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Nursing Home Residence Confounds Gender Differences in Medicare Utilization: An Example of Simpson's Paradox

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Abstract

Background—Gender differences in health care utilization in older Americans may be confounded by nursing home residence. Medicare data contain several files that can be used to create a measure of nursing home residence, but prior work has not addressed which best account for potential confounding. Simpson's paradox occurs when aggregated data support a different conclusion from what the disaggregated data show. We describe such a paradox that appeared when we sharpened our definition of “nursing home residence” while examining gender differences in Medicare utilization at the end of life.

Methods—To understand gender-specific health care utilization at the end of life, we conducted a retrospective analysis of a national random sample of Medicare beneficiaries aged 66 or older who died in 2001 with Parts A and B data for 18 months before death. We sought to associate each of total hospital days and costs during the final 6 months of life with numbers of primary care physician visits in the 12 preceding months. In addition to demographics, comorbidities, and geography, “nursing home residence” was a potential confounder, which we imputed in two ways: 1) from skilled nursing facility bills in the Part A Medicare Provider Analysis and Review (MedPAR) file; and 2) from Berenson-Eggers-Type-of-Service codes indicating widely spaced doctor visits in nursing homes obtained from Medicare's carrier file.

Conclusion—Gender differences in Medicare utilization are strongly confounded by nursing home resident status, which can be imputed well from Medicare's carrier file, but not MedPAR.

Background

During this time of health care reform, understanding gender differences in health care utilization in the Medicare population is critical, because women live longer and make up a larger proportion of the Medicare population (Medicare Beneficiary Demographics, 2006).

In addition, women live with greater disability and more chronic disease than men. For example, chronic conditions such as diabetes, arthritis, dementia, depression, and obesity are more common in women (Lubitz & Riley, 1993). As baby boomers age, Medicare faces escalating expenditures and dwindling numbers of workers to fund it. Because 30% of Medicare expenditures are spent on the 6% of beneficiaries who die each year (Approaching Death: Improving Care at the End of Life, 1997, Edwards and DeHaven, 2003 and Hogan et al., 2001), there is strong interest in improving the efficiency of health care at the end of life. Primary care medicine may improve this efficiency, because it is intended to address comprehensiveness, coordination, continuity, and “sustained clinician–patient partnerships” with the family and community (Montgomery et al., 2004). In addition, primary care providers may focus—more than specialists—on preventing medical complications, discussing patient preferences, and coordinating home palliative care at life’s end. Our prior work found more primary care visits in the preceding year were associated with reduced hospitalization, in-hospital death, and costs in the last 6 months of life (Kronman, Ash, Freund, Hanchate, & Emanuel, 2008).

We hypothesized that there were gender differences in the relationship between primary care and health care utilization at the end of life. Women tend to use more primary care and outpatient services, whereas men tend to use more in-patient hospital services (Bird et al., 2002 and Song et al., 2006). Because Medicare currently rewards in-hospital services more than primary care, the program’s financial incentives may affect men and women differently. To understand gender differences in the health care utilization of an elderly population, it is important to adjust for those who are nursing home residents, because more women are residents than men, and residents have different utilization of both primary care and hospital services. Because Medicare data do not contain a reliable indicator of nursing home resident status, we report here on two different methods of imputing nursing home resident status and demonstrate the effect on health care utilization outcomes.

Methods

Data source

To examine gender differences in end-of-life care, we used a randomly sampled population of 116,318 Medicare beneficiaries aged 66 or older who died in the last 6 months of 2001. Non-Whites were oversampled because the study population had been constructed to focus on end-of-life health care disparities (Hanchate, Kronman, Young-Xu, Ash, & Emanuel, 2009). To ensure completeness and comparability of health care utilization records before death, we excluded people who were not continuously enrolled in Medicare Parts A and B traditional fee-for-service program for the final 18 months of life. We also excluded decedents who could not be matched to the National Death Index, and those enrolled in the end-stage renal disease program, leaving a final analytical sample of 78,353.

