Review Article

Predicting Elderly People's Risk for Nursing Home Placement, Hospitalization, Functional Impairment, and Mortality: A Synthesis

Edward Alan Miller
William G. Weissert
University of Michigan

Long-term care resources would be allocated more cost-effectively if care planning and medical/functional eligibility decisions were grounded more firmly in extant evidence regarding the risk of nursing home placement, hospitalization, functional impairment, and mortality. This article synthesizes the studies that longitudinally assess the predictors of each of these outcomes for the 65 and older population in the United States. A database was assembled containing 167 multivariate analyses abstracted from 78 journal articles published between 1985 and 1998. Findings show that 22 risk factors consistently predict two or more outcomes, including three that predict all four: worse performance on physical function measures not based on activities of daily living, greater illness severity, and prior hospital use. Findings should help prioritize variable selection choices of those setting eligibility criteria, allocating care resources, and doing descriptive studies. Gaps are shown to exist in the understanding of outcome effects of facility, market, policy, and other system attributes.

Rapid expenditure growth in Medicaid long-term care programs is crowding out state spending for all other priorities, save prison construction

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(Weissert 1992). In FY97, overall Medicaid expenditures constituted 20 percent of total spending with close to 36 percent of that being devoted to long-term care—ranging from a low of 23.9 percent in Arizona to a high of 59.1 percent in North Dakota (Lamphere et al. 1998). In that same year, more than $31 billion in Medicaid dollars was spent on nursing home care, while an additional $10.5 billion was earmarked for home- and community-based services (Bectel and Tucker 1998). The rapidly growing elderly population (now 12.8 percent of the total U.S. population) is projected to more than double in more than half the states between 1990 and 2025 (Bectel and Tucker 1998). This is especially true among the "oldest old" or the group most in need of the services that long-term care provides.

A possible solution to the dilemma posed by growing state long-term care expenditures is to substitute home- and community-based services for expensive nursing home care. But initiatives of this type have been extremely disappointing. While the costs of long-term care continue to increase when home care is provided, improvement in health outcomes has been very limited, usually benefiting only a handful of recipients (Weissert, Cready, and Pawelak 1988; Weissert and Hedrick 1994) at very high cost-per-patient benefiting. For a variety of reasons, home- and community-based care has failed to meet expectations as a substitute for nursing home care. One reason is that most individuals who use home care are not at risk for institutionalization. Consequently, instead of diverting likely nursing home recipients to the community, existing programs add low-risk individuals to the client population, creating additional costs by expanding the pool of beneficiaries served.

In the face of these fiscal pressures and the inability of existing efforts to substitute home- and community-based care for institutionalization, it is clear that long-term care resources must be allocated more cost-effectively. But how? One way would be to develop a better instrument with which to assess elderly individuals seeking services. The federal government requires that states, in addition to assessing financial status, undertake a comprehensive medical/functional evaluation when determining Medicaid nursing home coverage eligibility for current and potential applicants. Each state establishes its own criteria for admission and so, not surprisingly, Snow (1995) found significant variability among the states in the approaches used to determine functional eligibility, including the specific criteria included in their instruments and the thresholds or level of impairment necessary to receive services. O'Keeffe (1996) came to a similar conclusion, observing that "there is no

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commonly accepted practice for determining eligibility for Medicaid LTC [Long-Term Care] waiver programs; each state's health and functional criteria are unique" (p. ii). Some might conclude that such variability calls into question the validity of many states' criteria for identifying individuals most at risk for placement.

In short, the cost-effective allocation of long-term care resources depends, in part, on establishing a more scientific basis for determining eligibility and for making care-planning decisions. This first requires recognizing that elderly people living in the community are at risk for a variety of adverse outcomes and not just nursing home placement. Other especially salient hazards include hospitalization, functional impairment, and mortality. While hospitalization and nursing home use are the most expensive services used by older persons, mortality and functional decline are undesirable and correlated with high service use.

On one hand, current assessment instruments are inadequately grounded in extant research evidence regarding what factors best predict each of these outcomes, although a thorough understanding of these risk factors is indispensable for policy planning, design, and evaluation. On the other hand, budgets are based entirely on estimated cost of providing nursing home care and fail to take risk or the ability of home care to ameliorate risk into account. As a consequence, case managers lack the tools and incentives necessary to prioritize patients and allocate resources effectively. The result is a system in which patients with similar characteristics display widely varying service mixes and intensities and durations in which too many resources are allocated to some and too little to others.

According to Weissert, Chernew, and Hirth (2000), an alternative payment method would encourage case mangers to adjust home care services to patient risks, the value of mitigating those risks, and the efficacy of home care in mitigating those risks. Toward this end we undertook a comparative review and analysis of the literature that empirically assesses the predictors or risk factors associated with nursing home placement, hospitalization, functional impairment, and mortality for elderly people living in the United States.[1]

NEW CONTRIBUTION

Our study is based on a database that we assembled containing 167 multivariate analyses of longitudinal data analysis projects abstracted from close to 80 journal articles published between 1985 and 1998. Unlike prior syntheses that focused only on the predictors of one or two outcomes (e.g., Wingard, Jones, and Kaplan 1987; Shapiro and Roos 1989; de Boer, Wijker, and de Haes 1997; Castle and Mor 1996; Idler and Benyamini 1997), our approach

encompasses multiple outcomes and provides a framework for understanding how predictors of competing hazards correlate. More specifically, it allows us to identify critical similarities and differences in the findings of the predictors of the outcomes studied. For institutionalization and functional impairment, our study provides an overdue update on prior literature reviews (such as Wingard, Jones, and Kaplan [1987] and Shapiro and Roos [1989] for institutionalization and Boult et al. [1994] for functional impairment). For hospitalization and mortality, this project provides the only recent reviews we could find focusing specifically on the elderly (for hospitalization of the chronically ill, see de Boer, Wijker, and de Haes [1997]; for the relationship between self-rated health and mortality, see Idler and Benyamini [1997] and Benyamini and Idler [1999]). Overall, our main objective is to rigorously integrate and conceptually clarify a highly fragmented literature to provide in one easily accessible source information useful to policy makers, researchers, and program and case managers.

First, we describe our search methodology and selection criteria along with descriptive information on the studies chosen. Next, we report the number of abstracted equations with positive significant, negative significant, and nonsignificant associations between each outcome and a set of risk factors organized according to Andersen's behavioral model of health services utilization. We also identify the most consistent positive and negative predictors of each outcome. We conclude with a brief discussion of our findings and their implications.

STUDY SEARCH, SELECTION, AND CHARACTERISTICS

We searched for all articles published since 1985 that empirically test or model the predictors or risk factors of nursing home placement, hospitalization, functional impairment, and mortality. In MEDLINE and HealthSTAR databases we used combinations of the following key words: risk factors, predictors, models, nursing homes, institutionalization, hospitalization, function, activities of daily living (ADLs), instrumental activities of daily living (IADLs), mortality, death, quality of life, long-term care, and health services utilization. We limited all searches to English language articles and the 65 and over cohort. Approximately 400 articles were identified, collected, and examined for other possible sources from their references. These too were collected, resulting in a total of 540 articles, each of which was examined carefully for appropriateness for inclusion in our analysis.

Acceptable studies shared the following criteria: they evaluated the predictors of mortality, functional impairment or decline, and/or the volume of hospital or nursing home use (i.e., admission or length of stay); they were published between 1985 and 1998; and they focused on the 65 and over population in the United States, used longitudinal data and multivariate techniques, and employed sample sizes of 50 or greater. We chose 1985 as our cutoff because we wanted to update rather than overlap prior reviews and further the contemporary applicability of our findings.[2] We eliminated cross-sectional studies because causality is much more easily attributed with longitudinal data, opted to focus on multivariate analyses because unlike univariate approaches they allow investigators to control for the confounding effects of other variables, and required sample sizes greater than 50 because larger samples increase statistical power and tend to be more representative of the populations from which they were drawn.

By employing the aforementioned criteria, 78 articles were selected for in-depth analysis. Table 1 provides a chronological summary of these studies according to whether they used nationally representative data (28 studies) or subnational data sources (50 studies). It shows that investigators chose to focus on a variety of populations, including the community-based elderly (25 national, 31 subnational); nursing home residents, admissions, and discharges (4 national, 10 subnational); and hospital admissions and discharges (1 national, 12 subnational).

Because most nationally representative studies relied on two sources of data—the Longitudinal Study of Aging (1984-1992) and the National Long-term Care Survey (1982-1984)—all but three employed data collected during the 1980s and 1990s and most used 2-year observation periods. Studies using subnational data, on the other hand, relied on a much more eclectic set of sources, including surveys or analyses of nursing homes and Veterans Affairs facilities (7 studies); hospitals, clinics, and health plans (14 studies); regions and communities (23 studies); and Medicaid recipients (3 studies). They also exhibited a wider and more evenly distributed range of study and observation periods.

Sample sizes employed by nationally representative studies ranged from 513 to 18,777, with most falling between 2,000 and 8,000. Sample sizes for subnational studies displayed much more variability (87 to 59,721), with nearly 50 percent (24 studies) employing sample sizes under 1,000 and 44 percent (22 studies) employing sample sizes between 2,000 and 7,000.

Most analyses used logistical regression (47 studies). More recent emphasis on panel designs with time-varying covariates and right-censored

TABLE 1 Longitudinal Studies Using Multivariate Analyses to Predict Institutionalization, Hospitalization, Function, and Mortality for Elderly People (ages 65 and over) since 1985

Author(s)	*Outcomes*	*Population*	*Data Source*	*Study Period*	n
Nationally representative					
Stearns et al. (1996)	H	C	LSOA	1984-1990 (LYOL)	870
Goldman, Korenman, and Weinstein (1995)	I, F, M	C	LSOA	1984-1990 (6 years)	7,478
Murtaugh and Freiman (1995)	H	NH	NMES	1987 (1 year)	2,694
Pacala, Boult, and Boult (1995)	H	C	LSOA	1984-1988 (4 years)	7,527
Wolinsky, Johnson, and Stump (1995)	M	C	LSOA	1984-1992 (8 years)	7,388
Boaz (1994)	F, M	C	NLTCS	1982-1984 (2 years)	5,722
Boaz and Muller (1994)	I, M	C	NLTCS	1982-1984 (2 years)	4,832
Boult et al. (1994)	F, M	C	LSOA	1984-1988 (4 years)	2,605
Dwyer, Barton, and Vogel (1994)	I	C	NLTCS	1982-1984 (2 years)	5,202
Kasper and Shore (1994)	I	C	NLTCS	1982-1984 (2 years)	5,795
Liu, McBride, and Coughlin (1994)	I	C	NLTCS	1982-1984 (2 years)	4,612
Mor et al. (1994)	I, F, M	C	LSOA	1984-1990 (6 years)	7,407
Wolinksy et al. (1994)	H	C	LSOA	1984-1990 (7 years)	7,527
Boult et al. (1993)	H	C	LSOA	1984-1988 (4 years)	5,876
Freiman and Murtaugh (1993)	H, M	NH	NMES	1987 (1 year)	2,790
Wolinsky et al. (1993)	I, M	C	LSOA	1984-1990 (2 years)	3,646
McFall and Miller (1992)	I	C	NLTCS, ICS	1982-1984 (2 years)	751
Pearlman and Crown (1992)	I	C	NLTCS	1982-1984 (2 years)	5,273
Steinbach (1992)	I, M	C	LSOA	1984-1986 (2 years)	5,151
Wolinsky et al. (1992)	I, M	C, NH	LSOA	1984-1988 (4 years)	5,151
Liu, Coughlin, and McBride (1991)	I, M	C, NH	NLTCS	1982-1984 (2 years)	5,795
Speare, Avery, and Lawton (1991)	I	C	LSOA	1984-1986 (2 years)	5,151
Wolinsky and Johnson (1991)	I, M	C	LSOA	1984-1986 (2 years)	4,603
Hanley et al. (1990)	I	C	NLTCS	1982-1984 (2 years)	18,777
Newman et al. (1990)	I	C	NLTCS, AHS	1978-1984 (2 years)	3,352
Harris et al. (1989)	F	C	LSOA	1984-1986 (2 years)	513
Cohen, Tell, and Wallack (1986)	I	C	Medicare survey	1977-1978 (1 year)	4,400

