Effect of Usual Source of Care on Depression among Medicare Beneficiaries: An Application of a Simultaneous-Equations Model

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Objective. To investigate whether having a usual source of care (USOC) resulted in lower depression prevalence among the elderly.

Data Sources. The 2001–2003 Medicare Current Beneficiaries Survey and 2002 Area Resource File.

Study Design. Twenty thousand four hundred and fifty-five community-dwelling person-years were identified for respondents aged 65+, covered by both Medicare Parts A and B in Medicare fee-for-service for a full year. USOC was defined by the question “Is there a particular medical person or a clinic you usually go to when you are sick or for advice about your health?” Ambulatory care use (ACU) was defined by having at least one physician office visit and/or hospital outpatient visit using Medicare claims. Depression was identified by a two-item screen (sadness and/or anhedonia). All measures were for the past 12 months. A simultaneous-equations (trivariate probit) model was estimated, adjusted for sampling weights and study design effects.

Principal Findings. Based on the simultaneous-equations model, USOC is associated with 3.8 percent lower probability of having depression symptoms ($p = .03$). Also, it had a positive effect on having any ACU ($p < .001$). Having any ACU had no statistically significant effect on depression ($p = .96$).

Conclusions. USOC was associated with lower depression prevalence and higher realized access (ACU) among community-dwelling Medicare beneficiaries.

Key Words. Access to care, health care use, usual source of care, depression, Medicare

Little research has been conducted on the relationship between access to care and depression prevalence among the elderly. The objective of the present study is to investigate the effect of having a usual source of care (USOC) on depressive symptom prevalence among Medicare beneficiaries. This question

is important because (1) depression is prevalent among the elderly; (2) detection and treatment of depression are critical for its prognosis; (3) USOC, a structural measure of access to care, often serves as entry to the medical and mental health care systems; and (4) there are disparities in mental health and having a USOC has been found to decrease inequalities in health. Studies are needed to examine whether having a USOC also helps decrease inequalities in mental health.

Depression is a major public health problem among people age 65 and older. The prevalence of major depression among the elderly in primary care settings is 6–9 percent (Schulberg et al. 1998; Lyness et al. 1999), and as high as 8–16 percent for clinically significant depressive symptoms (Blazer 2002). Major depression has been found to be associated with morbidity, mortality, compromised quality of life, and higher health care expenditures (Wells et al. 1989; Broadhead et al. 1990; Simon, Vonkorff, and Barlow 1995; Unutzer et al. 1997). Depression is projected to be second only to ischemic heart disease as the leading cause of disability adjusted life years by 2020 (Murray and Lopez 1997).

Early identification and proper treatment significantly decrease the negative impact of depression in most patients (Coulehan et al. 1997). Access is a prerequisite for receiving health care that affects mental health. Having a USOC can be classified as a structural measure of access to care (Sox et al. 1998), which has been found to be associated with higher health care utilization (including preventive, primary care, and specialty services), better health outcomes, and reduced disparities for health care utilization and health (Ettner 1999; Corbie-Smith et al. 2002; De Maeseneer, De Prins, and Gosset 2003; DeVoe et al. 2003; Starfield and Shi 2004; Starfield, Shi, and Macinko 2005).

Most previous studies about the relationship between access to care and health status have focused on general and/or physical health. No study has

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examined the effect of access to care on mental health status among the elderly. The IMPACT, PROSPECT, and PRISM-E trials focused on care management for elderly with clinical depression in primary care settings (Unützer et al. 2001; Levkoff et al. 2004; Alexopoulos et al. 2005). In addition, most previous studies failed to control for the unmeasured selection bias (potential heterogeneity-generated endogeneity) among access to care, health care use, and health status, resulting in potentially biased findings. The purpose of the present study is to examine the effect of having a USOC on depressive symptoms among Medicare beneficiaries controlling for potential endogeneity. Our hypothesis is that having a USOC is associated with lower depressive symptoms prevalence among the elderly.

METHODS

Data

The data used in this study are the 2001–2003 Medicare Current Beneficiary Survey (MCBS) Cost and Use files and the 2002 Area Resource File (ARF). Earlier MCBS data were not used because the variable of interest (a two-item screen for depression) has been only available since 2001 in the MCBS Cost and Use files. Limited resources only allowed for access to data for 2001–2003.

The MCBS data are a continuous survey of a representative national sample of the Medicare population drawn from the Medicare enrollment file. Interviews were conducted every 4 months on a variety of demographic and behavioral information (such as income, living arrangements, and access to medical care), health status and functioning, health insurance coverage, and health care services use and expenditures. A detailed description of the MCBS data has been reported elsewhere (Centers for Medicare and Medicaid Services 2009).

The ARF data provide information on the nation's health care delivery system and factors that may affect health status and health care at the county level, including information on health facilities, health professions, resource scarcity, and environmental characteristics (Health Resources and Services Administration 2002). The basic file contains geographic codes, which enable its linkage with other national survey files such as the MCBS. In this study a cross table between the five-digit zip code and the Federal Information Processing Standards county code was used to link the MCBS data with the ARF data.

Study Population

The population analyzed included all the MCBS community-dwelling participants for any full calendar year from 2001 through 2003, excluding persons under 65 years of age, those eligible for Medicare Part A or Part B only, and Medicare HMO enrollees. The reason to exclude those younger than 65 years is that they have substantial disability or end-stage renal disease, and are rather different from the general elderly population. Institutionalized beneficiaries were excluded because the USOC identified in this study was restricted to doctors' offices and outpatient clinics. Beneficiaries who enrolled in Medicare HMOs for any length of time in a given year, persons with only Medicare Part A or Part B, and those who participated in the MCBS for part of a calendar year were excluded because there was incomplete information about their health care use.

Measures

Dependent Variables

USOC. The definition of "having a USOC" was based on the responses to the following question in the MCBS data: "Is there a particular medical person or a clinic you usually go to when you were sick or asked for advice about your health?" When people responded "yes" to this question, they were defined as having a USOC = 1, otherwise USOC = 0.