Measures

We obtained age, gender, race, and zip code of residence from the Medicare denominator file, using the Medicare racial/ethnic categories of White, Black, Hispanic, and other (for those of Asian, North American Native, and other or unknown races and ethnicities). We

used an indicator that Part B Medicare insurance had been purchased by a state in 2000 (state Medicaid “buy-in”) as a proxy for low income. Place of death was derived from death certificates through the National Death Index. A summary comorbidity measure was determined using DxCG’s prospective relative risk score (DCG version 6.1 for Windows [DxCG, 2004]), derived from the presence in the pre-period of ICD-9-CM diagnosis codes from inpatient and outpatient encounters in Medicare’s utilization files. These encounters include all physician visits, hospital care, and nursing home care, but not codes used for diagnostic tests. The score is calibrated to associate 1.0 with average expected expenditures in the following year among all Medicare beneficiaries observed during routine 12-month periods (Ash et al., 2000).

Because Medicare Part A only pays for nursing home visits in the first 90 days after a hospitalization, we were unable to directly distinguish long-term nursing home residents from those in a nursing home for short-term rehabilitation after a hospitalization from our administrative billing data. We thus imputed two proxy measures. For the first measure, we defined those with “nursing home use” to be beneficiaries with at least one bill for residential costs in a skilled nursing facility (SNF) in the Part A Medicare Provider Analysis and Review (MedPAR) SNF file. This method is limited in not being able to distinguish nursing home residents from patients who are receiving short-term rehabilitation in a nursing facility. However, because MedPAR is more commonly utilized in health services research, this has the potential to be a readily utilized methodology. The second method utilizes the Medicare Part B carrier file. Unlike Medicare Part A, Medicare Part B does not pay for residential costs in a nursing home; however, it does pay for diagnostic tests and medical provider visits that take place in a nursing home. We used Berenson-Eggers-Type-Of-Service (BETOS) code 4B in Medicare’s “Carrier” file (available from: http://www.cms.hhs.gov.ezproxy.library.tufts.edu/HCPCSReleaseCodeSets/20_BETOS.asp) to define our second measure. This method of identifying nursing home use has been previously validated (Campbell et al., 2004). With it, a beneficiary was flagged for nursing home use if there were at least two health care encounters (e.g., blood draws and/or physician visits), separated by at least 90 days, that occurred in a nursing home. Because the maximum period of Medicare reimbursement for SNF care after a hospitalization is 90 days, people who received services spanning a longer period are likely to have resided in a nursing home receiving long-term care; although this method will also (spuriously) find occasional non-nursing home residents with rehabilitative SNF stays after two distinct hospitalizations.

Primary care visits

We used BETOS codes in the Medicare Carrier file to identify a visit in a nursing facility (code 4B) or office (codes 1A and 1B). We then linked these codes to the Medicare Health Care Financing Administration specialty codes to define a visit to an internist (11), geriatrician (38), or family practitioner (08), as a “primary care visit.” We used the number of these visits in the 12-month “pre-period” before the final 6 months of life to form five primary care groups: no visits, one or two, three to five, six to eight, and nine or more visits. We categorized visits that did not have these primary care Health Care Financing Administration specialty codes as “visits to specialists.” We calculated the ratio of number

of specialty visits to number of total outpatient encounters for each gender and by nursing home use.

Outcomes

We studied two outcomes during the last 6 months of life: 1) number of inpatient days (obtained from the MedPAR files) and 2) total costs paid by Medicare (from the MedPAR, Carrier, Durable Medical Equipment, Hospice, and Outpatient files).

Statistical analysis

We used bivariate analyses (chi-square test for categorical variables and analysis of variance for continuous variables) to identify differences in characteristics, end-of-life utilization, and costs across the primary care groups and genders. To compare the characteristics of our two definitions of nursing home use, we conducted bivariate analysis on the population within four groups, those with 1) both SNF bills from MEDPAR and encounters from carrier file, 2) only SNF bills, 3) only carrier file encounters, and 4) neither. STATA software version 9.1 (StataCorp, College Station, TX) was used for all analyses. We adjusted for factors from the pre-period that affect health care utilization and outcomes: age (Levinsky et al., 2001), race (Barnato et al., 2005, Degenholtz et al., 2003 and Skinner et al., 2003), Medicaid buy-in, comorbidity (Ash et al., 2003, Hogan et al., 2001 and Institute of Medicine, 1997), and place of residence (Baicker et al., 2004, Fisher et al., 2000 and Pritchard et al., 1998). For our first analysis, we adjusted for all confounders excluding either nursing home measure, which resulted in aggregated data around the confounder of nursing home use. To disaggregate the data, we then adjusted with the MedPAR-based measure of nursing home use, and a third time substituting the carrier file-based measure instead of the MedPAR measure. Our final analysis stratified the population by both gender and nursing home use based on the carrier file measure.

