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Predictors of Home Health Care Use in the Post-Hospitalized Elderly

A Thesis Submitted to the Yale University School of Medicine in Partial Fulfillment of the Requirement for the Degree of Doctor of Medicine

by

Daniel H. Solomon

1992

ABSTRACT

PREDICTORS OF HOME HEALTH CARE USE IN THE POST-HOSPITALIZED ELDERLY. Daniel H. Solomon and Sharon K. Inouye, M.D., M.P.H., Department of Internal Medicine, Yale University School of Medicine, New Haven, CT.

Although home health care (HHC) is commonly received by elderly patients upon discharge from acute-care hospitals, its predictors have not been well-studied. We prospectively studied the incidence and risk factors for HHC in a cohort of 226 medical and surgical patients aged 70 years and older discharged from a teaching hospital. Risk factor data was obtained from patient and surrogate interviews at hospital admission and discharge and 3 to 6 months after discharge; and medical records. Home health care information came from records of the 23 licensed agencies in the study area.

The incidence of HHC initiated within two weeks post-discharge was 75/226 (34%). The median duration of service was 30 days (range 3 - 483) with a median of 3 visits per week. Home health care was terminated due to no further need in 51% and due to less favorable outcomes in 24% (e.g., rehospitalization, referral to long-term care, or death).

Five independent predictors of HHC were identified through multivariate analysis: lower educational level (incidence density ratio, IDR, 3.13; confidence interval, CI, 1.6 to 6.3), more severe Weighted Diagnosis Index (WDI)

(medium risk: IDR, 1.75; CI, 1.2 to 2.7; high risk: IDR, 3.1; CI, 1.3 to 7.1), past HHC use (IDR, 1.9; CI, 1.1 to 3.3), impairment in instrumental activities of daily living (IDR, 1.7; CI, 0.9 to 3.0), and a smaller support network (IDR, 1.6; CI, 0.8 to 3.0). Risk strata were created by adding one point for each risk factor present, except two points for a high-risk WDI. With 0 points, 0% used HHC; with 1-2 points, 5%; with 3 points, 24%; with 4 points, 43%; and with 5-6 points, 67%. This trend was statistically significant (Mantel-Haenszel trend $p \leq 0.0001$).

Thus, demographic, biomedical, functional, and past health care use variables were the strongest predictors of HHC use in an elderly cohort following acute hospitalization. Unlike previous studies of community elderly, social supports were a weaker predictor. Our predictive model for HHC may have immediate clinical applications for discharge planning in elderly hospitalized patients, and health policy applications for health care utilization planning for the rapidly growing elderly population in general.

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Next, there are several key people at the Yale School of Medicine who have made this study possible. Sharon K. Inouye has acted as my thesis advisor and has helped me in more ways than I am able to articulate, but most importantly she has served as a mentor and role-model through tremendous personal strife of her own. I am deeply indebted to her for this. Leo Cooney and Linda Walker guided me to the proper resources to get this study off the ground. Dale Hendrickson and her staff in Clinical Information, Denise Acampora, and Kolie Chang answered my many data requests. Geraldine Hawthorne served as a trusted conduit to a busy advisor. Mark Lachs helped to create the Weighted Diagnosis Index. Marjorie Marenberg assisted in data management. And last but not least, Raye Wagner provided numerous hours of statistical supervision.

Finally, I owe tremendous gratitude to my parents and family who have supported me in countless ways through my medical studies and to Brenda who has helped to make this endeavor seem worthwhile.

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E. Framing the Issue

Approximately seven million Americans 65 years or older require assistance to live at home and approximately two million elderly Americans receive assistance from a paid caregiver (Keenan, 1989). A growing number of Medicare beneficiaries require home health care upon hospital discharge. The growth of the older adult population and the increasing number of Americans requiring assistance at home has increased the importance of home health care in the health care delivery system. Home health care is rapidly evolving in response to these trends and a recognized preference for community-based long-term care. These trends and the evolution of home health care warrant exploration.

Home Health Care Evolution

While community health nursing dates back to Phoebe who organized care of the sick poor in the Roman Empire during the first century, the visiting nurse movement was not recognized until the 1800s. During this time, nuns visited families in England and Ireland engulfed by the cholera and smallpox epidemics. By the end of the 19th century, Florence Nightingale had founded district nursing associations in Liverpool (Martin, 1988) and organized home care had begun to flourish in the United States. Philanthropic women founded visiting nurse associations (Buhler-Wilkerson, 1985) in many cities.

In the mid-20th century, Montefiore Hospital in New York City established the first hospital-based home care program which was to involve nurses, therapists, and physicians in a coordinated team. This attempt to couple physicians in a visiting nurse program, however, was not embraced. The original Medicare and Medicaid legislation set physician home care fees below hospital or office visit rates discouraging physician involvement in care of patients at home (Koren, 1986). Currently, home health care is provided primarily by nurses, physical therapists, occupational therapists, speech therapists, social workers, and home health aides.

Medicare's inception stimulated rapid growth in the number of home health agencies. Between 1967 and 1986, Medicare-certified home health care agencies more than tripled in number from 1,753 to 5,932. According to a 1987 survey by the National Association of Home Care, Medicare-certified agencies only account for slightly more than half of all agencies. This growth in the number of agencies has plateaued and even reversed slightly since 1986, but Medicare home health care visits and expenditures have continued to rise; in 1988, Medicare paid 2.5 billion dollars for 41.6 million visits (American Medical Association, 1989). This expansion can be accounted for by trends in demographics, health care financing, and public opinion.

Community Elderly

The United States population is aging due to two simultaneous factors. Falling birth rates account for a decline in young Americans, and a reduced death rate means more people are surviving to older ages. In addition, aging of the "baby boom" generation will translate into a surge in older age groups between 2010 and 2030. Projections are that the 85 and older age group will grow most rapidly -- between 1980 and 2050 the 2.2 million people age 85 or over will have grown to 16 million (Unites States Bureau of the Census, 1984).

While many older people are active and able to take care of themselves, it is clear that the prevalence of disability and poor health increases with age. Data from the National Medical Expenditure Survey (Leon and Lair, 1990) reveal that 12.9% of persons aged 65 or older living in the community in 1987 had difficulty with at least one activity of daily living (ADL, e.g., bathing, transferring, dressing, toiletting, feeding, or walking) and 17.5% of the same population had difficulty with at least one instrumental activity of daily living (IADL, e.g., use of telephone, handling money, shopping, transportation, meal preparation, or doing housework). In addition, one third of persons age 65 or older report fair of poor health status (National Center for Health Statistics, 1984).

The health status of elderly who have recently been discharged from hospitals has worsened slightly since 1983 with the inception of the prospective payment system (PPS), the Health Care Finance Administration's system for reimbursing acute care hospitals for Medicare admissions. While PPS has not increased 30-day or 6-month post-hospital mortality rates, patients are 43% more likely to be discharged with clinical problems that were not present on admission (Kosecoff et al., 1990). Over this same time period, there was a 97% increase in post-hospital home health care admissions for Medicare beneficiaries (Gornick and Hall, 1988). In addition to the population of medically unstable post-hospitalized elderly who use home care, four out of five elderly with long-term care needs live in the community (Keenan, 1989).

Formal and Informal Home Care

Approximately one-quarter of older people living in the community have some limitation in ADLs or IADLs which requires assistance, and approximately three-quarters of this assistance is delivered by unpaid caregivers. Unpaid or informal home care includes everything from bathing and toiletting to administration of medications. In 75% of cases, the caregiver is a spouse or child (Keenan, 1989). These activities pose a tremendous burden on caregivers; the Pepper Commission (1990) estimated that 80% of caregivers average

four hours a day, seven days a week of caregiving.

Shanas (1979) has pointed out that "old people turn first to their families for help, then to neighbors, and finally, to the bureaucratic replacements for families, social workers, ministers, community agencies and others." Hence, formal (i.e., paid) home care does not serve as a substitute for but rather as a supplement to informal assistance (Stoller and Earl, 1983; Hawes et al., 1988; Kemper, 1988). The need for supplemental formal home care will continue to increase as the ratio of dependents to working-age people increases (Keenan, 1989).

Community Versus Institutional Long-Term Care

Patients and their families prefer community home care over institutional long-term care. Steel (1991) pointed out that "institutional care is associated with a loss of autonomy and control" while "the home, in striking contrast, is recognized by the patient and physician as the patient's 'turf'." This sentiment is echoed in a report from the Hastings Center. According to its authors (Collopy et al., 1990), "the growth of home care ... is not simply the product of demographic and marketplace forces. Such community-based care is a paradigm of choice." In fact, the Connecticut State Plan on Aging (Connecticut Department on Aging, 1987) specifically notes that the most frequently mentioned need at public hearings was "home care and other alternatives to

institutionalization."

Public support is an important force in shaping long-term care policy. Numerous studies comparing home care with institutional long-term care have failed to show any clear benefits from home care. Specifically, whether community care could be substituted for nursing home care has been extensively studied in the National Long Term Care Demonstration, Channeling Project, as well as by multiple other researchers. Kemper (1988) in his overview of the Channeling Project and Hawes et al. (1988) in their critical review of community-based home care demonstrations have similarly concluded that home care: (1) does not substantially reduce nursing home use, hospital use or physician services; (2) increases overall costs; (3) does not affect measures of client functioning (i.e., ADLs); (4) does reduce unmet needs; and (5) increases client's and caregiver's satisfaction with life. These consistent findings have dashed the hopes of many who felt that home care could be justified on the basis that it would not only be preferred but also less expensive. However, Greene (1987) has astutely pointed out that "cost-effectiveness" analysis, i.e., whether home care is equivalent in cost to nursing home care, is inappropriate and that "cost-benefit" analysis, i.e., whether the perceived benefits (emotional well-being) outweigh the costs, would be a better method for capturing the life satisfaction differential. Future studies will need to refocus on quality of life issues

rather than simply cost savings.

Framing the Issue

While many studies have looked at whether home care is an effective alternative to nursing home care, relatively little work has been done looking at the characteristics of certain populations that receive home care. Specifically, the literature regarding who uses home care after hospital discharge is scant. As mentioned earlier, the use of post-hospital home care has dramatically increased since the inception of PPS, however the hospital discharge planning process still lacks a significant scientific basis. The Joint Commission on the Accreditation of Healthcare Organizations (1990) requires that hospitals have a formal discharge planning system, however, the process for deciding what services patients should have upon discharge is not uniform. This study was designed to develop a predictive model of home care use in the post-hospitalized elderly.

II. Literature Review

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Health Care Utilization Models

A home health care utilization model should be grounded in a conceptual framework of health care use. Ideally, such a framework is applicable to health care use in an elderly population, adaptable for a service such as home health care and, preferably, durable enough to have withstood empirical testing in real populations. Among the authors who have reviewed the health care use literature and developed broad models of health care utilization (Wirick, 1966; Greenlick et al., 1968; McKinlay, 1972), Andersen and Newman (1973) stand apart in having articulated a theoretical framework which has fulfilled the above criteria.

Andersen and Newman (1973) propose that while societal determinants (i.e., health care policy, technology and behavioral norms) and the structure of the health care system affect the use of health care, ultimately the individual determines his or her own health care use. According to Andersen and Newman (1973), individual health care behavior is governed by three levels of variables, which will be discussed below: predisposing factors, enabling factors, and illness level. Multiple risk factors can be described within each of the three levels of variables.

Predisposing variables exist prior to the need for health care and predict a propensity toward use behavior. They include demographics, social structure, beliefs, and past health care use behavior. Demographic indicators such as age

and sex are related to morbidity patterns which, in turn, affect utilization (McKinlay, 1972). Social structure includes education and race. Education has been shown to be correlated with the use of physician services, perhaps due to greater use of preventive services by those more educated (Aday and Eichhorn, 1972), and race correlates with whether individuals have a regular source of medical care (Andersen and Anderson, 1967). Beliefs are tightly intertwined with race, ethnicity, religion, and education and have been shown to affect use of health and social services (Kirscht et al., 1976; Snider, 1980; Weeks and Cuellar, 1981). Past health care use behavior has been found by some to be the best predictor of future health care use (McCall and Wai, 1983; Eve, 1988).

Enabling variables affect the availability of health care services and broadly relate to family and community. Factors such as income, insurance status, and access to health care may hasten or hinder use of the health care system. Income and insurance status, while clearly important factors for the general population (Mechanic, 1979), may be less important for the elderly since the institution of Medicare. However, many health care services are not covered routinely by Medicare (e.g., dental care) and therefore use of such services may depend on income or supplemental insurance status (Evashwick et al., 1984). Access to health services depends on the existence of an adequate supply of providers, transportation

for the patient or provider (in the case of home health care), and a health care system which is easy to use for the individual (Andersen and Aday, 1978).

Illness, the last category of variables according to Andersen and Newman (1973), indicates the need for health services. Disability, self-reported health and, in an ideal world, professionally evaluated symptoms, are indicators of illness. Thus, if the individual and/or family perceive illness or a high likelihood of it occurring and the predisposing and enabling conditions are present to some degree, then health care will be used.