Screened Depression. Two questions were used to identify individuals at risk for depression in the MCBS data. The screen included two questions: "In the past 12 months, how much of the time did you feel sad, blue, or depressed? Would you say you were sad or depressed all of the time, most of the time, some of the time, a little of the time, or none of the time?" and "In the past 12 months, have you had 2 weeks or more when you lost interest or pleasure in things that you usually cared about or enjoyed?" If an individual answered "all of the time" or "most of the time" to the first question, then s/he was defined as having depressed mood. If s/he answered "yes" to the second question, then s/he was defined as having anhedonia. A person was identified as screening positive for depression (referred to here for simplicity as "depression") when either or both questions were endorsed.

Ambulatory Care Visit. An ambulatory care visit (hospital outpatient visit or physician office visit) was defined using the summary variables in the MCBS data for the utilization of services rendered and reimbursed under traditional fee-for-service Medicare in each calendar year using

Medicare claims. A physician office visit was identified by the Healthcare Common Procedure Coding System codes in the series 90,000–90,090 and 99,201–99,215 in the Part B line item trailer group(s). If an individual had one or more hospital outpatient visit bills and/or one or more physician office visits in the past year, then s/he was identified as having at least one ambulatory care visit in the last 12 months. A dummy variable was generated.

Only ambulatory care visits were considered here because older adults are most likely to go to primary care settings for their health problems (Cooper-Patrick et al. 1999). Only community-dwelling participants were included in the study, and USOC was restricted to outpatient care. Ambulatory care visits analyzed here were not limited to mental health visits. Treatment of physical health problems can improve people's mental health status, in addition to improving their physical health (Spiegel et al. 1999).

Independent Variables. Table 1 presents definitions of the independent variables used in the analysis. A common set of variables was included in the simultaneous equations (see details below) based on an extension of Andersen's Behavioral Model (Andersen 1995): enabling factors (such as education, income, health insurance, number of children), predisposing factors (e.g., age, gender, and race), and need factors (for instance, activities of daily living, instrumental activities of daily living, and comorbidities).

In this study, a simultaneous-equations model including three equations with any USOC (yes or no), any ambulatory care use (ACU) (yes or no), and depression (yes or no) as the dependent variables, respectively, was used. Two variables from the ARF data were included in the USOC equation and ambulatory care visits equation as the restriction exclusions for the identification of the simultaneous-equations model: (1) primary care practitioner shortage area; and (2) percentage of residents with mean travel time of 45 minutes or more to work for people aged 16+ at the county level.

The shortage of primary care practitioners was assumed to affect people's health indirectly by acting as a barrier to access to care and/or resulting in lower quality of care (Macinko, Starfield, and Shi 2007). Average length of time to work for people aged 16+ is a general proxy for the inconvenience of transportation and barriers to access to care in a county. Travel barriers have been found to be related to lower health care utilization (Fortney et al. 1999). These variables are directly associated with having a USOC and ambulatory care visits but are not directly associated with mental health status among the elderly.

Table 1: Definition of Independent Variables

	<i>Variable</i>	<i>Description</i>	<i>Coding</i>	
Individual level	Calendar year	2001	1 = yes	
		2002	0 = no	
		2003	Year 2003 as reference	
	Demographic	Age	65–74	1 = yes
			75–84	0 = no
			85+	85+ as reference
	Gender	Male	0 = female	
			1 = male	
	Race	Non-Hispanic white	1 = yes	
		Non-Hispanic black	0 = no	
Socioeconomic status	Marital status	Hispanics	Non-Hispanic white as reference	
		Other		
		Married	1 = yes	
		Separated/divorced	0 = no	
	Children	Never married	Married as reference	
		Widowed		
	Live alone	Have a child or not	1 = have at least one child,	
			0 = otherwise	
	Education	No. of persons living in the household	1 = one	
			0 = otherwise	
Health status	Income	Have a high school or lower degree	1 = high school or lower	
			0 = college or above	
	Income	Annual personal income (annual household income/2 if reported married in MCBS)	1 = yes	
		Income U.S. < \$8,000	0 = no	
		Income > = U.S.\$8,000 and < U.S.\$15,000	> = U.S.\$30,000 as reference	
		Income > = U.S.\$15,000 and < U.S.\$30,000		
	Supplementary health insurance	Income > = U.S.\$30,000		
		No = Medicare only	1 = yes	
	Activities of daily living	Yes = otherwise (Medicaid + other public program/employer-sponsored/self-private)	0 = no	
		ADLs: having difficulty in walking, eating, bathing, dressing, toileting, getting in/out of bed/chair	1 = have at least one ADL	
		0 = otherwise		

continued

Table 1. *Continued*

	<i>Variable</i>	<i>Description</i>	<i>Coding</i>
Community level	Instrumental activities of daily living	IADLs: having difficulty in telephone, shopping, food preparation, light or heavy housekeeping, money managing	1 = have at least one IADL; 0 = otherwise
	Comorbidity	At least one of the following chronic conditions: coronary heart diseases, heart failure, hypertension, stroke, diabetes, arthritis, cancer, Parkinson's disease, mental disorder	1 = have at least one chronic condition 0 = otherwise
	Self-report health	General health compared to others same age Excellent, very good, good, fair, poor	1 = yes 0 = no Poor as reference
	Rural/urban	MSA area	1 = yes 0 = no
	Convenience (transportation)	Percentage of residents with mean travel time of 45 minutes or more to work for people aged 16+ at county level	
System level	Shortage area for PCPs	See methods section on page 5.	1 = yes 0 = no

ADL, activities of daily living; IADL, instrumental activities of daily living; MCBS, Medicare Current Beneficiaries Survey.