TABLE 1 Continued

Author(s)	*Outcomes*	*Population*	*Data Source*	*Study Period*	n
Nationally representative					
Anderson and Steinberg (1985)	H	H	Medicare/ AHA	1974-1977 (2 months)	21,043
Subnational					
Porell et al. (1998)	F, M	NH	Mass. NHs	1991 (3 months)	11,779
Berlowitz et al. (1997)	M	NH	VA data	1993 (6 months)	19,619
Fried and Mor (1997)	H	NH	Nursing homes	1991-1994 (6 months)	3,782
Ganzini et al. (1997)	M	H	VA setting	1990-1995 (2.5 years)	100
Mendes de Leon et al. (1997)	F, M	C	EPESE	1982-1992 (6 years, 8 years)	6,884
Bauer (1996)	I	C	AZLTC system	1989-1992 (4 years)	2,923
Freedman (1996)	I	C	EPESE	1982-1989 (7 years)	2,812
Freedman et al. (1996)	H	C	Health plan	1993-1994 (4.5 months)	3,745
Rudberg, Sager, and Zhang (1996)	I	H	5 hospitals	NR (HD)	1,265
Sager et al. (1996)	F	H	6 hospitals	1990-1993 (HD)	448
Satish et al. (1996)	I, H, M	H	VA (California)	1990-1991 (1 year)	508
Thomas et al. (1996)	M	H	Teaching hospital	1988-1992 (1 year)	286
D'Agostino et al. (1995)	I	C	Framingham	1981-1989 (6 years)	2,104
Temkin-Greener and Meiners (1995)	I, M	C, NH	Monroe, New York	1984-1990 (4 years, 5 years)	59,721
Bruce et al. (1994)	F	C	EPESE	1988-1990 (2.5 years)	1,040
Guralnik et al. (1994)	I, M	C	EPESE	1988-1990 (2.5 years)	5,174
Keller and Potter (1994)	M	C	Geriatric clinic	1986-1993 (25 months)	606
Kelman et al. (1994)	M	C	Bronx, New York	1984-1989 (4 years)	1,855
Kiel et al. (1994)	H, M	NH	43 NHs	1984-1988 (1 month)	2,556
Montgomery and Kosloski (1994)	I	C	Seattle	1985-1991 (44 months)	531
Seeman et al. (1994)	F	C	EPESE	1988-1991 (3 years)	843
Tatemichi et al. (1994)	M	H	New York medical center	1988-1993 (5 years)	251
Aneshensel, Pearlin, and Schuler (1993)	I, M	C	California Caregivers	NR (2 years)	555

(continued)

TABLE 1 Continued

Author(s)	*Outcomes*	*Population*	*Data Source*	*Study Period*	n
Subnational					
Engle and Graney (1993)	M	NH	8 NHs	NR (3 months, 6 months)	647
Greene, Lovely, and Ondrich (1993)	I	C	NLTCCD	1982-1984 (1 year)	3,446
Guralnik et al. (1993)	F	C	EPESE	1981-1987 (4 years)	6,981
Inouye et al. (1993)	F	H	Teaching hospital	1989-1990 (HD)	188
Salive et al. (1993)	I	C	EPESE	1986-1990 (3 years)	4,074
Cohen et al. (1992)	M	H	Medical center	1983-1986 (2 years)	167
Foley et al. (1992)	I	C	EPESE	1982-1985 (3 years)	9,597
Jette et al. (1992)	I	C	Mass. study	1974-1985 (10 years)	1,625
Reuben et al. (1992)	M	C	UCLA faculty	1984-1988 (51 months)	282
Braun, Rose, and Finch (1991)	I, F, M	C, NH	Hawaii Medicaid	1987 (6 months)	352
Kellogg et al. (1991)	H	H	New York hospital	1987 (6 months)	502
Binder and Robins (1990)	H	C	NIMH-ECA	NR (1 year)	4,301
Coughlin, McBride, and Liu (1990)	I	C	NLTCCD	1982-1984 (1 year)	3,170
Ford et al. (1990)	M	C	Cleveland	1975-1984 (9 years)	1,595
Greene and Ondrich (1990)	I	C	NLTCCD	1982-1984 (1 year)	3,332
Kelman and Thomas (1990)	I, M	C, NH	Bronx, New York	1984-1989 (3 years)	1,584
Magaziner et al. (1990)	F	H	7 Baltimore hospitals	1984-1987 (1 year)	535
Markides and Lee (1990)	F	C	San Antonio	1976-1984 (8 years)	254
Pollak et al. (1990)	I, M	C	Bronx, New York	1985-1989 (3.5 years)	2,186
Lewis et al. (1989)	H, M	NH	45 Southern California SNF	1984-NHD	814
Cohen, Tell, and Wallack (1988)	I	C	6 CCRC	1960-1983 (5 years)	3,316
Hughes et al. (1988)	M	C	5 Chicago hospitals	1977-1981 (4 years)	313
Weissert and Cready (1988)	H	H	3 Charlotte hospitals	6 months pre/ post-PPS	808
Fethke, Smith, and Johnson (1986)	H	H	Teaching hospital	1983-1984 (1 year)	87
Nocks et al. (1986)	I	C	SCCLTCP	1981-1983 (18 months)	624

TABLE 1 Continued

Author(s)	*Outcomes*	*Population*	*Data Source*	*Study Period*	n
Subnational					
Lewis et al. (1985)	M	NH	24 Southern California NH	1980-1982 (NHD/2 years)	563
Palmore, Nowlan, and Wang (1985)	F	C	OARS and Duke	1972-1983 (11 years)	295

Note: For outcomes, H = hospitalization, I = institutionalization, F = function, M = mortality; for population, C = community, H = hospital, NH = nursing home; for data source, LSOA = Longitudinal Study of Aging, NMES = National Medical Expenditure Survey, NLTCS = National Long-Term Care Survey, ICS = Informal Caregiver Survey, AHS = American Housing Survey, AHA = American Hospital Association Annual Survey of Hospitals, VA = Veteran Affairs, EPESE = Established Populations for Epidemiologic Studies of the Elderly, AZLTC = Arizona Long-Term Care, NLTCCD = National Long-Term Care Channeling Demonstration, NIMH-ECA = National Institute of Mental Health Epidemiologic Catachment Area Program, SNF = Skilled Nursing Facilities, CCRC = Continuing Care Retirement Communities, SCCLTCP = South Carolina Community Long-Term Care Project, OARS = Older Americans Resources and Services; and for study period, LYOL = last year of life, NR = not reported, HD = hospital discharge, NHD = nursing home discharge, PPS = Prospective Payment System.

observations, however, has led many to use Cox proportional hazard or other duration model techniques (23 studies).

EQUATIONS AND ABSTRACTION METHODOLOGY

From the 78 studies selected, we abstracted 167 multivariate equations or analyses evaluating the predictors of institutionalization (59 equations: 24 national, 35 subnational), hospitalization (22 equations: 11 national, 11 subnational), function (32 equations: 8 national, 24 subnational), and mortality (54 equations: 15 national, 39 subnational).[3] There are a number of reasons why we chose the equation and not the study as our unit of analysis. First, 22 articles estimated separate models for 2 or more of the outcomes of interest. Second, many reported more than one analysis per outcome, either because they estimated the same model for different subgroups (e.g., males and females) and populations (e.g., rural, small city, and urban) or employed multiple dependent variables indicative of the same outcome domain (e.g., any nursing home stay, short-term stay, and long-term stay). While a few

estimated the same model over different time periods (e.g., Fethke, Smith, and Johnson 1986), a handful analyzed the same dependent variable but with a fundamentally different set of predictors (e.g., Boaz and Muller 1994). In the few instances in which a study reported an increasingly comprehensive series of analyses, we selected the analysis that included the most inclusive set of predictors (e.g., Wolinsky, Johnson, and Stump 1995). It should be stressed that we accounted only for those predictors that appeared on the right-hand side of the multivariate analyses abstracted and excluded those analyses in which researchers only reported the odds ratios for some right-hand-side variables but not others.

A result was considered significant if it exhibited a p value less than .05. Results were recorded so that they predicted an increased likelihood of the outcomes studied. In some cases we had to reverse the sign on all coefficients because they predicted, say, survival rather than mortality (e.g., Porell et al. 1998) or physical ability rather than decline (e.g., Harris et al. 1989). Signs also had to be reversed when individual risk factors were coded in a direction opposite to what we were recording (e.g., males = 1, females = 0 rather than females = 1, males = 0). Sometimes we had to collapse the results reported to align them with the predictor domains used in this review. This dilemma was frequently posed with the inclusion of categorical variables (e.g., age 75-79, 80-84, etc.) or when multiple variables measured closely related concepts (e.g., "ever hardened arteries," "ever had heart attack"). With the introduction of multiple categories or related variables, some could end up positive, others negative, and still others nonsignificant. In the vast majority of cases, however, the coefficients on such categories or variables achieved the same sign. In the few where they did not, we made a case-by-case determination regarding their direction (see Miller 1999 for details).

Before continuing we would like to point out some similarities and differences between our study and a meta-analysis. Like a meta-analysis, our approach uses quantitative methods to efficiently summarize research findings drawn from a rather extensive literature. This has afforded us the opportunity to integrate the findings from a large collection of analyses and to reach stronger conclusions regarding the relationship between the predictors and outcomes studied than would have been the case through a casual, narrative discussion of the articles reviewed. Meta-analyses, however, rely on a well-developed methodology for pooling data from multiple studies to improve the accuracy of findings about the relationship between two variables, such as that between an intervention and an outcome. In doing so, they typically rely on statistical methods for combining the results of individual studies to generate more valid and reliable estimates of statistical significance

and effect size (Wolf 1986). What distinguishes our approach from a meta-analysis is that we focus on the consistency of findings across studies concerning direction only. In doing so, we essentially report data replicating analyses of the predictors of the outcomes analyzed. Through replicated studies using different data sets, we increase confidence that the findings are "real robust" and not a statistical fluke or the result of location variation.

ORGANIZING FRAMEWORK

We organize predictors according to Andersen's behavioral model, which posits that health behaviors are a function of predisposing, enabling, and need characteristics (Andersen and Newman 1973; Andersen 1995). We chose Andersen's framework because it is the most widely employed model and has long been used to explain the use of health services by the elderly (Evashwick et al. 1984) and other populations (Andersen and Aday 1978; Gelberg, Andersen, and Leake 2000). It is also the conceptual model most often used by the studies included in this review.[4] The model posits that individuals' use of health services and subsequent health outcomes are a function of their predisposition to use services, their ability to secure those services, and their state of illness. Predisposing characteristics (the most distal cause of health services use) include demographic, social support, and health belief indicators, whereas need (the most proximate cause) includes indicators of self-perceived and practitioner-evaluated health. Enabling characteristics, which have a more moderate effect, include indicators of familial and community resources, the latter of which we divide into facility resources and market and policy resources. Recent formulations of the behavioral model recognize that use may affect outcomes that in turn influence subsequent predisposing and enabling factors, need, and health behavior (Andersen 1995; Gelberg, Andersen, and Leake 2000). Figure 1 visually depicts the behavioral model, while Table 2 categorizes the particular predictors abstracted according to Andersen's general categories. Table 2 also reports the number of positive significant, negative significant, and nonsignificant associations between each outcome and predictor. Following Wolinksy, Johnson, and Stump (1995), we also include a domain indicative of health services use at baseline.

