admission ¹	4.2	*4.6	4.7	†4.8	3.8	4.0	4.1	3.9
Regular prescriptions at discharge ¹	4.4	*4.8	†4.8	†5.1	4.2	*4.5	†4.5	4.6
Hospital admissions	.0013	.0015	.0015	*.0013	.0008	.0009	.0009	.0007
Elective hospital days	.0018	.0030	.0018	.0016	.0012	.0007	.0006	.0006
Emergency hospital days	.0107	.0153	.0113	†.0092	.0054	.0073	.0057	.0055

*Differences within period between GNP and control patients significant at the 5-percent level.

†Differences within group between periods significant at the 5-percent level.

¹Actual number of prescriptions in 2-week period.

‡Drop from pre- to post-period within group.

NOTE: Pre-period is period before GNP added to staff; post-period is period since GNP added.

SOURCE: The RAND Corporation: Data from the Mountain States Project file.

continuing-resident population than between the GNP and control groups in the new-admission population. In the post-period, patients from GNP homes used significantly more therapy than patients in control homes. As with new admissions, all three hospitalization measures for continuing residents in GNP homes fell considerably from the pre-period to levels below those of the control group. However, for the continuing-resident group, this post-period difference was not statistically significant. In the continuing-resident control group, hospitalization rates increased slightly between the periods, the same pattern seen in the new-admission control cohort.

State variations

Do GNP effects differ by State as a result of geographic variations in Medicare implementation and Medicaid programs? Most of the participating nursing homes are concentrated in three States: California, Colorado, and Washington. Homes in the remaining five States, each with one or two pairs of nursing homes, and the pair of Veterans Administration homes have been grouped together in the analysis that follows. Homes with unknown pre-period imputed expenditures have been excluded, as have homes in which the GNP role was not implemented.

In California, post-period expenditures for medical services for the control homes increased considerably over the pre-period level. In GNP homes, the initially higher per diem expenditures changed little between the periods and, as a consequence, fell below the level of post-period control group expenditures. In Colorado, pre-period GNP expenditures were quite a bit higher than those of the control patients, and expenditures for both

groups fell approximately the same amount in the post-period. In Washington, pre-period GNP expenditures were slightly higher than control expenditures, and both changed little in the post-period. It is clear from Figure 1 that possible GNP effects are concentrated in the disparate residual group. Although the level of pre-period expenditures differed among the States in this group, each home had exceptionally high pre-period expenditures and large drops in the post-period. Post-period GNP expenditures remained somewhat higher than control expenditures in this group.