Primary care shortage areas are identified by the Health Resources and Services Administration. It designates a geographic area as having a shortage of primary care professionals if the following three criteria are met: (1) it is a rational area for the delivery of primary medical services; (2) one of the following conditions prevails within the area: the area has a population to full-time-equivalent primary care physician ratio of $> 3,000:1$ and has unusually high needs for primary care services or it has insufficient capacity of existing primary care providers; (3) primary medical care professionals in contiguous areas are overutilized, excessively distant, or inaccessible to the

area population under consideration (Health Resources and Services Administration 2002).

Statistical Analysis

The population characteristics are described for the study sample stratified by USOC and ACU for each year. Relationship between USOC and changes in screened depression is also described. Survey weights are used to produce results that are representative of the U.S. community-dwelling elderly population.

Having a USOC directly affects having any ACU and—through the ambulatory care visit equation—has indirect effects on depression. USOC also has a direct effect on depression prevalence in the depression equation. It is assumed that a USOC is a resource for social support for elderly people. Older adults have high demand for health care, and having a USOC may be associated with a lower stress level compared with those without a USOC. Depression was not included in the USOC equation because in theory coping resources (such as a USOC) may be unchanged by exposure to stress. This conceptual model has been demonstrated in previous studies among older adults (Chokkanathan 2009). Treatment on depression was not included in the depression equation because depression is seriously underdiagnosed and undertreated, especially among the elderly in primary care. Older adults with very severe, self-reported depressive symptoms were more likely to receive physician recognition and treatment (but not necessarily adequate treatment) (Garrard et al. 1998).¹

To examine the effect of having a USOC on screened depression, first we estimated a standard multivariate logistic regression model. The model is naïve in the sense that it does not account for endogeneity of having a USOC and ACU, which could arise, for example, from unobservable heterogeneity in health status or severity of illness. We address this by developing a simultaneous-equations approach in which we specify equations for USOC, health care utilization, and depression. The multivariate probit model has been demonstrated to have significant advantages in nonlinear settings with non-continuous endogenous variables (Bhattacharya, Goldman, and McCaffrey 2006; Terza, Bradford, and Dismuke 2008). We applied the Geweke–Hajivassiliou–Keane simulator technique (Terracol 2002) to develop the model in which the error terms were allowed to be correlated across equations in order to account for unobserved heterogeneity that could lead to having a USOC, health care utilization, and depression (Bhattacharya, Goldman, and

McCaffrey 2006), thereby creating spurious correlation in the standard logistic regression formulation. This technique specifies a trivariate normal distribution for the three error terms. Let

$$\begin{aligned} USOC_{ij}^* &= \beta_1 X_{ij} + \beta_2 race_{ij} + \beta_3 PCPshortage_{ij} + \beta_4 timetowork_{ij} + \varepsilon_{1ij} \\ ACU_{ij}^* &= \gamma_1 X_{ij} + \gamma_2 race_{ij} + \gamma_3 PCPshortage_{ij} + \gamma_4 timetowork_{ij} + \gamma_5 USOC_{ij} + \varepsilon_{2ij} \\ Depression_{ij}^* &= \kappa_1 X_{ij} + \kappa_2 race + \kappa_3 USOC_{ij} + \kappa_4 ACU_{ij} + \varepsilon_{3ij} \\ USOC_{ij} &= 1 \text{ if } USOC_{ij}^* > 0, 0 \text{ otherwise} \\ ACU_{ij} &= 1 \text{ if } ACU_{ij}^* > 0, 0 \text{ otherwise} \\ Depression_{ij} &= 1 \text{ if } Depression_{ij}^* > 0, 0 \text{ otherwise} \end{aligned}$$

where $USOC^*$, ACU^* , and $Depression^*$ are, respectively, latent variables that govern the propensity to have a USOC, ACU, and Depression. The index i represents individuals and the index j represents the calendar year. Exogenous independent variables include the following: X is a vector of individual characteristics (demographic factors, socioeconomic characteristics, health status, and a constant), $race$ is the indicator variables for race, $PCPshortage$ is the shortage area for primary care physicians, $timetowork$ is the percentage of residents with a mean time of 45 minutes or more traveling to work among people aged 16+ at the county level. Γ , κ , and β are vectors of coefficients. We assume the errors are drawn from a joint normal distribution with $E[\varepsilon_1] = E[\varepsilon_2] = E[\varepsilon_3] = 0$, $Cov[\varepsilon_1, \varepsilon_2, \varepsilon_3] = \rho$, and $\sigma_1 = \sigma_2 = \sigma_3 = 1$. If the null hypothesis that the unobserved explanatory variables are uncorrelated is rejected, the single equation formulation is rejected and the system should be estimated simultaneously. We tested this hypothesis with a likelihood ratio (LR) test. Although the trivariate probit (three-equation model) can be identified based on nonlinearities, these models are known to be sensitive to the parametric specification of the error terms. Thus, we include a set of *instruments* or exclusion restrictions to aid the identification. We contend that inconvenience to care (time to work) and shortage area for PCPs are important in the USOC equation and the ambulatory visit equation, but not the depression equation. Treating these measures as instruments and excluding them from the equation of interest (the Depression equation) ensures that the results are not merely dependent on the distributional assumptions imposed on the error terms and strengthens the causal interpretation of the results. Sensitivity analyses using different model specifications were used to examine the robustness of the results and assumptions.

For ease of interpretation, the incremental effect (calculated at means) and standard errors (calculated using the delta method) of having a USOC on any ACU and depression prevalence and that of having at least one ambulatory care visit on depression prevalence were calculated to test the impact on the probability of observing a change in the prevalence of screened depression.

Sampling weights and the potential cross-year correlations of the error terms for the same individual were incorporated into the analysis using an established method (Williams 2000). Analyses were conducted using Stata version 8.2 (StataCorp., College Station, TX).