To account for geographic differences, we used multivariable cluster analysis, specifically, fixed effects regression with dichotomous indicators for each geographic unit. Contrasting each outcome only for beneficiaries residing in the same geographic area accounts for both measured and unmeasured factors (including health care supply and labor), which vary by geographic location (Johnston & DiNardo, 1997). We mapped each beneficiary's zip code of residence into its "hospital service area," defined by the Dartmouth as a geographic unit associated with health care utilization patterns (Fisher & Wennberg, 2008).

We calculated risk-adjusted, expected outcomes for each gender by primary care visit group by using its coefficient together with mean values for each of the other covariates in the model, using sample weights to reflect the entire Medicare population, and tested for statistical differences by gender. The key independent variables of our first three analyses were fully interacted 2×5 matrices of gender by number of pre-period primary care visits. Our final analyses used a fully interacted 4×5 matrix of gender and nursing home use by number of pre-period primary care visits.

Results

The general characteristics of the 78,356 Medicare decedents in our sample are as follows: the mean age is 81 years (range, 66–98), 56% are female; 40%, White; 36%, Black; and 11%, Hispanic. On average, women decedents are 3 years older than men decedents (mean age 82 vs. 79 years; $p < .001$) and have similar overall comorbidity (mean risk score for both genders is 2.2). In the 12 months before the final 6 months of life (the “pre-period”), more women receive Medicaid assistance (38% vs. 25%), and have more than 3 primary care visits (43% vs. 36%) than men (all p -values $< .001$; Table 1). The modal number of visits for both men and women is zero. Twenty-two percent of both genders have one or two visits, whereas only 18% of men have six or more visits, compared with 23% of women. In the final 6 months of life, both genders average 15 total hospital days (unadjusted); 74% of both men and women had at least one hospitalization. Compared with men, women cost \$1,000 less per capita ($p < .05$) and use hospice a little more frequently (24% vs. 23%; $p < .001$) in the pre-period; they were more likely to die in a nursing home (29% vs. 20%; $p < .001$) and less likely in a hospital (41% vs. 45%; $p < .001$) or at home (19% vs. 22%; $p < .001$; Table 1).

Table 2 summarizes the unadjusted baseline comparisons by gender and nursing home resident status using each of our two definitions of nursing home residents: those with SNF bills from the MEDPAR files indicating a hospitalization during the pre-period, and those with BETOS code health care encounters from the carrier file received in a nursing home. We divided the population into four groups: Group 1 contains people who met both nursing home definitions (MedPAR and carrier file based); group 2 met the carrier file criterion only; group 3, MedPAR only; and, group 4, neither. During the pre-period, the comorbidity scores of the SNF groups 1 and 3 were higher than the non-SNF groups 2 and 4: namely, 3.6 for group 1, 2.7 for group 3, 1.5 for group 2, and 0.87 for group 4. During the pre-period, those with CARRIER file code definitions had more primary care visits than those who did not (41% of group 1 and 37% of group 2 had at least nine primary care visits, compared with 11% of group 3 and 7% of group 4); more Medicaid use (46% of group 1 and 55% of group 2, compared with 33% of group 3 and 28% of group 4); and less specialty use (14% for group 1, 7% for group 2 compared with 33% for group 3 and 46% for group 4). During the last 6 months of life, the carrier file only group 2 had the lowest costs (\$10,000 compared with \$17,000 for group 1, \$19,000 for group 3, and \$15,000 for group 4); lowest use of hospice (17%, compared with 28% of group 1, 29% of group 3, and 25% of group 4); and the most deaths in a nursing home (66%, compared with 55% of group 1, 33% of group 3, and 16% of group 4). Within each group, men received more specialty care, and more women had Medicaid and died in a nursing home.