Some predictors are analyzed much more frequently than others. Among predisposing characteristics, indicators of health beliefs such as healthy behaviors and feelings of personal control are particularly lagging, whereas certain demographic and social support indicators are well represented (e.g., age, gender, race, living arrangement, and marital status). With a few exceptions (e.g., income and educational level), enabling characteristics are studied

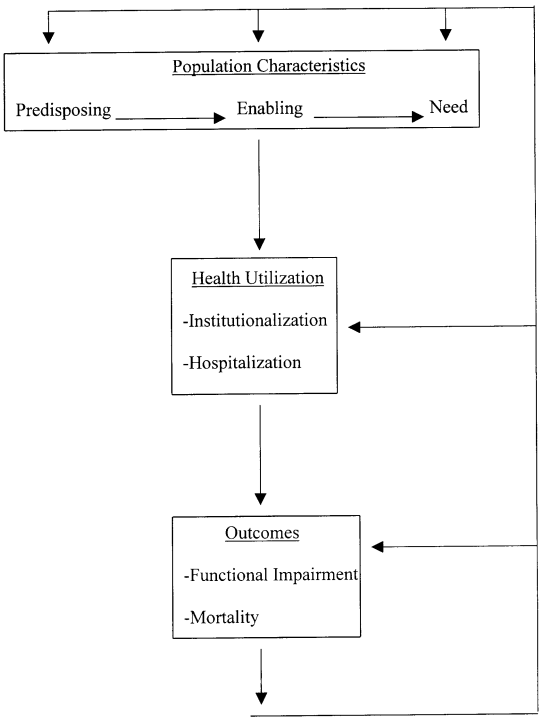

FIGURE 1 Andersen's Behavioral Model
Source: Adaptation of Figure 1 appearing in Gelberg, Andersen, and Leake (2000).

much less frequently than many predisposing and need-based characteristics. This is particularly true regarding indicators of facility, market, and policy resources. Scale-based measures of physical and cognitive functioning (e.g., ADLs, Short Portable Mental Status Questionnaire [SPMSQ]) are the most frequently employed indicators of need. Less frequently used are disease diagnoses, though some (e.g., heart, stroke, cancer, fractures, and dementia) are more commonly used than others (e.g., digestive, genito-urinary, and pressure ulcers). Overall, need-based characteristics appear more frequently than the other two Andersen model elements. While certain indicators of baseline use are relatively common (e.g., hospital, nursing home, and formal care), others are only rarely included on the right-hand side of the analyses studied (e.g., physician, medications, and services).

TABLE 2 Number of Equations (*n*) Reporting Positive Significant (+), Negative Significant (–), and Nonsignificant (*ns*) Associations among Predictors and Adverse Outcomes

	Institutionalization				*Hospitalization*				*Functional Impairment*				*Mortality*			
Predictor	n	+	–	ns	n	+	–	ns	n	+	–	ns	n	+	–	ns
Predisposing																
Demographic																
Age	55	*42*	2	11	20	6	5	*9*	30	*21*	0	9	50	*34*	1	15
Female	47	2	5	*40*	20	0	*12*	8	24	3	2	*19*	37	1	*26*	10
Nonwhite	33	0	*28*	5	11	2	2	*7*	16	1	0	*15*	25	1	2	*22*
Social support																
Living alone	41	*26*	0	15	13	0	2	*11*	1	0	0	*1*	16	1	1	*14*
Married	21	0	8	*13*	9	0	1	*8*	12	0	2	*10*	17	1	0	*16*
Greater familial support	15	1	6	*8*	5	1	0	*4*	4	0	1	*3*	15	2	4	*9*
Informal caregiver	16	*9*	1	6	2	*2*	0	0	1	0	0	*1*	4	0	1	*3*
Greater caregiver support	6	0	*4*	2	3	*1*	*1*	*1*	0	—	—	—	7	1	2	*4*
Greater social activity	2	0	*2*	0	0	—	—	—	4	0	*3*	1	5	0	*4*	1
Telephone	4	1	0	*3*	0	—	—	—	3	0	*2*	1	3	0	0	*3*
Health beliefs																
Greater personal control	5	*4*	0	1	1	0	0	*1*	1	0	0	*1*	4	*2*	0	*2*
Poor behavior	4	0	0	*4*	1	0	0	*1*	7	0	0	*7*	6	*5*	0	1
Higher body mass	2	0	0	*2*	0	—	—	—	3	*3*	0	0	5	0	*4*	1
Enabling																
Familial resources																
Low income	34	1	4	*29*	7	0	1	*6*	12	*8*	0	4	20	6	1	*13*
Not homeowner	15	*8*	0	7	0	—	—	—	2	0	0	*2*	3	1	0	*2*
Assets	3	0	0	*3*	0	—	—	—	0	—	—	—	0	—	—	—
Lower education	5	0	0	*5*	7	1	0	*6*	17	4	2	*11*	20	2	1	*17*
Greater residential stability	6	1	1	*4*	3	0	0	*3*	0	—	—	—	0	—	—	—
Medicaid	11	4	0	*7*	6	2	0	*4*	1	0	0	*1*	9	0	2	*7*
Private insurance	3	1	0	*2*	6	0	0	*6*	3	0	0	*3*	11	0	2	*9*
Medicare	0	—	—	—	3	1	0	*2*	0	—	—	—	2	0	0	*2*
Facility resources																
Private ownership	0	—	—	—	2	*2*	0	0	1	0	0	*1*	4	0	0	*4*
SNF certification	0	—	—	—	2	0	*1*	*1*	0	—	—	—	3	*2*	0	1
Number of facility beds	0	—	—	—	2	0	*1*	*1*	1	0	0	*1*	2	0	0	*2*
Price/revenue	0	—	—	—	1	0	*1*	0	0	—	—	—	2	0	0	*2*
Staffing	0	—	—	—	1	0	0	*1*	0	—	—	—	2	0	*1*	*1*
Facility case mix	0	—	—	—	0	—	—	—	1	0	*1*	0	1	0	*1*	0

(continued)

TABLE 2 Continued

Predictor	*Institutionalization*				*Hospitalization*				*Functional Impairment*				*Mortality*			
	n	+	−	ns	n	+	−	ns	n	+	−	ns	n	+	−	ns
Enabling																
Market/policy resources																
Urban	6	1	1	*4*	6	0	1	*5*	0	—	—	—	4	0	0	*4*
Northeast region	0	—	—	—	7	1	0	*6*	0	—	—	—	1	0	0	*1*
Number of NH beds	7	*4*	0	3	4	0	0	*4*	0	—	—	—	1	0	0	*1*
Hospital beds	0	—	—	—	4	0	0	*4*	0	—	—	—	1	0	0	*1*
Home health visits	3	0	0	*3*	0	—	—	—	0	—	—	—	0	—	—	—
State policy	4	1	0	*3*	1	0	0	*1*	0	—	—	—	1	*1*	0	0
Payment rate	4	0	*2*	*2*	0	—	—	—	0	—	—	—	0	—	—	—
Case mix	3	0	*2*	1	0	—	—	—	0	—	—	—	0	—	—	—
Need																
Self-perceived																
Lower self-rated	22	*7*	1	*14*	9	*5*	1	3	8	*5*	1	2	15	6	0	*9*
Lower life satisfaction	1	0	0	*1*	3	*2*	0	1	0	—	—	—	0	—	—	—
Practitioner evaluated																
Physical function																
Lower ADL	49	*36*	1	12	14	5	2	*7*	15	*9*	0	6	41	*27*	0	14
Lower IADL	19	*12*	1	6	6	1	0	*5*	6	*6*	0	0	10	*5*	0	*5*
Lower other physical	14	*7*	1	6	7	*5*	0	2	18	8	0	*10*	12	*10*	0	2
Incontinence	2	0	0	*2*	4	1	0	*3*	2	*2*	0	0	6	2	0	*4*
Bed disability	5	1	0	*4*	6	0	0	*6*	0	—	—	—	6	1	1	*4*
Cognitive function																
Lower cognitive scale	33	*25*	0	8	1	0	0	*1*	15	*7*	0	*8*	29	10	1	*18*
Disorientation/ behavior problems	9	*5*	0	4	5	1	0	*4*	0	—	—	—	5	2	0	*3*
Disease																
Heart/circulatory	15	4	2	*9*	13	*9*	0	4	17	3	1	*13*	20	*1*	0	*1*
Cerebrovascular	14	2	2	*10*	9	0	0	*9*	13	5	0	*8*	18	*9*	0	*9*
Hypertension	3	0	*2*	1	5	0	0	*5*	12	4	1	*7*	5	1	0	*4*
Neoplasms	17	0	2	*15*	13	2	1	*10*	14	*6*	2	*6*	18	*15*	0	3
Hip/other fractures	9	3	0	*6*	6	0	1	*5*	6	1	0	*5*	16	3	1	*12*
Musculoskeletal	4	0	*2*	*2*	6	1	0	*5*	13	2	0	*11*	8	1	2	*5*
Respiratory	11	0	3	*8*	7	3	0	*4*	9	*5*	0	4	10	*5*	0	*5*
Nervous/sense	7	3	0	*4*	5	1	0	*4*	4	1	0	*3*	7	1	*3*	*3*
Depression/mental	9	4	0	*5*	6	1	1	*4*	5	*4*	1	0	11	4	1	*6*
Dementia/ Alzheimer	10	*5*	0	*5*	5	1	*2*	*2*	9	3	0	*6*	13	1	1	*11*
Diabetes/metabolic	3	1	0	*2*	9	*6*	0	3	16	*11*	0	5	8	*5*	0	3
Digestive	6	*4*	0	2	2	*1*	0	*1*	2	0	*1*	*1*	2	0	0	*2*

TABLE 2 Continued

Predictor	*Institutionalization* n	+	−	ns	*Hospitalization* n	+	−	ns	*Functional Impairment* n	+	−	ns	*Mortality* n	+	−	ns
Practitioner evaluated Disease																
Genito-urinary	1	0	0	*1*	4	*2*	0	*2*	1	0	0	*1*	5	1	0	*4*
Pressure ulcer	0	—	—	—	3	1	0	*2*	1	*1*	0	0	3	*2*	0	1
Symp/signs/ill-def	4	1	0	*3*	2	0	0	*2*	1	0	0	*1*	4	1	1	*3*
Falls	1	0	0	*1*	3	0	0	*3*	2	*2*	0	0	0	—	—	—
Number/severity of illness	5	2	0	*3*	5	2	0	*3*	7	*5*	0	0	16	*9*	0	7
Use																
Prior hospital	24	*12*	2	10	16	*9*	0	7	4	*4*	0	0	14	*9*	0	5
Days hospitalized	0	—	—	—	1	0	0	*1*	4	*4*	0	0	2	*1*	0	*1*
Prior/current NH	23	*18*	0	5	6	1	1	*4*	10	0	0	*10*	18	6	2	*10*
NH length of stay	0	—	—	—	3	0	*2*	1	1	*1*	0	0	2	0	*1*	*1*
Medical procedures/ services	6	1	0	*5*	4	*2*	*2*	0	3	1	0	*2*	6	1	0	*5*
Paid helpers	32	*17*	4	11	1	0	0	*1*	0	—	—	—	15	*10*	1	4
Physician	3	0	1	*2*	6	*5*	0	1	0	—	—	—	6	1	0	*5*
Number of medications	2	*2*	0	0	4	1	0	*3*	6	0	0	*6*	4	1	0	*3*

Note: SNF = skilled nursing facility, NH = nursing home, ADL = activity of daily living, IADL = instrumental activity of daily living, Symp/signs/ill-def = symptoms, signs, and other ill-defined conditions. Each predictor-outcome combination number is italicized (positive significant, negative significant, or nonsignificant) with the predominance of findings. In those few instances in which a tie exists, both numbers are italicized.

