Informal Care and Medicare Expenditures

Courtney Harold Van Houtven,[1,2] Edward C. Norton[3]

[1] Center for Health Services Research in Primary Care, Durham Veterans Affairs Medical Center
[2] Department of Medicine, Division of General Internal Medicine, Duke University Medical Center
[3] Department of Health Policy and Administration, University of North Carolina at Chapel Hill

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Objectives. To measure the effect of informal care provided by adult children on Medicare expenditures of their single elderly parents. Secondarily, to examine whether the effect differs by the source of informal care (sons versus daughters, children versus others), or whether the effect is smaller for married parents.
Methods. Two-part expenditures models are used to model Medicare home health care expenditures, skilled nursing expenditures, and inpatient expenditures. We control for endogeneity using instrumental variables probit estimation and two-stage least squares.
Results. Informal care is a net substitute for Medicare long-term care expenditures, significantly reducing the likelihood of having any home health expenditures, any skilled nursing home expenditures, and the amount of skilled nursing expenditures. Informal care is also a net substitute to inpatient care.
Discussion. Informal care is an effective substitute for Medicare long-term care, even highly skilled care such as skilled nursing. Informal care results in no change in the likelihood of having any inpatient expenditures but reduces the total amount among users, perhaps because patients can be discharged to their homes faster.

In any health care system, changes in one form of care affect similar forms of care. This is particularly true in long-term care because of the many close substitutes. Skilled nursing homes compete with unskilled nursing homes, board and care homes, home health care, adult day care, and informal care (Norton 2000). Medicare and Medicaid have expanded home health care benefits over the past fifteen years to provide a low-cost alternative to traditional nursing homes for those able to live at home with assistance. Informal caregivers in Germany are compensated with a cash benefit, four weeks of respite care per year, and pension contributions by the government (Wiener and Cuellar 1999; Cuellar and Wiener 2000), whereas in the U.S. very modest state tax credits exist in a handful of states to support caregivers (NGA 2004). Finding cost-effective ways to care for elderly persons will become increasingly important as the American population ages. The large number of baby boomers combined with lengthening life expectancy is expected to raise demand for long-term care over many decades.

One recent study showed that informal care reduces home health care use and delays nursing home entry (Van Houtven and Norton 2004). We analyzed data from the Asset and Health Dynamics Among the Oldest-Old Panel Survey (AHEAD) to show that a 10 percent increase in informal care leads to a .87 percentage point decline in the probability of any home health care use (mean of 8.3%), and a two-night reduction in nursing home use (mean of 25 nights per year). These results were statistically significant.

However, that informal care study raised as many questions as it answered. Looking beyond use to the more policy relevant outcome of expenditures, does an increase in informal care reduce formal care expenditures? And if so, are the savings large enough to justify public policies—several states have tax breaks and a national tax credit has been proposed (FTB 2001;

Missouri 2003)—that promote informal caregiving? We recently merged the AHEAD data to Medicare claims data to answer these questions.

Because we do not expect the effect of informal care on formal care expenditures to be uniform across all persons, we ask whether this effect varies across three important subpopulations. First, is the effect of informal care on formal care expenditures as strong for married elderly persons as for non-married? We postulate that because spouses provide informal care to each other, additional informal care by children should have less effect for married persons. Comparing our results for a sample of married elderly persons to non-married elderly persons provides a robustness check to our main results, which focus on the single elderly.

Second, are sons as effective as daughters in providing informal care? Sons and daughters may interact differently with their parents and provide different types of informal care. Therefore, an hour of informal care from a son may have a different effect on expenditures than an hour from a daughter. Although there is a long literature on the differences between sons and daughters in the likelihood of being a caregiver and the amount of caregiving they provide (Stone, Cafferata et al. 1987; McGarry 1998), we are not aware of any studies of the effectiveness of the care they give.

Third, are other sources of informal care as effective as care from adult children? We postulate that informal care provided by adult children will have more potential to substitute for Medicare-based care because children may be more committed to caregiving than friends or other relatives.

We find that informal care by adult children is a net substitute for Medicare long-term care expenditures of their single elderly parents, significantly reducing the likelihood of having

any home health expenditures, any skilled nursing home expenditures, and the amount of skilled nursing expenditures. Informal care is also a small net substitute for inpatient care.