RESULTS

Patient Characteristics

There were 20,455 person-years that met the inclusion criteria. Only person-years without missing values were included in the analysis ($n = 18,889$, 92.3 percent of 20,455). Of those excluded ($n = 1,566$, 7.7 percent of 20,455), 484 had a missing value for depression (2.7 percent of 20,455), 50 had a missing value for race, and 49 had a missing value for having a USOC. Person-years with depression screening missing were older, had lower income and worse health status, more likely to live in an area with shortage of primary care physicians, and less likely to use ACU. Even though the data were not missing randomly, given such a large sample size, 7.7 percent missing is considered to be small and would not be expected to appreciably bias the results.

There were a total of 18,889 person-years included in the analysis, provided by 11,248 Medicare beneficiaries with an average of 1.99 years of follow-up in the survey. Of these, 83.8 percent were non-Hispanic whites, 11.9 percent were 85 years of age or older, 41.9 percent were males, 95.4 percent had a USOC, 92.5 percent had at least one ambulatory visit in the past year, and 12.9 percent were identified as having screened depression. No statistically significant differences in population characteristics were found between the total study sample and the list-wise sample. Among person-years screened positive initially, those with a USOC were more likely to screen negative for depression than those without in later years (34.1 versus 31.7 percent). No such difference was found among person-years screened negative initially. Population characteristics stratified by USOC and ACU for the study sample used in the simultaneous-equations model are presented in Table 2.

Table 2: Population Characteristics Stratified by USOC and ACU for the Study Sample ($n = 18,889^{\dagger}$)

Characteristics	USOC [†]		ACU	
	Yes (n [%])	No (n [%])	Yes (n [%])	No (n [%])
Age (years)				
65–74	6,851 (37.94)	397 (47.72)***	6,579 (37.46)	669 (50.49)***
75–84	7,638 (42.30)	307 (36.90)***	7,500 (42.70)	445 (33.58)***
≥ 85	2,841 (15.73)	98 (11.78)**	2,774 (15.79)	165 (12.45)**
Male	7,618 (42.19)	395 (47.48)***	7,213 (41.07)	800 (60.38)***
Race				
Non-Hispanic white	15,152 (83.91)	654 (78.61)***	14,805 (84.29)	1,001 (75.55)***
Non-Hispanic black	1,374 (7.61)	60 (7.21)	1,288 (7.33)	146 (11.02)***
Hispanics	955 (5.29)	77 (9.25)***	911 (5.19)	121 (9.13)***
Other	347 (1.92)	22 (2.64)	338 (1.92)	31 (2.34)
Marital status				
Married	9,659 (53.49)	375 (45.07)***	9,338 (53.17)	696 (52.53)
Widowed	6,639 (36.77)	300 (36.06)	6,553 (37.31)	386 (29.13)***
Divorced/separated	1,243 (6.88)	84 (10.10)**	1,170 (6.66)	157 (11.85)***
Never married	516 (2.86)	73 (8.77)***	503 (2.86)	86 (6.49)***
Have no child	1,611 (8.92)	148 (17.79)***	1,577 (8.98)	182 (13.74)***
Live alone	6,262 (34.68)	335 (40.26)***	6,159 (35.07)	438 (33.06)
MSA	12,166 (67.38)	550 (66.11)	11,815 (67.27)	901 (68.00)
High school graduate or less	12,336 (68.32)	611 (73.44)**	11,984 (68.23)	963 (72.68)
Annual income				
< U.S.\$8,000	1,820 (10.08)	109 (13.10)	1,774 (10.10)	155 (11.70)
U.S.\$8,000–U.S.\$14,999	4,051 (22.43)	241 (28.97)***	3,923 (22.34)	369 (27.85)***
U.S.\$15,000–U.S.\$29,999	5,971 (33.07)	264 (31.73)	5,837 (33.23)	398 (30.04)
≥ U.S.\$30,000	6,215 (34.42)	218 (26.20)***	6,030 (34.33)	403 (30.42)
Supplemental insurance	16,545 (91.63)	652 (78.37)***	16,252 (92.53)	945 (71.32)***

continued

Table 2. Continued

Characteristics	USOC [†]		ACU	
	Yes (n [%])	No (n [%])	Yes (n [%])	No (n [%])
Self-rated health				
Excellent	2,677 (14.83)	213 (25.60)***	2,555 (14.55)	335 (25.28)***
Very good	5,190 (28.74)	274 (32.93)***	5,016 (28.56)	448 (33.81)***
Good	6,099 (33.78)	218 (26.20)***	5,991 (34.11)	326 (24.60)***
Fair	3,170 (17.56)	97 (11.66)**	3,118 (17.75)	149 (11.25)***
Poor	921 (5.10)	30 (3.61)	884 (5.03)	67 (5.06)
At least one comorbidity	17,135 (94.89)	557 (66.95)***	16,688 (95.01)	1,004 (75.77)***
No ADL	5,118 (28.34)	182 (21.88)***	5,018 (28.57)	282 (21.28)***
No IADL	3,653 (27.44)	132 (20.12)***	3,618 (27.97)	167 (16.17)***
% Of residents travel time to work ≥ 45 minutes at county level (mean, SE)	14.85 (0.35)	16.16 (0.74)**	14.80 (0.36)	16.32 (0.55)***
Shortage area for PCPs	14,090 (78.03)	676 (81.25)***	13,716 (78.09)	1,050 (79.25)
USOC			17,093 (97.32)	964 (72.75)***
Ambulatory visit	17,093 (94.66)	471 (56.61)***		
Screened depression	2,394 (13.26)	102 (12.26)	2,337 (13.31)	159 (12.00)***

[†] n = number of person-years analyzed based on the inclusion criteria; sampling weights used.
[‡] Population characteristics by USOC (usual source of care) and ACU (ambulatory care use) were consistent across study years.
***p < .001,
**p < .05.
ADL, activities of daily living; IADL, instrumental activities of daily living; MCBS, Medicare Current Beneficiaries Survey.

