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An examination of the person, disease, and provider factors on the outcomes of hospital AIDS care in an HMO

Author

Forsey, Lynn M.

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An Examination of the Influence of Person, Disease, and Provider Factors on the Outcomes of Hospital AIDS Care in an HMO

by
Lynn M. Forsey, R.N., PhD.

DISSERTATION

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Dedication

To all my patients, friends, and colleagues who are no longer among us.

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Abstract

An Examination of the Influence of Person, Disease, and Provider Factors on the Outcomes of Hospital AIDS Care in an HMO

Lynn M. Forsey, R.N., PhD.

This study described and investigated factors that contributed to hospital outcomes of 317 persons with AIDS (PWAs) who received care within a staff model Health Maintenance Organization (HMO) system during 1994. The goal was to determine the influence of measurable hospital care system factors on the outcomes of hospitalization using a systems framework. Multiple regression was used to determine predictors of length of stay (LOS), nursing cost, mortality, and need for additional skilled care following hospitalization. Factors contributing to the outcomes of hospitalization were organized as sociodemographic and economic, disease condition and health status, and provider related factors. LOS was predicted by number of comorbid conditions, a disease related factor and the average predicted need for nursing care score, a provider related factor. Total nursing costs were predicted by five factors, four of them being disease related factors: presence of dementia, number of comorbid conditions, disease stage, and principal diagnosis of PCP. Average predicted need for nursing care was the provider related factor predictive of nursing cost. A higher likelihood of expiration while hospitalized was associated with disease stage, principle diagnosis of PCP, total number of hospitalizations during the year, and average projected need for nursing care. Time spent on the AIDS nursing unit was a significant negative factor on in-hospital mortality. The likelihood of need for additional nursing care in a skilled nursing facility (SNF) or homecare was associated with average projected need for nursing care and long LOS during hospitalization. Notable factors that did not influence the

outcomes of hospitalization were age, ethnicity, history of drug or alcohol use, physician experience with AIDS, and actual nursing care hours delivered. This study adds evidence to the role of disease burden, measured by comorbidity and projected nursing needs, as the major predictor of variability in hospital costs and utilization. It demonstrates that predicted nursing needs may underestimate actual nursing needs at the patient level, that PWAs require more nursing care than typical medical/surgical patients, and identifies the need for post hospital care services for PWAs. Finally, it provides evidence that patient placement on dedicated AIDS nursing units affects hospital mortality.

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Chapter 1: Problem Statement & Significance

Introduction, Problem Statement, Significance

The hospital care and treatment of persons with Acquired Immune Deficiency Syndrome (AIDS) occurs in an environment of limited resources for health care. Hospital managers and administrators operate under continuing pressure to minimize costs. The need to reduce hospital expenses has stimulated efforts to redesign care delivery in hospital systems, but there are concerns that these efforts come at the cost of reductions in quality of care (Aiken, Sochalski, & Fagin, 1997b). Hospital nursing care, in particular, has a potential to affect both the quality of the hospital experience as well as the resources used during hospital episodes of care for AIDS. Examples of the types of decisions that could influence both the cost and quality of AIDS care include; development of dedicated AIDS units, or changing the mix of RNs to ancillary staff. A hospital operating within an integrated delivery system is also affected by system decisions such as the extent that case managers will influence care across the continuum of sites or whether medical practice will develop specialty clinics.

This retrospective study examined the outcomes of the response of one facility in an integrated Health Maintenance Organization (HMO) system to the challenges presented by the potentially overwhelming needs of AIDS care. In the early 1990's hospitals in San Francisco were struggling to care for large numbers of persons with AIDS (PWAs) who required much more nursing care than other medical patients. AIDS related admission had increased significantly from the late 1980s to early 1990s (Kozak, McCarthy, & Moien, 1993). Traditional hospital systems in San Francisco were

challenged to mount a response to the increasing numbers of patients as well as meeting the special needs of the predominantly homosexual population. How does a hospital system remain prepared to meet the physical and emotional needs of its patients and still remain cost conscious? Acute hospital care for the AIDS patient population is characterized by innovation and complexity while hospitals seeking to design integrated care delivery systems that promote quality are operating in an environment of economic constraints. Finding solutions to this dilemma requires information about the myriad systems of care and the outcomes for patients interacting with these systems.

AIDS Care Issues

Advances in pharmaceutical treatments has been providing hope to individuals afflicted with AIDS, however there is still much to be learned about caring for hospitalized PWAs and the rate of new infections has only slowed. From 1996 to 1997 age-adjusted death rates from AIDS dropped 47 percent for all Americans. AIDS is now the 14th leading cause of death, dropping from the 8th leading cause of death in one year (Office of Vital Statistics, 1998). However, AIDS among the top five leading causes of death for those 25 to 44 years old. The treatment of AIDS continues to challenge nurses and physicians by its complicated disease progression and multiple symptoms. The Center for Disease Control (CDC) estimates that between 40,000 and 60,000 Americans are becoming infected with HIV each year (1996). "According to the CDC, other available data suggest that, while death rates are improving dramatically, the annual number of new HIV infections in the U.S. have not declined in recent years, and the total number of people living with HIV is still increasing" (Smith, 1998).

In San Francisco, there are about 1,000 persons newly infected with HIV per year despite aggressive prevention efforts(Office of AIDS, 1997). Twenty-one percent of the AIDS cases in the state of California lived in San Francisco County (Sun & Jungkeit, 1997). AIDS is the leading cause of death for men in San Francisco and the third leading cause of death for all San Franciscans behind heart disease and cancer (Department of Health Services, 1996).

Hospital care of PWAs still consumes a significant portion of the resources for AIDS care. Approximately 60% of the projected costs of AIDS care has been attributed to hospital care. Projections of lifetime costs for AIDS care has been estimated at $119,000 per person but this predates current pharmaceutical treatments (Hellinger, 1993). The full impact of the current pharmaceutical cocktail treatment on hospital utilization over the lifetime of AIDS care is still to be determined.

Hospital Issues

Care of hospitalized AIDS patients present opportunity for improvement because of long lengths of stay, the likelihood of complicating illness, and treatment complexity. The complexity of AIDS care mirrors the trend of an increasingly sick patient population. The perception that hospitals are downsizing nursing staffs in an effort to cut costs is a direct reflection of the increase in patient acuity (Aiken, Sochalski, & Anderson, 1996a). Aiken explains that when Medicare adjusted case mix is taken into account there has been no change in the use of RN FTEs from 1984 to 1994. Yet, the perception that hospitals are decreasing the numbers of RNs to reduce costs is still an issue. There is a need to change the discussion to assessing the value of nursing care by linking the use of nursing resources to outcomes. If the factors that affect hospital outcomes for PWAs can

be identified then interventions may be designed to promote positive outcomes with a minimum use of resources.