Methods

Analytic Methods

Our basic model specifies health care expenditures as a function of the quantity of informal care and other explanatory variables. We estimate similar models for different types of Medicare expenditures, including home health, skilled nursing home, and hospital expenditures. We expect the strongest effect to be for long-term care, because informal care is a closer substitute to long-term care. Because a high fraction of observations have no expenditures during the year for any specific type of care, we estimate the familiar two-part model (Duan, Manning et al. 1984). The first part is a probit model that predicts the probability of any health expenditures. The second part uses least squares to predict the continuous amount of expenditures, conditional on having any. The dependent variable in the second part is logged to diminish the influence of outliers.

The hypotheses are all related to tests of whether the coefficient on informal care is statistically different from zero. If we had estimated single equation models, then simple *z*-tests or *t*-tests would suffice. However, hypothesis testing in two-part models, where one variable influences both access and the extent of expenditures given access, requires incorporating the effect of informal care from both parts of the model. In addition, computing the marginal effect on the scale of interest (dollars) when the dependent variable is logged requires accounting for both heteroskedasticity and the non-normality of the error term (Manning 1998; Ai and Norton 2000). Therefore, we estimate the full marginal effect of a change in informal care on

expenditures (incorporating both parts of the two-part model) and then bootstrap confidence intervals. A change in informal care may influence expenditures either by changing the probability of any expenditures or the amount of expenditures conditional on having any. The effect could even be positive in one equation and negative in the other.

The test of the main hypothesis is whether the full marginal effect of a change in informal care changes expenditures, for each of type of expenditure. We expect the effect to be negative for types of care that are substitutes to informal care. We then repeat the analysis on a sample of married persons only, and expect that the magnitude and statistical significance of the results is less. Finally, returning to the original sample of unmarried elderly persons, we interact the effect of informal care with whether the primary caregiver is a son or a daughter, and test for differences.

One further complication is that informal care is endogenous in a model of formal care (Greene 1983; Lo Sasso and Johnson 2002; Van Houtven and Norton 2004). Children make decisions about the amount of informal care to provide jointly with decisions about whether their parent should receive home health care or enter a nursing home. Just as informal care may cause formal care to change, so might formal care cause informal care to change. Statistically, unobserved variables that determine both formal and informal care cause informal care to be correlated with the error term, leading to biased and inconsistent estimates. The interdependence of formal and informal care means that we must test for and control for the endogeneity of informal care in the empirical work.

To correct for endogeneity, we estimate instrumental variable models, which produce consistent parameter estimates if the instruments are valid. Good instruments are highly correlated with informal care but not correlated with the error terms in the expenditure models.

Excellent instruments exist in the literature on informal care—family-level variables that affect a child's informal care decision, and through that decision, a parent's consumption of formal care. The number of siblings is a strong predictor of informal care (Ettner 1995; Van Houtven and Norton 2004); it is also well-known that daughters are more likely to be caregivers, although sons are becoming important sources too (Carmichael and Charles 2003). Furthermore, there is evidence that step children are less likely to provide care to parents (Pezzin and Schone 1999). Therefore, we use three instruments in our empirical work: the number of siblings, whether the eldest child is a daughter, and whether a child is a stepchild. Tests of the validity of the instruments are reported in the results section.

Standard two-stage least squares methods to control for endogeneity are inconsistent in nonlinear models. Instead, we propose to use two-stage residual inclusion which gives consistent estimates when the instruments are valid (Rivers and Vuong 1988; Blundell and Smith 1989; Terza 2005). For the discrete outcomes, we use the instrumental variables probit (`ivprobit`) program in Stata, which is based on Amemiya's Generalized Least Squares estimation (Newey, 1987; program written by Joe Harkness, Johns Hopkins University). For continuous expenditures, we use two-stage least squares estimation (`ivregress` command in Stata). We estimated robust standard errors for all models.

Data

The data set consisted of information from the Standard Analytic Files of Medicare Claims (UNICON 2002) and the 1992/93 and 1994/95 waves of the Asset and Health Dynamics Among the Oldest-Old Panel Survey (AHEAD), a nationally representative sample of non-institutionalized persons over age 70 in the United States (Michigan 1998). The AHEAD survey

is one of the richest sources of data on informal care and elderly health care utilization, because it contains data about informal care from all sources, not just a primary caregiver. There is information on all children in the family and the care that they provide. There were well-known problems with the way infrequent caregivers were estimated in the 1992 wave of AHEAD (Wolf, Freedman et al. 1997), so we may be underestimating the total amount of informal care received by all adult children in families with more than one caregiver. In addition, because the 1992 AHEAD sample was drawn from the non-institutionalized elderly, we are likely underestimating total long-term care utilization in the general over-70 population. Nevertheless, AHEAD is one of the richest sources of caregiving data on a nationally representative sample of elderly.