Table 3: Results of Single-Equation Model and Simultaneous-Equations Model

Variables	Simultaneous-Equation Model			Single-Equation Model	
	USOC Equation	ACU Equation	Depression Equation	Depression Equation	Depression Equation
Non-Hispanic black	0.098 (0.085)	-0.168 (0.074)**	-0.154 (0.055)***	-0.277 (0.103)***	
Hispanic	-0.196 (0.084)**	-0.152 (0.075)**	0.032 (0.062)	0.053 (0.129)	
Non-Hispanic other	-0.109 (0.150)	-0.086 (0.121)	-0.084 (0.096)	-0.166 (0.170)	
Non-Hispanic white (reference)					
MSA area	0.013 (0.046)	-0.067 (0.041)	0.075 (0.031)**	0.142 (0.085)*	
Supplemental insurance	0.335 (0.060)***	0.626 (0.052)***	-0.016 (0.049)	-0.059 (0.072)	
Medicare only (reference)					
Never married	-0.451 (0.114)***	-0.320 (0.120)***	-0.022 (0.100)	-0.045 (0.187)	
Divorced/separated	-0.199 (0.086)**	-0.302 (0.075)***	0.209 (0.062)***	0.395 (0.108)***	
Widowed	-0.127 (0.071)*	-0.135 (0.061)**	0.200 (0.047)***	0.372 (0.072)***	
Married (reference)					
No child	-0.186 (0.069)***	-0.027 (0.073)	-0.050 (0.057)	-0.083 (0.104)	
Have at least one child (reference)					
Live alone	-0.032 (0.065)	0.122 (0.057)**	0.001 (0.043)	-0.008 (0.068)	
Live with other people (reference)					
Have at least one comorbidity	1.014 (0.061)***	0.476 (0.062)***	0.127 (0.073)*	0.178 (0.133)	
Have no ADL	0.047 (0.050)	0.031 (0.046)	-0.264 (0.032)***	0.475 (0.069)***	
Have no IADL	0.057 (0.051)**	-0.145 (0.046)***	-0.218 (0.034)***	0.403 (0.061)***	
Percent of adults aged 16 and older with a travel time to work $\geq$ 45 minutes	-0.473 (0.217)**	-0.460 (0.202)**			
Shortage area for PCPs	-0.133 (0.056)**	-0.018 (0.047)	-0.176 (0.079)**	-0.151 (0.127)	
USOC		1.478 (0.088)***	0.003 (0.060)	0.005 (0.002)**	
ACU			-0.396 (0.136)***	-1.774 (0.234)	
Constant	1.216 (0.168)***	-0.293 (0.164)*			

continued

Table 3. Continued

Variables	Simultaneous-Equation Model		Single-Equation Model	
	USOC Equation	ACU Equation	Depression Equation	Depression Equation
Observations	18,889			Observations: 18,889
Wald χ^2 (84)	2,639.94			LR χ^2 (27): 1,416.41
Probability > χ^2	0			Probability > χ^2 : 0
Log-likelihood	-4,5641,114			Log-likelihood: -6,666.7309
ρ	(1,2) (-0.1223)**	(2,3) (0.0022)	(1,3) (0.0405)**	

*Significant at 10%.

**Significant at 5%.

***Significant at 1%.

ACU, ambulatory care use; ADL, activities of daily living; IADL, instrumental activities of daily living; LR, likelihood ratio; USOC, usual source of care.

Multivariate Model Results

Table 3 presents the estimation results of the simultaneous-equations model and the single-equation model. The results from the trivariate probit model provide strong evidence that accounting for the potential endogeneity between having a USOC, ACU, and depression is quite important. There was a negative and statistically significant correlation between the error terms of the USOC and ACU equations ($p = .002$), and a positive and statistically significant correlation between the error terms of the USOC equation and the depression equation ($p = .01$). The correlation between the ACU equation and the depression equation was not statistically significant. The LR test rejected at the 1 percent level the hypothesis that the estimated correlations in the error terms across equations are zero.

USOC and ACU

Enabling and need factors were found to be significantly associated with USOC and ACU. For example, persons who were widowed, divorced, or separated were less likely to have a USOC and ACU compared with those who were married. Persons who had comorbidities and functional limitations were more likely to have a USOC and ACU compared with those without. Persons with Medicare supplemental insurance were significantly more likely to have a USOC and ACU than those without. In addition, Hispanics were significantly less likely to have a USOC, and non-Hispanic blacks and Hispanics were significantly less likely to have an ACU compared with non-Hispanic whites.

Older adults living in an area with a shortage of primary care physicians were less likely to have a USOC. People living in an area with a higher proportion of people aged 16+ transiting to work for 45 minutes or more were less likely to have ACU in the past 12 months. Sensitivity analyses indicated that the coefficients for having a USOC and having any ACU in the depression equation were robust to different model specifications, which suggested that they were valid restriction exclusions.

USOC and Depression

The trivariate probit model detected a significant negative effect of USOC on depression prevalence ($\beta = -0.18$, $p = .03$) in the depression equation. Having a USOC is associated with 3.8 percentage points lower probability of having depression (SE = 0.018). Having any ACU was found to have no statistically significant effect on having depression ($\beta = 0.003$, $p = .10$). In the ACU equation, having a USOC was found to have a positive effect on having

any ACU ($\beta = 1.48$, $p < .001$). Having a USOC is associated with 36.7 percentage points higher probability of having any ACU ($SE = 0.03$).

If endogeneity was not controlled for, as indicated by the single equation results, the estimated effect on depression of having a USOC was smaller than that estimated from the simultaneous-equations model, given that the correlation between the error terms in the USOC equation and the depression equation (ρ_{13}) is positive and statistically significant. For example, a single-equation model indicates that having a USOC is associated with a 1.2 percent decrease in the probability of propensity to have depression. Having any ACU was found to have no statistically significant effect on having depression ($\beta = 0.001$, $p = .99$). There was no statistically significant interaction between having a USOC and any ACU ($p = .18$).