When adjusting for all confounders except either of the two measures of nursing home use, we found that among those with nine or more primary care visits, women spent less time in the hospital than men (11.8 vs. 13.4 days; $p < .05$; Figure 1A), and averaged \$3,677 less than men ($p < .05$; Figure 2A). After a threshold of three to five visits, more primary care visits were associated with fewer hospital days for both genders, but the association was stronger for women (Figure 1A). After a threshold of one to two visits, more primary care visits were generally associated with lower costs for women, but not for men (Figure 2A). Our results

were similar when adjusting for nursing home use using MedPAR data: of those with nine or more primary care visits, women spent less time in the hospital than men (13.2 vs. 14.1 days, $p < .05$; Figure 1B) and averaged \$2,641 less than men ($p < .05$; Figure 2B).

After a threshold of three to five visits, more primary care visits were generally associated with less hospital utilization and lower costs for women, but not for men (Figures 1B and 2B). However, when we adjusted for nursing home use using carrier file data (having at least two separated encounters in a nursing home defined by BETOS codes), we found that more primary care was not associated with decreased hospital utilization (Figure 1C) or costs (Figure 2C). Moreover, we did not find a significant gender difference in total hospital days, although women with at least nine primary care visits still had lower costs than men (\$20,594 for women vs. \$24,157 for men). When we stratified the population by gender and the carrier file definition of nursing home residence, both men and women residents had remarkably lower costs than nonresidents. After accounting for nursing home residence, there were no significant gender differences within these strata (Figures 1D and 2D).

Discussion

We sought to examine gender differences in health care utilization at the end of life. We expected nursing home use to be a confounder, because more women are nursing home residents than men, and such residence affects several kinds of Medicare utilization. Because Medicare billing data do not have a direct indicator of nursing home residence, we imputed two different proxy measures of nursing home use using variables from different Medicare file sources. When we did not control either at all, or adequately, for nursing home residence (using MedPAR files only), we reached conclusions different from those when using a more reliable marker of nursing home residence (based on receiving services, widely spaced in time, in a nursing home). This is an example of Simpson's paradox. Health care utilization outcomes are influenced by nursing home resident status, with costs and utilization being much lower for nursing home residents than nonresidents, and women receiving Medicare being far more likely than men to reside in nursing homes.

Our first method of imputing nursing home use (1 billed day in a SNF) from Medicare MedPAR files is frequently used when analyzing costs and utilization at the end-of-life Medicare billing data (Lubitz and Riley, 1993 and Shugarman et al., 2007). When we used this definition in our analyses, we found the association between more primary care visits and decreased hospital utilization and costs to be stronger for women than men. This finding is consistent with studies showing that, because women generally use more primary care than men, they may have more trusting relationships with their health providers, and more easily express their preferences for end-of-life care (Bertakis et al., 2000 and Bird et al., 2002). Compared with men, women may value a dignified death over receiving intensive, life-sustaining treatments (Bookwala et al., 2001). These findings suggest a gender-related disparity, in which men receive more expensive and intensive procedures than women at the end of life (Ayanian and Epstein, 1991, Bird et al., 2002 and Valentin et al., 2003).

However, this way of identifying nursing home users only identifies beneficiaries who have been hospitalized and used Medicare-financed SNF care for a period of at most 90 days of

rehabilitation, leaving a record in the Medicare's MedPAR (SNF) file. Beneficiaries in this group are heterogeneous, containing both outpatients who require nursing care or rehabilitation after a hospitalization and nursing home residents. It includes a mix of nursing home residents and nonresidents.

Our second definition of nursing home use (at least two BETOS codes in the Medicare carrier file for nursing home encounters, separated by at least 90 days) distinguished a population likely to be nursing home residents. This is confirmed by the high percentage Medicaid receipt, high numbers of primary care visits, high proportion of nursing home deaths, and lower overall costs. When we stratified the population with this definition of nursing home use, we found no gender differences among either nursing home residents or nonresidents. Thus, the gender differences we observed seem to be principally driven by the fact that far more women are nursing home residents, who (be they male or female) have lower hospital utilization and costs and more primary care visits than nonresidents. Our findings illustrate Simpson's paradox, in that relationships among utilization, cost, and primary care visits that seemed to differ by gender, disappear when beneficiaries were disaggregated by nursing home status. Although examples of Simpson's paradox have been described in clinical data (Charig, Webb, Payne, & Wickham, 1986) and meta-analyses (Cates, 2002), to our knowledge this is the first example of Simpson's paradox reported in Medicare data.