All AHEAD respondents were asked to provide their Medicare identification number, and for those that did, Unicon Corporation obtained their Medicare data from CMS, cleaned and created summary level Medicare files, and then created a restricted data set of Medicare claims to the University of Michigan Health and Retirement Survey project. Researchers with NIH funding and an approved restricted data agreement (approval came from Duke IRB board, University of Michigan Restricted Data Committee, National Institute on Aging and Centers for Medicare and Medicaid Services) can obtain access to the restricted Medicare data along with a cross-reference file to merge the claims with AHEAD. We also used DxCG Software Release 6.1 (DxCG 2002) to calculate retrospective Diagnostic Cost Group Scores (DxCG scores) using claims-level and summary-level Medicare data.

Sample selection criteria

As our starting point, we used all observations from the respondent-level AHEAD surveys (8,222 observations in wave 1, and 7,027 observations in wave 2). We identified all

single elderly parents with living children, or 5,617 observations consisting of 3,287 individual parents. We used the cross-reference file from the University of Michigan in order to merge the Medicare claims with the AHEAD data. The cross-reference file included all individuals that had provided a valid Medicare identification number, or 5,292 unique individuals. We were able to find matches in the cross-reference file for 2,289 out of our 3,287 individual single parents identified (66 percent), giving us a final data set of 3,942 person-wave observations.

Our ability to match 70 percent of the single elderly with the cross-reference file was slightly lower than expected, given that 78 percent of AHEAD respondents with Medicare in Wave 1 and 83 percent of respondents with Medicare in Wave 2 provided their Medicare number as a part of their AHEAD responses (statistic calculated from variables V757 and D126 in the 1992 and 1994 codebooks, respectively). The reason for the lower match was that respondents may have provided invalid Medicare numbers.

For the analysis of married AHEAD respondents, we were able to match a similar percentage of people with claims, totaling 8,182 observations.

Expenditures

We constructed annual expenditures by type of expenditure. We considered three types of long-term care expenditures, home health agency, hospice, and skilled nursing facility. Because of power problems with hospice care (less than 50 persons had any hospice expenditures), we could not examine hospice care. We also examined Part A inpatient expenditures. We did not consider doctor's visits because we found a very small effect of informal care on doctor's visits in past work (Van Houtven and Norton 2004). Inpatient expenditures were included because they are a significant cost to the Medicare program and

because inpatient care precedes a skilled nursing stay, so it is an important gateway to long-term care in the Medicare program.

Expenditures were defined over the year following the AHEAD interview date, exclusive of the quarter in which the interview was completed. For example, if a person responded in June of 1992, their home health agency expenditures were aggregated across the second two quarters of 1992 and the first two quarters of 1993. This was an attempt to reduce the endogeneity bias arising from reverse causation. The Medicare claims were available through all of 1996 and the last interview date in AHEAD was in the last quarter of 1995, so we have one full year of post-interview expenditures for each respondent.

Key Explanatory Variables

Informal care. Informal care was measured as the number of hours in the past month that all children assisted a parent, including hours provided by a child's spouse and children (the respondent's grandchildren). Including hours from all children best reflects the extent of the parent's informal care network. A parent was asked "During the last month, on about how many days did [NAME] help you?"(Michigan 1998). If a parent responded "every day" we consider it to be 30.4 days. Subsequently the parent is asked "On the days [NAME] helps you, about how many hours per day is that?" Answers were recorded as hours per week or per month. If the hours were recorded per week they were multiplied by 4.28 to get average hours per month. Some respondents answered one question but not another, so we used a method described in Van Houtven and Norton 2004 to fill in these values. Because informal care hours are skewed, we take the log in the first-stage regression and the utilization models.

Other explanatory variables. Other variables expected to affect expenditures are a respondent's age, gender, race, income, supplemental insurance (other than Medicare), and whether or not he or she had a proxy respondent, and health status.