DISCUSSION

This study found that better access to care has a positive effect on mental health. A USOC was directly associated with lower likelihood of screening positive for depression among community-dwelling Medicare beneficiaries. Consistent with prior studies, a USOC was also found to be associated with higher probability of having any ACU (Ettner 1996; Sambamoorthi and McAlpine 2003). A simultaneous-equations model provided a better structure for estimating such effects than a single-equation model.

Our finding that USOC is associated with lower depression prevalence is consistent with a previous study on the benefits of primary care access on health outcomes and quality of depression care (Solberg et al. 2006). To the authors' knowledge, this is the first study of a national sample of community-dwelling elderly adults to examine the effect of having a USOC on screened depression prevalence. Previous studies have found similar effect of access to care on general health status (Starfield, Shi, and Macinko 2005) but not on mental health status specifically. In addition, this study provides evidence to support the policy changes to foster USOC in Medicare such as Medicare Advantage in that it might help address the burden of depression.

There are several potential explanations for the relationship between USOC and depression among the elderly. First, a USOC may represent an important resource for social support. Older adults residing in areas with a shortage of primary care physicians and inconvenient access to care are more likely to be rural and poor. These factors have been associated with social isolation, which in turn is a risk factor for late life depression (Prince et al.

1997). Having a USOC may reduce social isolation and thus the risk of developing depression. This is consistent with previous research that has found that social support is associated with less depression in older adults (Brummett et al. 2000; Moak and Agrawal 2009). Second, older adults rely more on health care services compared with other age groups due to increasing vulnerability (e.g., increasing disability and higher prevalence of chronic conditions). A USOC may help older adults obtain timely access to needed health care and continuity of care, which in turn result in lower risk of depression due to chronic illnesses, pain, and functional impairments. It may also help change their health behaviors to prevent stressful events. Third, people who lived in an area with a shortage of health professionals were more likely to lack a USOC. In such areas, it may take longer to get a medical appointment compared with areas without such a shortage (United States General Accounting Office [GAO] 2002). Unmet needs have been found to be a significant predictor of depression among the elderly after controlling for income and other known correlates (Blazer, Sachs-Ericsson, and Hybels 2007).

The coefficient of having any ACU was positive in the depression equation in both the single-equation model and the simultaneous-equations model. This conflicts with the assumption that health care services are beneficial for people's health. There are several potential reasons for this. On the one hand, this finding may result from persons with depression being more likely to seek care of some kind including that related to somatic symptoms. In addition, this may be due to the effect of any ACU contributing to having a USOC. Consequently, the effect of a USOC may be overestimated and the effect of health care utilization may be underestimated. On the other hand, only probability of use was considered in the present study, which assumed that having one ambulatory visit is equivalent to having many visits. This may underestimate the effect of health care utilization on depression prevalence.

Several limitations of the study must be acknowledged. First, screened depression was measured using the two-item screen based on self-reported depressive symptoms. The validity of the MCBS two-item screen as a measure of major depression has not been established. However, it is very similar in structure and in the scoring algorithm typically used to the Patient Health Questionnaire (PHQ)-2,² a two-item version of the PHQ (Kroenke, Spitzer, and Williams 2003). The PHQ-2 has been found to be a valid screen for major depression among the elderly (Li et al. 2007), indicating when positive the need for further diagnostic assessment, and possibly treatment, for affective illness. The two-item screen in the MCBS data is assumed to be as good a measure as the PHQ-2. The prevalence of screened depression was estimated to be 12.9 percent in this study,

which is within the range of depression prevalence reported in previous studies among community-dwelling elderly (Schulberg et al. 1998; Lyness et al. 1999; Blazer 2002). The two-item screen has high sensitivity but relatively low specificity. Even subsyndromal depression has been associated with poor health outcomes and higher service utilization, and is a risk factor for developing major depression. Thus, using the more sensitive measure has advantages. There could be recall and/or misclassification bias, which may underestimate or overestimate the effect on depression of having a USOC among the elderly. On the other hand, depression is reported by patients rather than physicians, so physician detection bias or failure to access care will not be an issue.

Second, the outcomes of interest (a USOC and screening positive for depression) were measured only once a year. Information on the trajectory of depressive symptoms was not available for the study sample, and neither was their temporal association with the USOC item specified. For example, we cannot know whether depressive symptoms are due to medical conditions or represent an autonomous affective disorder (e.g., major depressive disorder rather than major depression due to a medical condition). It is important to distinguish between depressive subgroups (type and severity) that may possess different etiological pathways and implications for treatment (Van den Berg et al. 2001). This may limit the estimation of the effect of a USOC on depression. Third, identification (causal inference) of the triprobit model relies on either or both of the following: the parametric assumptions of the error distributions and the exclusion restrictions (instruments). While our assumptions about the instruments are plausible and the results are consistent with our expectations, there is no way to test the assumptions quantitatively. However, the single-equation model estimates suggest there may be a substantively important reverse causal relationship (i.e., depression causes visits [ACU]). That result is substantially weakened in the simultaneous equations model estimates, lending credibility to the model assumptions. The simultaneous equations results indicate the major benefit is through having a USOC.

CONCLUSION

Our findings provide valuable information for policy makers and health services researchers. They suggest that improving primary care access to the elderly might have the added benefit of reducing rates of depression. Depressive symptoms are associated with functional disability and other undesirable long-term outcomes among the elderly (Gallo et al. 1997).

Enhancing older people's ability to access care may decrease psychological stress associated with unmet needs and increase safety, and improve mental health and quality of life. Enhancing minorities' ability to access care may also help decrease racial/ethnic disparities in mental health among the elderly. Our results also provide important implications for health care reform that access to care has a direct impact on people's health beyond that of health insurance.