Hospital nursing continues to feel pressure to find and refine nursing care delivery systems yet definitive outcomes are difficult to measure. Nursing care is but one aspect of the process of health care that occurs in a hospital. Identifying and measuring the unique contributions that nursing care adds to the outcomes of hospitalization is a significant challenge of health services outcomes research. In terms of AIDS care there is little outcomes research that specifically evaluates nursing factors.

There is evidence that hospital ownership and type of hospital plays a role in the type of AIDS services provided. LeBlanc and Hurley examined 1988 and 1991 data from the Annual Survey of Hospitals conducted by the American Hospital Association (LeBlanc & Hurley, 1995). They found that public or secular, not-for-profit in ownership, large, affiliated with a medical school, and high volume users of Medicaid funding hospitals were more likely to provide comprehensive HIV-related services. For-profit hospitals were the least likely to offer HIV-related services of any kind. Public ownership was the key determinant of greater service investment even after controlling for the other factors listed above.

The HMO system with its comprehensive and integrated services presents particular opportunity for study. One study evaluated patient satisfaction with AIDS care among differing types of clinics. Those receiving care via the staff model HMO rated their care favorably along with the care of general internal medicine group practice at a teaching hospital (Stone, Weissman, & P.D., 1995). Findings specifically related to HMO hospitals have been reported in few of the AIDS outcomes studies however (Hiatt,

Quesenberry, Selby, Fireman, & Knight, 1990). One advantage to using this type of hospital for outcomes research is that it presents a level field in terms of type of insurance and subsystems of care. It is an example what Aiken (Aiken, Sochalski, & Lake, 1996b) terms a natural experimental site like studies completed using Veterans Administration (VA) system patients (Bennett et al., 1996).

The problem addressed by this study is to determine the influence of measurable hospital care delivery system factors on the outcomes of hospitalization for PWAs in a facility that was operating under managed care cost pressures. The study of AIDS care was chosen because nursing care is a significant contributor to the treatment of PWAs and there is great potential for improving outcomes and our understanding of the complexity this disease and symptoms it presents.

Research Questions & Study Aims

There is a small body of research on the factors affecting the outcomes of hospitalization for PWAs but very little specifically about the nature of nursing care in an integrated HMO system. What is the nature of hospital utilization for PWAs who receive their care from an integrated HMO? What influence do nursing and medical system factors have in this HMO system on the outcomes of hospitalization for PWAs? These are the primary questions this study addresses. The study aims are: (1) To describe the demographic, disease specific characteristics, nursing costs per case, utilization, and disposition following hospitalization of PWAs from one HMO hospital. (2) To identify the predictors of length of stay (LOS), mortality, and discharge disposition (to home versus home care, discharge to a SNF, or other acute care), for the study population.

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From 1993-1994, 1,514 residents of San Francisco died from AIDS while 6,675 residents were living with the disease (SF Dept. of Health, Office of AIDS, Kevin McKinney, personal communication, September, 1997). Of these, over 300 adults were hospitalized under the care of one staff-model integrated HMO. This retrospective study provides information about individual and system predictors of disposition, LOS, and cost per case for this sample of PWAs hospitalized under managed care.

Chapter 2: Review of the Literature

In this chapter the model and concepts used to frame the study are presented along with an analysis of the relevant literature. The following statements characterize what is known about the phenomena studied: AIDS care is multidisciplinary and changing rapidly with increased treatment knowledge. Care is shifting to outpatient settings, but the remaining hospital patients are very ill (Sande & Volberding, 1990), (Morrison, 1993), (Hellinger, 1993), (Beck et al., 1993), (Holzemer, 1992), (Lewis, 1988). Hospitals have been and continue to be under increasing pressure to contain costs and managed care models, favored as cost reduction models, have been under scrutiny (Blendon & Edwards, 1991), (Russell & Barnum, 1993), (Action, 1994). Nursing system variables demonstrate evidence of affecting patient outcomes and costs of care (Prescott, 1993), (Lutjens, 1993). This study was designed to provide information about the following knowledge gaps: Information about nursing care delivery for AIDS care in relation to other subsystems of care, additional information on nursing costs of AIDS care and hospital disposition, information about systems of care under a staff-model HMO, and continued development and use of individual level dataset for health services research.

Conceptual Framework

The primary theory which guided the design of the study was system theory. The hospital organization is the system within which acute care services of a PWA is delivered. Medical and nursing care are the two primary types of care processes operating within this system although there are many supporting disciplines and services also involved. Examples

of other services include Pharmacy, Laboratory, and Radiology. When a PWA requires hospitalization due to ill health he/she enters the hospital system and health care processes are delivered towards achievement of a state of equilibrium in regards to the person's health. Namely, this achievement requires resolution of the acute disease process or symptom causing the hospitalization.

System Theory Applied to Hospitalization of PWA

Contemporary developments in systems theory provided the theoretical basis for the study. The theory of organizational ecology provided the overall perspective. Here, organizational systems emerge in response to the environment and adapt and evolve with changes in the environment (Morgan, 1986). Where the economic environment is placing contingencies on behavior, Feldstein's utility maximizing model of hospital behavior serves as the overriding construct (Feldstein,). The hospital operating within a managed care system is an example of this.

Information about financial performance and utility requires establishing average costs and marginal costs for a patient population, determining quantity of services, and the use of resources. Cost accounting methods have been established for these determinations (Cockerill, O'Brien Pallas, Bolley, & Pink, 1993), (Drummond, Stoddart, & Torrance, 1989), (Edwardson & Giovannetti, 1987). In the process of costing out nursing services it is necessary to have some measure of inputs and outputs. The output measure has been termed case costing and is defined as the determination of patient specific costs (Cockerill et al., 1993). The role of nursing workload systems measures both the technical and professional aspects of nursing care (the process of care) and is a significant potential predictor.