In addition to number of ADL limitations and self-reported health, and a health behavior measure of whether the respondent is a former smoker, we used DxCG prediction variables to help control for health status (DxCG User Documentation, 2004). Rather than the amount that an individual is expected to cost, based on past claims, we use the relative risk scores that reflect the relative risks of costliness (using the year prior to the interview year). For example, a relative risk score of 1.00 indicates an individual of average expected costliness, whereas values over 1 reflect higher than average expected cost and values under 1 reflect lower than average expected cost (DxCG User Documentation, 2004). Relative risk scores are calculated using diagnoses from all inpatient and outpatient encounters over the year. Because DxCG scores are only calculated for individuals with some expenditures in either inpatient or outpatient utilization, or for individuals with a diagnosis that is included in DxCG score calculations, we code the DxCG scores to one for persons with missing values, giving them the average relative risk. We take the logarithm of the DxCG score in order to reduce the influence of outliers, which provides a smooth, normal distribution. Finally, to supplement the DxCG data we include whether an elderly parent had certain chronic conditions or health shocks in the past such as incontinence, diabetes, arthritis, cancer, major falls, hip fractures, and stroke.

Results

Descriptive results

Medicare Expenditures. About 14 percent of the sample had Medicare-financed home health care services (HHA), whereas a much smaller percentage, 4 percent, had any skilled nursing facilities expenditures (Table 1, left hand data column). Annual HHA expenditures averaged around $4,000 and annual SNF expenditures averaged $7,701. Approximately 20 percent of parents had any Medicare-financed hospital expenditures, averaging just under $10,000 in the year following the interview date. As mentioned previously, less than 1 percent of respondents used hospice care so we do not examine hospice separately.

Informal care and other key variables. Just under a quarter of respondents received some informal care from adult children. Among those who received any informal care, the average hours per month were 37, whereas the median level of care was 14.

On average, respondents were 80 years old, female (81%), non-Black (84%) and do not consider themselves Hispanic or Latino (93%) (Table 3, left hand data column). About 18 percent were on Medicaid. Only 10 percent used a proxy respondent. This is 3 percentage points lower than in our other study that used AHEAD 1995 and HRS 1998 (Van Houtven and Norton 2004), reflecting the higher general health status in this sample due to the requirement that a person had to be non-institutionalized to qualify for the study in the first wave (1992).

Self-reported health was rated as "good" on average, and about one-third of the sample had some limitations in ADLs and IADLs. Among those with some limitations, respondents reported needing help with 2.4 ADLs and 2.2 IADLs on average. DxCG scores were missing for 75 percent of respondents, reflecting the large proportion of the sample with no Medicare utilization. Because the number of IADL limitations was highly collinear with informal care hours (0.73), we excluded number of IADL limitations from the model. The most common

medical comorbidity was arthritis, followed by having a major fall and having incontinence (Table 3).

Specification test results

We used three instruments that were expected to be strong predictors of informal care but not expenditures: the number of siblings in the family, whether the oldest child was a daughter, and whether a child is a stepchild. The instruments pass all the tests in all models (see Table 2). The instruments are highly predictive of informal caregiving (*F*-statistic of 13.74 in the first-stage). They also pass the test of overidentification in all models. Furthermore, the explanatory power of the first-stage regression was high, (adjusted-R^2 of 0.40) (Bollen, Guilkey et al. 1995). Although informal care is theoretically endogenous, in a given data set the amount of bias may be too small to detect. A modified Wu-Hausman test of the exogeneity of informal care in each of the first-part models showed that informal care is endogenous to long-term care expenditures (both home health agency and skilled nursing facility) but not to inpatient care expenditures. In the second-part model to predict the amount of expenditures, conditional on any, informal care was found to be endogenous in the skilled nursing facility model. Accordingly, we report instrumental variable results for long-term care and probit and least squares results for inpatient expenditures.

Main results

We find that informal care has a strong negative effect on the likelihood of incurring any Medicare-financed LTC (Table 1), and that informal care reduces the amount of expenditures among skilled nursing home users (significance at the 10 percent level only, n=170), but not

home health care users. Furthermore, informal care increases the chance of having some inpatient expenditures (at the 10 percent level only, n=3942) but reduces the amount of inpatient expenditures.

We did not discern heteroskedasticity in the continuous expenditure equations using White tests, so we used a constant Duan smearing estimator before retransforming and calculating the marginal effects (Duan 1983). Next we talk about the findings by expenditure type.