PREDICTOR RESULTS

We had considered reporting our results separately for studies using nationally representative and other data sources, but doing so would have been terribly cumbersome given the 69 predictors reviewed here. Nevertheless, we were still interested in obtaining a rough indication as to whether the pattern of findings differed for national and subnational data sources. For each outcome, therefore, we estimated a series of Pearson correlations to assess whether a statistically significant association existed among national and subnational studies with regard to the percentage of positive significant, negative significant, and nonsignificant results across the 69 predictors examined. Take nursing home placement, for example. First, we separated our

findings by data source, national and subnational. For each of the 69 predictors examined, we next calculated (1) the percentage of positive significant findings as a proportion of total national findings, (2) the percentage of positive significant findings as a proportion of total subnational findings, and (3) a Pearson correlation evaluating the association between these two groupings. We repeated this process for negative significant and nonsignificant findings and, of course, for the remaining three outcomes.

In short, a modest statistically significant association could be discerned between the percentage of positive significant results and negative significant results of national and subnational studies for institutionalization (.398***, .570***), functional impairment (.675***, .454**) and mortality (.555***, .251*).[5] For mortality we also found a modest statistically significant association for the percentage of equations reporting nonsignificant results (.319**). Hospitalization was the major exception, as no association was found between nationally representative and subnational results.

Combining national and subnational findings (see Table 2), the following reports our overall assessment of the relationship between each outcome and predictor.

PREDISPOSING CHARACTERISTICS

Demographics. Increasing age appears to be a strong and consistent predictor of institutionalization (76 percent or 42/55 equations), functional impairment (70 percent, 21/30), and mortality (68 percent, 34/50).[6] Results for hospitalization were inconsistent, though when limited to national studies a positive relationship between age and hospitalization could be discerned.

Most results indicate that an inverse relationship exists between being female and hospitalization (60 percent, 12/20) and mortality (70 percent, 26/37). Though 40 of 47 equations (85 percent) reported no significant relationship between female gender and nursing home placement, 5 out of 7 significant findings indicate that a negative relationship may exist (10.6 percent overall, 5/47). The relationship between gender and function is unclear.

All significant equations report that being nonwhite decreases the likelihood of institutionalization (84.8 percent overall, 28/33). On the other hand, virtually all results reveal no impact of being nonwhite on functional impairment (93.8 percent, 15/16) or on the likelihood of dying (88 percent, 22/25). No definitive conclusions could be made with respect to hospitalization, though interestingly both positive results came from subnational studies (18.2 percent, 2/11) while both negative results came from national studies (18.2 percent, 2/11).

Living alone was studied most frequently with respect to nursing home placement and the significant findings are unequivocal: living alone increases the risk of this outcome (63 percent, 26/41). It does not, however, appear to be a reliably significant predictor of the other outcomes. The literature is virtually unanimous in reporting no relationship between marital status and mortality (94 percent, 16/17), hospitalization (89 percent, 8/9), and function (83.3 percent, 10/12). Significant findings indicate that it may reduce the risk of nursing home placement (38.1 percent, 8/21), however. Greater familial support does not appear to be a strong predictor of any of the outcomes, though 6 out of 7 significant results (40 percent, 6/15) indicate that it may decrease the likelihood of institutionalization and 4 out 6 significant results (27 percent, 4/15) indicate that it may be associated with a reduced risk of dying. Having an informal caregiver, on the other hand, is associated with an increased risk of institutionalization in 9 of the 10 significant results reported (56 percent, 9/16) while being little examined with respect to the other three outcomes. Finally, greater caregiver support may be associated with a lower risk of institutionalization (67 percent, 4/6), while more frequent social activities (100 percent, 2/2) may be associated with a reduced risk of functional impairment (75 percent, 3/4) and mortality (80 percent, 4/5).

Though few studies included greater personal control, significant results indicate that it may be associated with an increased risk of institutionalization (80 percent, 4/5) and mortality (50 percent, 2/4). Poor health behaviors (e.g., inadequate nutrition and exercise, smoking, and alcohol consumption) also exhibit a positive relationship with mortality (83 percent, 5/6), though not with the other three outcomes. Not surprisingly, body mass displays a positive significant association with functional impairment (100 percent, 3/3); unexpectedly, it displays an inverse association with death (80 percent, 4/5).

ENABLING CHARACTERISTICS

The vast majority of results report no significant relationship between income and institutionalization (85 percent, 29/34) and hospitalization (86 percent, 6/7). Though most mortality results also show no relationship (65 percent, 13/20), 6 of 7 significant results intimate that it may be positively associated with low income. All significant function results are positive (67 percent, 8/12). Not owning a home, on the other hand, is associated with an increased risk of institutionalization in most equations (53 percent, 8/15), while its association with the other three outcomes remains to be examined thoroughly. For the most part, level of education did not prove to be a significant predictor of institutionalization (10 percent, 5/5), hospitalization (86

percent, 6/7), and mortality (85 percent, 17/20). Though it also failed to achieve significance in most function analyses (65 percent, 11/17), 4 positive and 2 negative significant results were reported. Greater residential stability does not appear to have a statistically significant impact on either hospitalization or mortality.

Most studies failed to find a relationship between insurance status and any of the outcomes studied. Nevertheless, the significant findings are unanimous. They show that Medicaid enrollment and eligibility may be associated with an increased risk of institutionalization (36.4 percent, 4/11) and hospitalization (33 percent, 2/6) and a decreased risk of dying (29 percent, 2/9). The few significant private insurance findings also report a positive association with institutionalization (33 percent, 1/3) and a negative association with death (18.2 percent, 2/11).

Nursing home facility characteristics are irrelevant to the likelihood of nursing home placement. However, they can be quite important in determining outcomes of those already residing in a nursing home. Only five studies, however, contributed findings pertinent to the remaining three outcomes: hospitalization, functional impairment, and mortality.

At the market level, no study examined the relationship between market and policy variables and functional impairment. And besides four nonsignificant findings regarding the relationship between urban/rural location and mortality, only a handful have examined the relationship between these variables and mortality either.

The relative impact of market and policy indicators was more often studied with respect to nursing home placement and hospital admission. In particular, most studies found no relationship between urban residency and these two outcomes (67 percent, 4/6; 83.3 percent, 5/6). Only one study found a positive significant relationship between hospitalization and geographic region (14.2 percent, 1/7). No study examined the relationship between region and institutionalization.

Four of seven studies identified a positive relationship between nursing home bed supply and the risk of nursing home placement (57.1 percent, 4/7). No analysis, on the other hand, found a relationship between the number of Medicare home health visits and institutionalization, and no study examined institutionalization with respect to hospital bed supply. Likewise, no analysis found a relationship between nursing home bed supply or hospital bed supply and hospitalization, while no study examined it with respect to the number of Medicare home health visits.

Few studies examined the relationship between state policy, nursing home placement, and hospitalization. Of those that did, only one yielded a significant result. In particular, Liu, Coughlin, and McBride (1991) found that

individuals living in states that prescreen expected Medicaid eligibles were more likely to be institutionalized than those living in states that do not prescreen. Finally, analyses indicate that individuals living in states with higher Medicaid nursing home reimbursement rates were less likely to enter a nursing home than those living in states with lower rates (50 percent, 2/4). Case mix also appeared to make a difference in the risk of institutionalization in two of the three instances in which it was examined (67 percent).

NEED

With few exceptions, most significant results indicate that worse self-rated health is associated with an increased risk of institutionalization (32 percent, 7/22), hospitalization (56 percent, 5/9), functional impairment (63 percent, 5/8), and mortality (40 percent, 6/15). It should be pointed out, however, that there was a rather large percentage of nonsignificant findings for institutionalization (54 percent, 14/22) and mortality (60 percent, 9/15). Few studies included life satisfaction on the right-hand side of their analyses. Worse satisfaction scores appear to be associated only with hospitalization (67 percent, 2/3).

Approximately three times as many equations examined the relationship between ADL scores and institutionalization and mortality than hospitalization and function. With few (if any) contradictory findings, an overwhelming number found that worse ADL scores are correlated with an increased risk of nursing home placement (74 percent, 36/49), death (66 percent, 27/41), and functional impairment (60 percent, 9/15). Five out of 7 significant results for hospitalization also revealed a positive association with worse ADL performance (36 percent overall, 5/14).

As with worse ADLs and self-rated health, the majority of institutionalization (63 percent, 12/19), functional impairment (100 percent, 6/6), and mortality (50 percent, 5/10) analyses reveal a positive significant association with worse IADL scale performance—though as with self-rated health, mortality also yielded a high percentage of nonsignificant findings (50 percent, 5/10). Hospitalization does not appear to be related to the level of IADL impairment (83 percent, 5/6).

A number of studies use a diverse array of physical function measures in addition to or in place of ADLs, IADLs, incontinence, and disability. Examples include upper and lower body limitations, activity, disability status, and various non-ADL-based scales. With only one contradictory finding from the institutionalization literature, significant findings indicate that worse performance on these measures is correlated with an increased risk of nursing home placement (50 percent, 7/14), hospitalization (71 percent, 5/7), functional

impairment (45 percent, 8/18), and death (83 percent, 10/12). We observe a comparatively high percentage of nonsignificant findings for function (56 percent, 10/18), however. In comparison, only a handful of studies analyzed the relationship between the four outcomes and incontinence and bed disability. Most indicate no significant relationship, though incontinence may be positively related to decline in functional impairment (100 percent, 2/2) and mortality (33 percent, 2/6).

As with ADLs, more equations examined the relationship between cognitive scale performance on the SPMSQ and Mini-Mental State Examination (MMSE) and mortality and nursing home placement than hospitalization and function. Other than 8 nonsignificant findings, worse performance unanimously predicted an increased likelihood of institutionalization (76 percent, 25/33). And although most mortality and function results proved nonsignificant, 10 out of the 11 significant results for mortality (35 percent overall, 10/29) and all 7 of the significant results for function (47 percent, 7/15) indicated that worse cognitive scale score increased the risk of these outcomes as well. There was only one nonsignificant hospitalization entry.

Not nearly as many studies operationalized cognitive function using disorientation/problematic behavior. On the one hand, the majority of institutionalization findings agree with the cognitive scale results in reporting a direct relationship between this outcome and disorientation and problematic behavior (57 percent, 5/9). The few significant hospitalization (20 percent overall, 1/5) and mortality (40 percent, 2/5) findings are also positive. No function study examined this risk factor.