The difference between nursing home residents and nonresidents for both hospital utilization and costs was noteworthy. Nursing home residents had significantly more primary care visits than nonresidents, likely because Medicare nursing home regulations require at least one primary care visit every one or two months (Medicare Claims Processing Manual, N.D.). It is possible that regular primary care visits for nursing home residents may prevent hospitalization by better management of chronic conditions. In addition to using less specialty care, doctors who specialize in nursing home care may be better situated to implement directives that avoid hospitalization. Even when stratified by nursing home use, men received a higher proportion of their care by specialists compared with women.

The study has several limitations. Although we measured the quantity of primary care by counting visits to a primary care physician, we did not count other forms of primary care such as nurse visits, telephone consultations, or primary care provided by specialists. If there was a differential receipt of these services between men and women, these services could also be confounders when comparing genders in the receipt of primary care. Medicare claims data provide little to no information on the quality of primary care provided, the nature of clinician-patient interactions, beneficiary preferences, and the appropriateness of clinical treatment. Our findings do not address non-Medicare costs, such as for home health aides and nursing home residence, which can be considerable, and may not generalize to Medicare beneficiaries in managed care plans or to those without optional Medicare Part B (ambulatory care) coverage.

The decedent follow-back method that we used has been criticized for studying health care utilization before death (Bach, Schrag, & Begg, 2004). However, unlike Bach et al.'s study of cancer patients, 80% of our subjects did not die of cancer, meaning that there was likely

not a well-defined moment at which such patients enter into a cohort with the expectation of a steady trajectory toward death (Lunney, Lynn, Foley, Lipson, & Guralnik, 2003). Most of our subjects have a vacillating trajectory of generally declining functional status resulting from chronic diseases such as heart failure and diabetes. So, although the prospective cohort approach may be more fruitful than the follow-back method for cancer patients, it is less clear how it might usefully be applied to a general population of elderly patients, with highly variable survival expectations.

In conclusion, when using Medicare data to examine gender-specific differences in health care utilization, it is important to account for nursing home use based on nursing home residence to avoid erroneous conclusions. Nursing home residence is highly confounded by gender because nursing home residents are predominantly female (Spillman, Liu, & McGilliard, 2002). We found that Medicare's MedPAR data does not identify nursing home residents, which can confound the interpretation of gender differences, even when studying only MedPAR (hospital or SNF) outcomes. However, we have shown how the potential confounding can be solved by using Medicare carrier file data, as described in this paper.

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1A. No Adjustments For Nursing Home Use **1B. Adjusting For Nursing Home Use With MedPAR SNF file** **1C. Adjusting For Nursing Home Use With BETOS Codes In Carrier File** **1D. Stratified By Nursing Home Use With BETOS Codes And Gender** **Figure 1.**

Preceding Primary Care Visits^{**} and Hospital Utilization at the End of Life^{***}, by Gender

Abbreviations: NH, nursing home; BETOS, separated healthcare encounters in nursing facility based on Berenson-Eggers-Type-Of-Service code 4B in the Medicare Carrier file; SNF = nursing home use based on bills in Medicare MedPAR Skilled Nursing Facility file

*P < 0.05, difference between genders

** Pre-period, months 18-7 before death; ***measured during final 180 days of life, adjusted for age, race, Medicaid use, comorbidity, geographic variation (hospital service area)

2A. No Adjustments For Nursing Home Use **2B. Adjusting For Nursing Home Use With MedPAR SNF file** **2C. Adjusting For Nursing Home Use With BETOS Codes In Carrier File** **2D. Stratified By Nursing Home Use With BETOS Codes And Gender** **Figure 2.**

Preceding Primary Care Visits[†] and ** Total Costs at the End of Life^{***}, by Gender