Home health expenditures

Any home health care. Parents who received informal care from their adult children were significantly less likely to use any Medicare-financed home health care in the subsequent year, after controlling for endogeneity (Table 3, column 2). Parents receiving no informal care are predicted to have a 21.5 percent chance of some home health care in the following year. Additionally, a parent receiving the 25th percentile level of informal care (7 hours per month) had a 9.3 percent chance of any home health expenditures whereas parents receiving the 75th percentile level (40 hours per month) had a 3.5 percent chance. Besides informal care, males and were less likely to use home health care compared to females. Older parents, parents with proxy respondents, more ADL limitations, and those who were former cigarette smokers were more likely to use Medicare-financed home health care.

Amount of home health care expenditures. Informal care is not significant in the two-stage least squares regression. Considering oneself Hispanic was associated with a lower amount of home health expenditures compared to non-Hispanics, the only other significant coefficient other than the intercept.

The full marginal effect for home health expenditures is –237.9 (calculated using the IV results). Therefore, a 10 percent increase in informal care hours per month by children would lead to savings of $23.79 per elderly parent in Medicare HHA expenditures. Calculating bootstrapped marginal effects is our next step in order to ascertain the significance of the marginal effects. Because informal care was only significant in the IV probit model, the full marginal effect may not be significant.

Skilled Nursing Expenditures

Any skilled nursing expenditures. Informal care had a strong negative effect on the likelihood of any skilled nursing care. A parent receiving no informal care is predicted to have a 15 percent chance of skilled nursing facility expenditures, whereas receiving 25th percentile levels of informal care leads to a 3.9 percent chance and receiving the 75th percentile level leads to a mere 0.9 percent chance. In addition, having worse self-rated health, more ADL limitations, and a proxy respondent was associated with a higher likelihood of skilled nursing use. The chronic conditions in the model are not individually significant (after applying a Bonferroni correction to them) but a joint *F*-test of them is significant at the 5 percent level, hence we keep them in the model.

Amount of skilled nursing expenditures. Informal care had a significant reduction in the amount of Medicare skilled nursing expenditures if 10 percent is used as the significance level. Given the low sample size, this may be the appropriate significance level, but this finding can still be considered marginally significant. Receiving no informal care means a skilled nursing facility user would be predicted to have around $32,568 in expenditures, whereas having the median level of informal care, just 7 hours per month, predicts only $8,275 in SNF expenditures.

Receiving the 75th percentile level of informal care leads to just $2500 in SNF expenditures. Few other independent variables significantly affected the level of skilled nursing home expenditures (*N*=170).

The full marginal effect for skilled nursing expenditures is –4,845. Therefore, a 10 percent increase in informal care provided by children would lead to a savings of $485 per year in Medicare skilled nursing expenditures. We have yet to bootstrap the marginal effects to assess the significance of the marginal effect.

Inpatient

Parents receiving informal care were no more likely to have any Medicare-financed hospital care (the coefficient was positive but not significant), but among hospital users, had slightly lower amounts of expenditures. The coefficient on informal care, interpreted as the elasticity, is –0.061 (far RHS column of table 3). This means that a 10 percent increase in informal care hours leads to a 0.61 percent reduction in inpatient expenditures. Given that mean inpatient expenditures were around $10,000, a 10 percent increase in informal care would lead to savings of $61 for the year on average among hospital users. To place this in the same magnitude as the above two models, if a parent received zero informal care s/he would be expected to have $11,000 in expenditures the following year (using Duan smearing factor). Receiving the 25th percentile amount leads to inpatient expenditures of $8,762 whereas receiving the 75th percentile amount leads to inpatient expenditures of $7,083.

The full marginal effect for inpatient expenditures is –20 (using probit and OLS results). Therefore, a 10 percent increase in informal care leads to a $2 dollar reduction in inpatient expenditures for the year across the full sample of single elderly parents.

Married parents and gender of the primary caregiver.

Married sample. We expected the effect of informal care from children on the expenditures of married parents to be smaller than for the sample of single elderly, because it is likely that a parent's spouse is the most important source of informal care among married persons. Essentially, we expected this to lessen the marginal utility of an hour of care provided by a child. We re-ran all the models on a sample of married parents (N=8,182) and confirmed this hypothesis in part. For the likelihood of any long-term care use the coefficients were smaller in magnitude (from –.51 to –.38 for home health agency and from –.74 to –.58 for skilled nursing facility) and dropped in significance from the 5 percent level to the 10 percent level. Upon reflection it seems logical that the significance levels dropped because the spouse's caregiving time is much more likely to be affect utilization and expenditures rather than the child's, who is less likely to be a primary caregiver. By contrast, the magnitude was actually larger for amount of skilled nursing expenditures, although it was not significant at the 10 percent level. Perhaps an explanation for the stronger magnitude on skilled nursing expenditures is that a parent could be discharged faster from the skilled nursing facility if a spouse and a child are available to offer care as they recover at home. Too much stock in this is not merited, however, since the effect was not significant.