Heart and other circulatory conditions (*International Classification of Diseases–Clinical Modification* [*ICD-9-CM*] 1980, 390-459) include rheumatic, valvular, and coronary heart disease in addition to myocardial infarction, angina, and atherosclerosis. Most analyses found no relationship between heart conditions and institutionalization (60 percent, 9/15) and functional impairment (77 percent, 13/17), though the balance of significant findings indicates that a direct relationship may indeed exist. This is clearly true with the other two outcomes, as all significant results indicate that the presence of a heart or circulatory problem increases the risk of both hospitalization (69 percent, 9/13) and death (50 percent, 10/20). Cerebrovascular disease (*ICD-9-CM* 1980, 430-38), on the other hand, exhibits no clear or consistent relationship with institutionalization and hospitalization. All significant entries indicate that it may be directly correlated with worse functional performance (39 percent, 5/13) and death (50 percent, 9/18), however.

Hypertension (*ICD-9-CM* 1980, 401-5) was studied much less frequently than cerebrovascular or heart and circulatory disease more generally. Still, it is

informative to observe that two of three institutional analyses report an inverse association with high blood pressure (67 percent), while four of five significant function findings report a direct association (33 percent, 4/12). The only significant mortality finding was positive (20 percent, 1/5). No hospital analysis proved significant (100 percent, 5/5).

Most analyses report a nonsignificant relationship between neoplasms (*ICD-9-CM* 1980, 140-239) and nursing home placement (88 percent, 15/17) and hospitalization (77 percent, 10/13). Alternatively, six of eight significant function entries report a direct relationship between cancer and impairment (42 percent overall, 6/14), while all 10 significant mortality results do so as well (50 percent, 10/20).

Most analyses indicate that hip fractures and other injuries (*ICD-9-CM* 1980, 800-899) are not correlated with any of the outcomes studied. Focusing on the statistically significant findings, however, yields the impression that such fractures and injuries may reduce the risk of hospitalization, while increasing the risk of the remaining three outcomes.

Diseases of the musculoskeletal system (*ICD-9-CM* 1980, 710-39) refers primarily to arthritis and osteoporosis. In most analyses they are not associated with any of the outcomes studied. Still, all of the significant associations with hospitalization (17 percent, 1/6) and function (15 percent, 2/13) are positive, while all the significant associations with nursing home entry are negative (50 percent, 2/4).

Respiratory conditions (*ICD-9-CM* 1980, 460-519) include emphysema, bronchitis, pneumonia, chronic obstructive pulmonary disease (COPD), and other disorders that make breathing difficult. Though a number of nonsignificant findings are reported, none of the significant entries are contradictory. In this regard, respiratory conditions are associated with a reduced risk of institutionalization (27 percent, 3/11) and an increased risk of hospitalization (43 percent, 3/7), functional impairment (56 percent, 5/9), and mortality (50 percent, 5/10).

Diseases of the nervous system include Parkinson's and multiple sclerosis (among others). Most analyses report no significant relationship between these conditions and institutionalization (47 percent, 4/7), hospitalization (80 percent, 4/5), and function (75 percent, 3/4), though the few significant analyses indicate that the relationship may be positive. The mortality results are contradictory.

Depression and other mental disorders (*ICD-9-CM* 1980, 290-319) mainly encompass measures of depression and the severity of depressive symptoms, but also include more general indicators of psychiatric diagnosis. The majority of nursing home, hospital, and mortality entries report no association with

depression. Still, most significant findings indicate that it may increase the risk of functional impairment (80 percent, 4/5), institutionalization (44 percent, 4/9), and mortality (36 percent, 4/11).

Dementia and Alzheimer's disease (*ICD-9-CM* 1980, 290, 331.0) may increase the risk of institutionalization (50 percent, 5/10) and functional impairment (33 percent, 3/9) according to every significant finding reported for each. The few hospitalization findings are inconclusive, whereas the vast majority of mortality entries report a nonsignificant association (85 percent, 11/13).

Most studies report that the presence of diabetes or another metabolic disorder (*ICD-9-CM* 1980, 240-79) is associated with an increased risk of hospitalization (67 percent, 6/9), functional impairment (69 percent, 11/16), and mortality (63 percent, 5/8). Few analyses explore its relationship with institutionalization. Digestive system diseases (*ICD-9-CM* 1980, 520-79), on the other hand, appear correlated with an increased risk of institutionalization (67 percent, 4/6). Very few studies, however, examined its association with the remaining three outcomes. Similarly, only a handful of significant results were reported for genito-urinary diseases (*ICD-9-CM* 1980, 580-629); pressure ulcers (*ICD-9-CM* 1980, 707); symptoms, signs, and ill-defined conditions (e.g., sleep problems, comas; *ICD-9-CM* 1980, 780-99); and falls.

Finally, illness severity has been measured using severity indexes such as APACHE in addition to other approaches (e.g., estimated remaining life expectancy). Number of illnesses, on the other hand, simply refers to the number of medical, chronic, or secondary diagnoses. Though some nonsignificant findings have been reported for each outcome, every significant finding suggests that the more severely ill have a higher risk of institutionalization (40 percent, 2/5), hospitalization (40 percent, 2/5), functional impairment (71 percent, 5/7), and mortality (56 percent, 9/16).

USE

Significant findings indicate that prior hospital use is a consistent positive predictor of nursing home placement (50 percent, 12/24), hospitalization (56 percent, 9/16), functional impairment (100 percent, 4/4), and mortality (64 percent, 9/14). Though not examined nearly as frequently, the number of hospital days also proved to be a positive significant predictor of functional impairment (100 percent, 4/4) and dying (50 percent overall, 1/2) in the only significant results reported.

Not surprisingly, prior nursing home use had an undisputed positive association with future nursing home use (78 percent, 18/23). Though most entries displayed no relationship, six of eight significant findings suggest a positive

relationship between prior institutionalization and dying as well (33 percent, 6/18). Prior use does not appear to be associated with function (100 percent, 10/10) or hospitalization (67 percent, 4/6). Though not studied nearly as extensively, nursing home length of stay proved to be a positive significant predictor of mortality (50 percent, 1/2) and functional impairment (100 percent, 1/1) and a negative significant predictor of hospitalization (67 percent, 2/3) in the only significant results reported.

Medical procedures and special services (e.g., surgery, radiation therapy, tracheotomy, IV tubes, feeding, rehabilitation, oxygen, home modifications, turning, and positioning) did not achieve significance in 12 of the 18 analyses within which they were included. Still, at least one analysis displayed a significant result for each of the four outcomes studied here. These results were positive for nursing home placement, function, and mortality, and mixed for hospitalization.

By far, more analyses examined the relationship between paid help/formal care and institutionalization than for any other outcome. Interestingly, more than 50 percent of those analyses revealed a positive association between paid help and the likelihood of being institutionalized (17/32). The results also indicated that paid help might also be associated with an increased risk of dying (67 percent, 10/15). No equation predicting function evaluated paid help, while only one predicting hospitalization did so and the result was not significant.

More frequent doctor visits appear to be correlated with an increased risk of hospital admission (83 percent, 5/6), uncorrelated with mortality (83 percent, 5/6), and little examined with respect to function and institutionalization. Significant findings indicate that taking more medications is associated with an increased risk of nursing home placement (100 percent, 2/2), hospitalization (25 percent, 1/4), and mortality (25 percent, 1/4). The results for function were consistently not significant (100 percent, 6/6).

CONSISTENT PREDICTORS OF MULTIPLE OUTCOMES

Using comparatively conservative criteria laid out in Table 3, we made systematic summary determinations regarding the relationship between each predictor and the relative risk of institutionalization, hospitalization, functional impairment, and mortality. Most of the 276 possible predictor-outcome combinations (4×69) receive a positive significant, negative significant, or nonsignificant designation. Only 16 received an indeterminate designation because of contradictory findings (e.g., prior nursing home use and mortality). However, 47 received no designation because no analyses evaluated the

TABLE 3 Summary Determinations: The Relationship between Each Predictor and the Risk of Institutionalization, Hospitalization, Function Impairment, and Mortality

Predictor	*Institutionalization*	*Hospitalization*	*Functional Impairment*	*Mortality*
Predisposing				
Demographic				
Age	+	?	+	+
Female	*ns*	–	*ns*	–
Nonwhite	–	*ns*	*ns*	*ns*
Social support				
Living alone	+	*ns*	*ns*	*ns*
Married	*ns*	*ns*	*ns*	*ns*
Greater familial support	–	*ns*	*ns*	?
Informal caregiver	+	+	*ns*	*ns*
Greater caregiver support	–	*ns*	*ns*	?
Greater social activity	–	x	–	–
Telephone	*ns*	x	–	*ns*
Health beliefs				
Greater personal control	+	*ns*	*ns*	+
Poor behavior	*ns*	*ns*	*ns*	+
High body mass	*ns*	x	+	–
Enabling				
Familial resources				
Low income	*ns*	*ns*	+	*ns*
Not homeowner	+	x	*ns*	*ns*
Assets	*ns*	x	x	x
Lower education	*ns*	*ns*	*ns*	*ns*
Greater residential stability	*ns*	*ns*	x	x
Medicaid	*ns*	*ns*	*ns*	*ns*
Private insurance	*ns*	*ns*	*ns*	*ns*
Medicare	?	*ns*	x	*ns*
Facility resources				
Private ownership	x	+	*ns*	*ns*
SNF certification	x	–	x	+
Number of facility beds	x	–	*ns*	*ns*
Price/revenue	x	–	x	*ns*
Staffing	x	*ns*	x	–
Facility case mix	x	x	–	–
Market/policy resources				
Urban	*ns*	*ns*	x	*ns*
Northeast region	x	*ns*	x	*ns*
Number of NH beds	+	*ns*	x	*ns*

TABLE 3 Continued

Predictor	*Institutionalization*	*Hospitalization*	*Functional Impairment*	*Mortality*
Enabling				
Market/policy resources				
Hospital beds	x	*ns*	x	*ns*
Home health visits	*ns*	x	x	x
State policy	*ns*	*ns*	x	*ns*
Payment rate	–	x	x	x
Case mix	–	x	x	x
Need				
Self-perceived				
Lower self-rated	*ns*	?	?	+
Lower life satisfaction	*ns*	+	x	x
Practitioner evaluated				
Physical function				
Lower ADL	+	?	+	+
Lower IADL	+	*ns*	+	*ns*
Lower other physical	+	+	+	+
Incontinence	*ns*	*ns*	+	*ns*
Bed disability	*ns*	*ns*	x	*ns*
Cognitive function				
Lower cognitive scale	+	*ns*	+	*ns*
Disorientation/behavioral problems	+	*ns*	x	+
Disease				
Heart/circulatory	?	+	*ns*	+
Cerebrovascular	*ns*	*ns*	*ns*	+
Hypertension	–	*ns*	?	*ns*
Neoplasms	*ns*	*ns*	?	–
Hip/other fracture	*ns*	*ns*	*ns*	*ns*
Musculoskeletal	–	*ns*	*ns*	*ns*
Respiratory	*ns*	+	+	+
Nervous/sense	+	*ns*	*ns*	?
Depression/mental	+	*ns*	+	?
Dementia/Alzheimer	+	?	*ns*	*ns*
Diabetes/metabolic	*ns*	+	+	+
Digestive	–	+	–	*ns*
Genito-urinary	*ns*	+	*ns*	*ns*
Pressure ulcer	x	*ns*	+	+
Symp/signs/ill-def	*ns*	*ns*	*ns*	*ns*
Falls	*ns*	*ns*	+	x

(continued)

TABLE 3 Continued

Predictor	*Institutionalization*	*Hospitalization*	*Function Impairment*	*Mortality*
Need				
Practitioner evaluated				
Disease				
Number/severity of illness	+	+	+	+
Use				
Prior hospital	+	+	+	+
Days hospitalized	x	*ns*	+	+
Prior/current NH	+	*ns*	*ns*	?
NH length of stay	x	–	+	–
Medical procedures/ services	*ns*	?	*ns*	*ns*
Paid helpers	+	*ns*	x	+
Physician	*ns*	+	x	*ns*
Number of medications	+	*ns*	*ns*	*ns*

Note: SNF = skilled nursing facility, NH = nursing home, ADL = activity of daily living, IADL = instrumental activity of daily living, Symp/signs/ill-def = symptoms, signs, and other ill-defined conditions. For a particular predictor, a determination regarding significance was based on the following criteria: If the percentage nonsignificant for a given predictor-adverse outcome combination was greater than 60 percent, then a determination of nonsignificance (*ns*) was made. If the percentage nonsignificant was less than or equal to 60 percent, then the number of positive significant and negative significant results was examined. If the number of positive significant results was greater than 85 percent of all significant results, then a determination of positive significance was made (+). If the number of negative significant results was greater than 85 percent of all significant results, then a determination of negative significance was made (–). If neither the number of positive significant nor negative significant results was greater than 85 percent of all significant results, then an indeterminate designation was assigned (?). No determination was made for those predictor-adverse outcome combinations for which no analyses were reported (x).

efficacy of certain risk factors in predicting one or more of the outcomes studied (e.g., the effect of residential stability on subsequent mortality and baseline life satisfaction on subsequent function). These gaps are disproportionately concentrated among enabling characteristics, facility, market, and policy indicators, in particular.