Future longitudinal studies might be conducted to estimate the magnitude of the causal effect of access to care on depression and to confirm findings in the present study. This study preceded a recent large expansion of Medicare Advantage (and specifically excluded those in HMOs), but it is possible that linkage to USOC through HMOs might improve depression. Further study would be needed to confirm whether such an effect would apply to Medicare HMO participants, persons without Part B coverage, and younger people. Last, study is needed to elucidate potential pathways through which USOC might affect depression.

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NOTES

1. In our study, person-years under treatment for depression (5.6 percent, 1,053 out of 18,749) in the past year were more likely to screen positive for depression than those without treatment (47.0 percent versus 10.8 percent, $p < .001$).
2. The PHQ-2 consists of two questions as follows: "Over the past two weeks, how often have you been bothered by any of the following problems? (1) Little interest or pleasure in doing things and (2) Feeling down, depressed, or hopeless. 0 = Not at all; 1 = Several days; 2 = More than half the days; 3 = Nearly every day."

REFERENCES

- Alexopoulos, G. S., I. R. Katz, M. L. Bruce, M. Heo, T. Ten Have, P. Raue, H. R. Bogner, H. C. Schulberg, B. H. Mulsant, C. F. III Reynolds, and PROSPECT

- Group. 2005. "Remission in Depressed Geriatric Primary Care Patients: A Report from the PROSPECT Study." *American Journal of Psychiatry* 162: 718–24.
- Andersen, R. M. 1995. "Revisiting the Behavioral Model and Access to Medical Care: Does It Matter?" *Journal of Health Social Behavior* 36: 1–10.
- Bhattacharya, J., D. Goldman, and D. McCaffrey. 2006. "Estimating Probit Models with Self-Selected Treatments." *Statistical Medicine* 25: 389–413.
- Blazer, D. G. 2002. *Depression in Later Life*. 3d Edition. New York: Springer.
- Blazer, D. G., N. Sachs-Ericsson, and C. F. Hybels. 2007. "Perception of Unmet Basic Needs as a Predictor of Depressive Symptoms among Community-Dwelling Older Adults." *Journal of Gerontology* 62: 191–5.
- Broadhead, W. E., D. G. Blazer, L. K. George, and C. K. Tse. 1990. "Depression, Disability Days and Days Lost from Work in a Prospective Epidemiologic Survey." *Journal of American Medical Association* 264: 2524–8.
- Brummett, B. H., J. C. Barefoot, I. C. Siegler, and D. C. Steffens. 2000. "Relation of Subjective and Received Social Support to Clinical and Self-Report Assessments of Depressive Symptoms in an Elderly Population." *Journal of Affective Disorders* 61: 41–50.
- Centers for Medicare and Medicaid Services. 2009. "Medicare Current Beneficiary Survey (MCBS)" [accessed on December 23, 2009]. Available at http://www.cms.hhs.gov/limiteddatasets/11_mcbs.asp
- Chokkanathan, S. 2009. "Resources, Stressors and Psychological Distress among Older Adults in Chennai, India." *Social Science Medicine* 68: 243–50.
- Cooper-Patrick, L., J. J. Gallo, J. Gonzalez, H. T. Vu, N. R. Powe, C. Nelson, and D. E. Ford. 1999. "Race, Gender, and Partnership in the Patient–Physician Relationship." *Journal of American Medical Association* 37: 1034–45.
- Corbie-Smith, G., E. W. Flagg, J. P. Doyle, and M. A. O'Brien. 2002. "Influence of Usual Source of Care on Differences by Race/Ethnicity in Receipt of Preventive Services." *Journal of General Internal Medicine* 17: 458–64.
- Coulehan, J. L., H. C. Schulberg, M. R. Block, M. J. Madonia, and E. Rodriguez. 1997. "Treating Depressed Primary Care Patients Improves Their Physical, Mental, and Social Functioning." *Archives of Internal Medicine* 157: 1113–20.
- De Maeseneer, J. M., L. De Prins, and C. Gosset. 2003. "Provider Continuity in Family Medicine." *Annual Family Medicine* 1: 144–8.
- DeVoe, J. E., G. E. Fryer, R. Phillips, and L. Green. 2003. "Receipt of Preventive Care among Adults: Insurance Status and Usual Source of Care." *American Journal of Public Health* 93: 786–91.
- Ettner, S. L. 1996. "The Timing of Preventive Services for Women and Children: The Effect of Having a Usual Source of Care." *American Journal of Public Health* 86: 1748–54.
- . 1999. "The Relationship between Continuity of Care and the Health Behaviors of Patients: Does Having a Usual Physician Make a Difference?" *Medical Care* 37: 547–55.
- Fortney, J., K. Rost, M. Zhang, and J. Warren. 1999. "The Impact of Geographic Accessibility on the Intensity and Quality of Depression Treatment." *Medical Care* 37: 884–93.