Primary caregiver a son or daughter. We wondered whether there was a difference in the amount of Medicare expenditures saved by whether or not informal care was provided by a son versus a daughter of single elderly parents. There has been research that shows daughters are more likely to provide care (Stone, Cafferata et al., 1987), and since many of our single elderly are women there is a chance that mother's prefer to receive certain types of care tasks

from daughters (McGarry, 1998). There may be differences in effectiveness depending upon whether the care is provided by a son or a daughter, so we examined whether the effect on expenditures differed by gender of the primary caregiver (defined as the child providing the most care to the parent in the past month). We used a discrete measure of informal care, primary caregiver is a son, along with the same identifying instruments, and did not find a significant relationship. In addition, we interacted hours of care with the indicator variable "son is primary caregiver" and did not find a significant relationship with expenditures (Ai and Norton 2000; Ai and Norton 2003). Gender of a parent's primary caregiver does not appear to have a different effect on Medicare expenditures overall.

Other sources of informal care. Finally, we postulated that informal care provided to single elderly parents from sources other than their children (could be a friend, a parent's own sibling, or some other relative other than a parent's child, child's spouse or grandchildren) would be less effective at reducing expenditures. To measure this one would include measures of informal care hours from both sources, which introduces two potentially endogenous variables into the estimation of expenditures. To address this, we explored using three stage least squares (reg3 command in Stata8) using "child is married" as an additional identifying instrument for the "other informal care" equation. "Child is married" is not a valid instrument, however, because it does not pass the exclusion restriction tests. Therefore we used the three identifying instruments from the main analysis, but faced efficiency losses that caused both informal care measures to be non-significant across the board.

Another approach was to include both informal care measures, but to treat informal care from children as exogenous and informal care from others as potentially endogenous. The steps used were to estimate the equations using IV Probit and IV regression and to compare the effects

of informal care from others to the coefficients for informal care by children in Table 3. The original identifying instruments were good predictors of informal care from others, endogeneity existed in the first part of the home health and skilled nursing models, and the coefficients on informal care from others generally agreed with our hypothesized effect of being smaller in magnitude (in the levels of LTC expenditures and the inpatient models). However, there was an interesting finding that we need to explore more in the next version of this paper: informal care from others, contrary to reducing the likelihood of any home health care use or any skilled nursing use, appears to increase the likelihood—and the effects are large. We need to further explore this because we treat informal care by children as exogenous (preferring endogeneity bias to omitted variable bias in this case), and the estimates for the two types of informal care are likely correlated. A tentative conclusion is that informal care from other sources does not fit the pattern of informal care by children, which, by and large, serves to reduce Medicare expenditures.

Discussion

Analyzing how informal care affects Medicare expenditures shows that informal care strongly reduces the likelihood of use of two main types of long-term care financed by Medicare. Once LTC is accessed, however, informal care only has a small negative effect on skilled nursing facility expenditures but not home health agency expenditures. Furthermore, we find that informal care is a small net substitute for inpatient care by reducing the amount of expenditures on inpatient care. This contradicts our past work in which informal care was not a significant predictor of either the likelihood or the amount of inpatient utilization (Van Houtven and Norton 2004). Despite its significance, the magnitude of the effect on inpatient care is

almost too small to be of policy relevance. The reduction in home health and skilled nursing expenditures (recall that the skilled nursing result is significant only at the 10% level) in particular, however, is large.

The poor matching between Medicare claims and the AHEAD survey, which is a nationally representative sample of elderly Americans, raises concerns about the representativeness of the sample. In addition, because of the years for which Medicare claims were available (up to 1996 only), we had to use the first wave of AHEAD, which has been shown to under-measure infrequent informal care (Wolf and Freedman, 1997). Hence, we are likely missing informal care from children and others who provide few hours of care, with uncertain implications for the results. We also had significant power problems in the analysis, identifying only 170 skilled nursing facility users, thus our conclusions about informal care's effect on the level of SNF expenditures are significant at the 10% level only. Finishing the bootstrapped marginal effects will help illuminate the overall significance of informal care for skilled nursing expenditures.