The prepaid group HMO, a form of managed care, has been touted as an example of needed health care reform, but there is little information regarding the performance of nursing under this model (Congress of Nursing Practice and Congress on Nursing Economics, 1992). The HMO structure promotes savings by creating different incentives for keeping costs in line than Fee for Service financing (Luft, 1978), (Buerhaus, 1992), (Wallack, 1992). Under Fee For Service, revenues are directly related to the number and type of services provided and the net revenue per service so there is no incentive for physicians and hospitals to restrict services. Conversely, the fixed monthly payment and shared financial risk of the physician group under the HMO model provides an incentive to monitor and reduce utilization of services (Luft, 1987). Research has demonstrated that HMO hospital cost savings are due to a focus on decreased utilization through screening of admissions and a shorter LOS than Fee For Service hospitals which could have a tendency to lead to a population of sicker patients in the hospital (Ibid). This situation suggests therefore, the potential impact of inpatient nursing services on LOS and service utilization. Given the state of the external environment, the need for demonstrating the cost-effectiveness of hospital nursing care, particularly HMO care, becomes the most important issue for ensuring the continued delivery of quality nursing care to individuals and families (Holzemer, 1990), (Prescott, 1993).

Components of the care processes functioning within the hospital include the following. The primary subsystems of hospital care include nursing, physicians, other professionals (e.g. social work, physical therapy, nutrition, pharmacy, radiology), and support services (e.g. materials, housekeeping, engineering). The complexity of hospital care makes direct evidence of nursing's impact on patient outcomes difficult, but evidence is

growing (Prescott, 1993), (Armstrong & Stetler, 1991), (Moritz, 1991), (Shamian, Hagen, Hu, & Fogarty, 1992), (Lutjens, 1993). Understanding nursing systems development requires description of process and structural variables.

The person entering the hospital is interacting with the providers of care, the hospital as a system, and all its subsystem components. It is theorized that the interaction of the person with these systems determines the outcomes of hospitalization. Holzemer describes an outcomes model for health care research. He uses the model to identify input, process, and outcomes variables of interest regarding the primary constituents in a health care encounter; primarily the client, provider, and care setting (Holzemer, 1994), (Holzemer & Reilly, 1995). However, this model does not allow for the process of disease as a separate entity. Although it is part of the person, the presence of disease is the reason that the person seeks hospital care. So, the model used for this study was a variation of the Holzemer model which included disease specific factors to account for disease as a modifier in hospital outcomes. Table 1 presents the situation of the person being hospitalized for AIDS care and concepts of interest using the modified outcomes model. The following review of the literature was used to identify key measurable factors that have been found to influence the outcomes of interest.

Table 1. The Interaction of Person and Disease with Hospital Care in a Systems Framework

	Inputs	**Processes**	**Outcomes**
Person	Person related characteristics on admission i.e. age, ethnicity	Self care activities	Length of Stay, Disposition
Disease	Type and level of AIDS disease	Progression of disease	Status of AIDS on discharge
Provider	Number , type, experience of health care providers, organization of services	Nursing and Medical Care factors, Treatments and procedures	Cost of Care (a proxy for resources consumed)
Setting	Type of hospital factors	Hospitalization within staff model HMO system	

Outcomes of Interest

Cost of AIDS Care

The utilization and costs of formal health services for PWAs has been a concern. Studies show a shift of utilization and costs from hospital care to outpatient services, but hospital services continue to account for the largest percentage of health expenditures for PWAs (Bennett, Cvitanic, & Pascal, 1991), (Seage, Landers, Lamb, & Epstein, 1990). Hellinger conducted a series of studies reporting the cost of AIDS care (Hellinger, 1988), (Hellinger, 1993). In 1988 he used a projection model to determine projections of the lifetime costs of AIDS care. At that time he projected lifetime costs to be $147,000 per person which included outpatient visits, pharmaceuticals and hospital charges over an expected survival of about 3 years. This figure has proven to be high based on both actual experience and closer evaluation of the methods used to determine that figure (Green, Oppenheimer, & Wintfeld, 1994), (Scitovsky, Cline, Arno, & Lee, 1985), (Scitovsky, Cline, & Lee, 1986).

There were two studies in the mid-1980s that reported hospital costs of about $6,000 per episode (Kelly, Ball, & Turner, 1989), (Scitovsky et al., 1986). The population of interest for both these studies was white gay male persons with Kaposi's Sarcoma. Three studies in the early 1990's reported annual inpatient hospital charges of $22,000 to $27,000 in 1989,1990 dollars (Bennett et al., 1991), (Seage et al., 1990), (Bennett et al., 1992b). One example, the study of Intravenous drug users on Medicaid in New York, reported an annual cost of $33,000 (1989 dollars) with an average hospital cost of $24,000 (Bennett et al., 1992b). The inpatient portion of that cost was based on 1.1 hospital episodes per patient and

the mean hospital length of stay was 34 days. They noted that persons with unstable housing arrangements had significantly longer hospital stays but they did not report hospital use stratified by housing issues. The hospital costs were imputed from charges data and not specific to the study hospital. They reported the room and board portion of the hospital charges, where nursing charges would be 60% of the total charges (Bennett et al., 1992b).

Since all the research reports vary costs and lengths of stay, one way to compare their findings is to use cost per day of hospitalization. Table 1 presents each of the studies discussed above and a comparison of their cost per day findings. It should be noted that all studies used charges versus cost data and included room and board, pharmacy, and laboratory. Factors reported by the authors to account for the variations in hospital costs include; geographic location, type of health insurance, risk behavior, housing situation, and severity. Two additional components to the cost discussion was a finding by Fleishman, Mor and Laliberte that inpatient costs varied by ethnicity in their study of over 1,300 PWAs from cities across the U.S. They also found that inpatient utilization and costs increased significantly in the months immediately preceding death, which is consistent with information regarding other terminal illnesses (Fleishman, Mor, & Laliberte, 1995). They attributed their findings to the possibility that white PWAs had more outpatient support and services available which allowed them to stay out of the hospital during the terminal stage if illness.

The cost studies related to AIDS care vary in their findings. Most of the studies contribute to the health policy debate regarding the amount of resources consumed by AIDS

care. However, they have used aggregate charges and they have not focused on hospital nursing costs, which have been usually rolled into overall hospital charges.

Table 2. Comparison of Hospital Costs for AIDS Care.