- Gallo, J. J., P. V. Rabins, C. G. Lyketsos, A. Y. Tien, and J. C. Anthony. 1997. "Depression without Sadness: Functional Outcomes of Nondysphoric Depression in Later Life." *Journal of American Geriatric Society* 45: 570-8.
- Garrard, J., S. J. Rolnick, N. M. Nitz, L. Luepke, J. Jackson, L. R. Fischer, C. Leibson, P. C. Bland, R. Heinrich, and L. A. Waller. 1998. "Clinical Detection of Depression among Community-Based Elderly People with Self-Reported Symptoms of Depression." *American Journal of Gerontology: Medicine Science* 53: M92-101.
- Health Resources and Services Administration. 2002. *Area Resource File (ARF)*. US Department of Health and Human Services, Health Resources and Services Administration, Bureau of Health Professions, Rockville, MD.
- Kroenke, K., R. L. Spitzer, and J. B. Williams. 2003. "The Patient Health Questionnaire-2: Validity of a Two-Item Depression Screener." *Medical Care* 41: 1284-92.
- Levkoff, S. E., H. Chen, E. Coakley, E. C. Herr, D. W. Oslin, I. Katz, S. J. Bartels, J. Maxwell, E. Olsen, K. M. Miles, G. Constantino, and J. H. Ware. 2004. "Design and Sample Characteristics of the PRISM-E Multisite Randomized Trial to Improve Behavioral Health Care for the Elderly." *Journal of Aging Health* 16: 3-27.
- Li, C., B. Friedman, Y. Conwell, and K. Fiscella. 2007. "Validity of the Patient Health Questionnaire 2 (PHQ-2) in Identifying Major Depression in Older People." *Journal of American Geriatric Society* 55: 596-602.
- Lyness, J. M., E. D. Caine, D. A. King, C. Cox, and Z. Yoediono. 1999. "Psychiatric Disorders in Older Primary Care Patients." *Journal of General Internal Medicine* 14: 249-54.
- Macinko, J., B. Starfield, and L. Shi. 2007. "Quantifying the Health Benefits of Primary Care Physician Supply in the United States." *International Journal of Health Services* 37: 111-26.
- Moak, Z. B., and A. Agrawal. 2009. "The Association between Perceived Interpersonal Social Support and Physical and Mental Health: Results from the National Epidemiological Survey on Alcohol and Related Conditions." *Journal of Public Health* 32 (2): 191-201.
- Murray, C. J., and A. D. Lopez. 1997. "1990-2020: Global Burden of Disease Study." *Lancet* 349: 498-504.
- Prince, M. J., R. H. Harwood, R. A. Blizard, A. Thomas, and A. H. Mann. 1997. "Social Support Deficits, Loneliness and Life Events as Risk Factors for Depression in Old Age. The Gospel Oak Project VI." *Psychological Medicine* 27: 323-32.
- Sambamoorthi, U., and D. D. McAlpine. 2003. "Racial, Ethnic, Socioeconomic, and Access Disparities in the Use of Preventive Services among Women." *Preventive Medicine* 37: 475-84.
- Schulberg, H. C., B. Mulsant, R. Schulz, B. L. Rollman, P. R. Houck, and C. F. Reynolds, III. 1998. "Characteristics and Course of Major Depression in Older Primary Care Patients." *International Journal Psychiatry Medicine* 28: 421-36.
- Simon, G. E., M. Vonkorff, and W. Barlow. 1995. "Health Care Costs of Primary Care Patients with Recognized Depression." *Archive of General Psychiatry* 52: 850-6.

- Solberg, L. I., A. L. Crain, J. M. Sperl-Hillen, M. C. Hroschikoski, K. I. Engebretson, and P. J. O'Connor. 2006. "Effect of Improved Primary Care Access on Quality of Depression Care." *Annual Family Medicine* 4: 69–74.
- Sox, C. M., K. Swartz, H. R. Burstin, and T. A. Brennan. 1998. "Insurance or a Regular Physician: Which Is the Most Powerful Predictor of Health Care?" *American Journal of Public Health* 188: 364–73.
- Spiegel, D., G. R. Morrow, C. Classen, R. Raubertas, P. B. Stott, N. Mudaliar, H. I. Pierce, P. J. Flynn, L. Heard, and G. Riggs. 1999. "Group Psychotherapy for Recently Diagnosed Breast Cancer Patients: A Multicenter Feasibility Study." *Psychooncology* 8: 482–93.
- Starfield, B., and L. Shi. 2004. "The Medical Home, Access to Care and Insurance." *Pediatrics* 113: 1493–8.
- Starfield, B., L. Shi, and J. Macinko. 2005. "Contribution of Primary Care to Health Systems and Health." *Milbank Quarterly* 83: 457–502.
- StataCorp. 2001. *Statistical Software: Release 7.0*. College Station, TX: Stata.
- Terracol, A. 2002. "TRIPROBIT: Stata module to estimate trivariate probit model using the GHK simulator." Statistical Software Components from Boston College Department of Economics [accessed on July 27, 2007]. Available at <http://econpapers.repec.org/software/bocbocode/s424302.htm>
- Terza, J. V., W. D. Bradford, and C. E. Dismuke. 2008. "The Use of Linear Instrumental Variables Methods in Health Services Research and Health Economics: A Cautionary Note." *Health Services Research* 43: 1102–20.
- United States General Accounting Office (GAO). 2002. "Mammography Capacity Generally Exists to Deliver Services." Report to the Chairman, Special Committee on Aging, U.S. Senate [accessed on January 21, 2008]. Available at <http://www.gao.gov/new.items/d02532.pdf>
- Unützer, J., W. J. Katon, J. W. Williams, C. M. Callahan, L. Harpole, E. M. Hunkeler, M. Hoffing, P. A. Areán, M. T. Hegel, M. Schoenbaum, S. M. Oishi, and C. A. Langston. 2001. "Improving Primary Care for Depression in Late Life: The Design of a Multi-Center Randomized Trial." *Medical Care* 39: 785–99.
- Unutzer, J. U., D. Patrick, G. Simon, G. David, W. Edward, R. Carolyn, and K. Wayne. 1997. "Depressive Symptoms and the Use of Health Services in HMO Patients Age 65 and Over: A Four Year Prospective Study." *Journal of American Medical Association* 277: 1618–23.
- Van den Berg, M. D., A. J. Oldehinkel, A. L. Bouguys, E. I. Brilman, A. T. Beekman, and J. Ormel. 2001. "Depression in Later Life: Three Etiologically Different Subgroups." *Journal of Affective Disorders* 65: 19–26.
- Wells, K. B., A. Stewart, R. Hays, M. A. Burnam, W. Rogers, M. Daniels, S. Berry, S. Greenfield, and J. Ware. 1989. "The Functioning and Well-Being of Depressed Patients: Results from the Medical Outcomes Study." *Journal American Medical Association* 262: 914–9.
- Williams, R. L. 2000. "A Note on Robust Variance Estimation for Cluster-Correlated Data." *Biometrics* 56: 645–6.

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