Andersen and Newman's (1973) framework for health care utilization has been employed for studying physician and hospital utilization with mixed results. Criticisms include: predisposing and enabling variables are relatively weak indicators as compared to illness variables (Wolinsky, 1978; Coulton and Frost, 1982; Evashwick et al., 1984); illness and health care use should be analyzed in a longitudinal fashion (Eve, 1988); and supply of services should be routinely considered in the model (Shapiro and Tate, 1989); the measures of health care use should be broadened to include bed disability days (Wolinsky et al., 1983); and the model explains only a small portion of the variance in health care use (Wan, 1982). Despite these caveats, Andersen and Newman's (1973) model has remained the framework for studying health care utilization.

Home Health Care Utilization Models

Andersen and Newman's (1973) model has been adapted for studying home health care use, but other models for predicting home health care use exist. Many have evolved out of the health care use forecasting literature and can be attributed to State Health Planning Department Agencies. Ryder-Warhola (1980) reviewed nine such models and suggested a five step additive approach for home health care planning which considers population estimates and rates of home health care need based on the National Health Interview Survey. Sharma (1980) also critiqued several state planning forecasting techniques and suggested that a good model must: be explicit in defining "need" and "demand" for home health care; use local estimates of hospitalization and unnecessary long-term care institutionalization; and use sophisticated demographic data, such as health status indicators. Reid et al. (1987) from the Maine Department of Human Services outlined such a model. Forecasting techniques may be useful for health planners looking at home health care use by populations, however clinicians need a predictive home health care model which is applicable to the individual patient.

Andersen and Newman's framework has been directly applied by many home health care researchers and adapted by others. Bass and Noelker (1987) agree with Andersen and Newman's general framework but argue that there is a general lack of emphasis on the caregiver in the model. They suggest revising

the predisposing category to include the demographic characteristics of the caregiver as well as the patient, adding indicators of the family support system to the enabling category, and dividing the illness category into the patient's needs and the caregiver's needs. Noelker and Bass (1989) have attempted to further delineate the role of the informal caregiver by developing a typology of formal and informal caregiver relationships.

Predictors of Home Health Care Utilization

Through review of the last 15 years of health care literature using MEDLINE and HEALTHPLAN (online bibliographic databases for the medical and health planning literature, respectively), 19 studies were identified which analyzed predictors of home health care use. Nine of these studies, however, were not included in this review for reasons including: known confounders were not controlled for (Wartski and Green, 1971; Shapiro and Tate, 1989; Taylor, 1989; Edwardson and Nardone, 1990; Frederiks et al., 1990); variables were only considered in a bivariate fashion (Berk and Bernstein, 1985); no measures of association were calculated (Ahroni, 1990); or the outcome was not clearly defined (Snider, 1980; Steel et al, 1982). Based on the population studied (current home health care users, non-institutionalized elderly, and post-hospitalized elderly) and the source of home health care (formal or informal), the ten

remaining studies were analyzed.

Current Home Health Care Users

Ballard and McNamara (1983) studied 397 patients with cancer or cardiac diagnoses who were receiving home health care from nine randomly selected proprietary and not-for-profit home health care agencies. Patients ranged in age from 1 to 96 with a mean of 71 years. Risk factors considered include demographics and support network indicators. In addition, a Health Status Scale was developed which included activities of daily living (ADL, i.e., bathing, dressing, grooming, toileting, transferring, and feeding), hearing, vision, continence, behavior and skin breakdown assessments. The outcome was total number of home health care visits per day, and data was analyzed in a multiple regression model. As **Table 2.1** reveals, a higher Health Status Score (more impaired), being female, and not requiring family support predicted more total home health care agency visits per day for cancer patients. For cardiac patients, a higher Health Status Score was the only significant predictor of total visits per day. A major limitation of this study is the Health Status Score, which is a composite of so many variables that clinical interpretation is difficult.

In another study of current home health care users, Williams et al. (1990) used routinely collected home health care data to predict volume, duration and intensity of home

health care use. Patient records were randomly selected from Virginia Department of Health home care agencies. Subjects ranged from 1 to 99 years of age, with a mean of 69 years. By design, a limited number of variables were studied in multivariate fashion and the results are reported in **Table 2.1**. Age less than 75, non-Medicaid status, one of several diagnoses (e.g., injury and poisoning, diseases of skin, diseases of musculoskeletal system), and a "good" prognosis were significant independent predictors of a greater intensity of home health care services.

Non-Institutionalized Elderly

The use of formal and informal home care have been examined in the community-dwelling elderly. Most of these studies focused on the use of formal home health care services, i.e, those delivered by a home health care agency. Evashwick et al. (1984) used interview data on 887 participants in the Massachusetts Health Care Panel Study. The use of informal home care was self-reported and included any home care service utilization in the last fifteen months. Many predisposing, enabling and illness variables were examined as possible predictors of home care use in a multivariatae fashion (see **Table 2.2**). Significant predictors of home health care use included: predisposing variables, age, race and marital status; enabling variables, lack of

Table 2.1: Variables Considered as Predictors of Home Health Care Intensity in Studies of Current Home Health Care Users

Variables	Authors	
	Ballard (1983) Cancer/Cardiac[1]	Williams (1990)
Predisposing		
Age, younger	-/-	+
Sex, female	+/-	0
Race, non-white	-/-	0
Unmarried	-/-	0
Lives Alone	-/-	0
Enabling		
Caregiver, present	-/-	0
Strong Supports	+/-	0
Payment Source	-/-	0
Medicaid Non-enrollment	0/0	+
Medicare Enrollment	0/0	-
Illness		
Sicker on HHC[2] Discharge	-/-	0
HHC Duration, longer	-/-	0
Health Status Scale[3]	+/+	0
Primary Diagnosis	0/0	+
Prognosis, worse	0/0	+

Note: "-" means no association, "+" means positive association, and "0" means not examined. Only the first author's name is included.

1. Ballard and McNamara (1983) stratified their population into cancer patients/cardiac patients.
2. HHC denotes home health care.
3. See text for explanation.

transportation and Medicaid status; and illness variables, problems with stairs, requiring assistance with ADLs, and chronic medical problems. The study used well-defined variables and careful analyses, however since the outcome was self-reported up to 15 months retrospectively, the potential for recall error in home health care use data exists.

McAuley and Arling (1984) studied a subsample from the Statewide Survey of Older Virginians, 524 non-institutionalized persons over the age of 75 who used either formal or informal home health care. They examined predisposing, enabling and illness variables which differentiated the formal from the informal home health care users. Several risk factors were identified: living in an urban community, being more educated, having more ADL impairments, and having fewer IADL impairments. The authors hypothesized that the differential effects of ADL and IADL impairment may be due to a hierarchy in the types of care older people receive in the home. People with IADL impairments may be more likely to be cared for by a spouse, child or friend while an individual with impairment in the ADLs is much more disabled and thus would more likely require formal assistance.

Bass and Noelker (1987) interviewed the primary caregivers of 586 persons over the age of 60 living in the Greater Cleveland metropolitan area. Respondents were referred from social service and health agencies, senior

Table 2.2: Variables Considered as Predictors of Home Health Care Use in Studies of Non-Institutionalized Elderly

Variables	Authors					
	Evashwick (1984)	Bass (1987)	Branch (1983)	Branch (1988)	McCauley (1984)	Newhouse (1986) rural/urban[1]
Predisposing						
Age, older	+	-	+	0	+	-/-
Age CG[2], older	0	-	0	0	0	0/0
Sex, female	0	0	0	0	-	-/-
Sex CG, female	0	-	0	0	0	0/0
Race, non-white	+	+	0	0	-	-/+
Unmarried	+	-	0	0	-	-/-
Lives Alone	0	na	+	0	0	-/-
More Educated	-	0	0	0	+	-/-
No Prior HHC[3]	-	0	0	0	0	0/0
Enabling						
Socially Involved	0	0	0	+	-	-/+
Supports Nearby	0	0	+	-	0	+/+
More Supports[4]	0	+	+	0	0	-/-
White Collar Job	-	0	0	0	0	0/0
Income, lower	-	+	+	0	-	+/-
Medicaid Bene	+	0	0	0	0	0/0
Primary MD	+	0	0	0	0	0/0
Telephone, yes	0	0	0	0	0	-/+
Transport, no	+	0	0	0	0	+/-
Illness						
IADL Impairment	0	0	0	-	+	0/0
ADL Impairment	+	0	0	+	+[10]	+/+
PDI[5]	0	0	+	0	0	0/0
Paralysis	0	+	0	0	0	0/0
Stairs Difficult	+	0	0	+	0	0/0
Walking Difficult[6]	-	0	0	+	0	0/0
Mental Impairment	0	-	0	+	-	+/+
Homebound	0	0	0	+	0	0/0
Incontinent	0	+	0	0	0	0/0
Poor Health, SR[7]	-	0	0	-	-	+/+
CG Restricted[8]	0	+	0	0	0	0/0
CG Deterioration[9]	0	+	+	0	0	0/0
CG Task Burden	0	+	0	0	0	0/0

Table 2.2: Variables Considered as Predictors of Home Health Care Use in Studies of Non-Institutionalized Elderly

Note: "-" = no association, "+" = positive association, "0" = not examined, and "na" = not applicable. Only the first author's name is included. Please see the text for better explanation of the variables.

1. Newhouse stratified her sample into rural/urban.
2. CG denotes caregiver.
3. HHC denotes home health care.
4. More supports signifies more family members available to assist elder.
5. PDI denotes Physical Disability Index.
6. Difficulty with walking one-half mile.
7. SR denotes self-rated.
8. Caregiver reports restrictions in their life due to caregiving responsibilities.
9. Caregiver reports deterioration in their own physical health.
10. McCauley found ADLs to be associated with home health care use but in the opposite direction, i.e., less impaired predicted use.

citizen centers and other organizations and were eligible only if the elderly subject needed assistance with one or more ADLs. As **Table 2.2** reveals, these investigators expanded the illness category to include indicators of the caregiver's need, (e.g., whether or not the caregiver's normal daily activities were interrupted due to caregiving responsibilities), the caregiver's state of health, and the subjective sense of burden placed on the caregiver by the caregiving tasks. These caregiver need variables were found to be significant predictors of home health care use when analyzed in a multivariate model. However, since the selection criteria for the study population weighted the subjects heavily towards physical disability, it is not

surprising that caregiver needs were important predictors of home health care use. Additionally, since home health care use was a common outcome in the study population (51%), the results of the authors' multivariate logistic regression may not be valid (see **Appendix H**).

In the last study of risk factors for formal home health care use by the community-dwelling elderly, Branch et al. (1988) interviewed 3,706 persons over 65 years of age not receiving home health care who lived in East Boston. Interviewees who received "medical" home care from the East Boston Neighborhood Health Center in the subsequent 24 months were considered incident home health care cases. A wide range of variables were considered as risk factors in an age-sex adjusted fashion, then a selected group of variables was placed in a Cox proportional hazards model (**Table 2.2**). Except for one enabling variable, lack of social group involvement, all significant variables were illness level risk factors and pertained to the needs of the elderly, e.g., being homebound, mental impairment, difficulty with stairs, walking a half-mile or doing heavy housework, and ADL impairment. Predisposing variables (demographics, living arrangement, education) were not considered in the multivariate analysis. Problems with this study include the authors' acknowledged neglect of home health care services delivered by other agencies serving the East Boston community (two such agencies were identified by Branch et al.) and the lack of clear

definition given to the outcome. The authors note that home care is delivered in a multidisciplinary fashion with physicians as part of the "medical" home health care team, but fail to indicate whether physician home visits were considered "medical" home health care visits.

Several researchers have looked at risk factors for informal home health care use in the non-institutionalized elderly. Branch and Jette (1983) analyzed interview data from a subsample of 825 persons over the age of 70 who participated in the Massachusetts Health Care Panel Study. Specifically, they were interested in how the elder's support network impacted on use of informal assistance for ADLs and IADLs. Hence, the outcome was amount of informal assistance with ADLs and/or IADLs. Several aspects of the support network were predictive of informal home health care by multiple linear regression, including the size of the network, the number of geographically close supports, and the number of healthy supporters (see **Table 2.2**). However, other important categories of risk factors were not analyzed. For example, only one poorly-defined composite illness variable, the "physical disability index," was included in the model.

Newhouse (1986) examined predictors of informal home health care use in 2,146 non-institutionalized elderly who participated in the Statewide Survey of Older Virginians. She was particularly interested in differences between rural and urban elders, and thus she considers these populations

separately in her analyses. Results of the multiple logistic regression are reported according to urban or rural status in **Table 2.2.** Illness indicators, such as poor self-reported physical health, mental status impairment and ADL impairment, were consistent predictors of informal home health care use. Also, lacking a support network in close proximity predicted informal home health care use. However, none of the predisposing variables were significant predictors.

Post-Hospitalized Elderly

Only one group of investigators (Benjamin et al., 1989) has examined the focus of the present study, use of formal home health care in the post-hospitalized elderly. They conducted a prospective, case-control study of 540 individuals over the age of 65, all Medicare enrollees, who were discharged from either of two hospitals in California. Discharge planners at these two hospitals enrolled and conducted the baseline patient interviews for the study. All subjects were served by either of two home health care agencies, one was hospital-affiliated, and home health care use data was collected from these agencies' records. Controls were identified as patients who (1) had a "significant" diagnosis (e.g., cancer, stroke, pneumonia, heart failure, chronic obstructive pulmonary disease, and hip fracture), (2) were being discharged from the participating hospitals without home health care, and (3) lived alone or with a frail

caregiver. Many predisposing, enabling and illness variables were tested in a bivariate fashion, then a selected group were analyzed in a multiple logistic regression model. Significant risk factors included: medical severity (based on a modified Greenfield Comorbidity Index (1988)) and ADL impairment from the illness category, and living alone from the predisposing category (see **Table 2.3**). However, since 55% of the study population were incident cases, it is unclear whether the multiple logistic regression equation is valid for use in these analyses (see **Appendix H**). In addition, detection bias may have been inherent in this study, since the discharge planners identified cases and collected risk factor data in an unblinded fashion.