Authors	**Scitovsky, Cline, Lee**	**Kelly, Ball, Turner**	**Bennett et al**	**Bennett et al**	**Seage et al**
Year	1984	1985	1989	1991	1990
Place	San Francisco	New York	New York	Los Angeles	Massachusetts
Total cost per Hospital Episode	$6,548	$6,813	$25,178	$22,300	$28,254
Length of Stay	7.6 days	8 days	34 days	11 days	15 days
Cost per Day	$862	$851	$740	$2,027	$1,884

Note. Reported in 1991 dollars.

Utilization

Use of formal health services is closely associated with health insurance coverage. Fleishman and Mor found in one sample of PWAs that only 30 percent had private insurance, 29 percent had no insurance, and 41 percent were covered by some form of public health insurance (Fleishman & Mor, 1993). Those with public insurance and those without insurance were less likely to have been hospitalized and had shorter lengths of stay (Ibid). A shift in the number of AIDS patients with private insurance towards Medicaid coverage has also been demonstrated (Green & Arno, 1990). Utilization data specific to HMO care have not been available.

Utilization differences by demographics have been attributed to diagnosis and income level (Andrews, Keyes, Fanning, & Kizer, 1991). Seage et al. found injection drug users (IDUs) had longer lengths of hospital stay and higher costs than non-IDU AIDS patients (Seage, Hertz, Stone, & Epstein, 1993). Merzel et al. also documented differences in utilization patterns for IV drug users with HIV (Merzel, Crystal, Sambamoorthi, & and

others, 1992). Utilization is also accounted for by severity of illness. One study found severity to account for a larger portion of the variance in hospital LOS and cost than gender, race, and drug use (Kelly et al., 1989).

There is previous history of variations in LOS between the geographic regions of New York and both San Francisco and Los Angeles which has been attributed to patient and community factors (Kelly et al., 1989). Since 1985, various studies have determined that utilization is linked to patient risk factors such as IV drug use, sexual practices, age, ethnicity, severity of illness, type of insurance, and community resources such as housing (Fleishman et al., 1995), (Bennett et al., 1992b), (Kelly et al., 1989), (Hellinger, 1993), (Johnston, Smith, & Stall, 1994).

Volume and experience with care also affects utilization. A 1987 study found that hospitals in California that treated more than 300 patients over 4 years for Pneumocyctis Pneumonia (PCP) were more likely to use resources efficiently. Patients in these hospitals received diagnostic bronchoscopies, anti-PCP medications, and Intensive Care Unit (ICU) care earlier than other hospitals which contributed to shorter lengths of stay (Bennett et al., 1990).

Disposition

Hospital mortality has been the focus of AIDS outcome studies. Other types of patient disposition have not been reported as an outcome of hospitalization. There is a documented need for HIV services for SNF care which result in an increasing burden on providers in the home setting and home care services (Crystal, Merzel, & Kurland, 1990), (Boland & Klug, 1986), (Hurley & Ungvarski, 1994). However, data documenting the extent

to which skilled nursing care and homecare services are utilized have been limited. Rango et. al reported that 23 percent of a sample of 269 PWAs in a New York City hospital qualified for SNF care (Rango, Anderson, Feldman, Collins, & Green, 1989). However, they did not report the number that actually found placement facilities. The San Francisco Health Department in 1989 reported that about 10 percent of the City's AIDS population was in a SNF or hospice at any one time while 8 percent were receiving home care (Stern, Chen, & L., 1989).

Hospital Mortality

There is evidence that high nursing care hours and a nursing skill mix rich in RN hours contributes to lower inpatient mortality(Hartz et al., 1989), (Shortell & Hughes, 1988), (Al-Haider & Wan, 1991). These studies, however, were conducted at the unit and organizational level of analysis and examined mortality rates in the aggregate. The measurement and influence of nursing care hours at the individual level of analysis have not been determined. Also, there could be other organizational factors such as support for nursing that influence mortality care besides nurse staffing (Aiken, Smith, & Lake, 1994).

Use and timing of medical treatments also impact mortality. Horner et al investigated variations in resource use for persons with PCP who were hospitalized in various types of hospitals; VA, county, and private hospital (Horner et al., 1996). From 1987 to 1990, they reviewed the medical records of over 2,100 persons with PCP to determine whether patient or hospital characteristics were associated with the treatment and outcomes of PCP. One of their concerns was that patients at county hospitals may not have received the potential benefit of diagnostic bronchoscopy or care in an ICU. The resources of interest were: use

and timing of diagnostic bronchoscopy; use and timing of PCP medications; and the outcome of interest was inpatient mortality. They found evidence that patients who were more severely ill on admission were more likely to receive care in an ICU and that the more severely ill patients were more likely to die in the hospital. After adjusting for severity of illness, they found differences in care for Medicaid patients, IDUs, and for patients in VA or county hospitals. These groups were less likely to have diagnostic bronchoscopies that confirm PCP diagnosis. They concluded that type of insurance, risk group characteristics, severity of illness and hospital characteristics were important determinants of the timing and outcome of medical care for PCP.

Person and Disease Related Issues

Sociodemographics of PWAs

The population of PWAs in San Francisco has been described by Osmond et al who conducted cohort studies of homosexual and bisexual men at risk for obtaining AIDS (Osmond et al., 1994).

The influence of sociodemographic factors such as sex, ethnicity, or age on AIDS survival is mixed and intertwined with access to care issues (Mor, Fleishman, Dresser, & Piette, 1992). Differences in survival rates may be related to biological differing responses to the virus (von Overbeck, Egger, & Smith, 1994). (Chaisson, Fuchs, & Stanton, 1991). There is evidence that older age may be associated with an increased risk of death, but other sociodemographic factors such as sex, race, or socioeconomic status have not been found to effect progression rates to AIDS or survival in another study. Chaisson, Keruly, and Moore studied a cohort of 1372 HIV+ patients at an urban medical center and provided evidence

that access to medical care and not sociodemographic factors may explain differences in rates of progression to AIDS and AIDS survival (Chaisson, Keruly, & Moore, 1995). However, previous studies had found differences in progression and survival by demographic groups (Melnick, Sherer, & Louis, 1994), (Lemp et al., 1992), (Rothenberg et al., 1987). The focus of all of these studies was on overall progression of HIV+ status to AIDS and eventual death. The studies did not specifically focus on hospital care.

The seasonality of AIDS admissions is a potential factor affecting length of stay. Markson, Turner and Fanning documented that hospital length of stays increased over the fall and winter months for the population of PWAs in New York State (Markson, Turner, & Fanning, 1992). They analyzed four years of hospital data and found decreasing lengths of stay over time but also found a winter seasonal pattern to the data.