Abbreviations: NH, nursing home; BETOS, separated healthcare encounters in nursing facility based on Berenson-Eggers-Type-Of-Service code 4B in the Medicare Carrier file; SNF = nursing home use based on bills in Medicare MedPAR Skilled Nursing Facility file

*P < 0.05, difference between genders

** Pre-period, months 18-7 before death; ***measured during final 180 days of life, adjusted for age, race, Medicaid use, comorbidity, geographic variation (hospital service area)

Table 1

Decedent Characteristics by Gender

Pre-Period Characteristic ^{***}	Total	Male	Female
N	78,356	34,302	44,054
%		44	56
Mean age (SD)	80.9 (8.1)	79.1 (7.6)	82.3 (8.2) ^{**}
Race ^{**}			
White, %	40	39	40
Black, %	36	36	37
Hispanic, %	11	11	10
Other, %	14	14	14
Medicaid receipt, %	32	25	38 ^{**}
Mean comorbidity risk score [‡] (SD)	2.2 (1.7)	2.2 (1.7)	2.2 (1.7)
Unadjusted End-Of-Life Utilization[‡]			
Mean total hospital days (SD)	15.1 (20.2)	15.3 (20.3)	15.0 (20.1)
Mean total costs, \$1000 (SD)	24.9 (30.9)	25.4 (32.4)	24.4 (29.8) [*]
Any hospital admission, %	74	74	74
Hospice, %	24	23	24 ^{**}
In-hospital death, %	43	45	41 ^{**}
Nursing home death, %	25	20	29 ^{**}
Death at residence, %	21	22	19 ^{**}

Abbreviations: SD, standard deviation

^{*} P < 0.05, difference between genders

^{**} P < 0.001, difference between genders

^{***} Pre-period, months 18-7 before death

[‡] Measured during final 180 days of life

[‡] Comorbidity risk score determined by the relative risk score from DxCG's prospective risk adjustment software, which organized ICD-9-CM diagnosis codes from the Medicare utilization files, assigns weights to them, and summarizes their expected impact on future expenditures via a relative risk score.

Table 2
Population of Nursing Home Residents, Characteristics by Gender and Two Definitions of Nursing Home Use

	Group 1	Group 2	Group 3	Group 4
Pre-Period Characteristic*	+ SNF + Carrier	+ Carrier - SNF	+ SNF - Carrier	- SNF - Carrier
N	3949	8935	6089	59383
Men, %	34	29	39	47
Women, %	66	71	61	53
Medicaid, %	46	55	33	28
Among Men	14	15	11	10
Among Women	31	40	22	18
Mean co-morbidity score*** (SD)	3.6 (2.1)	1.5 (1.5)	2.8 (1.9)	0.88 (1.4)
Among Men	3.9	1.8	3.0	0.90
Among Women	3.4	1.4	2.7	0.87
Number of Primary Care Visits, % In Each Category				
0	9	10	23	45
1-2	8	8	27	24
3-5	21	22	26	18
6-8	21	23	13	7
9+	41	37	11	5
Mean % of Specialty Visits Total Physician Visits (for those with any provider visits) (SD)	14 (25)	7 (20)	33 (35)	46 (40)
Among Men	16 (27)	9 (21)	36 (36)	49 (40)
Among Women	13 (24)	7 (19)	31 (35)	43 (40)
Unadjusted End-Of-Life Utilization**				
Mean total costs, \$1000 (SD)	17 (22)	10 (16)	19 (24)	15 (20)
Hospice, %	28	17	29	25
In-hospital death, %	21	20	26	24
Nursing home death, %	55	66	33	16
Among Men	52	57	31	14
Among Women	56	70	35	18

Abbreviations: SD, standard deviation; NH, nursing home; BETOS, separated healthcare encounters in nursing facility based on Berenson-Eggers-Type-Of-Service code 4B in the Medicare Carrier file; SNF = nursing home use based on bills in Medicare MedPAR Skilled Nursing Facility file

* Pre-period, months 18-7 before death,

** Measured during final 180 days of life

*** Comorbidity risk score determined by the relative risk score from DxCG's prospective risk adjustment software, which organized ICD-9-CM diagnosis codes from the Medicare utilization files, assigns weights to them, and summarizes their expected impact on future expenditures via a relative risk score.