Summary of Literature

Several points can be taken from the health care and home health care utilization literature. Andersen and Newman's (1973) model of predisposing, enabling, and illness variables has utility for analyzing home health care use by the elderly. Bass and Noelker (1987) have revised this model to encompass more caregiver variables. However, there are few studies in the literature which have analyzed predictors of home health care utilization, and these have considered a very inconsistent group of variables.

Table 2.3: Variables Considered as Predictors of Home Health Care Use in a Study of Post-Hospitalized Elderly

Variables	Author Benjamin (1989)
Predisposing	
Age, older	-
Sex, male	-
Race, white	-
Lives Alone	+
Enabling	
Medicaid Enrollment	-
Number of Informal CGs[1]	-
Illness	
Medical Severity	+
ADL Impairment	+
Mental Impairment[2]	-

Note: "-" means no association and "+" means positive association. Only the first author's name is included. Please see text for further explanation of variables.

1. CG denotes caregiver.
2. Based on interviewer's rating of subject's need for supervision.

Studies looking at predictors of home health care use intensity (see **Tables 2.1**) reveal no consistent pattern. Younger age was a significant predictor in one study but not another. Female gender and a stronger support system were significant predictors for cancer patients but not cardiac patients. Both studies did identify illness variables as significant predictors of higher intensity home health care use, but the illness measures were different.

Researchers investigating predictors of formal and

informal home health care use in community-dwelling elderly examined a tremendous range of variables (see **Table 2.2**). Many variables were examined in only one or two studies. Variables consistently found to be significant predictors of formal or informal home health care use by more than one researcher were illness variables, such as having problems walking stairs, ADL impairment, and poor caregiver physical health. Certain variables were significant in some studies and not others, including older age, non-white race, more education, living alone, unmarried, lack of social group involvement, having a telephone, having access to transportation, lower income, greater number of family-assisted tasks, mental impairment, unable to walk a half-mile, and poor self-reported health.

Finally, the only study to consider predictors of formal home health care use in post-hospitalized elderly (see **Table 2.3**) found two illness variables, medical severity and ADL impairment, and a predisposing variable, living alone, to be significant. However, these findings may be flawed by methodologic and analytic problems.

III. Methods

A. Aims and Hypotheses

B. Study Population

C. Study Sites

D. Data Collection

E. Predictors of Home Health Care Use

1. Demographic
2. Social Network and Supports
3. Functional
4. Biomedical
5. Past Health Care Use
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F. Home Health Care Data

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H. Data Analysis and Statistics

Aims and Hypotheses

The aims of the current study were: to develop a predictive model of home health care use in the period immediately following hospital discharge in the elderly; and to describe the subpopulation of elderly home health care users in terms of service utilization, referral sources, payers, and reasons for terminating home health care. The major hypothesis was that the risk of home health care use in the period immediately following hospitalization would be most dependent on biomedical and functional factors, and relatively independent of the patient's support network, an important enabling factor. Thus, after controlling for predisposing factors such as demographics and past health care use, and illness variables such as functional and biomedical status, support network variables would not be important predictors of home health care use.

This hypothesis runs counter to Benjamin et al.'s (1989) findings in their study of home health care use in the post-hospitalized elderly. However, several points support this hypothesis. First, many of the health care use studies which explicitly use Andersen and Newman's (1973) theoretical framework have shown little contribution from predisposing variables (e.g., age, gender, race, living arrangement) and enabling variables (e.g., income, family assistance). Second, home health care delivered in the post-hospital discharge period is more medically intensive and thus should be less

dependent on enabling or demographic factors such as the patient's support network or living arrangement.

Study Population

Patients were drawn from an ongoing study at Yale-New Haven Hospital (YNHH) investigating functional decline in the hospitalized elderly (Human Investigation Committee, HIC, # 5359 , Inouye et al.). All patients 70 years and older consecutively admitted to ten surgical and medical wards at YNHH during the period from 11/1/89 to 7/31/90 were eligible to participate. Since it was important to include demented patients in the study, a modified consent procedure was employed which included a surrogate consent option approved by the Yale School of Medicine's Human Investigation Committee (see **Appendix A**). Patients excluded from this original sample were: those unable to cooperate with interviews, e.g., severe hearing impairment or severe cognitive impairment; those with a significant language barrier; or those who refused to participate. Three hundred and twenty-three patients were enrolled at hospital admission into the study of functional decline in the hospitalized elderly.

Of the 323 eligible subjects, a total of 76 were excluded from the present study due to: death during hospitalization (n = 21), discharge to a nursing home (n = 26), and residence outside of New Haven county (n = 29). These exclusion criteria were selected in order to assure that all subjects

were eligible to receive home health care and to restrict our study to the New Haven County catchment area for logistic reasons. An additional 21 subjects refused to have their home health care records reviewed, leaving a final sample of 226 or 70% of the total.

Study Sites

Yale-New Haven Hospital (YNHH) is a 785-bed tertiary-care university hospital with admissions totalling 35,251 in 1990. Of these admissions, 7,820 (22.2%) were billed to Medicare. The average length of stay in 1990 for all admissions was 7.3 days and 11.1 days, for Medicare patients. The hospital does not operate its own home health care agency.

All 23 Medicare-licensed home health care agencies whose service areas included parts of New Haven County participated in the study (see **Appendix B**). Nine (39%) of the agencies were proprietary and 14 (61%) were government or non-profit entities. Overall, these 23 agencies served 13,777 persons in 1989-1990, of whom 10,485 (76%) were over 65 years of age (Connecticut Department of Health Services, 1990).

Data Collection

There were three primary data sources for this study: subject or family surrogate and primary inpatient nurse interviews; hospital records; and home health care agency

records. Subjects or surrogates and primary nurses were interviewed by trained interviewers on multiple occasions. Data were taken from baseline interviews (within 48-hours of hospital admission), discharge interviews (within 48-hours of hospital discharge), and follow-up interviews (3-6 months post-hospital discharge). Hospital data were collected by trained medical record extractors and home health care records were extracted by the primary investigator (PI). All data collection instruments were approved by Yale University School of Medicine's Human Investigation Committee (HIC #s 5637 and 5359, see **Appendix C**).

Predictors of Home Health Care Use

Since development of a predictive model for post-hospitalization home health care use was the focus of this study, hospital discharge was chosen as zero-time. Thus, in all time-related calculations (e.g., time to home health care admission) hospital discharge was used as the starting point. Ideally, therefore, data collected at hospital discharge and thereafter would have been used. However, some of the patient data were only collected at hospital admission (see **Table 3.1**). For several of the variables (e.g., annual household income; children, friends, and relatives seen in the last month; highest educational level obtained; home health care use prior to hospitalization; hospital admissions in the last year; marital status; and social supports) the time of

Table 3.1: Study Variables and Their Sources

Source	Variable
Baseline Interview (Within 48 hours of hospital admission)	o Annual Household Income o Highest Educational Level Obtained o Past Home Health Care Use o Hospital Admissions in Last Year o Jaeger Vision Test o Whisper Test o Lawton Instrumental Activities of Daily Living (IADL) Score o Living Arrangement (Alone or With Others) o Marital Status o Residence Type o Size of Social Network o Social Supports (Instrumental, Confidante, and Emotional)
Discharge Interview (Within 48 hours of hospital discharge)	o Age o Folstein Mini-Mental Status Exam (MMSE) o Geriatric Depression Scale (GDS) Score, Short Form o Confusion Assessment Method for Delirium o Incontinence, Assessed by Nurse o Katz Activities of Daily Living (ADL) Score, Assessed by Nurse o Mobility, Assessed by Nurse o Severity of Illness, Assessed by Nurse o Skin Check for Decubitus Ulcers, by Interviewer
Follow-Up Interview (Within 3-6 months of hospital discharge)	o Home Health Care Use o Nursing Home Admission o Vital Status
Hospital Record	o Gender o Race o Reason for Hospital Admission o Number of Active Diagnoses on Hospital Admission o Length of Stay (LOS) in Hospital
Home Health Care Record	o Referral Source for Home Health Care o Home Health Care Agency o Date of Admission to Home Health Care o Prognosis on Home Health Care Admission o Payment Source for Home Health Care, on Admission and Discharge o Types, Volume and Duration of Home Health Care Services o Date of Discharge from Home Health Care

collection was not critical. Data which may have changed during the time of hospitalization include vision, hearing, IADL score, living arrangement, and residence type. Of these variables, the IADL score would probably be subject to the greatest change, but cannot validly be measured at discharge.

Demographic

The subjects' race and gender were collected from the hospital record. Age of the patient was calculated from the date of hospital discharge and the date of birth. Age was analyzed in a continuous fashion and then in 5, 10 and 15 year increments. Annual household income data was collected by asking patients to indicate from a list which figure represents their income for the past year. Income figures were in $5,000 increments. These increments were aggregated into $10,000 and $20,000 groups for analysis. Also, subjects were asked about their highest level of education in years or grades. Responses were categorized into five levels of education: no formal, elementary school, high school, college, and graduate school. Analysis was carried out on these five groups and then on two aggregate groups -- high school degree or less and college and greater.

Social Networks and Supports

Several aspects of the subjects' support networks were examined: living arrangement (alone or with others); marital

status; network size (number of children, friends, and relatives seen in last month); the presence of instrumental supports such as household help (i.e., "extra help...with daily tasks"), emotional support, and a confidante; and composites of the above variables. A subject's marital status was recorded as married if the subject was neither divorced, widowed, nor single. The number of friends, children and relatives seen in the last month was analyzed in a continuous fashion and then dichotomized at the median value of five. Subjects reported the presence or absence of instrumental support, emotional support, and a confidante. This information was considered in an ordinal fashion (i.e., one, two, or three present). A composite variable was created in an attempt to capture the direct caregiving potential of the patient's home environment (i.e., living arrangement) and the caregiver's supports (i.e., number of friends, children and relatives seen in the last month). These variables were placed in a contingency table and then combined according to the similarity of cells (see **Appendix D**) such that the composite variable was dichotomized into two groups: (1) living alone or having few contacts per month and (2) all others.

Functional

Several physical and cognitive functional status indicators were investigated. Patients reported their ability

to perform instrumental activities of daily living (IADL, Lawton and Brody, 1969) -- telephone use, shopping, transportation, meal preparation, housework, taking medications, and finances. The IADL scores were considered in a continuous (IADL equals zero through seven) and a dichotomous fashion, i.e., needing no help (IADL equals zero) or needing any help (IADL greater than or equal to 1). Activities of daily living scores (ADL, Katz et al., 1963) -- feeding, bathing, grooming, dressing, transferring (i.e., bed to chair), walking, and toiletting -- were reported by the patient's primary nurse. Again, data was considered in continuous (ADL equals zero through seven) and dichotomous fashions (ADL equals zero or ADL greater than or equal to 1).

A Mini-Mental Status Examination (MMSE, Folstein et al., 1975) was administered to the patient. The data were dichotomized using a previously validated cutpoint (Folstein et al., 1975). The presence or absence of delirium was assessed using the Confusion Assessment Method (CAM, Inouye et al., 1990). The CAM questionnaire identifies the acuity of onset of confusion, fluctuating course, inattention, disorganized thinking and an altered level of consciousness -- all aspects of the DSM-IIIR criteria for delirium. Subjects were rated as delirious if they had an acute onset and a fluctuating course of inattention, and either disorganized thinking or an altered level of consciousness. Episodes of bowel and bladder incontinence were noted by nurses. Patients

with urinary catheters were considered incontinent of bladder if this was the reason for catheter placement. Depression was investigated using a 15-item Geriatric Depression Scale (GDS, Yesavage et al., 1983). No data was found in the literature concerning a cutpoint for depression on this short form of the GDS. Five was chosen as the cutpoint in this study based on previous cutpoints for the long form of the GDS.

Biomedical

Length of hospital stay (LOS), the APACHE II score (Knaus et al, 1985), a weighted diagnostic index (WDI), and the presence of skin breakdown as assessed by trained interviewers were all examined as clinical indicators. The LOS was calculated by subtracting the date of hospital admission from the date of hospital discharge. Length of stay was analyzed in a dichotomous fashion using the median (9 days) as the cutpoint. The APACHE II score takes into account admission vital signs (heart rate, systolic blood pressure, respiratory rate, and temperature), key laboratory values on admission (arterial pH, paO_2, serum sodium, serum potassium, serum bicarbonate, serum creatinine, hematocrit, white blood count), the patient's age, and chronic medical conditions. The maximum APACHE II score is 71 and the median in this study population is 16. The data was dichotomized using 16 as the cutpoint.