Disease Related Factors

Severity of illness on admission to the hospital appears to be a determinant of hospital mortality for those with PCP (Bennett, Adams, & Gertler, 1992a), (Bennett, Garfinkle, & Greenfield, 1989), (Stone, Seage, Hertz, & Epstein, 1992) (Turner & Ball, 1992). Kelly, Ball and Turner reported severity as the most important predictor of hospital LOS and charges in their study of interhospital comparisons. Measures used to determine severity of illness include APACHE and AIDS severity classification measures focused on stages of disease (Turner, Kelly, & Ball, 1989). The development of the AIDS severity classification was completed to facilitate comparisons of patient groups that present with variable clinical findings. More recent work has focused on the use of disease specific versus generic measures of risk adjustment(Henry, Dolter, & Holzemer, 1998). Other illness related factors

discussed in the literature include complications from IV drug use, and geographic differences in clinical conditions, which is also linked to risk group. Patients with PCP have been the focus of much of the outcome literature. This is attributed to the fact that PCP was determined to be the precipitating cause of hospital mortality for PWAs.

Provider System Related Issues

Nursing Unit Organization

One strategy for organizing patients within the hospital is to cluster patients by like diagnoses. Clustering patients on designated AIDS units has been proposed as a way to improve patient outcomes but there are few research studies on the topic and mixed results in the literature. One rationale behind developing designated units was that patient care would be improved because it was provided by a nursing staff that was familiar with the various treatment protocols and would be more experienced at recognizing and intervening in emergent changes in patient condition (Weinberg & Murray, 1987), (Morrison, 1993). The opposition has argued about the potential for stigmatization by separating PWAs into separate units (Weinberg & Murray, 1987).

Fahs et al, studied the outcomes of hospitalization for patients with AIDS who were either clustered on designated AIDS nursing units or scattered to other medical/surgical nursing units (Fahs et al., 1992). In an analysis that consisted of 325 cases of AIDS, the authors found no difference in LOS, hospital charges or inpatient mortality by type of nursing unit when controlled for severity of illness. They found that severity of illness was a predictor of admission to the AIDS unit and that female patients, blacks, and older patients were significantly less likely to be placed on the AIDS unit. They also attributed the higher

LOS and mortality of the AIDS unit to patient severity of illness. In a similar but smaller study, van Servellen and colleagues found patients cared for in a dedicated unit were very satisfied with their care but found no difference in outcomes due to the type of unit (van Servellen, Lewis, Leake, & Schweitzer, 1991).

Aiken et al have designed a comprehensive study that evaluates the characteristics of magnet hospitals in addition to designated AIDS unit models on the outcomes of AIDS care, although their findings are not available at this time (Aiken, Lake, Sochalski, & Sloane, 1997a). They suggest that factors such as nurse autonomy may have a greater influence on outcomes than the type of unit itself.

Nurse Staffing

There is evidence that high nursing care hours and a nursing skill mix rich in RN hours contributes to lower inpatient mortality(Hartz et al., 1989), (Shortell & Hughes, 1988), (Al-Haider & Wan, 1991). Studies specific to AIDS care have not examined nurse staffing levels, however.

Hospitals use acuity and workload measurement systems to determine nurse staffing. In the process of costing out nursing services it is necessary to have some measure of inputs and outputs. The output measure has been termed case costing and is defined as the determination of patient specific costs (Cockerill et al., 1993). Instruments that measure both the technical and professional aspects of nursing care are used as the input measure. One of the most intractable barriers to the use of a measure designed to determine staffing for the determination of cost effects of nursing services on individual patients is the fact that the provision of hospital nursing care is essentially a group activity. During the course of one

shift a nurse will care for many patients and the time spent with each may not be equally divided. The nurse makes choices about the care of one patient contingent on the needs of the whole group for which she/he is responsible. Some staff such as charge nurses may only indirectly assist in the care of a patient. Conversely, one individual hospitalized patient is cared for by several nurses throughout their stay.

One patient classification system that has been proposed as a valid measure at the individual level is the GRASP system. The GRASP nursing workload system was developed in 1974 and is predicated on the assumption that quality patient care can be given if nursing care hours equals patient care hours (Meyer, 1978). It was one of the first systems to allow nurse staffing to move from a census to acuity orientation. The original GRASP instrument determines patient needs in hours of care based on time measurements in the categories of nursing process, physical care, medications, teaching, and indirect time. The time element is what differentiates GRASP from other patient classification systems such as Medicus (Corporation, 1983). In the GRASP system patient needs for nursing are reflected by a list of tasks and measured on a continuous scale. Patients are not categorized as in the other systems. Each patient's acuity score is the sum of the time required for each task selected. The individual patient scores are summed to yield a unit score. The GRASP instrument consists of the list of direct care tasks felt to reflect the variability of patient care on the nursing unit and a portion of the indirect care given on the unit. If this instrument were valid at the individual level then it would be useful in determining case level costs.

Physician Experience

Bennett and Deneffe examined the effect of hospital physician experience with treating AIDS on inpatient mortality among hospitals (Bennett & Deneffe, 1993). They note in their review of the literature an established relationship between volume and outcomes for surgical cases. But, the relationship between volume and positive outcomes for medical care has been less studied (Bennett et al., 1989), (Kelly & Hellinger, 1987), (Williams, 1979). Bennett and Deneffe reviewed four studies that examine the relationship between the volume of patients with AIDS and mortality and found convincing evidence that hospitals treating high volumes of patients had better outcomes than other hospitals although there were differing thresholds for defining the high volume hospitals (Bennett & Deneffe, 1993). All the studies examining AIDS and physician experience were analyzed at the hospital level. There were no studies that examined within hospital variations in physician experience. It is possible that there could be variability of physician experience with AIDS with physicians practicing within the hospital group that also affects patient outcomes.

Summary of Variables of Interest

This study evaluated the influence of two structural variables of nursing care; skill level and hours. Both of the two hospital nursing systems approaches for the care of AIDS have been studied. First is creation of dedicated AIDS unit, second is patient placement on general medical-surgical or oncology units (Morrison, 1993). Although the dedicated AIDS unit is thought to promote high quality care, the effect of these units has been characterized by findings of no difference but there is evidence that time in the ICU may be a factor in those outcomes (Halloran, Corless, & Belyea, 1994). Nursing hours and skill mix are factors

in hospital mortality rates. For example, Hartz et al. and Krakauer et al. found low mortality rates associated with high percent RN and higher nursing HPPD (direct Hours per Patient Day) (Hartz et al., 1989),(Krakauer et al., 1992).