In all, we conclude that 53 of the 69 risk factors consistently predict at least one of the outcomes studied. Though we found that most predict one outcome only, 22 predict multiple outcomes (see Table 4), including three that predict all four hazards: worse performance on non-ADL-based physical function

TABLE 4 Most Consistent Positive and Negative Predictors of Multiple Outcomes

Outcome	*Positive*	*Negative*
All four outcomes	Worse non-ADL physical function, illness severity, prior hospital use	
Institutionalization, functional impairment, and mortality	Age, ADL performance, and IADL performance	Greater social activity
Hospitalization, functional impairment, and mortality	Respiratory conditions, diabetes, and other metabolic diseases	
Institutionalization and hospitalization	Having an informal caregiver	
Institutionalization and functional impairment	Worse cognitive scale performance, depression/ miscellaneous mental conditions	Digestive condition
Institutionalization and mortality	Disorientation/problematic behavior, greater personal control, and paid help/ formal care	
Hospitalization and mortality	Heart/miscellaneous circulatory	Being female, nursing home length of stay
Functional impairment and mortality	Pressure ulcers, days hospitalized	Facility case mix

Note: Education; marital status; hip and other fractures; symptoms, signs, and ill-defined conditions; Medicaid enrollment or eligibility; and being privately insured consistently failed to predict any outcome.

measures, greater illness severity, and prior hospital use. Those associated with an increased risk of three include age, worse ADL performance, worse IADL performance, respiratory conditions, and diabetes, while those associated with an increased risk of two include having an informal caregiver, worse cognitive scale performance, disorientation/problematic behavior, greater personal control, heart/circulatory conditions, depression/mental conditions, pressure ulcers, days hospitalized, and paid help/formal care.

Although no risk factor was consistently associated with a lower risk of all four outcomes, one (greater social activity) was associated with a reduced

likelihood of three: institutionalization, functional impairment, and mortality. Furthermore, being female, digestive conditions, nursing home length of stay, and facility case mix were all associated with a reduced likelihood of two.

On the whole, mortality shared the most risk factors with other outcomes (18), followed by function (16), institutionalization (15), and hospitalization (10). It appears that the predictors correlate well among three of the four outcomes, hospitalization being the outlier. This may be because death, functional impairment, and institutionalization (due to its unattractiveness as an outcome state as well as supply and subsidy barriers limiting use to the very sick) reflect the natural decline in health status, while hospitalization is more complicated and curative, subject to style of practice and variations in preferences, and not as well determined by a natural decline of human capacity.

Risk factors that failed to consistently predict any of the outcomes include education; marital status; hip and other fractures; symptoms, signs, and ill-defined conditions; Medicaid enrollment or eligibility; and being privately insured.

ANDERSEN MODEL ELEMENTS AND PREDICTOR CONSISTENCY

Table 5 takes predictors designated as positive and negative significant in Table 3 and lists them by outcome and Andersen model element—predisposing, enabling, need, and baseline use. It shows that a consistent association exists between each outcome and at least two predictors classified under each Andersen category. It also shows that some categories of predictors are more consistent across facility/health outcomes than others. In particular, need-based characteristics appear to exhibit the most consistent associations across all four outcomes studied. This is not surprising, as the behavioral model posits need as the most proximate cause of health services use. In combination with the finding that characteristics indicative of baseline use also exhibit an association with all four outcomes, this finding supports Andersen's notion that the health behavioral process may be recursive, with use affecting outcomes and outcomes affecting subsequent need and use.

Interestingly, predisposing characteristics correlate more frequently with nursing home placement and mortality than with hospitalization and functional impairment. Predisposing characteristics also correlate more frequently than enabling characteristics with all but one of the outcomes studied—though they are supposed to represent a more distal cause of health services use. On one hand, this is likely due to the comparatively infrequent inclusion of enabling characteristics on the right-hand side of the equations analyzed. On the other hand, it may be due to the way Andersen has traditionally been

TABLE 5 Positive and Negative Summary Determinations by Adverse Outcome and Andersen Model Element

Outcome	*Andersen Model Element Predictors*
Nursing home placement	
Predisposing	+: Age, living alone, informal caregiver, greater personal control
	–: Nonwhite, greater familial support, greater caregiver support, greater social activity
Enabling	+: Not homeowner, number of nursing home beds in market
	–: State nursing facility payment rate and market case mix
Need	+: Lower ADL, lower IADL, lower other physical, lower cognitive scale, disorientation/behavior problems, nervous/sense organs, depression/mental, dementia/Alzheimer, number/severity of illness
	–: Hypertension, musculoskeletal, digestive
Use	+: Prior hospitalization, prior/current nursing home use, paid helpers, number of medications
Hospitalization	
Predisposing	+: Informal caregiver
	–: Female
Enabling	+: Private ownership
	–: Skilled nursing facility certification, number of facility beds, price/revenue
Need	+: Lower life satisfaction, lower other physical, heart/circulatory, respiratory, diabetes/metabolic, digestive, genito-urinary, number/severity of illness
Use	+: Prior hospitalization/physician
	–: Nursing home length of stay
Functional impairment	
Predisposing	+: Age, high body mass
	–: Greater social activity, telephone
Enabling	+: Low income
	–: Facility case mix
Need	+: Lower ADL, lower IADL, lower other physical, incontinence, less cognitive scale, respiratory, depression/mental, diabetes/metabolic, pressure ulcer, falls, number/severity of illness
	–: Digestive
Use	+: Prior hospitalization, days hospitalized, nursing home length of stay

(continued)

TABLE 5 Continued

Outcome	*Andersen Model Element Predictors*
Mortality	
Predisposing	+: Age, greater personal control, and poor behavior
	–: Female, greater social activity, and high body mass
Enabling	+: Skill nursing facility certification
	–: Staffing and facility case mix
Need	+: Less self-rated, less ADL, less other physical, disorientation/behavior problems, heart/circulatory, cerebrovascular, respiratory, diabetes/metabolic, pressure ulcer, and number/severity of illness
	–: Neoplasms
Use	+: Prior hospitalization, days hospitalized, and paid helpers
	–: Nursing home length of stay

Note: ADL = activity of daily living, IADL = instrumental activity of daily living.

assessed, with simple regression models rather than more advanced structural equation techniques.

CONCLUSIONS

We reviewed 167 analyses abstracted from close to 80 studies and identified the set of characteristics that predict specific adverse outcomes. Moreover, we identified the subset that consistently predict multiple hazards.

Our major findings are as follows:

1. For institutionalization, functional impairment, and mortality, a modest statistically significant association could be discerned between the percentage of positive and negative significant results of national and subnationally derived studies. Hospitalization was the major exception, as no association was found.
2. Some predictors (such as age, gender, race, ADLs, heart disease, living arrangements, and prior hospitalization) were studied much more frequently using a longitudinal, multivariate framework than others (e.g., health beliefs). Enabling factors such as facility, market, and policy resources were particularly lacking in this regard.
3. Most risk factors failed to predict more than one outcome; however, 22 risk factors did. Some of these were associated with an increased risk of two outcomes

(e.g., worse cognitive scale performance, paid help), three outcomes (e.g., worse ADL performance, diabetes), or four outcomes (e.g., greater illness severity, prior hospital use).

4. Some risk factors (such as education, marital status, and Medicaid enrollment) failed to significantly predict any of the four outcomes studied.
5. Though a consistent association exists between each outcome and at least two predictors classified under each Andersen model category, need-based characteristics exhibit the most consistent associations across the four outcomes studied, followed by predisposing characteristics and enabling characteristics.

IMPLICATIONS

One implication of these findings is that the field now has some guidance for setting priorities when engaging in the inevitable narrowing of variables suggested by the behavioral model for inclusion in use and outcome surveys and other studies. Within the limits of the specific research questions being addressed by a new study, priority in variable selection should be given to the 22 that are consistently found to be predictors of at least one outcome. Others are better candidates for omission since their effects are likely measured by 1 or more of the 22 that are frequently associated with adverse outcomes. These issues are of particular concern for state policy makers allocating scarce budgetary resources and developing nursing home and other service eligibility screens. But they should also be of special interest to case managers who may wish to focus their care planning efforts on patient characteristics shown here to be useful in identifying patients most likely to suffer adverse outcomes.

It must be recognized, however, that we have taken a very narrow focus on adverse outcomes in this article. To be sure, these are the favorite of policy makers and budget analysts. And they are the essentials if cost savings are expected from home care. But the list could be much larger if policy were to shift to patient and caregiver satisfaction and self-determination (e.g., Doty, Kasper, and Litvak 1996; Keigher 1997), for example, as the desired outcomes of home care. Researchers and funding sources may wish to refocus future outcomes research toward these broader end points. In that case, predictors relevant to home care screening and planning for risk mitigation might well differ from those synthesized here.

Funding sources may also wish to pay more attention to relatively neglected predictor candidates, especially community-wide enabling variables such as facility, market, and policy resources. The few studies investigating the impact of these neglected variables indicate that they may, in some instances, represent important explanatory factors. In particular, some studies have identified an association between at least one of the outcomes studied

and the following facility characteristics: ownership type (Freiman and Murtaugh 1993; Murtaugh and Freiman 1995; Porell et al. 1998), skilled nursing facility (SNF) certification (Murtaugh and Freiman 1995; Engle and Graney 1993), number of beds (Anderson and Steinberg 1985), per diem (Freiman and Murtaugh 1993), staffing (Porell et al. 1998), and case mix (Porell et al. 1998). Others have found an association with the following market and policy attributes: region (Wolinsky et al. 1994; Wolinsky, Johnson, and Stump 1995), urban/rural location (Wolinsky and Johnson 1991; Wolinksy et al. 1992, 1993; Wolinsky, Johnson, and Stump 1995; Salive et al. 1993), state policy (Freiman and Murtaugh 1993; Liu, Coughlin, and McBride 1991), hospital and nursing home bed supply (Coughlin, McBride, and Liu 1990; Liu, Coughlin, and McBride 1991; Greene, Lovely, and Ondrich 1993; Greene and Ondrich 1990), Medicaid nursing facility reimbursement (Liu, McBride, and Coughlin 1994; Liu, Coughlin, and McBride 1991), and case mix (Liu, McBride, and Coughlin 1994). Unfortunately, public use versions of national databases do not contain the local identifiers necessary to add variables such as these, whose exclusion is ironic since they are particularly subject to policy interventions.