The method for developing the WDI was modelled after

Charlson et al. (1987) and was used as a means of controlling for illness severity and comorbidity. Each patient was assigned a primary reason for hospital admission; for medical patients this was the primary discharge diagnosis and for surgical patients this was the most debilitating surgical procedure performed. Except, in the case of one surgical patient, who was admitted for an orchiectomy due to prostate cancer, the cancer diagnosis was considered the primary reason for hospital admission. Reasons for admission were ranked as low, medium, or high potential for subsequent home health care use by three reviewers (P.I., Sharon Inouye, MD, MPH, and Mark Lachs, MD, MPH) (see **Appendix E**). These rankings were averaged and added (low = one point, medium = three points, and high = five points) to the number of active diagnoses on admission to create a summary score. The summary scores were trichotomized based on statistical similarities into three groups: low WDI (one to four points), medium WDI (five to nine points), and high WDI (ten to fourteen points) (see **Appendix F**).

Skin breakdown was assessed by trained interviewers at six potential sites for decubitus ulcers -- heels, ankles, knees, buttocks, hips, and sacrum. Decubiti data was dichotomized into those with and those without areas of skin breakdown.

Past Health Care Use

Two aspects of prior health care use were assessed. Subjects reported the number of times they were hospitalized in the past year. This information was analyzed as continuous data and then dichotomized into those who had and those who had not been hospitalized. Subjects also reported whether or not they had had prior home health care.

Other Variables

Several variables listed in **Table 3.1** were not mentioned in the above categories (e.g., vision test, hearing test, residence type, mobility, and severity of illness as assessed by nurse). These variables were considered in bivariate analysis but were eliminated either due to poor quality data or due to a high degree of collinearity with other variables.

Home Health Care Data

Home health care data were extracted from the subjects' home health care records. Subjects who received home health care were identified by reviewing patient lists for the period of interest at the participating agencies. The P.I. reviewed the patient lists at all but two agencies; at these two agencies, agency administrators cross-referenced their files with the study subject list. Data were extracted using the form found in **Appendix C.** Home health care admission was

defined as the first day any service was delivered to the patient and discharge was defined as the last day. Therefore, if physical therapy was discontinued but the patient was still receiving home health aide, the patient was not yet discharged from home health care.

Home health care referral source (e.g., hospital, physician, family) was found on all charts, and primary payment sources on admission to and discharge from home health care were found in most charts. (Most agencies indicated whether a payer was primary or secondary. In cases where this was not clear, the payer which was billed for the majority of services was considered primary.) Home health care visits were tallied for each service of interest, including skilled nursing, physical, occupational, and speech therapy, social work, and home health aide. Supervisory and evaluatory visits were counted, however telephone consultations were not considered visits. Duration was calculated by subtracting discharge from admission dates. Intensity was indicated by the number of visits per seven days. (For those still receiving service, the last date on which data was collected was considered the discharge day for purposes of calculating intensity.)

Reason for home health care termination was indicated in most charts, however, this information was sometimes included only in a clinical note. These responses were then categorized into one of 10 answers listed in **Table 3.2**. Also,

several patients were still receiving home health care service at the end of the study period, and thus, in these cases, home health care was not terminated.

Main Outcome Measures

The primary outcome of interest was home health care admission in the immediate post-hospitalization period, which we defined as fourteen days after hospital discharge based on the distribution of time until home health care (see **Appendix G**). One patient who died in this period was censored at the time of death. We defined home health care admission as the initiation of service which included at least two visits by any home health care worker including nurse, physical, occupational, or speech therapist, social worker, or home health aide. Patients who received only one visit (n = 6) were not included in the incident group. Service to five of these patients was terminated due to the lack of need and the last patient refused service.

Reason for terminating home health care was also considered as an outcome. Patients who were discharged due to no further need were considered to have had a "favorable outcome". Conversely, patients who were transferred to a hospital, were discharged to a long-term care facility, or died were considered to have had a "less favorable outcome". The subpopulation for this analysis included only 75 of the original 226 subjects, and for only 58 of these 75 cases was

Table 3.2: Reasons for Home Health Care Termination

o No further need for home health care services
o Referred to hospital or hospice
o Referred to long-term care
o Referred to another home health care agency
o Refused home health care service
o No longer under medical care
o No funding available
o Deceased
o Relocated out of service area
o Refused to obtain medical appointment

the outcome of home health care clear.

Data Analysis and Statistics

The measures of association between home health care utilization and risk factors used in this analysis include incidence density rates, incidence density ratios, and cumulative cohort rates. The incidence density rate (ID) is calculated as the number of new incident cases divided by the total patient-days at risk for the outcome, where patient-days refers to days in study (i.e. from hospital discharge until incidence or censoring at death or day fourteen). The incidence density ratios (IDR), the ratio of ID's (ID for

exposed / ID for unexposed), provide the relative risk of home health care use over follow-up time for each risk factor. Cumulative cohort rates (CCR) differ from ID's in that the proportion of incident cases is divided by the number of patients at risk for the outcome, without consideration of the differing follow-up times of the at-risk patients.

In order to develop the predictive model, risk factors for home health care admission were classified into one of several axes: demographic, social network and supports, function, biomedical, and past health care use. To avoid collinearity within the final model, only non-correlated variables from within each axis were selected. The selection of variables was based on three criteria: (1) the a priori clinical relevance of each variable; (2) at least a 50% increase in relative risk (i.e., IDR $\geq$ 1.5); and (3) variables whose 95% confidence interval did not include one. The crude (unadjusted) IDR and confidence intervals (CI) used for this reduction procedure were obtained from univariate Cox proportional hazards models (Cox, 1972). If more than one variable from an axis met these criteria and were correlated, the variable with the greater IDR was chosen.

The independence of variables which met the three criteria was tested using a multivariate Cox proportional hazards model (see **Appendix H**). Any variable failing to meet the clinical significance criteria (i.e., IDR $\leq$ 1.5) after adjustment for the other risk factors was removed from the

final model in a backward stepwise fashion. The independent risk factors in the final model were used to create a risk stratification system. The strata were created by assigning point values for each risk factor and summing the points. So that the system would be less cumbersome in the clinical setting, each risk factor was weighted equally with one point except high WDI which was assigned two points.

Incidence density ratio estimates and confidence intervals were derived from the model coefficients and standard errors (Kelsey et al., 1986). The method of Kaplan-Meier was used to calculate the cumulative rates of home health care admission. Bivariate statistics and Kaplan-Meier curves were carried out using the SAS program (SAS Institute, Cary, North Carolina), and Cox proportional hazards analysis was carried out using PRODAS (Conceptual Software, Houston, Texas).

IV. Results

A. Characteristics of Study Population

B. Risk Factors for Home Health Care Admission

C. Rates of Home Health Care Admission: Survival Analysis

D. Utilization Parameters of Home Health Care

E. Home Health Care Payment and Referral Sources

F. Home Health Care Termination

Characteristics of Study Population

General attributes of the study population are shown in **Table 4.1**. The mean subject age was 78.8 years, with a range from 70 to 95. 18.6% of the population fell into the old-old category, i.e., those 85 or older. The population was predominantly white (87.5%) and female (57.1%). Of the 220 subjects who reported their highest level of education, 31.5% had a college or graduate education. While of the 153 who received a high school degree or less, 43.8% had less than a junior high school education. Only 57.1% (129) of subjects indicated their annual household income, and more than half (61.2%) of those answering reported less than $20,000.

Widowed, divorced, and patients never married were slightly outnumbered by those married or separated. Nearly half (49.1%) of all patients were widowed, and patients living alone were only slightly in the minority (45.1%). Of the 124 patients who reported living with another person, 96.7% lived with relatives. Subjects reported a wide range of the number of contacts in the past month with friends, children and relatives; from 0 to 102 contacts with a median of 5.

Less than one third (32.7%) of subjects needed assistance with one or more activities of daily living (ADL), but more than half (58.0%) needed assistance in one or more instrumental activities of daily living (IADL). One-third of all patients scored in the impaired range (less than 24) on the Mini-Mental Status Exam

Table 4.1: Characteristics of Study Group (N = 226)

Patient Feature[1]	n (%)[2]
Demographic	
Age, years, mean ± SD	78.8 ± 5.7
Female	129 (57.1)
White	196 (87.5)
Education ≤ HS Degree	153 (69.5)
Income < $20,000	79 (61.2)
Social Network and Supports	
Unmarried	93 (41.1)
Living Alone	102 (45.1)
Contacts/Month, median (range)	5 (0,102)
Functional	
ADL ≥ 1	74 (32.7)
IADL ≥ 1	131 (58.0)
MMSE Score ≤ 23	74 (33.0)
Delirious at Hospital Discharge	18 (8.2)
GDS Score ≥6	36 (17.2)
Biomedical	
LOS, days, mean ± SD	10.9 ± 8.4
APACHE II Score, mean ± SD	13.5 ± 3.4
Active Diagnoses, mean ± SD	5.0 ± 2.5

Note: Total respondents varies due to missing information.
1. Please see text for explanation of variables.
2. Unless otherwise indicated.

(MMSE), and 18 (8.2%), were rated as delirious at the time of hospital discharge. Of note, Geriatric Depression Scale scores (GDS) suggested that 17% of the population was depressed.

The mean length of hospital stay (LOS) was about average for a Medicare population, 10.9 days, and ranged from 3 to 73 days. The mean APACHE II score was 13.5 ± 3.4. The subject population was chronically ill with a mean of 5 active diagnoses on hospital admission. Overall, the incidence of home health care use was 75/226 (34%), and 70/75 (93%) subjects who received home health care were referred to it upon hospital discharge.

Risk Factors for Home Health Care Admission

Twenty variables classified into one of the five axes (i.e., demographic, social support and networks, functional, biomedical, and past health care use) were selected based on a priori clinical criteria. Many of the risk factors carry a greater than 50% increased risk in home health care admission (i.e., IDR > 1.5) but only education, support networks, IADL, ADL, MMSE, LOS, WDI, and prior home health care use achieve statistical significance (see **Table 4.2**). From the functional axis three highly correlated variables, IADL, ADL, and MMSE, met the inclusion criteria. The IDR for IADL exceeded the IDR's for the other two and thus was chosen to represent the functional axis. Similarly, WDI was chosen over LOS from the

Table 4.2: Variables Considered as Risk Factors for Home Health Care Use (N = 226)

Risk Factor:	Home Health Care Users (n) Present (N)	Absent (N)	
Risk Factor[1]	n/N (%)	n/N (%)	Unadjusted IDR[2]
Demographic			
Age ≥ 85 years	18/42 (43)	57/184 (31)	1.5
Female	50/129 (39)	25/97 (26)	1.6
Non-White	14/30 (47)	61/196 (31)	1.6
Education ≤ HS Degree	62/153 (41)	9/67 (13)	3.5*
Income < $20,000	31/79 (39)	12/50 (24)	1.8
Social Network and Supports			
Unmarried	52/138 (38)	23/88 (26)	1.5
Living Alone	38/102 (37)	37/124 (30)	1.3
Contacts ≤ 5 or Alone[3]	67/181 (37)	8/45 (18)	2.0*
Functional			
IADL ≥ 1	58/131 (44)	17/95 (18)	2.8*
ADL ≥ 1	32/74 (43)	42/152 (28)	1.6*
MMSE Score ≤ 23	29/64 (45)	43/152 (28)	1.7*
Delirious at Discharge	8/18 (44)	67/201 (33)	1.4
Incontinent	12/44 (27)	62/175 (35)	0.7
GDS Score ≥ 6	14/36 (39)	55/173 (32)	1.2

Table 4.2 (continued): Variables Considered as Risk Factors for Home Health Care Use (N = 226)

Risk Factor:	Home Health Care Users (n) Present (N)	Absent (N)	
Risk Factor[1]	n/N (%)	n/N (%)	Unadjusted IDR[2]
Biomedical			
LOS ≥ 9 days	50/119 (42)	25/107 (23)	2.0*
APACHE II > 16	15/37 (41)	58/184 (32)	1.4
WDI -- medium	36/131 (28)	3/25 (12)	2.2
-- high	35/68 (51)	39/156 (25)	4.9*
Decubiti	8/21 (38)	50/153 (33)	1.3
Prior Health Care Use			
Recent Hospitalization	36/91 (40)	38/132 (29)	1.5
Prior Home Health Care	24/38 (63)	51/188 (27)	2.9*

* P-value < 0.05.
1. Please see text for explanation of variables.
2. IDR denotes incidence density ratio.
3. Contacts refers to children, friends, and relatives seen in past month.

biomedical axis.

The remaining five variables -- prior use of home health care, a higher WDI, IADL impairment, a weaker support network, and lesseducation -- were then entered in a multivariate Cox proportional hazards model (1972). Since all of the variables initially placed in the model were either clinically or

statistically significant, the model was not reduced further (see **Table 4.3**). Lesser education and a high WDI were very strong independent predictors of home health care use, increasing the likelihood by over 200 percent. Past use is a moderate predictor of post-hospital home health care use. In addition, the major hypothesis of this study, i.e., that support networks would not be an important predictor of home health care use in the post-hospitalized elderly, is marginally supported; the adjusted IDR for the composite support network variable is clinically significant but not statistically significant ($p = .15$). The R statistic, a measure of the predictive ability of the model (Harrell, 1986), equals 0.25. Thus, 25% of the variance in home health care use is explained by the model. A risk stratification system was created based on the number of risk factors present (see **Methods section**). The risk strata are Group I, 0 points; Group II, 1-2 points; Group III, 3 points; Group IV, 4 points; and Group V, 5-6 points. Finally, the rate of home health care admission for each stratum was calculated (see **Figure 4.1**). The cumulative cohort rate increases from 0% to 5%, 24%, 43%, and 67% in Groups I to V, respectively (Mantel-Haenszel trend $p \leq 0.0001$).