Conclusions and policy implications

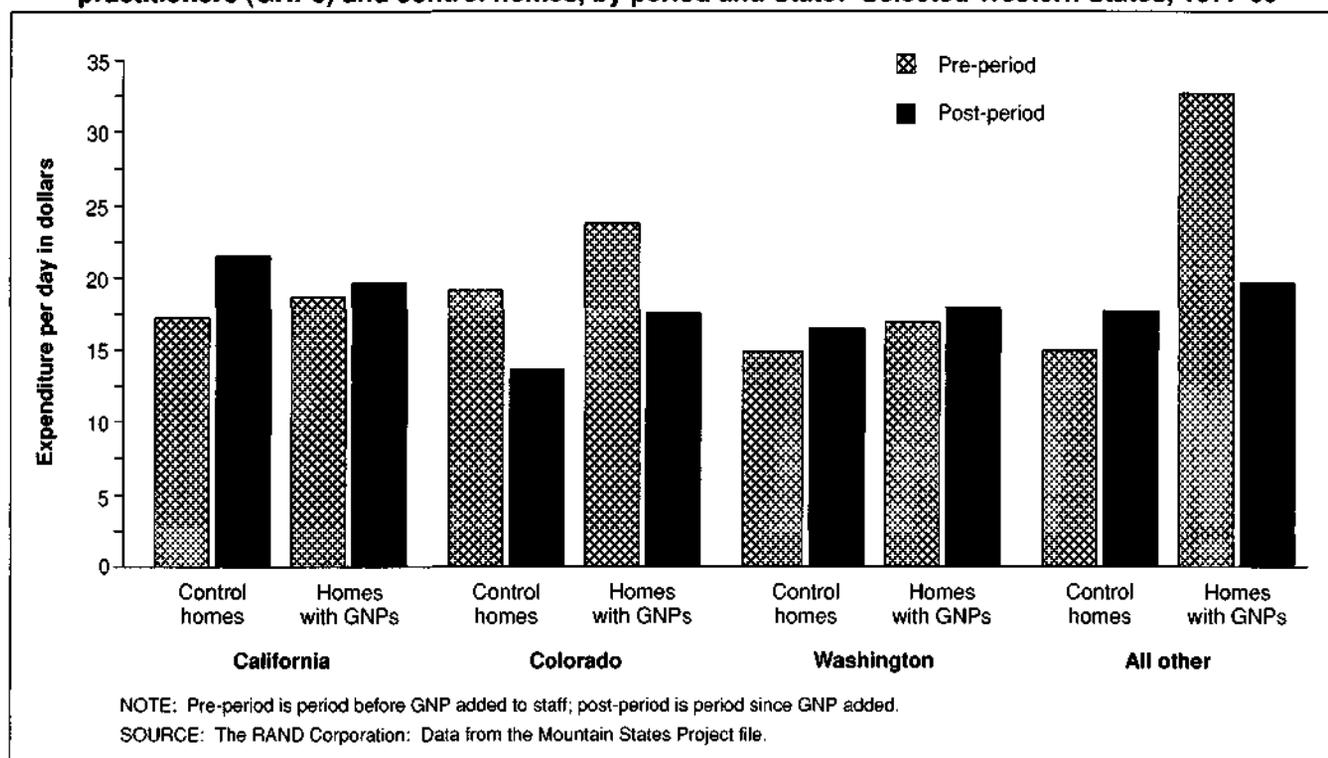
With the broad goal of improving the quality of nursing home care in a cost-effective manner, MSHC's Geriatric Nurse Practitioner Program was designed to provide additional training and expertise to nurses currently working in nursing homes. With the additional training, these GNPs were expected to provide improved care to nursing home patients.

Although the program was timely and the goals easily stated, operationalizing the concepts was at best a challenging task. Role models for the newly trained providers did not exist. Continuous efforts were needed to define the role and to educate colleagues, both superiors and subordinates, regarding the tasks and benefits of this new professional.

New programs intended to improve quality seldom actually save costs as well. From the outset, our expectations for cost savings from this program were limited. We hoped that, with improved quality of care and more medical attention, unnecessary hospitalizations could be avoided. However, we recognized that better

Figure 1

Patient-level per diem Imputed expenditures for medical services in nursing homes with geriatric nurse practitioners (GNPs) and control homes, by period and State: Selected Western States, 1977-86



medical care could increase the use of corrective and restorative medical services, thus tending to increase costs. With respect to costs borne by the nursing home, we had limited expectations that cost savings would accrue from the program. Almost any program aimed at assisting patients to achieve their maximum levels of independent functioning and enhanced socialization are staff intensive and require more resources. Programs to improve nutrition, add counseling, or increase social interaction all tend to increase costs. Greater satisfaction among the nursing home staff, leading to possible future reductions in staff turnover, was the only real cost saving area initially identified.

For the most part, the results were consistent with our expectations. At the patient level, we found no evidence of change in medical service use among continuing residents. Although small in number, this group accounts for the bulk of patient days. Within the new-admission group, we found some evidence that GNPs can reduce costs for a limited sample of homes with unusually high pre-period expenditures. However, even with the reduction, patient-level expenditures remained higher than those of the control group. Because our sample contained no control homes with unusually high pre-period expenditures, we cannot separate the amount of reduction in the post-period that would have occurred as a natural regression toward average levels of expenditures without the benefit of the GNP intervention. Because the homes with unusually high pre-period expenditures were a disparate group, with only a single pair in any State and only a pair of Veterans Administration homes, neither

conclusions nor inferences can be drawn from knowledge of the State or its Medicaid program.