We see from the IV results that modest increases in informal care hours—of 10 percent—are predicted to lead to Medicare savings of around $485 in skilled nursing, around $24 in home health expenditures, and around $2 in inpatient expenditures. The few caregiver tax credits that exist in the United States are $500. Thus, if a tax credit program (or some other factor) induces small increases in informal care, say from the 25th percentile quantity hours up 10 percent to 8 hours a month, the cost of the tax credit would be offset by the Medicare savings. This should be viewed with caution because to fully evaluate this question one would need to know more accurately the opportunity cost of a caregiver's time (leaving the labor force to become a caregiver may entail productivity losses in the paid labor force (Van Houtven and Norton,

2004)), the uptake of the caregiver tax credit (these state statutes require that a caregiver be working as a caregiver full time for a set length of time, meet strict income requirements, and prove cognitive or physical disability of the elderly family member, and we have yet to find data on number of beneficiaries), not to mention the effect on long-term care expenditures to the Medicaid program (as well as consideration of the financial payments that are made to caregivers in many states as a part of Medicaid's Home and Community-Based Waiver program). Already we know that very few of the 44 million caregivers in the U.S. qualify for a tax credit, so the savings to Medicare are likely to be larger than the foregone tax revenues. A policy analysis addressing some of these missing links, a comparison to the Van Houtven and Norton 2004 utilization paper findings, and bootstrapped marginal effects will appear in the next version of this paper.

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Address correspondence to Courtney H. Van Houtven, courtney.vanhoutven@duke.edu, or by mail to: Bldg 16 HSRD, VAMC; 508 Fulton Street (558/152); Durham, NC 27705

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Table 1
Effect of informal care on expenditures one year after AHEAD interview date for the single elderly, by analysis type

Dependent Variable	*N*	Mean	Probit/OLS Coeff. on Informal Care	IV Probit/ 2SLS Coeff. on Informal Care
Home Health Care				
Any HHA expenditures	3,942	0.14	0.083**	–0.58§*
			(0.021)	(0.25)
HHA expenditures	554	4,146		
ln(HHA expenditures)			0.046	0.21
			(0.043)	(0.33)
Skilled Nursing Home Care				
Any SNF expenditures	3,942	.04	0.053#	–.90*§
			(0.030)	(0.39)
SNF expenditures[1]	170	7,701		
ln(SNF expenditures)			0.054	–0.70#§
			(0.047)	(0.41)
Hospital Care				
Any inpatient expenditures	3,942	0.20	0.039#	–0.210
			(0.021)	(0.204)
Inpatient expenditures	800	9,837		
ln(inpatient expenditures)			–0.061*	–0.176
			(0.025)	(0.187)
Other parent-level controls used?			Yes	Yes
Controls for endogeneity?			No	Yes

Notes: Data are from the 1993, 1995 AHEAD. Observations are parent-years and they differ by expenditure category due to differences in missing values on expenditures.

1. Nights in the nursing home were truncated at 730 nights for some parents due to the two-year recall period. Identifying instruments are number of offspring, eldest child is a daughter, and parent has a stepchild. Robust standard errors are shown in parentheses for 2SLS and probit models. * Denotes statistical significance at the 5 percent level. ** at the 1 percent level.

§ denotes that endogeneity was detected.

Signifies significance at the 10 percent level.

Table 2. Medicare expenditures in year after the AHEAD interview date
Strength of the instruments and tests of the exclusion restrictions and exogeneity of informal care

Dependent Variable	Strength of The instruments	Test of Exclusion Restrictions	Hausman Exogeneity Test – Regression Form	Level of Identification and Preferred Estimation Method
Any home health Expenditures	F(3, 3920)= 13.74	χ^2_2 = 0.12	F(1, 3,921) = 8.24*	Overidentified I.V. Probit
Home health expenditures	"	F(2, 532) = .61	F(1, 533) = 0.16	Overidentified Two-stage least squares[1]
Any SNF Expenditures	"	χ^2_2 = 0.20	F(1, 3921) = 11.20**	Overidentified I.V. Probit
SNF Expenditures	"	F(2, 148) = 0.51	F(1, 149) = 6.20*	Overidentified Two-stage least squares[1]
Any inpatient expenditures	"	χ^2_2 = 0.06	F(1, 3921) = 1.76	Overidentified Probit
Inpatient Expenditures	"	F(2, 778) = 0.53	F(1, 779) = 0.40	Overidentified Ordinary least squares