Table 4.3: Predictive Model of Home Health Care Admission

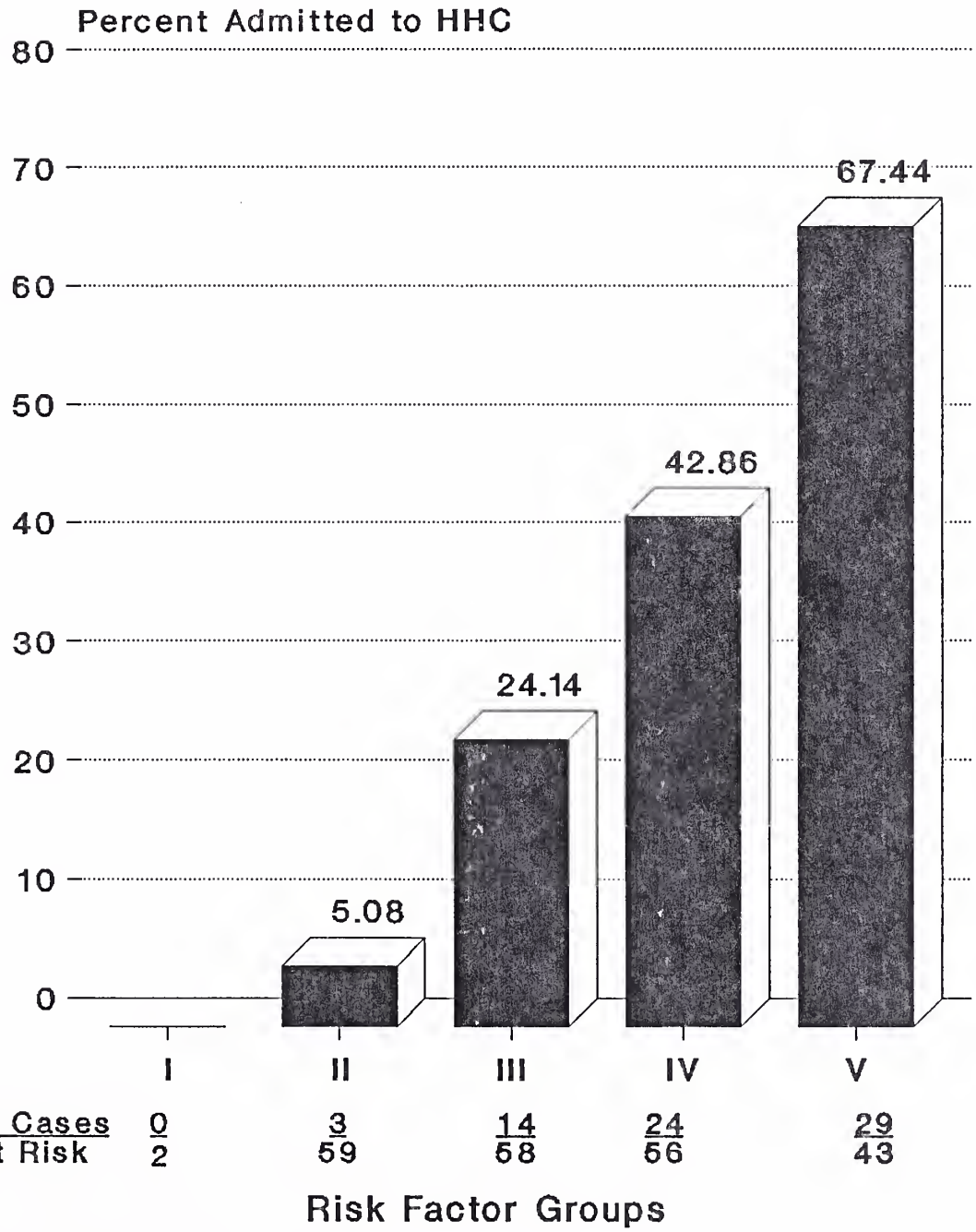
Risk Factor[1]	Adjusted Incidence Density Ratio[2] (CI)[3]
Education ≤ High School Degree	3.13 (1.55, 6.33)
Weighted Diagnosis Index -- High	3.08 (1.34, 7.08)
Past Home Health Care Use	1.87 (1.08, 3.25)
Weighted Diagnosis Index -- Medium	1.75 (1.16, 2.66)
IADL ≥ 1	1.67 (0.92, 3.03)
Contacts ≤ 5 or Alone[4]	1.59 (0.84, 3.03)

1. Please see text for explanation of risk factors.
2. Adjusted incidence density ratios were obtained from Cox proportional hazards analysis.
3. CI denotes 95% confidence interval.
4. Contacts refers to children, friends, and relatives seen in past month.

Rate of Home Health Care Admission: Survival Analysis

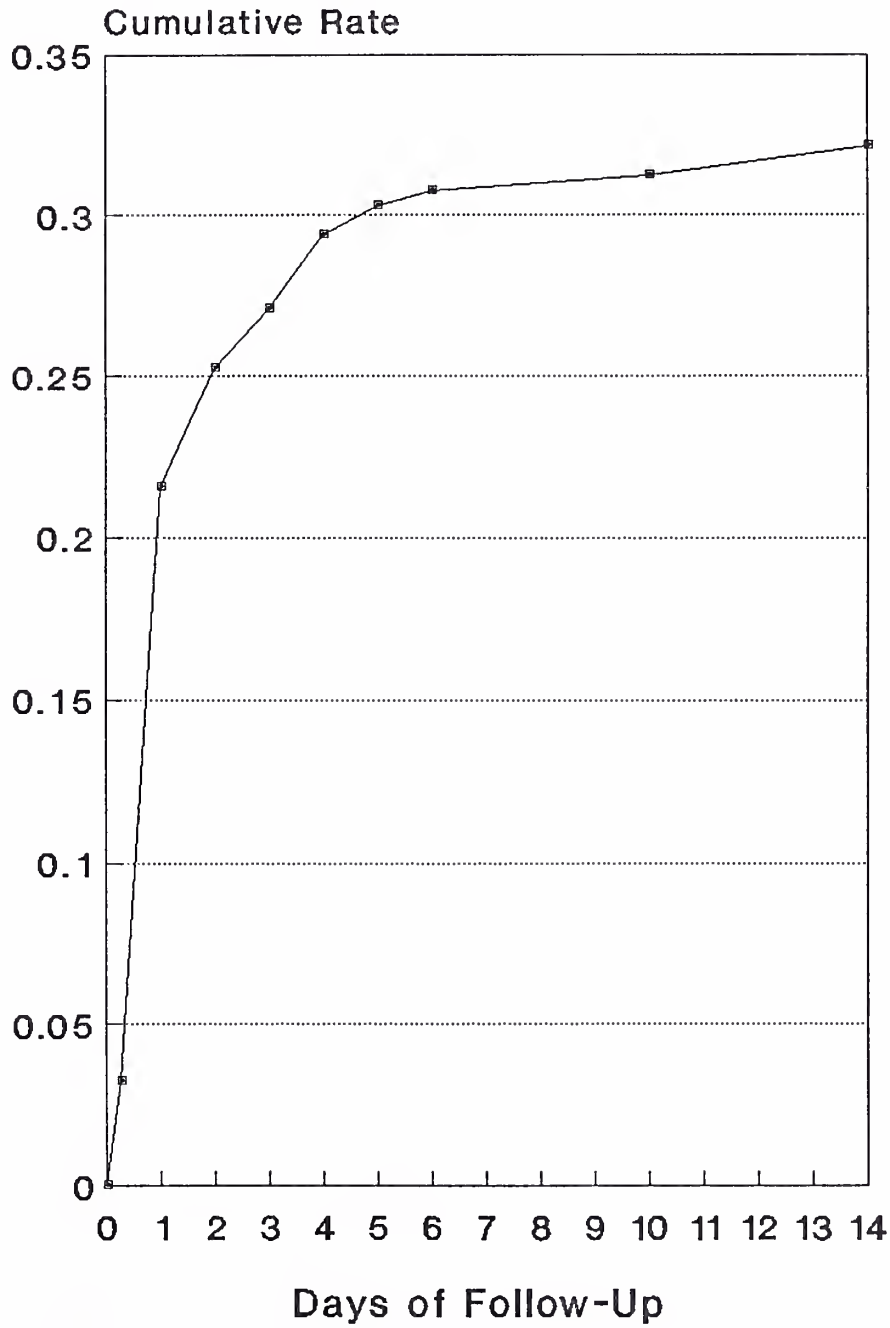
The rate of admission to home health care in the post-hospital period was not constant over time. **Figure 4.2** reveals the cumulative rate of home health care admission for the total sample over the first 14 days after hospital discharge. Home health care admission rates are more than two times higher in the first two days post-hospital discharge than in the next twelve days, but events occur up to the last

Fig 4.1: Admission to Home Health Care According to Risk Factor Stratum



Mantel-Haenszel P-value < 0.0001

Fig 4.2: Rate of Home Health Care Admission Overall Sample (N = 218)



Log Rank P-value $\leq$ 0.0001

Table 4.4: Duration, Volume and Intensity of Home Health Care Use

Service	Duration[1], median (range)	Volume[2], median (range)	Intensity[3], median (range)
Skilled Nursing (n=71)	27 (1,483+)	6 (1,125+)	2 (1,9+)
Physical Therapy (n=29)	22 (3,144)	7 (1,47)	2 (1,7)
Home Health Aide (n=42)	45 (11,483+)	19 (1,377+)	3 (1,14+)
All Services (n=75)	30 (3,483+)	18 (2,431+)	3 (1,17+)

1. Duration is measured in days.
2. Volume is measured in visits per study period.
3. Intensity is measured in visits per seven days.
+ These ranges were truncated for seven patients who were still receiving home health care at the end of the study period.

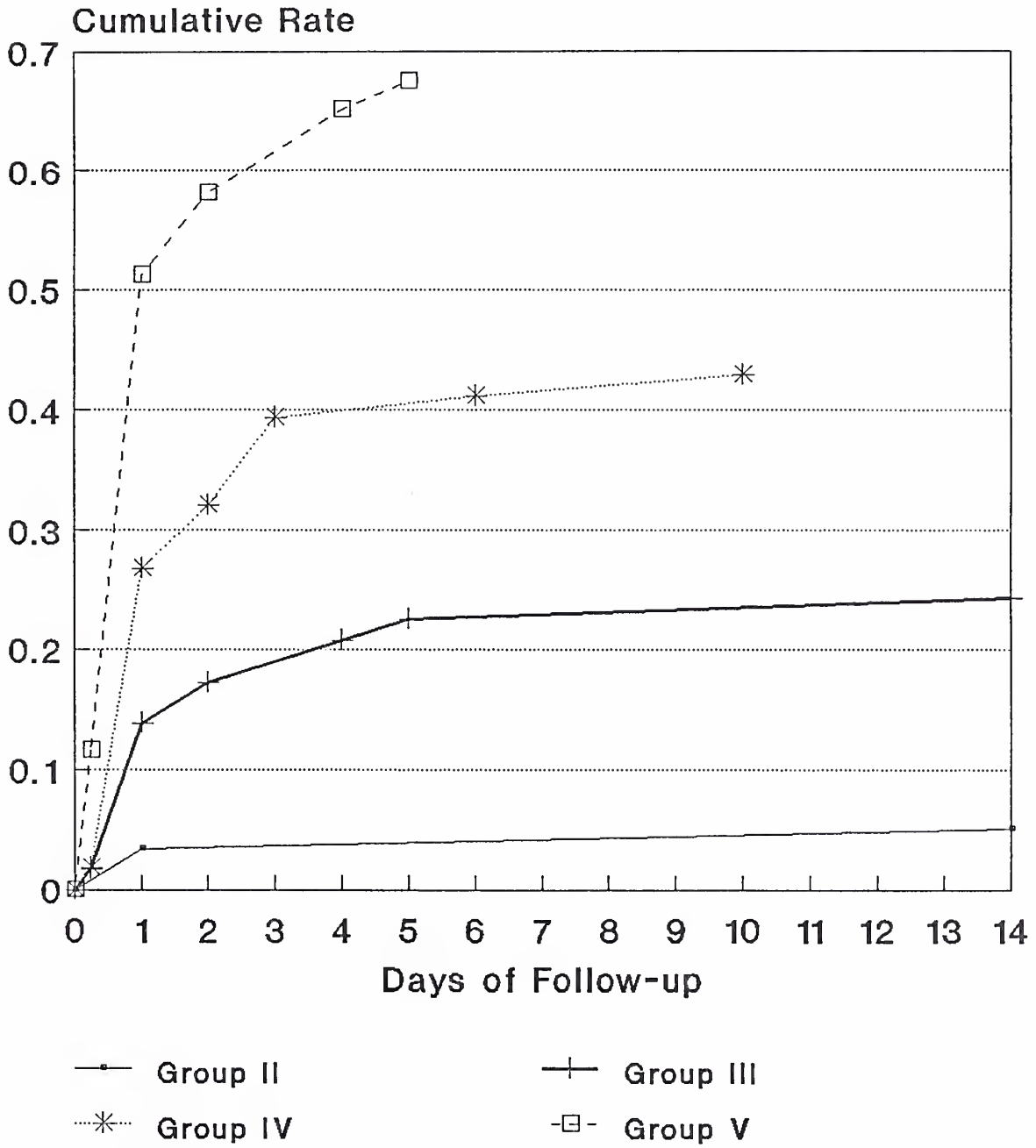
day of this fourteen-day period. In addition, the 75 patients admitted to home health care in the two weeks following hospital discharge represent 94% of all patients admitted to home health care in the study period (see **Appendix G**). Perhaps of greater interest is the finding that proportionality is maintained over time for each risk stratum (see **Figure 4.3**), a necessary assumption for Cox proportional hazards modelling (see **Appendix H**).Utilization Parameters of

Home Health Care

Statistics for the 75 subjects who used home health care are displayed in **Table 4.4**. The median duration for home health care was 30 days with a range from three to 483 days. For the more medically-intensive services (i.e., skilled nursing and physical therapy) median durations were slightly lower than that for home health aide, probably reflecting the more acute nature of problems addressed by such professionals. Of note, seven subjects were still receiving home health care at the end of the study period, and data were truncated at this time.