Medical service variables may serve as important modifiers to outcomes. Two variables; the patient's primary physician and that physician's volume of AIDS admissions were included in this study. There is evidence of a relationship between physician patient volume and outcomes (Showstack & and others, 1987), (Marwick, 1992). Stone et al. found mortality rates to be higher at hospitals with less AIDS experience (Stone et al., 1992). Other physician related variables such as treatment profiles are unavailable for this study, but potential variations in outcomes by provider will be included.

One potential difficulty with studying an HMO setting is that with a lack of individual patient billing there has been no incentive to create online links of radiology, pharmacy, laboratory, and other professional services to individual patients. Clearly, the treatment of AIDS requires high utilization of lab and pharmacy resources, but measuring utilization of these subsystems of care was not possible for this study.

Chapter 3: Study Design & Methods

This chapter describes the methodology used for this study of hospitalized PWAs. The chosen design and patient population are described and the following points will be reviewed for each study aim: data collection methods, psychometrics, and statistics used for data analyses, including power analysis.

Research Design

The research design chosen is a descriptive, retrospective design. This design allows analyses at the factor- relating level of theoretical development (Dickoff & James, 1968). This has been determined to be appropriate since, as demonstrated by the literature review, the state of science regarding the affect of interdependent systems on patient outcomes is at the factor-relating stage and the purpose of this study is to build on the theory of behavioral systems by identifying the relationship between factors. The chosen methods were consistent with this inductive strategy. Factors identified by the literature as correlates for key aspects of the patient care system were measured and described, then regression models developed based on an analysis of the descriptive data.

Assumptions

The research design has underlying assumptions that are the following: the selected variables for study are measurable and obtainable in the dataset. It is possible that other potentially important variables are not included in the study because they are not measurable or available in the dataset.

Sampling

The patient population consists of all patients hospitalized with AIDS at the San Francisco hospital campus of a Northern California staff model HMO for one year from September 1, 1993 to August 31, 1994. The rationale for choosing one individual hospital site is that it presented the opportunity to control for several potential modifier support service variables. For example, all patients received the same pharmacy, dietary, and social services.

There were 317 individuals and 504 cases during the year. The most recent (last) hospitalization for each individual that year was selected as the episode of interest. This was done so that the data analyses were at the level of the individual and the principal of independence was preserved. Additionally, the entire population of individuals for that year was included instead of a selected sample because it was feasible and would enable sufficient sample size to have statistical power.

All AIDS cases for calendar year, Sept. 1 1993 to Aug. 31, 1994, hospitalized at the clinical site were selected by extracting those cases with a discharge diagnosis where the DRG (Diagnosis Related Grouping) was 488 or 489. The cases had been previously coded using industry standard ICD-9 and DRG coding guidelines and using the revised 1993 CDC definition of AIDS (Buckland, Brouch, Jones, & Aaron, 1993),(Center for Disease Control, 1992). This population included all women and minorities that were hospitalized with an AIDS diagnosis and excluded pediatric cases. Although the study will provide important information about AIDS care in an HMO setting, the sample is not representative of the population of hospitalized AIDS cases in the United States. All study subjects are either

employed or have the means to pay for self-enrollment in the HMO, therefore the sample may over represent middle income white male cases and under represent the low income and minority population.

Human Subjects

Confidentiality of each individual was strictly maintained. Although the medical record and case number for each individual was used to assemble the database, no identifying information was included in any reporting and the primary investigator was the only one with access to identifying information. The study database was secured by password entry and not replicable. Human subjects approval for this study was obtained from the Nursing Research Committee at the site and the UCSF Human Subjects Committee prior to data collection.

Data Source

Data for the study were extracted from several computerized data tables, in DB2 format (IBM product name of relational database), that constitutes this HMO system's database. All the data came from mainframe sources and were extracted using SAS language statements. A mainframe data matrix specific to the study was constructed by query of the larger database tables and then cleaned and merged. Individual level data, linked by Medical Record Number and Case Number, were pulled from the Admission, Discharge, and Transfer data tables, the Hospital Utilization Records data tables, and the Nursing Utilization data table.

Some paper data records were also used to verify the mainframe data. The reliability and validity of the various data tables were reported and monitored by the Information Systems Committees of the organization and outlined in the Information System Plan which is reviewed as part of the accreditation process conducted by the Joint Commission for Accreditation of Healthcare Organizations. Specific issues raised by this study related to the validity of some variables pulled from the database will be discussed below.

The time period of September to August was chosen for several reasons. It had the most complete data for the variables of study and it was a window where the dataset was stable i.e. no major systems changes occurred that would complicate the analyses. External issues delayed the availability of fourth quarter 1994 calendar year data, i.e. the implementation of laboratory software.

Plan for Data Analysis

The data analysis was conducted by assembling the dataset, using frequencies and plots of each variable to check for missing data, outliers and errors in the dataset. Then, the descriptive data were analyzed by study aim. The study aims were: (1) Describe the demographic, disease specific characteristics, nursing costs per case, utilization, and disposition following hospitalization for the population. (2) To identify the predictors of LOS, mortality, and discharge disposition; to home versus home care, discharge to a SNF or other acute care. The study design was a retrospective analysis of selected patient and hospital system predictors. Forty variables were selected based on their potential significance as indicated by the literature and accessibility from the database. The variables

were grouped into four categories; sociodemographic and economic, disease condition and health status, provider related, and outcome variables.

Variable List

Table 2 presents the variables by category and type. The operational definition for each variable is listed in Table 3. Four potential predictors elicited in the literature review were not included in this study because they were unavailable. They are; source of HIV infection, CD4 value on admission, primary nurse provider, and health status. Source of infection, health status, and primary nurse provider were not available in the computerized database being used. CD4 values were kept in a separate regional lab database for which this researcher was not able to gain access to. Although potential differences in utilization by source of infection such as for IDUs will not be known, ICD-9 data were available and those cases with a history of IV drug abuse were captured. Also, the retrospective design of the study precluded measurement of health status for this sample. Health status is an important outcome indicator. Measures specifically designed for the AIDS patient population were being developed, but it was not feasible to conduct a concurrent design to include health status. Potential correlates for health status that were available instead are the number of comorbid conditions, the nursing workload value, and disease stage.