We find greater promise in the results on the composition of services. For the new-admission sample, we observed a decline in all three measures of hospital use (admissions, elective hospital days, and emergency hospital days) in the GNP facilities. Although use rates were higher in GNP than in control homes in the pre-period, rates in GNP homes declined to below control rates in the post-period. The decline from pre to post for emergency hospital days for the implemented GNP group was statistically significant, and the post-period admission level was significantly lower than that of control patients. Among continuing residents, all three hospital-use measures declined in the post-period for GNP patients and fell below the rates of the controls. In the control samples, for both new admissions and continuing residents, hospital admission rates increased between the pre- and post-periods. None of the differences, however, was statistically significant. If these trends continue as the program matures, perhaps the differences will become significant. Increases in the use of other services among the GNP group were not unexpected and were perhaps the unavoidable result of increased medical attention.

We found no evidence that GNPs increased costs to nursing homes. GNPs did not significantly improve profitability either, although the data suggest some minor movement in that direction. Per diem operating costs across nursing homes are relatively variable, and direct employment costs for GNPs are small. Incremental per diem costs of GNP employment were estimated under

alternative sets of assumptions for small (50 beds), medium (100 beds), and large (200 beds) homes. Under the high-cost assumptions, GNPs were assumed to supplement the existing nursing home staff. In the lower cost variations, GNPs constituted upgraded skills but did not increase the staffing complement. Estimates were prepared with and without amortized training costs. Per diem incremental costs were obviously highest for small homes, ranging from \$0.07 to \$2.50 per day. For large homes, incremental costs varied from \$0.02 to \$0.63 per day. Therefore, if the employment market for nurses remains unchanged, any nursing home that is considering GNP employment can afford to do so. (If the current nursing shortage substantially increases nursing wages, this conclusion will no longer hold.) Although our analyses had limited power to detect costs of this order, the small size of employment costs and the lack of any evidence of increased costs among the GNP homes lends confidence to the conclusion. A new program that introduces new providers and does not increase costs, particularly in the early years, is a rare finding among health programs.

In any evaluation, it is important to identify properly who benefits from the program and who pays the bills. Nursing home care is financed primarily by the Medicaid program and by patients and their families. Medicaid contributes 45 percent of nursing home payments, private payments by patients and their families contribute 50 percent, and Medicare contributes only a fraction (2 percent) of the total nursing home costs. Our results suggest that GNPs have not affected Medicaid costs adversely. We were unable to discern whether nursing homes with GNPs increased charges to private patients, possibly enhancing the homes' revenue position. Any cost saving attributable to the program is achieved through lower hospitalization rates and fewer inpatient days. To the extent that GNPs reduce hospitalizations and achieve a cost saving at the patient level, the Medicare program (which pays for 75 percent of all hospital costs and 54 percent of all physician services) will benefit.

Participating nursing homes were not randomly selected. Factors that motivated homes to employ GNPs and to support their training are not necessarily discernible. Clearly, participating homes sought to improve the quality of care offered within their facilities, so they may comprise a select group of nursing homes. A large expansion of the program might require additional incentives and could also have different outcomes. From a policy perspective, the homes least interested in improved quality of care and therefore least likely to employ a GNP may, in fact, need one the most. Perhaps the easiest way to provide incentives for program expansion is through Medicare reimbursement for GNP services. The cost implications of this new offering cannot be predicted from our results, but experience suggests that the introduction of Medicare reimbursement would not be cost neutral.

Another program currently under evaluation, the Nursing Home Connection, should provide more direct evidence on the cost implications of a Medicare reimbursement provision. Like the MSHC program, this Massachusetts-based project tests the use of midlevel providers—nurse practitioners and physician assistants—to deliver primary care to nursing home patients. In the

Massachusetts model, however, physician groups, not nursing homes, employ the new health professionals. Waivers from the Health Care Financing Administration allow provider groups to bill Medicare for nurse practitioner or physician assistant visits to nursing home patients. In this demonstration, all providers are reimbursed at the same rate, and customary Medicare restrictions on billing frequency have been removed. Results from the Nursing Home Connection evaluation are presently being released (Buchanan et al., 1989).

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