The median number of total home health care service visits was 18. The same trends observed with service duration apply to volume of visits. Median visits for skilled nursing and physical therapy were slightly lower than that for total home health care services and the median for home health aide was slightly higher. Median intensities (visits per week) for each service were similar. The median intensity was 3 visits per week overall, however this ranged up to 17 (i.e., home health aide 2 times per day plus another home health care worker several times per week).

Fig 4.3: Rate of Home Health Care Admission By Risk Factor Stratum



Log Rank P-value < .0001
There were no incident cases in Group I.

Home Health Care Payment and Referral Sources

Medicare parts A and B are the predominant payers of home health care (**Table 4.5**). Most elderly patients recently discharged from an acute care hospital would potentially be eligible for Medicare home health care benefits. Medicaid was the next most frequent payer on admission, followed by the state of Connecticut's Pre-Admission Screening/Community-Based Services (PAS/CBS) program. Few patients were primarily private pay. Also, 70 out of the 75 subjects who were admitted to home health care were referred by YNHH. The five others were referred by either their family or private physician.

Home Health Care Termination

Slightly greater than half (51%) of all patients in the incident group were discharged from home health care secondary to lack of need (i.e., "more favorable" outcome), as deemed by the agency (see **Table 4.6**). By and large, the charts of these subjects reveal patients with short-term home health care needs which were met, and services were subsequently discontinued. However, another 23% of patients were discharged secondary to a "less favorable" outcome, i.e., rehospitalization, referral to long-term care or death. The other 17 patients who received home health care were either not discharged or their reason for discharge was not able to

Table 4.5: Primary Payor Sources at Admission to and Discharge from Home Health Care (N = 75)

Payor	Admission, Frequency (%)	Discharge[1], Frequency (%)
Medicare A or B*	65 (85)	57 (76)
Medicaid	6 (8)	6 (8)
Private Insurance	1 (1)	2 (3)
Private Pay	0 (0)	1 (1)
Other[2]	3 (3)	7 (9)

Note: Columns may not add up to 100% due to rounding.

* $p < .05$

1. Discharge payor sources also includes payor sources at time of the study's termination. This column does not add to 75 because this information was missing from 2 charts.
2. This includes a special pooled funding program in the state of Connecticut called the Pre-Admission Screening/Community-Based Services program.

Table 4.6: Reasons for Terminating Home Health Care (N = 75)

Reasons	Frequency (%)
"More Favorable" Outcome	
No Further Need	38 (51)
"Less Favorable" Outcome	
Rehospitalized	14 (15)
Referred to LTC	3 (4)
Deceased	3 (4)
Other	
No Funding Available	4 (5)
Relocated out of Service Area	2 (3)
Referral to Another HHC Agency[1]	1 (1)
Other	3 (4)
Not Discharged	7 (9)

Note: The column may not add up to 100 % due to rounding.
1. One patient's service period was terminated due to referral to another home health care agency. However, there was never any record of the second agency admitting the patient.

be categorized as "more" or "less favorable" (e.g., no funding, relocated out of area, referral to another home health care agency).

V. Discussion and Conclusions

A. Major Findings

1. Home Health Care Predictors

2. Rate of Home Health Care Admission

B. Study Limitations

C. Implications and Future Research

Major Findings

The two major findings of this study of home health care use concern independent predictors of and the incidence rate of home health care use in the post-hospitalized elderly.

Home Health Care Predictors

This study demonstrates that less education, a higher index of comorbidity and illness severity, past use of home health care, IADL impairment, and a small support network are independent predictors of home health care use for elderly patients being discharged from an acute care hospital.

Thus, demographic (education), biomedical (illness severity), past health care use (prior home health care), and functional (IADL) variables were the strongest measured predictors of home health care use in this study. Unlike previous studies of community elderly, social supports were a weaker predictor. The major hypothesis this study set out to test, that support networks would not be an important predictor of home health care use, was supported but not proven by this study. Subjects who lived alone or had few (five or less) contacts with children, friends or relatives per month had a clinically significant (IDR $\geq$ 1.5) but not a statistically significant (95% confidence interval included 1.0) increased risk of using home health care. This hypothesis followed from the assumption that home health care in the immediate post-hospitalization period would be

providing essential medical care and, thus, less dependent on the patient's social supports. Lack of definitive evidence for this hypothesis may be explained in several ways.

The composite variable comprised of living arrangement and number of contacts per month may not have been a good measure of the support network. However, other variables (i.e., marital status, support type (emotional, confidant, and instrumental), and place of residence) were tried individually, in tandem and as composite variables to represent the support network. While it is true that none of these variables was significant, the variable presented was deemed the best measure of support network because it includes information on the presence of a spousal caregiver and secondary caregivers.

In addition, the conceptual basis for the hypothesis could be wrong. Andersen and Newman's (1973) model places family support in the enabling category and living arrangement in the predisposing category, categories of variables which have typically had only weak effects on health care use. However, in the case of home health care, the support network should probably be considered as an indicator of need and thus be placed in the illness category, typically the strongest predictor of use. Lastly, the assumption that home health care delivered post-hospital discharge is more medically intensive than usual home care may be incorrect. This could not be determined from the data collected for the present

study, however this issue should be investigated in future research.

Educational level, the variable with the highest adjusted IDR, is significantly correlated with annual household income ($r = .41$) and thus lower education is probably associated with lower income, Medicaid eligibility, and residence in the inner city; all potential facilitators of home health care use. Also, one could postulate that a higher income would predispose an individual to hiring a private non-Medicare licensed home care worker whose service would not be reflected in this study's database. This hypothesis was tested, however, and was not supported by the current data (see **Appendix I**).

By design, a higher Weighted Diagnosis Index (WDI) predicts home health care use. This variable was created to control for biomedical severity in a population of potential home health care users. Past home health care use is an indicator of propensity toward health care use, but it also reflects a past need for home health care, i.e., prior disability. Past need for health care has been shown to be a strong predictor of future use (Eve, 1988), hence this finding is not surprising. Impairment with at least one IADL represents disability at the time of hospital admission, and functional disability has consistently been recognized as a predictor of health care use in the elderly (Wolinsky, 1978).

Rate of Home Health Care Admission

The cumulative rate of home health care admission is highest in the first two days post-hospital discharge with 79% of admissions, representing 25% of the total population, occurring in this period. All but one of these early admissions was referred to home health care by the hospital. The cumulative rate of admission drops from 25% within the first two days post-hospital discharge to 9% in the next 12 days of follow up. The drop in rate is expected, however one would expect less home health care admissions in the third through fourteenth days. Why is it that patients are waiting two, three and up to fourteen days for home health care to start after hospital discharge? Have these individuals developed new needs or have their caregivers quickly become overwhelmed with caregiving responsibilities? Or, worse yet, is it secondary to home health care agencies being unavailable for service delivery in a timely fashion? Brief analysis was conducted to attempt to answer these question (see **Appendix J**), but future work on this question is needed.

Study Limitations

Several limitations of this study must be raised. Health care practice patterns have been recognized to be regional (Wennberg and Gittlesohn, 1982), and thus it is unclear whether the findings of this study would be generalizable to other parts of the country. The rate of formal home health

care use in Benjamin et al.'s (1989) study of Medicare populations in San Francisco and Oakland, the only other study on a post-hospitalized population, was much higher than the findings presented here. This difference may be due to certain aspects of Benjamin et al.'s research design. As noted above, the persons enrolling patients in their study were also discharge planners, and thus may have had a tendency to discharge patients to home health care. In addition, one of the participating home health care agencies was affiliated with the hospital, further potential incentive to refer patients for home health care.

Health care practice patterns may also be dependent on the institution. The site of this study is a teaching hospital at which several large research projects investigating the characteristics of hospitalized elderly are being conducted. Thus, the provision of health care to the elderly in this study may not be typical.

Another potential pitfall of this study is the limited range of variables investigated. Variables not studied which have been found by other researchers to be associated with health care use include: the availability of alternative long-term care services and the policies surrounding payment and eligibility (Shapiro and Tate, 1989); the ethnicity of the patient (Weeks and Cuellar, 1981); the safety of the patient's community (Visiting Nurse Association of South Central Connecticut, 1990); and access to health care services

(Andersen and Aday, 1978). These variables may have affected the predictive model and should be analyzed in future research. Also, one could argue that a referral from the hospital discharge planner is the ultimate predictor of home health care, hence the variables examined in this study are relatively insignificant. However, the risk factors contributing to the decision for a home health care referral are probably similar to those studied here, and remain to be delineated.

Several issues concerning the quality of data could be raised. As mentioned in the methods section, data for several of the variables (see **Table 3.1**) were collected on hospital admission rather than hospital discharge (zero-time). This would be problematic for attributes predicted to change during hospitalization, such as IADLs, which would be expected to decline. Using slightly inflated IADL scores (i.e., from hospital admission) should have only weakened the effects of IADL scores in this study. In addition, one could question the accuracy of the self-reported data used in this study. In the case of functional status indicators, Rubenstein et al. (1984) have pointed out that IADL scores have a high degree of interrater variability -- patient's self-rating of IADLs is significantly higher than nurse or caregiver derived scores. However, since IADL scores were originally validated in a patient population (Lawton and Brody, 1969), use of patient-generated IADL scores is justified. Other self-reported data

used in this study are mostly demographic or socioeconomic indicators which are typically collected in this fashion.

The basis for considering a subject incident -- receiving at least two home health care visits during a home health care service period starting within fourteen days of hospital discharge -- could be considered unfounded. However, the question being investigated in this study was which factors predict home health care use in patients being discharged from an acute care hospital; hence, extending the period past fourteen days would have added patients to the incident population who were without home health need post-hospital discharge and then developed a need. One could argue that fourteen days is too long a period, however the distribution of days between hospital discharge and home health care admission suggests that this population is somehow similar in their need for home health care (see **Appendix G**). The requirement for two visits is based on the observation that in instances when the need for home health care is unclear, patients will be referred for a home health care evaluation. In fact, many home health care agencies will not even open up a case record unless the evaluatory visit reveals a need for further visits.

One last possible source of inaccuracy in the data is an overestimation in patient days. Patients should have been censored when they became unavailable to receive home health care. Vital status information was available, thus the one

patient who died in the first fourteen days post-hospital discharge was censored at his time of expiration. However, patients who were transferred to long-term care facilities, rehospitalized, or relocated out of New Haven County in the first fourteen days should also have been censored. Data on such patients were not always available and thus the patient-days denominator may be inflated. If the denominator is inflated, incidence density rates would be artificially low, particularly for those patients who should have been censored. Therefore, the predictive model may not apply as well for patients who were transferred to long-term care facilities, rehospitalized, or relocated out of the study area.

Implications and Future Research

The principle clinical use for this study's findings and the area with the most promise for future research would be to screen hospital admissions for their subsequent home health care needs. Patients in Groups V (i.e., those having five or six of the independent predictors of home health care identified in this study) had a high rate of home health care use, 67% (see **Figure 4.1**). Also, patients in Group I (i.e., no risk factors) did not use any home health care, and only 5% in Group II (i.e., one or two risk factors) used home health care. Thus, collection of this risk factor information on admission would facilitate targeting of high-risk groups for home health care by discharge planners.

Another potential application of these findings is the use of the WDI as a tool for home health care researchers who want to control for clinical severity. Development of the WDI was modelled on Charlson et al.'s (1987) clinical severity index. Charlson et al.'s index plus other previously developed indices (Charlson et al., 1986; Greenfield et al., 1988) were not appropriate for this study in that they were developed with mortality as the endpoint not disability or home health care use. Greenfield et al.'s (1988) index was modified by Benjamin et al. (1989) for their home health care use study, however neither the original index nor the modifications are well-outlined in the literature. Another accepted illness severity measure which was tested as a risk factor for home health care use was the APACHE II index (Knaus et al., 1985). However, this index was developed with mortality for intensive care unit patients as the endpoint. Not surprisingly, the APACHE II index did not perform well as a predictor of home health care use. Hence, the WDI may have utility in future post-hospital home health care use studies.

Several areas of needed future research have been identified, i.e., the contributions of health care service supply, health care policy, access to home care service, patient ethnicity, and safety of the patient's community on home health care use patterns; and how patients who are admitted to home health care immediately post-hospital discharge differ from those admitted after several days.