Table 2. List of Variables

Variable Category Variable Name	**Type of Variable** **Continuous**	**Type of Variable** **Categorical**
Sociodemographic & Economic Variables		
Gender		X
Ethnicity		X
Age	X	
Marital Status		X
Source of Payment		X
Zip Code		X
Month of Admission		X
Disease Condition & Health Status Variables		
Principal Procedure		X
Principal Diagnosis		X
# of Comorbid Conditions	X	
ICD9 Category		X
History of Alcohol Abuse		X
History of Smoking		X
History of Drug Abuse		X
Adverse Medication Reaction		X
Occurrence of Dementia		X
Total Number of Hospitalizations	X	
Total Days of Hospitalization	X	
Average Length of Stay for all Hospitalizations	X	
Disease Stage		X
Provider Variables		
Admission Nursing Workload Score	X	
Mean Nursing Workload Score	X	
Admit Type		X
Admit Unit		X
Number of Days of Sitter Use	X	
Number of Patient Days in ICU	X	
Number of Patient Days in TCU	X	
Number of Patient Days in HIV Unit	X	
Number of Patient Days in Med-Surg Unit	X	
Mean Nursing Care Hours per Day	X	
Medical Provider Service		X
Primary MD		X
Number of AIDS Admits per Primary MD	X	
Outcome Variables		
Disposition: Home		X
Disposition: Homecare		X
Disposition: Skilled Nursing Facility		X
Disposition: Expired		X
Length of Stay	X	
Nursing Cost per Patient	X	
Nursing Cost per Patient per Day	X	

Aim 1: Descriptive Information

The data analysis plan for completing this Aim was to create a data matrix of all the independent and dependent variables and format the raw data so that descriptive statistics could be completed. The raw data came in multiple time intervals. Some data were collected once for each hospital admission, others were collected daily during each admission. For example, the gender for each PWA was noted only once in the ADT table and was easily pulled for the study database. However, projected nursing care hours (PCH) were recorded every eight hours throughout hospitalization. Before being merged into the study database the PCH data had to be processed to get the mean PCH value for the hospital episode (see next section for specifics). The first step was to get one record for each person for each episode of hospitalization (case level data). How individual variables were treated is discussed below.

An extract file to obtain the study data from the database was written using SAS statements that ensured collection of all AIDS adult cases and exclusion of pediatric cases. Patient medical record number and case number were used to link data from the tables. Initially, data were collected for each admission for each individual during the year. The diagnostic data contained ICD-9 coding for each day of stay. These data were then reformatted to list every diagnostic code listed during a persons stay and then further refined to obtain the information for each individual's most recent stay. The actual nursing workload scores (NCH) and projected nursing workload scores (PCH) were also collected daily and were transformed to values for the most recent admission. Data for each variable were analyzed for missing observations and outliers using plots and descriptive statistics.

Statistics used to describe the dataset were frequency distribution, means, and cross tabulations.

Once the data were prepared for analysis the descriptive statistics were completed for each variable. SAS version 6.03 was the statistical package used. Frequencies, histograms, and descriptive statistics were run and the data assessed for errors in coding, missing data, etc. Then final formatting was completed and the descriptive statistics, frequencies, histograms, crosstabulations and chi square tests were run to examine relationships of interest. A correlation matrix of all variables was also run to assess potential multicolinearities.

Table 3 outlines the specific operational definitions and notes for each variable. The following section discusses the data preparation and measurement for each category of variables. Sociodemographic and economic variables are those variables that are related to the person who was hospitalized. Disease condition and health status variables are those related to the disease of AIDS and measure correlates for the point along the continuum of health for the PWA at the time of hospitalization. Provider variables are those factors that the hospital controlled as it applied health care practices to treat illnesses. These variables related to the structure and processes of healthcare. The outcome variables were the factors that measured the immediate outcomes of the hospital episode; how long the person was hospitalized, costs that represent consumption of resources while hospitalized and the disposition of the person following hospitalization.

Table 3. Operational Definitions of Variables

Variable Name	Coding	Description/Notes on Calculation/ Treatment of Missing Observations
Gender	0=Female 1=Male	No missing observations
Ethnicity	1=Not listed 2=Asian 3=Black 4=Latino 5=White	No missing or 'Not Listed' observations
Age	Numeric	Adult Cases >18 yrs., no missing observations
Marital Status	1=Divorced 2=Married 3=Single 4=Widowed	Self-report on admission, no category for domestic partners. Missing = 0
Source of Payment	1=Plan Member 2=Medicare 3=Self Pay 4=Other Gov't 5=Unverified	Self pay is usually a former member who no longer has employer coverage. Unverified are members that claim coverage; usually new or members in transition of coverage type. No other government (Medicaid) members during study period. No missing observations.
Zip Code		5 Character zip code, no missing observations
Month of Admission		Calculated from admission date, an indicator of seasonal variation, no missing observations
Principal Procedure	ICD9 Missing=0	From ICD9 Codebook, organization uses industry standard coding procedures (Buckland et al., 1993). Some missing values if no procedure performed.
Principal Diagnosis	ICD9	Same as Principal Procedure. No Missing
Number of Comorbid Conditions	Numeric	Count of ICD9 Diagnoses per patient during most recent hospitalization. No missing
ICD9 Category	See appendix A	Category of Principal Diagnosis
Hx Alcohol Abuse	1=yes 0=missing	ICD9=3050 ETOH use or 3030-3039 chronic ETOH. ETOH use (3050) deemed significant if MD noted as such.
Hx Smoking	1=yes 0=missing	ICD9=3051 Tobacco use disorder.
Hx Drug Use	1=yes 0=missing	ICD9=3040-3049 drug dependence or abuse or 3052-3059 drug use nondependent, not including ETOH or marijuana.
Adverse Medication Reaction	1=yes 0=missing	ICD9=e9300-9499. Patient's admission to hospital was due to an adverse medication reaction or medication allergy.
Dementia	1=yes 0=missing	ICD9= dementia, psychosis or increased anxiety (neurotic) behavior exhibited during hospitalization.
Total Number of Hospitalizations	Numeric	Count of Cases per individual, no missing.
Total Days of Hospitalization	Numeric	Sum of Length of Stay (LOS) per individual over all hospitalizations during the study year. No missing.