NOTES: * significant at the 5 percent level. ** at the 1 percent level. For number of observations see Table 1. 1. Because endogeneity was detected in the other part of the two-part model for this expenditure type, we use IV estimation for both parts.
SOURCE: AHEAD 1993, 1995

Table 3
Estimation of informal care and other characteristics' effect on Medicare Expenditures

		Home Health		Skilled Nursing		Inpatient Care	
Variables	Mean	IV Probit	2SLS	IV Probit	2SLS	Probit	OLS
Log of Hours of Informal Care	.49	–.58*	.21	–.895*	–.704#	.039#	–.061*
		(.253)	(.325)	(.391)	(.41)	(.021)	(.025)
Demographic characteristics							
Age (min=70, max=105)	79.67	.042**	–.004	.055**	.012	.0077	.000
		(.009)	(.015)	(.014)	(.020)	(.0042)	(.005)
Male	.20	–.20*	–.255	–.138	–.66	.059	.125
		(.09)	(.199)	(.132)	(.49)	(.063)	(.096)
Race							
Black	.16	.016	.276	–.274	.34	–.192**	.115
		(.094)	(.167)	(.150)	(.50)	(.069)	(.096)
Hispanic/ Latino	.07	.034	.84**	–.367*	–.88	–.297**	.167
		(.12)	(.22)	(.205)	(.80)	(.106)	(.135)
Income, and wealth							
Income categories (min=1, max=6)	3.14	–.015	–.014	–.036	–.084	–.030	.028
		(.024)	(.046)	(.034)	(.096)	(.019)	(.025)
Insurance							
Medicaid	.18	.17	–.234	.212	.329	.035	.036
		(.094)	(.188)	(.135)	(.355)	(.069)	(.087)
Proxy respondent	.10	.64*	–.326	.920*	.503	–.180*	.175
		(.29)	(.424)	(.433)	(.430)	(.091)	(.100)

* denotes statistical significance at the 5 percent level. ** at the 1 percent level.

		Home Health		Nursing Home		Inpatient Care	
Variables	Mean	IV Probit	2SLS	IV Probit	2SLS	Probit	OLS
Health							
Number of ADL limitations	2.41	.268**	.027	.340**	.263	.047*	.015
		(.078)	(.127)	(.120)	(.193)	(.020)	(.022)
SRhealth	3.11	.217**	.080	.213**	–.013	.169**	.049
		(.037)	(.056)	(.055)	(.113)	(.024)	(.029)
Stroke	.12	.286[1]	.200	.400[1]	.130	.146	–.175
		(.105)	(.154)	(.149)	(.322)	(.073)	(.090)
Hip frac	.04	.184	.249	.468[1]	.404	.207[1]	–.186
		(.156)	(.243)	(.211)	(.496)	(.109)	(.127)
Fall	.32	.064	.037	.160	–.020	-.021	.078
		(.064)	(.123)	(.089)	(.284)	(.052)	(.064)
Diabetic	.14	.294[1]	.270	.195	.198	.123	.102
		(.089)	(.183)	(.130)	(.439)	(.067)	(.083)
Cancer	.14	.103	–.245	.024	.376	.085	–.037
		(.082)	(.157)	(.116)	(.316)	(.067)	(.082)
Arthritis	.46	–.093	.080	–.046	–.308	–.004	–.012
		(.067)	(.132)	(.095)	(.378)	(.050)	(.063)
Incontinence	.25	–.035	–.261	.069	.221	.047	–.141*
		(.070)	(.147)	(.097)	(.269)	(.056)	(.069)
DXCG Score							
Ln(DXCG score, prior year's use)	-.36	–.313**	.016	–.017*	–.013	-.221**	.095**
		(.029)	(.041)	(.042)	(.086)	(.024)	(.020)
Health behavior							
Former cigarette smoker	.34	.183**	.025	.223*	.127	–.023	.079
		(.066)	(.125)	(.094)	(.251)	(.052)	(.069)
Intercept		–5.30**	7.25**	–6.76**	8.18**	-2.109**	8.58**
		(.78)	(1.17)	(1.18)	(1.84)	(.353)	(.44)
N		3942	554	3942	170	3942	800

Notes: Data are from the 1992 and 1993 AHEAD, matched with Medicare claims.
* denotes statistical significance at the 5 percent level. ** at the 1 percent level. # denotes statistical significance at the 10 percent level (noted for informal care coefficients only).
1. Not significant after applying Bonferroni multiple comparison correction.