Another research question yet to be adequately investigated is whether a predictive model for volume of home health care use can be developed. This study was unable to investigate this issue because after controlling for home health care discharge reasons (i.e., if a subject dies early in the home health care admission, volume of service is going to be necessarily low), the subject population was too small for further analyses. Other researchers (Wartski and Green, 1971; Taylor, 1989; Edwardson and Nardone, 1990; Williams et al., 1990) who have investigated this issue have not adequately controlled for home health care discharge reasons, and thus their findings may be questioned. A study of adequate size should be undertaken to attempt to answer this question.

Although some researchers may be interested in examining differences between the present study population and those referred to nursing homes, this was beyond the scope of this paper. Patients discharged to nursing homes were excluded in this study since our aim was to examine only patients eligible for home health care at the time of discharge. The nursing home population is quite different from the present study group -- older, more likely to use ambulatory aides, more mentally disabled, more impaired in IADLs, and more likely to be living alone (Branch and Jette, 1982) -- and comparison of the two groups could pose an interesting area for future work.

Home health care has taken on increasing importance as the elderly population grows and the pressure to find

alternatives to institutional care intensifies. The bulk of the home health care literature deals with comparisons between institutional and community long-term care. Research on home health care needs and predictors in community and post-hospitalized populations is scant and lacking consistency. The research presented here has built upon a conceptual basis of health care utilization and shown that there are several independent predictors of home health care use in the post-hospitalized elderly, including social supports. Such independent predictors could be incorporated into a screening tool for hospital discharge planning. In the future, more resources must be dedicated to fostering academic medical interest in home health care research so that the fund of knowledge applied to the challenge of caring for our growing elderly population can be increased.

VI. References

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VII. Appendices

A. Consent Form

B. Participating Home Health Care Agencies

C. Home Health Care Data Extraction Form and Codes

D. Support Network Composite Variable Contingency Table

E. Weighted Diagnosis Index Ranking Lists

F. Creation of Weighted Diagnosis Index Levels

G. Time To Home Health Care Admission

H. Rationale for Methods of Analysis

I. Non-Medicare Licensed Home Health Care Users

J. Non-Referred Home Health Care Users

Appendix A: Consent Form

Information Sheet for Patients

We invite you to participate in our study of the effects of hospitalization on older people. We are trying to learn more about how being in the hospital affects both the physical and mental functions of older people. You have been chosen to be part of our study because you are over the age of 70 and have been admitted to one of the wards at Yale which we are studying.

If you decide to participate, we will interview you for approximately 40 minutes during our first session. The purpose of this interview is to learn more about you, your activities, and your health. Following the first session, we will visit you two to three times a week for about 10 minutes during your hospital stay. During these visits, we will check to see how you are doing in the hospital. Each session will also include a partial physical examination by the interviewer. In addition, we would like to interview you for about 15 minutes on the day before discharge from the hospital, review your hospital record, and review your visiting nurse service records from the responsible home health agency(s). If you agree we would like to remain in contact with you for one year after you are discharged from the hospital. We will contact you by telephone once during the next year to see how you are doing. All of the interviews and procedures will be conducted by nurses or by trained persons under the supervision of doctors.

Your participation will help us to understand how hospitalization affects older people, and in the future, to improve hospital care to make it more tolerable for older people. It is not our intention that the interviews be burdensome, and you can choose to stop an interview at any time. All information will be kept in strictest confidence. Your name will never be attached to any report. In the event that you should want us to convey information to a medical professional, it will be disclosed only with your written consent. You are free to choose not to participate, and if you decide to participate you are free to withdraw at any time. Your decision, whatever it is, will not interfere in any way with your relationship with the doctors, the visiting nurses, the hospital, or Yale.

Please feel free to ask about anything you do not understand. Dr. Sharon Inouye will be available at 785-7302 to answer any questions about the study. You may take as much time as you need to think this over. This letter is for you to keep for future reference.

Signature of Interviewer_____ Date_____

Appendix B: Participating Home Health Care Agencies

Susan Amarante, Administrator
Branford Visiting Nurse Association, Inc.
Branford, CT

Clare Pace, Administrator of Home Health Care
William Norton
The Connecticut Hospice, Inc.
Branford, CT

Elizabeth Zeman, Administrator
Home Health Care Services Corp.
Branford, CT

Kathleen E. Paul, Executive Vice President
Visiting Nurse Services of Connecticut, Inc.
Bridgeport, CT

Eileen Geis, Administrator
Nancy Siemkowski
Community Care Services, Inc.
Cheshire, CT

Dorothy Wilson, Administrator
Laurie Wicko
Visiting Nurse Association of Guilford, Inc.
Guilford, CT

Pat Alt, Administrator
Kay Charigues
Visiting Nurse Association of Madison
Madison, CT

Arne Solli, Administrator
Family Service Association of Central Connecticut, Inc.
Meriden, CT

Suzanne Gross, Administrator
Franciscan Home Care
Meriden, CT

Dace Putnins, Administrator
VNA Home Care Services of Meriden
Meriden, CT

Joyce Lindsey, Administrator
Immaculata Home Care Services, Inc.
Milford, CT

John O'Connell, Administrator
Marcia Takacs
New England Home Care, Inc.
Milford, CT

Anna M. Butler, Administrator
Naugatuck Visiting Nurse Association
Naugatuck, CT

Eric Peterson, Administrator
Medical Personnel Pool
New Haven, CT

Carol Richards, Supervisor
Omni Home Health Services, Inc.
New Haven, CT

Sharon Corriveau, Administrator
Staff Builders Health Care Services
New Haven, CT

Joanna Walsh, Administrator
Cindy Istvan, Supervisor
Visiting Nurse Association Of South Central Connecticut, Inc.
New Haven, CT

Margaret S. Benton, Administrator
Nancy Hummiston
Regional Visiting Nurse Agency, Inc.
North Haven, CT

Beatrice Torrenti, Administrator
Orange Visiting Nurse Association
Orange, CT

Ellen A. Mandes, Administrator
Homecare, Inc.
Wallingford, CT

Eilleen McMahon, Supervisor
Masonic Community Services Home Health Care Program
Wallingford, CT

Ellen Phillips, Administrator
Visiting Nurse Association of Wallingford, Inc.
Wallingford, CT

Eileen Cain, Administrator
Professional Relief Nurses, Inc.
West Haven, CT

Appendix C: Home Health Care Data Extraction Form and Codes

DATA EXTRACTION FORM

1. Patient Identification # (ID) _ _ _ _ _ (01)

2. Home Health Care Agency Code (HHCAC) _ _ (06)

Admission

3. Date of HHC Admission (HHCADM) _ _ / _ _ / _ _ (08)

4. Start of HHC Service Date (HHCSTART) _ _ / _ _ / _ _ (14)

5. Reason for HHC Service (up to three) (RSNHHC) _ _ (20)
_ _ (22)
_ _ (24)

6. Primary Diagnosis on HHC Admission (PDXHHCA) _ _ _ . _ _ (26)

7. Secondary Diagnoses (up to five) (SDXHHCA) _ _ _ . _ _ (32)
_ _ _ . _ _ (38)
_ _ _ . _ _ (44)
_ _ _ . _ _ (50)
_ _ _ . _ _ (56)

8. Functional Index on HHC Admission (FIADM)

a) Dependence _ (62)

b) Ambulation _ (63)

c) Continence _ (64)

d) Mental Status _ (65)

e) Vision/Hearing/Speech _ (66)

f) Emotional Stability _ (67)

9. Prognosis (PROG) _ (68)

10. Living Arrangement on HHC Admission (LARR) _ (69)

11. Primary Source of Payment on HHC Admission (FPAYADM) _ _ (70)

12. Secondary Source of Payment (SPAYADM) _ _ (72)

13. Special Program Participant (SPEC) _ _ (74)

14. Referral Source (REFER) _ _ (76)

Discharge

15. HHC Termination Date (HHCTERM) _ _ / _ _ /_ _ (01)

16. Outcome (OUTCOME) _ (07)

17. Primary Source of Payment on Disch/Extract (FPAYDC) _ _ (08)

18. Secondary Source of Payment (SPAYDC) _ _ (10)

Service Delivery

19. HOME NURSING (NURS)
    a) Total # Visits _ _ _ (12)
    b) Date of Termination of Service _ _ / _ _ / _ _ (15)
    c) Reason for termination of service _ _ (21)

20. PHYSICIAL THERAPY (PT)
    a) Total # Visits _ _ _ (23)
    b) Date of Termination of Service _ _ / _ _ / _ _ (26)
    c) Reason for Termination of Service _ _ (32)

21. OCCUPATIONAL THERAPY (OT)
    a) Total # Visits _ _ _ (34)
    b) Date of Termination of Service _ _ / _ _ / _ _ (37)
    c) Reason for Termination of Service _ _ (43)

22. SPEECH THERAPY (ST)
    a) Total # Visits _ _ _ (45)
    b) Date of Termination of Service _ _ / _ _ / _ _ (48)
    c) Reason for Termination of Service _ _ (54)

23. SOCIAL WORK (SW)
    a) Total # Visits _ _ _ (56)
    b) Date of Termination of Service _ _ / _ _ / _ _ (59)
    c) Reason for Termination of Service _ _ (65)

24. HOME HEALTH AIDE (HHA)
    a) Total # Visits _ _ _ (67)
    b) Date of Termination of Service _ _ / _ _ / _ _ (70)
    c) Reason for Termination of Service _ _ (01)

25. HOMEMAKER (HMKR)
    a) Total # Visits _ _ _ (03)

    b) Date of Termination of Service _ _ / _ _ / _ _ (06)

    c) Reason for Termination of Service _ _ (12)

26. Other Services Provided (OSVCS) _ _ (14)

HHC. Use Immediately Prior to Index Hosp Adm (PRIORHHC) _ (16)

DATA EXTRACTION CODES

question #	code	response
1 ID	-----	from coded list
2 HHCAC	01 ----------	VNA-Branford
	02 ----------	VNA-Cheshire
	03 ----------	VNA-Guilford
	04 ----------	VNA-Madison
	05 ----------	VNA-Meriden
	06 ----------	VNA-S.Central CT
	07 ----------	VNA-Orange
	08 ----------	VNA-Regional
	09 ----------	VNA-Stratford
	10 ----------	VNA-Wallingford
	11 ----------	Home Care Inc.
	12 ----------	Hospice Home Care
	13 ----------	Madison Rehab.
	14 ----------	Medical Personnel Pool
	15 ----------	Omni Home Health Services
	16 ----------	Professional Relief Nurses
	17 ----------	Staff Builders
	18 ----------	NE Home Care
	19 ----------	Others (Specify)
3 HHCADM	------	Date from record
4 HHCSTART	------	Date from record
5 RSNHHC	01 ----------	Restorative
	02 ----------	Maintenance
	03 ----------	Health Teaching
	04 ----------	Evaluation
	05 ----------	To Facilitate Hospital Discharge
	06 ----------	To Facilitate LTC Discharge
	07 ----------	To Prevent Institutionalization
	08 ----------	Prepare for Tests
	09 ----------	Others (specify)
	98 ----------	Info Missing
	99 ----------	Not Available
6 PDXHHCA	---.--	(ICD-9-CM Codes)
7 SDXHHCA	---.--	(Same as Question #6)
	999.99	Less than Five Coded
8 FIADM		
a) Depend	1	Independent
	2	Partially Dependent
	3	Totally Dependent
	8	Info Missing
	9	Not Available

8 FIADM (cont'd)		
b) Ambu	1	Ambulatory/Needs no Assistance
	2	Ambulatory/Needs Assistance
	3	Non-Ambulatory
	8	Info Missing
	9	Not Available
c) Cont	1	Continent
	2	Incontinent of Urine
	3	Incontinent of Stool
	4	Incontinent of Urine and Stool
	8	Info Missing
	9	Not Available
d) MS	1	Mentally Alert/Oriented
	2	Mentally Confused
	8	Info Missing
	9	Not Available
e) VHS	1	Unimpaired
	2	Impaired in One Area
	3	Impaired in Two Areas
	4	Impaired in Three Areas
	8	Info Missing
	9	Not Available
f) Emot	1	Emotionally Stable
	2	Emotionally Unstable
	8	Info Missing
	9	Not Available
9 PROG	1	Poor
	2	Guarded
	3	Fair
	4	Good
	5	Excellent
	8	Info Missing
	9	Not Available
10 LARR	1	Alone
	2	With Competent Caretaker
	3	With Impaired Caretaker
	4	With Other than Caretaker
	8	Info Missing
	9	Not Available
11 FPAYADM	01----------	Medicare Part A
	02----------	Medicare Part B
	03----------	Medicaid
	04----------	VA
	05----------	BC/BS
	06----------	BC High Option