Of particular interest is the finding that hospitalization predictors at the subnational level fail to correlate well with national level findings. The most likely outcome is substantial practice variation over and above the well-documented regional variation in hospital use rates observed for decades.

We point out that the coding of certain variables probably contributed to some of the findings reported. For example, the lack of any relationship between neoplasms and hospitalization is probably due the combination of all cancers in the neoplasms category. While some cancers are treated on an inpatient basis, others are treated on an outpatient basis. The lack of any relationship between neoplasms and hospitalization may also be due to coding such as "ever had cancer" and "hospitalization in the past year." Someone may have had breast cancer and received a mastectomy 5 years earlier but may have had no recent hospitalization.

Finally, the findings support some of the basic tenets of the Andersen model, including the usefulness of categorizing predictors as predisposing, enabling, and need characteristics, and the possible recursive nature of the relationship between health outcomes, use behaviors, and Andersen's attributes. We suggest, however, that more advanced modeling techniques are necessary if Andersen is to be tested properly. Nonetheless, our findings may provide a basis for further theory-building efforts, a topic to be addressed elsewhere by the authors and hopefully others.

NOTES

1. The list of outcomes studied could have included any for which risk can or has been calculated. However, we chose these outcomes because of their particular relevance to those likely to seek long-term care services. We had initially considered life satisfaction but decided to exclude it when our literature search revealed only a handful of studies meeting our inclusion criteria.
2. We wanted to begin our examination with articles published after the systematic changes wrought by the Medicare Prospective Payment System (PPS) in 1983, though, as we quickly discovered, a large number of studies published since 1985 used data collected prior to the implementation of PPS. We included these anyway, as in some instances they were the only articles to examine risk for particular subgroups.
3. Specific outcomes varied. For institutionalization, they included any short-term and long-term admission, age at first admission, length of stay, and number of admissions. For hospitalization, they included any terminal admission, two or more nonterminal admissions, multiple admissions, number of admissions, length of stay, readmission, and unnecessary hospital days. For mortality they included death and survival. For function they included the presence of an activity of daily living (ADL), instrumental activity of daily living (IADL), and/or work-related limitation, decline in ADL score, physical ability, physical performance and its decline, mobility, deterioration, activity, function, and self-rated health.
4. Only 20 out of the 78 studies employed an explicit conceptual model, theoretical framework, or hypotheses to guide the selection of risk factors for analysis. Eight of these used Andersen.
5. Correlation significant at the .10 level*, .05 level**, and .01 level*** (all 2-tailed).
6. The denominator used to calculate all percentages is the total number of equations abstracted for a particular predictor-outcome combination (i.e., the *n* in Table 2).

REFERENCES

Andersen, R. 1995. Revisiting the behavior model and access to care: Does it matter? *Journal of Health and Social Behavior* 36 (1): 1-10.

Andersen, R., and L. A. Aday. 1978. Access to medical care in the U.S.: Realized and potential. *Medical Care* 7:533-46.

Andersen, R., and J. Newman. 1973. Societal and individual determinants of medical care utilization in the United States. *Milbank Memorial Fund Quarterly* 51 (winter): 95-124.

Anderson, G. F., and E. P. Steinberg. 1985. Predicting hospital readmissions in the Medicare population. *Inquiry* 22 (fall): 251-58.

Aneshensel, C. S., L. I. Pearlin, and R. H. Schuler. 1993. Stress, role captivity, and the cessation of caregiving. *Journal of Health and Social Behavior* 34:54-70.

Bauer, E. J. 1996. Transitions from home to nursing home in a capitated long-term care program: The role of individual support systems. *Health Services Research* 31 (3): 309-25.

Bectel, R. W., and N. G. Tucker, eds. 1998. *Across the states 1998: Profiles of long-term care systems*. 3rd ed. Washington, DC: American Association of Retired Persons.

Benyamini, Y., and E. L. Idler. 1999. Community studies reporting association between self-rated health and mortality: 1995 to 1998. *Research On Aging* 21 (3): 392-401.

Berlowitz, D. R., G. H. Brandeis, J. Anderson, W. Du, and H. Brand. 1997. Effect of pressure ulcers on the survival of long-term care residents. *Journals of Gerontology* Series A, Biological Sciences & Medical Sciences 52 (2): M106-10.

Binder, E. F., and L. N. Robins. 1990. Cognitive impairment and length of hospital stay in older persons. *Journal of the American Geriatrics Society* 38 (7): 759-66.

Boaz, R. F. 1994. Improved versus deteriorated physical functioning among long-term disabled elderly. *Medical Care* 32 (6): 588-602.

Boaz, R. F., and C. F. Muller, with J. Hu. 1994. Predicting the risk of "permanent" nursing home residence: The role of community help as indicated by family helpers and prior living arrangements. *Health Services Research* 29 (4): 391-414.

Boult, C., B. Dowd, D. McCaffrey, L. Boult, R. Hernandez, and H. Krulewitch. 1993. Screening elders for risk of hospital admission. *Journal of the American Geriatrics Society* 41 (8): 811-17.

Boult, C., R. L. Kane, T. A. Louis, L. Boult, and D. McCaffrey. 1994. Chronic conditions that lead to functional limitation to the elderly. *Journal of Gerontology* 49 (1): M28-36.

Braun, K. L., C. L. Rose, and M. D. Finch. 1991. Patient characteristics and outcomes in institutional and community long-term care. *The Gerontologist* 31 (5): 648-56.

Bruce, M. L., T. Seeman, S. S. Merrill, and D. G. Blazer. 1994. The impact of depressive symptomatology on physical disability: MacArthur studies on aging. *American Journal of Public Health* 84 (11): 1796-99.

Castle, N. G., and V. Mor. 1996. Hospitalization of nursing home residents: A review of the literature, 1980-1995. *Medical Care Research and Review* 53 (2): 123-48.

Cohen, H. J, C. C. Saltz, G. Samsa, L. McVey, D. Davis, and J. R. Feussner. 1992. Predictors of two-year post-hospitalization mortality among elderly veterans in a study evaluating a geriatric consultation team. *Journal of the American Geriatrics Society* 40 (12): 123-35.

Cohen, M. A., E. J. Tell, and S. S. Wallack. 1986. Client-related risk factors of nursing-home entry among elderly adults. *Journal of Gerontology* 41 (6): 785-92.

———. 1988. Risk factors of nursing home entry among residents of six continuing care retirement communities. *Journal of Gerontology* 43 (1): S15-21.

Coughlin, T. A., T. D. McBride, and K. Liu. 1990. Determinants of transitory and permanent nursing home admissions. *Medical Care* 28 (7): 616-31.

D'Agostino, R. B., A. J. Belanger, E. W. Markson, M. Kelley-Hayes, and P. A. Wolf. 1995. Development of health risk appraisal functions in the presence of multiple indicators: Framingham study nursing home institutionalization model. *Statistics in Medicine* 14:1757-70.

de Boer, A.G.E.M., W. Wijker, and H.C.J.M. de Haes. 1997. Predictors of health care utilization in the chronically ill: A review of the literature. *Health Policy* 42:101-15.
Doty, P., J. Kasper, and S. Litvak. 1996. Consumer-directed models of personal care from Medicaid. *Milbank Memorial Fund Quarterly* 74 (3): 377-409.
Dwyer, J. W., A. J. Barton, and W. B. Vogel. 1994. Area of residence and the risk of institutionalization. *Journal of Gerontology* 49 (2): S75-84.
Engle, V. F., and M. J. Graney. 1993. Predicting outcomes of nursing home residents: Death and discharge. *Journal of Gerontology* 48 (5): S269-75.
Evashwick, C., G. Rowe, P. Diehr, and L. Branch. 1984. Factors explaining the use of health care services of the elderly. *Health Services Research* 19 (3): 357-82.
Fethke, C. C., I. M. Smith, and N. Johnson. 1986. Risk factors affecting readmission of the elderly into the health care system. *Medical Care* 24 (5): 429-37.
Foley, D. J., A. M. Ostfeld, L. G. Branch, R. B. Wallace, and J. McGloin. 1992. The risk of nursing home admission in three communities. *Journal of Aging and Health* 4 (2): 155-73.
Ford, A. B., M. R. Huang, P. K. Jones, A. W. Roy, and S. J. Folmar. 1990. Race-related differences among elderly urban differences: A cohort study, 1975-1984. *Journal of Gerontology* 45 (4): S163-71.
Freedman, J. D., A. Beck, B. Robertson, B. N. Calonge, and G. Gade. 1996. Using a mailed survey to predict hospital admission among patients older than 80. *Journal of the American Geriatrics Society* 44 (6): 689-92.
Freedman, V. A. 1996. Family structure and the risk of nursing home admission. *Journal of Gerontology* 51B (2): S61-69.
Freiman, M. P., and C. M. Murtaugh. 1993. The determinants of the hospitalization of nursing home residents. *Journal of Health Economics* 11:349-59.
Fried, T. R., and V. Mor. 1997. Frailty and hospitalization of long-term stay nursing home residents. *Journal of the American Geriatrics Society* 45 (3): 265-69.
Ganzini, L., D. M. Smith, D. S. Fenn, and M. A. Lee. 1997. Depression and mortality in medically ill older adults. *Journal of the American Geriatrics Society* 45 (3): 307-12.
Gelberg, L., R. M. Andersen, and D. Leake. 2000. The behavioral model for vulnerable populations: Applications to medical care use and outcomes for homeless people. *Health Services Research* 34 (6): 1273-1302.
Goldman, N., S. Korenman, and R. Weinstein. 1995. Marital status and health among the elderly. *Social Science and Medicine* 40 (12): 1717-30.
Greene, V. L., M. E. Lovely, and J. I. Ondrich. 1993. The cost-effectiveness of community services in a frail elderly population. *The Gerontologist* 33 (2): 177-89.
Greene, V. L., and J. I. Ondrich. 1990. Risk factors for nursing home admissions and exits: A discrete-time hazard function approach. *Journal of Gerontology* 45 (6): S250-58.
Guralnik, J. M., A. Z. LaCroix, R. D. Abbott, L. F. Berkman, S. Satterfield, D. A. Evans, and R. B. Wallace. 1993. Maintaining mobility in late life. I. Demographic characteristics and chronic conditions. *American Journal of Epidemiology* 137 (8): 845-57.
Guralnik, J. M., E. M. Simonsick, L. Ferrucci, R. J. Glynn, L. F. Berkman, D. G. Glazer, P. A. Scherr, and R. B. Wallace. 1994. A short physical performance battery assessing

lower extremity function: Association with self-reported disability and prediction of mortality and nursing home admission. *Journal of Gerontology* 49 (2): M85-94.

Hanley, R. J., L.M.B. Alecxih, J. M. Wiener, and D. L. Kennell. 1990. Predicting elderly nursing home admissions. *Research on Aging* 12 (2): 199-228.

Harris, T., M. G. Kovar, R. Suzman, J. C. Kleinman, and J. J. Feldman. 1989. Longitudinal study of the physical ability of the oldest-old. *American Journal of Public Health* 79 (6): 698-702.

Hughes, S. L., K. J. Conrad, L. M. Manheim, and P. L. Edelman. 1988. Impact of long-term home care on mortality, functional status, and unmet needs. *Health Services Research* 23 (2): 269-94.