11 FPAYADM (cont'd)	07----------	Other Commercial Insurance
	08----------	Private Pay -- Full
	09----------	Private Pay -- Part
	10----------	CCCI
	11----------	CHAMPUS
	12----------	Free
	13----------	Promotional Visit (Non-Billable)
	14----------	Government/Railroad
	15----------	Others (Specify)
	97----------	Not Discharged
	98----------	Info Missing
	99----------	Not Available/ Only One Payer
12 SPAYADM	(see question #11)	
13 SPEC	01	CCCI
	02	Promotion of Ind Living
	04	Others (Specify)
	98	Unknown
	99	Non-Participant
14 REFER	01----------	Self
	02----------	Family
	03----------	Primary MD
	04----------	SNF/ICF
	05----------	Hospital
	06----------	Clinic
	07----------	Hospice
	08----------	HMO
	09----------	Case Finder
	10----------	CCCI
	11----------	Others (Specify)
	98----------	Info Missing
	99----------	Not Available
15 HHCTERM	------	Date from Record
	999997	Not Discharged
	999998	Info Missing
	999999	Not Available
16 OUTCOME	1	Goals Met
	2	Goals Not Met
	7	Not Discharged
	8	Info Missing
	9	Not Available
17 FPAYDC	(see question #11)	
18 SPAYDC	(see question #11)	

19	NURS (cont'd)		
	a	---	From Record
		998	Info Missing
		999	Did Not Receive Service
	b	------	Date from Record
		999997	Not Discharged
		999998	Info Missing
		999999	Did Not Receive Service
	c	01----------	Self/Family Care
		02----------	Referral to Hospital/Hospice
		03----------	Referral to LTC
		04----------	Referral to Another HHA
		05----------	Pt Refused Service
		06----------	Pt No Longer Under Medical Care
		07----------	No Funding Available
		08----------	Deceased
		09----------	Pt Relocated out of Service Area
		10----------	Refused to Obtain MD Appt
		11----------	Referred to Hospice
		12----------	Others (Specify)
		97----------	Not Discharged
		98----------	Info Missing/Unknown
		99----------	Did Not Receive Service
20	PT	(see question #19)	
21	OT	(see question #19)	
22	ST	(see question #19)	
23	SW	(see question #19)	
24	HHA	(see question #19)	
25	HMKR	(see question #19)	
26	OSVCS	01	Meals-on-Wheels
		02	Chore Services/HMKR/HHA
		03	Transportation
		04	Companion/Friendly Visitor
		05	Shopping Assistance
		06	Home IV Therapy
		07	Medical Equipment
		08	Others (specify)
		09	Personal Emergency Response
		10	Adult Day Care
		98	Info Missing/Unknown
		99	No Other Services Received
27	PRIORHHC	1	Service in last year from HHCA
		9	No Documentation of prior service

Appendix D: Support Network Composite Variable Contingency Table

In an attempt to most accurately represent the subject's support network, a composite variable was created. The variables selected to comprise the composite variable represented the patient's primary and secondary caregiving situation. Hence, the living arrangement (whether the patient lived alone or with others) and the number of contacts per month (including children, friends, and relatives) were chosen. In addition to the value of these variables as representing important qualities of the support network, these variables represent different dimensions of the same axis as displayed by their lack of statistical correlation, $r = -0.023$.

In developing the composite variable, a contingency table was created with living arrangement and the number of contacts (see **Table 7.1**). Since the incidence density (ID) rates were very similar for three of the four cells in the table, the composite variable was dichotomized to create two categories of support networks; persons who lived with others and had greater than five contacts per month were considered to have a strong support network (ID rate = 1.7) and all others were considered to have a weak support network (ID rate = 4.1).

Table 7.1: Stratum Specific ID[1] Rates by Living Arrangement and Contacts per Month

Contacts[2]/Month	Living Arrangement: Alone	Living Arrangement: With Others
Less than 5	3.3	4.5
5 or Greater	4.4	1.7

1. ID denotes incidence density.
2. Contacts refers to children, friends, and relatives seen in past month.

Appendix E: Weighted Diagnosis Index Ranking Lists

Medicine Patients / Diagnosis Ranks

Low Rank	Medium Rank	High Rank
Fever	Sepsis	MI, NS
Viral "Flu"	Atypical Angina	Cerebrovasc Dz
Angina, NS	Unstable Angina	MS Change
Palpitations	Acute MI	TIA
Upper Resp Infxn	Cong Heart Fail	Lung Ca
Bronchitis	Arrhythmias	Liver Ca
Pulmonary Embolus	Cardiac Arrest	Pancreatic Ca
Pleural Effusion	Valvular Heart Dz	Vertebral Fx
UTI, NS	Dyspnea	UE Fx
Gastritis	COPD	Dementia
Intest Obstruct	Pneumonia	
Diverticulitis	ATN	
Cholelithiasis	Anorexia, N/V	
Pancreatitis	GI Bleed, NS	
Colonic Angiodys	Upper GI Bleed	
Syncope	Abd/Pelvic Absc	
Colonic Polyps	Hypovolemia	
	Vertigo	
	Tetany	
	Drug Toxicity	
	Cellulitis	
	Skin Abscess	

Surgery Patients / Diagnosis Ranks

Low Rank	Medium Rank	High Rank
Venous Stasis	CAD	Cardiogen Shock
Upper Resp Infxn	Cong Heart Fail	Abd/Pelvic Absc
Neprholithiasis	DVT	Bowel Surgery, NS
Abdominal Pain	COPD	PV Surg, NS
PUD	Pneumonia	LE Amp, NS
Gastroenteritis	Renal Failure	Digit Amp, NS
Diverticulitis	Hematuria, NS	Hip Surg, NS
Diverticulosis	Urinary Retention	Laminectomy
Cholelithiasis	GI Bleed, NS	Knee Surg, NS
Pancreatitis	UGI Bleed	UE Surg, NS
Pancreatic Cyst	LGI Bleed	LE Ortho Surg, NS
Fe Defic Anemia	Heme + Stool	LE Fx
Cellulitis	Peritonitis	Dementia
Cholecystectomy	Ischemic Bowel	Prostate Ca
Herniorrhaphy	Acic-Base Disturb	
Other Abd Surg	HyperNa/HypoNa	
Prostatectomy	Head Injury	
Orchiectomy	Art Thrombectomy	
Other GU Surg	AV Fistula	
Carpal Tunnel	Skin Ulcer Closure	
Soft Tissue Inj	Uret Stent	
	Vert Fx	

Appendix F: Creation of Weighted Diagnosis Index Levels

In order to investigate the effects of social networks and supports on the use of home health care, it was important to control for functional and biomedical status. Several appropriate functional status indicators were available (i.e., IADL, ADL, MMSE), however previously developed biomedical status indicators were not appropriate for the outcome of interest in this study, home health care. Hence, a Weighted Diagnosis Index (WDI) was created to control for biomedical/illness severity and comorbidity in this study population.

The WDI process was modified from Charlson et al.'s (1987) illness severity index. Two elements comprise the WDI -- the number of comorbid illnesses on hospital admission and the primary reason for hospital admission. The number of comorbid illnesses was the number of active diagnoses on admission, derived from medical record reviews. The primary reason for hospital admission was chosen as the primary diagnosis assigned in the discharge summary for medicine patients and the most significant surgical procedure for surgery patients. The reasons for hospital admission were ranked according to future risk of home health care need, such that diagnoses were stratified into "high" risk (e.g., stroke or total hip replacement), "medium" risk (e.g., sepsis, congestive heart failure), and "low" risk (e.g., gastroentiritis, palpitations). See **Appendix E** for full

listing of diagnosis ranks. "Low" risk diagnoses were assigned one point, "medium" risk three points, and "high" risk five points.

A WDI summary score was calculated by adding the total number of active diagnoses (one point each) to the point scores assigned (as above) to the reasons for hospital admission. These summary scores, which ranged from one to fourteen points, were plotted against the incidence density rates for home health care admission. The graph suggested that the summary scores fell into three separate levels. Hence, the WDI data was trichotomized into "low" (one to four), "medium" (five to nine), and "high" (ten to fourteen) levels. As the statistics suggest (see **Table 7.2**), the trend between WDI level and incidence density rate for home health care admission is significant (Mantel-Haenszel p-value $\leq$ 0.0001). Thus, the WDI can be used to control for biomedical status in a multivariate model.

Table 7.2: Predictive Value of Weighted Diagnostic Index Levels

Level	WDI Score	ID Rate[1]	IDR
Low	1 - 4	0.958	1.00
Medium	5 - 9	2.56	2.67
High	10 - 14	6.83	11.76

Note: ID denotes incidence density and IDR denotes incidence density ratio.
1. Rate is per 100 person-days.

Appendix G: Time To Home Health Care Admission

Table 7.3: Time To Home Health Care Admission

Days Post-Hospital Discharge	Frequency	Cumulative Percentage
0[1]	9	11.3
1	42	63.8
2	8	73.8
3	4	78.8
4	5	85.1
5	2	87.6
6	1	88.9
8	1	90.2
10	1	91.5
14	2	94.0
47	1	95.3
56	2	97.5
58	1	98.8
108	1	100.1

Note: Percentages do not add to 100 due to rounding.
1. Day 0 is the day of hospital discharge.

Appendix H: Rationale for Methods of Analysis

Two aspects of the statistical analysis warrant further explanation. Incidence density (ID) rates were used instead of the more traditional cumulative cohort (CC) rates. Use of ID rates allows one to analyze the risk per person-day versus the risk per person of being admitted to home health care. The outcome for analysis based on ID rates consists of two elements: (1) the dichotomous response of whether or not the patient received home health care, and (2) the amount of time at risk, i.e. time until home health care admission or time until censoring. Hence, ID rates distinguish between early and late home health care admissions which may have slightly different predictors.

A linear regression model was not appropriate for this type of analysis since the outcome is not continuous. The commonly used logistic regression model was also unsuitable because the "rare disease assumption" was not met; of the 226 patients at risk, 75 (33%) became incident during the study. Hence, the odds ratio, the point estimate obtained from a logistic regression model, would not be a good estimate of the risk ratio. Since the relationship of time to event, IDR, was of interest, Cox's (1972) method of proportional hazards analysis was the best choice. In addition, Cox's method assumes only that the hazard ratios are constant over time. The graphs of the cumulative rates of home health care admission by risk strata (see **Figure 4.3**) illustrate that

proportionality is maintained over time, thus satisfying this assumption.

Appendix I: Non-Medicare Licensed Home Care Users

The finding that a higher level of education was predictive of lower home health care use was surprising. Since higher education was positively correlated with higher income ($r = .41$), one might wonder whether more highly educated subjects had the means to hire non-Medicare licensed home care providers and thus used less Medicare-licensed home care (the outcome studied in this project). This hypothesis was tested through self-reported use of home care. In the follow-up interviews, patients and surrogates were asked about the use of paid home care since hospitalization. These responses were cross-referenced with the home health care data collected from the participating agencies. Patients who reported home care use but were not found to have received home care from one of the participating Medicare-licensed home care agencies ($n = 21$) were assumed to have used non-Medicare licensed home care. When highest educational level was tested in a contingency table with use of non-licensed home care (see **Table 7.4**), there was no significant association. Thus, one can assume that use of non-licensed home care does not confound the association between lower educational level and use of home health care.

It is important to recognize that non-Medicare licensed home care services are widely used. Attempts were made to quantify the size of this local non-Medicare licensed home care market. The State of Connecticut's Home Health Section

in the Department of Health Services investigated 120 agencies in 1986-1987 which arranged for or provided homemaker or health aid services which were not previously licensed (State of Connecticut, 1988). In addition, the National Association of Home Care, the largest home care trade association, reports that 55% of home care providers surveyed in 1987 were Medicare-licensed (American Medical Association, 1989). While it is clear that there are a significant number of non-licensed home care providers operating in the community, it is impossible to tell how many persons are served by them.

Table 7.4: Educational Level as a Predictor of Non-Medicare Licensed Home Care Use (N = 220)

Educational Level	Non-Medicare Home Care User	
	Yes	No
High School Degree or Less	14 (9.1%)	139 (90.9%)
College or Greater	7 (10.5%)	60 (89.5%)

Note: Percentages refer to rows.
Chi-square p-value = 0.763.

Appendix J: Non-Referred Home Health Care Users

The distribution of time from hospital discharge to home health care admission versus hospital referral for home health care was analyzed to investigate whether late admissions were due to new needs or untimely service delivery (see **Table 7.5**). Eighty percent of home health care users who did not receive a hospital referral versus 16% who did receive a hospital referral started to receive home health care after post-hospital day two. This striking contrast probably reflects new needs or newly recognized needs in those patient not receiving a home health care referral from the hospital. In addition, the 16% of patients who were referred home health care and not served within the first two days post-discharge went up to 8 days without receiving service. There was not a specific home health care agency responsible for these patients' care. This delay in home care admission needs to be investigated.

Table 7.5: Time To Home Health Care vs. Referral Status for Home Health Care

Days Post-Hospital Discharge	Referred Home Health Care	
	Yes n (%)	No n (%)
0	9 (12.9)	0 (0.0)
1	41 (58.6)	1 (20.0)
2	8 (11.4)	0 (0.0)
3	4 (7.1)	0 (0.0)
4	5 (7.1)	0 (0.0)
5	2 (2.9)	0 (0.0)
6	0 (0.0)	1 (20.0)
7	0 (0.0)	0 (0.0)
8	1 (1.4)	0 (0.0)
9	0 (0.0)	0 (0.0)
10	0 (0.0)	1 (20.0)
11	0 (0.0)	0 (0.0)
12	0 (0.0)	0 (0.0)
13	0 (0.0)	0 (0.0)
14	0 (0.0)	2 (40.0)

Note: Percentages refer to columns and may not add to 100 due to rounding.

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