Idler, E. L., and Y. Benyamini. 1997. Self-rated health and mortality: A review of twenty-seven community studies. *Journal of Health and Social Behavior* 38 (March): 21-27.

Inouye, S. K., R. Wagner, D. Acampora, R. I. Horowitz, L. M. Cooney, L. D. Hurst, and M. E. Tinetti. 1993. A predictive index for functional decline in hospitalized elderly medical patients. *Journal of General Internal Medicine* 8:645-52.

International classification of diseases–clinical modification. 1980. 9th rev. Washington, DC: U.S. Department of Health and Human Services, Public Health Service.

Jette, A. M., L. G. Branch, L. A. Sleeper, H. Feldman, and L. M. Sullivan. 1992. High-risk profiles for nursing home admission. *The Gerontologist* 32 (5): 634-40.

Kasper, J. D., and A. D. Shore. 1994. Cognitive impairment and problem behaviors as risk factors for institutionalization. *Journal of Applied Gerontology* 13 (4): 371-85.

Keigher, S. M. 1997. Austria's new attendance allowance: A consumer choice model of care for the frail and disabled. *International Journal of Health Services* 27 (4): 753-65.

Keller, B. K., and J. F. Potter. 1994. Predictors of mortality in outpatient geriatric evaluation and management clinic patterns. *Journal of Gerontology* 49 (6): M246-51.

Kellogg, F. R., P. W. Brickner, L. Conley, and M. Conroy. 1991. Controlling hospital readmission of elderly persons living at home: A risk factor analysis. *Home Health Care Services Quarterly* 12 (2): 5-16.

Kelman, H. R., and C. Thomas. 1990. Transitions between community and nursing home residence in an urban elderly population. *Journal of Community Health* 15 (2): 105-22.

Kelman, H. R., C. Thomas, G. J. Kennedy, and J. Cheng. 1994. Cognitive impairment and mortality in older community residents. *American Journal of Public Health* 84 (8): 1255-60.

Kiel, D. P., A. Eichorn, O. Intrator, R. A. Silliman, and V. Mor. 1994. The outcomes of patients newly admitted to nursing homes after hip fracture. *American Journal of Public Health* 84 (8): 1281-86.

Lamphere, J., N. Brangan, S. Bee, and R. Semansky. 1998. *Reforming the health care system: State profiles 1998*. Washington, DC: American Association of Retired Persons.

Lewis, M. A., R. L. Kane, S. Cretin, and V. Clark. 1985. The immediate and subsequent outcomes of nursing home care. *American Journal of Public Health* 75 (7): 758-62.

Lewis, M. A., B. Leake, V. Clark, and M. Leal-Sotelo. 1989. Case mix and outcomes of nursing home patients: The importance of prior nursing home care and admission from home versus hospital. *Medical Care* 27 (4): 376-85.

Liu, K., T. Coughlin, and T. McBride. 1991. Predicting nursing-home admission and length of stay: A duration analysis. *Medical Care* 29 (2): 125-41.

Liu, K., T. McBride, and T. Coughlin. 1994. Risk of entering nursing homes for long versus short stays. *Medical Care* 32 (4): 315-27.

Magaziner, J., E. Simonsick, M. Kashner, J. R. Hebel, and J. Kenzora. 1990. Predictors of functional recovery one year following hospital discharge for hip fracture: A prospective study. *Journal of Gerontology* 45 (3): M101-7.

Markides, K. S., and D. J. Lee. 1990. Predictors of well-being and functioning in older Mexican Americans and Anglos: An eight-year follow-up. *Journal of Gerontology* 45 (1): S69-73.

McFall, S., and B. H. Miller. 1992. Caregiver burden and nursing home admission of frail elderly persons. *Journal of Gerontology* 47 (2): S73-79.

Mendes de Leon, C. F., L. A. Beckett, G. G. Fillenbaum, D. B. Brock, L. G. Branch, D. A. Evans, and L. F. Berkman. 1997. Black-white differences in risk of becoming disabled and recovering from disability in old age: A longitudinal analysis of two EPESE populations. *American Journal of Epidemiology* 145 (6): 488-97.

Miller, E. A. 1999. *Predicting elderly people's risk for nursing home placement, hospitalization, functional impairment, and mortality: A comparative review and analysis*. Report submitted to the BCBS Foundation of Michigan, Department of HMP, the University of Michigan.

Montgomery, R. J., and K. Kosloski. 1994. Longitudinal analysis of nursing home placement for dependent elders cared for by spouses vs. adult children. *Journal of Gerontology* 49 (2): S62-74.

Mor, V., V. Wilcox, W. Rakowski, and J. Hiris. 1994. Functional transitions among the elderly: Patterns, predictors, and related hospital use. *American Journal of Public Health* 84 (8): 1274-80.

Murtaugh, C. M., and M. P. Freiman. 1995. Nursing home residents at risk of hospitalization and the characteristics of their hospital stays. *The Gerontologist* 35 (1): 35-43.

Newman, S. J., R. Struyk, P. Wright, and M. Rice. 1990. Overwhelming odds: Caregiving and the risk of institutionalization. *Journal of Gerontology* 45 (5): S173-83.

Nocks, B. C., M. Learner, D. Blackman, and T. E. Brown. 1986. Effects of a community-based long term care project on nursing home utilization. *The Gerontologist* 26 (2): 150-57.

O'Keeffe, J. 1996. *Determining the need for long-term care services: An analysis of health and functional eligibility criteria in Medicaid home and community based waiver programs* (#9617, December). Washington, DC: American Association of Retired Persons.

Pacala, J. T., C. Boult, and L. Boult. 1995. Predictive validity of a questionnaire that identifies older persons at risk for hospital admission. *Journal of the American Geriatrics Society* 43 (4): 374-77.

Palmore, E. B., J. B. Nowlan, and H. S. Wang. 1985. Predictors of function among the old-old: A 10-year follow-up. *Journal of Gerontology* 40 (2): 244-50.

Pearlman, D. N., and W. H. Crown. 1992. Alternative sources of social support and their impacts on institutional risk. *The Gerontologist* 32 (4): 527-35.

Pollak, C. P., D. Perlick, J. P. Lisner, J. Wenston, and F. Hsieh. 1990. Sleep problems in the community elderly as predictors of death and nursing home placement. *Journal of Community Health* 15 (2): 123-35.

Porell, F., F. G. Caro, A. Silva, and M. Monane. 1998. A longitudinal analysis of nursing home outcomes. *Health Services Research* 33 (4): 835-65.

Reuben, D. B., L. V. Rubenstein, S. H. Hirsch, and R. D. Hays. 1992. Value of functional status as predictor of mortality: Results of a prospective study. *American Journal of Medicine* 93:663-70.

Rudberg, M. A., M. A. Sager, and J. Zhang. 1996. Risk factors for nursing home use after hospitalization for medical illness. *Journal of Gerontology* 51A (5): M189-94.

Sager, M. A., M. A. Rudberg, M. Jalaluddin, T. Franke, S. K. Inouye, C. S. Landefeld, H. Siebens, and C. H. Winograd. 1996. Hospital admission risk profile (HARP): Identifying older patients at risk for functional decline following acute medical illness and hospitalization. *Journal of the American Geriatrics Society* 44 (3): 251-57.

Salive, M. E., K. S. Collins, D. J. Foley, and L. K. George. 1993. Predictors of nursing home admissions in a biracial population. *American Journal of Public Health* 83:1765-67.

Satish, S., C. H. Winograd, C. Chavez, and D. A. Bloch. 1996. Geriatric targeting criteria as predictors of survival and health care utilization. *Journal of the American Geriatrics Society* 44 (8): 914-21.

Seeman, T. E., P. A. Charpentier, L. F. Berkman, M. E. Tinetti, J. M. Guralnik, M. Albert, D. Blazer, and J. W. Rowe. 1994. Predicting changes in physical performance in a high-functioning elderly cohort: MacArthur studies of successful aging. *Journal of Gerontology* 49 (3): M97-108.

Shapiro, E., and N. P. Roos. 1989. Predictors and patterns of nursing home and home care use. In *Health care of the elderly: An information sourcebook*, edited by M. D. Petersen and D. L. White, 127-66. Newbury Park, CA: Sage.

Snow, K. 1995. *How states determine nursing facility eligibility for the elderly: A national survey* (#9517, November). Washington, DC: American Association of Retired Persons.

Speare, A., Jr., R. Avery, and L. Lawton. 1991. Disability, residential mobility, and changes in living arrangements. *Journal of Gerontology* 46 (3): S133-42.

Stearns, S. C., M. G. Kovar, K. Hayes, and G. G. Koch. 1996. Risk indicators for hospitalization during the last year of life. *Health Services Research* 31 (1): 39-69.

Steinbach, U. 1992. Social networks, institutionalization, and mortality among elderly people in the United States. *Journal of Gerontology* 47 (4): 183-90.

Tatemichi, T. K., M. Paik, E. Bagiella, D. W. Desmond, D. M. Pirro, and L. K. Hanzawa. 1994. Dementia after stroke is a predictor of long-term survival. *Stroke* 25 (10): 1915-19.

Temkin-Greener, H., and M. R. Meiners. 1995. Transitions in long-term care. *The Gerontologist* 35 (2): 196-206.

Thomas, D. R., P. S. Goode, P. H. Tarquine, and R. M. Allman. 1996. Hospital-acquired pressure ulcers and risk of death. *Journal of the American Geriatrics Society* 44 (12): 1435-40.

Weissert, C. S. 1992. Medicaid in the 1990s: Trends, innovations, and the future of the "PAC-Man" of state budgets. *Publis: The Journal of Federalism* 22:93-109.

Weissert, W. G., M. Chernew, and R. Hirth. 2000. Beyond managed care: The case for paying for home care based upon risks of adverse outcomes. Under review.

Weissert, W. G., and C. M. Cready. 1988. Determinants of hospital-to-nursing home placement delays: A pilot study. *Health Services Research* 23 (5): 619-47.

Weissert, W. G., C. M. Cready, and J. E. Pawelack. 1988. The past and future of home- and community-based long term care. *Milbank Memorial Fund* 66:309-88.

Weissert, W. G., and S. C. Hedrick. 1994. Lessons learned from research on effects of community-based long-term care. *Journal of the American Geriatrics Society* 42 (3): 348-53.

Wingard, D. L., D. W. Jones, and R. M. Kaplan. 1987. Institutional care utilization by the elderly: A critical review. *The Gerontologist* 27 (2): 157-63.

Wolf, F. M. 1986. *Meta-analysis: Quantitative methods for research synthesis*. Beverly Hills, CA: Sage.

Wolinsky, F. D., C. M. Callahan, J. F. Fitzgerald, and R. J. Johnson. 1992. The risk of nursing home placement and subsequent death among older adults. *Journal of Gerontology* 47 (4): S173-82.

———. 1993. Changes in functional status and the risks of subsequent nursing home placement and death. *Journal of Gerontology* 48 (3): S93-101.

Wolinksy, F. D., S. D. Culler, C. M. Callahan, and R. J. Johnson. 1994. Hospital resource consumption among older adults: A prospective analysis of episodes, length of stay, and charges over a seven-year period. *Journal of Gerontology* 49 (5): S240-52.

Wolinsky, F. D., and R. J. Johnson. 1991. The use of health services by older adults. *Journal of Gerontology: Social Sciences* 46 (6): S345-57.

Wolinsky, F. D., R. L. Johnson, and T. E. Stump. 1995. The risk of mortality among older adults over and eight-year period. *The Gerontologist* 35 (2): 150-61.