Variable Name	Coding	Description/Notes on Calculation/ Treatment of Missing Observations
Average LOS	Numeric	Mean LOS per individual over all hospitalizations during study year, no missing.
Disease Stage	1=no complications 2=one system 3=multi-site 4=death	Indicating severity of illness within DRG. A two column code (e.g. 1.2) where the first node expresses the general severity of the illness and the second node is a refinement of the first. Uses AIDS specific coding rules where 1= no complications or minimal severity, 2=problems limited to one organ system with significantly increased risk of complication, 3=multiple site involvement, generalized system involvement, poor prognosis, no missing.
Admit Nursing Workload Score (PCH)	Numeric	Projected Nursing Care Hours (PCH) required on day of admission. Nursing workload measure is the GRASP system, shift by shift values averaged to obtain day score. Missing observations filled with predetermined default per nursing unit.
Mean Nursing Workload Score (PCH)	Numeric	Estimated patient care hours averaged over length of stay for most recent hospitalization.
Mean Nursing Care Hours (NCH)	Numeric	Actual Nursing Care Hours (NCH) per individual per day, average of NCH for most recent hospitalization. No missing.
Admit type	1=emergent 2=urgent 3=elective	Emergent=admission medically required within 24 hours of request, urgent= medically required within 10 days of request, elective= not medically required within 10 days of request. no missing.
Admit Unit	ICU TCU MS8 Other	Intensive Care Unit Transitional Care Unit (Telemetry) AIDS/Hospice Unit All other Medical Surgical Units
Days of Sitter Use	Numeric	A sitter is defined as need for 1:1 nursing aide to prevent patient harm. If PCH > 24 in ICU, >12 in TCU or Med-Surg then sitter is present. Each day of stay coded as sitter=1 or 0, Value=sum of sitter days per individual for last hospitalization.
# Days ICU	Numeric	Count of patient days spent in each unit. ICU= Intensive care unit where budgeted Nursing Hours per Patient Day (HPPD) is 16.0. (Sum of all patient days = length of stay)
# Days TCU	Numeric	Patient days in Transitional Care Unit where budgeted nursing HPPD is 10.0.
# Days HIV Unit	Numeric	Patient days in designated HIV/Hospice Unit where budgeted nursing HPPD is 7.0.
# Days Med-Surg Unit	Numeric	Patient days in any Med-Surg unit except HIV. Budgeted nursing HPPD is 6.0.
Mean NHPPD	Numeric	NHPPD= Actual direct, productive nursing care hours per patient per day. Mean of HPPD for each day of stay. Does not include indirect or nonproductive nursing time.
MD Service	HO=Hospice	Represents the Department of the individual's

Variable Name	Coding	Description/Notes on Calculation/ Treatment of Missing Observations
	ME=Medicine OR=Ortho SU=Surgery	primary physician.
Primary MD		Numeric code for each admitting physician. Name of primary physician kept confidential for this study.
#Admits/MD	Numeric	Count of the number of individuals (not cases) admitted by each physician caring for AIDS patients. Each individual assigned the value corresponding to their primary physician. A measure of physician load. Medical Department Physicians with zero AIDS admissions are not included.
Disposition: Home Home care SNF Expired	1=yes 0=no	Each type of disposition coded as separate variable. Home care= Discharged to home with skilled nursing services (RN). SNF= Discharged to a skilled nursing facility.
Length of Stay	Numeric	Length of most recent hospitalization per individual during study period.
Nursing Cost (Total)	Numeric	Sum of daily nursing costs for each unit per individual. Based on actual NCH (variable cost), accounting for under/overstaffing and actual skill mix plus a portion of the indirect and nonproductive time for each unit (nonvariable).
Nursing Cost per Day	Numeric	Total Nursing Cost / LOS.

Sociodemographic and Economic Factors

The analysis of gender, age, ethnicity, marital status, and zip code was straightforward and came directly from the database. Marital status was based on self-report on admission and there was no category for domestic partner at the time of the study. Now, married and domestic partner are put in the same category.

Source of payment reflected the type of health plan coverage that the member was hospitalized under. The possibilities included employer paid insurance of various group sizes, self paid, Medicare coverage, or other government funded membership such as Medicaid. There was also a category for unverified coverage, which usually reflected a

member in transition from one type of coverage to another or a new member who was hospitalized before being entered into the health plan data systems.

Disease Condition and Health Status Variables

Principal procedure and ICD9 Coding were taken from the medical record problem list and entered into the health plan database once the medical record was dictated upon discharge. The key treatments, procedures, and events were coded using ICD-9 guidelines. Each case extract contained codes for each day of hospitalization.
The principle procedure was a procedure that was key to the patient's hospital admission. The patient was either admitted specifically to have the procedure performed or the procedure was a key element in the treatment plan during hospitalization. The principle diagnosis was the disease or symptom that led to or resulted in the hospital episode. For the study, a list of all diseases and symptoms treated during the hospital episode was included in the study database. The sum of these was used as the count of comorbid conditions. The raw data required recoding in order to compute the value for comorbid conditions.

Specific codes were searched using if-then statements and dummy variable coding was programmed in order to create the variables for Alcohol (ETOH) use, Smoking use, Drug use, Adverse Medication Reaction, presence of PCP, and Dementia. The specific ICD-9 code numbers for each are listed in Table 3.

Disease stage was also abstracted from the health plan database and based on the medical record. The health plan uses a two-column coding scheme that represents nine possible categories. The first column value indicates general severity and ranges from 1, minimal severity and no complications to 3, generalized system involvement, multiple site

body involvement with poor prognosis. The second level of specificity was indicated by the second column number and represents variation within the general category. A fourth general number is used to indicate death.

The total number of hospitalizations during the year was computed by searching cases by medical record number. The total number of days of hospitalization for the year was a sum of the LOS for each hospital episode by medical record number.

Provider Factors

The admit type, admit unit, primary physician, and service were taken directly from the hospital database and no cleaning of data was required. The primary physician data were coded in the database for confidentiality. The actual number of days and portion (%) of total LOS that each PWA spent on a nursing unit were computed from the hospital data tables and variables created for the study database.

The PCH on admission and the mean PCH for each episode of hospitalization were taken directly from the hospital data tables. However, there were data for each shift of the hospitalization therefore, the mean was obtained per patient. The GRASP system was used by the facility to obtain PCH. The data were verified to be valid and reliable per the facility's own standards and national GRASP guidelines. A complete description of the system is beyond the scope of this report, however, several points are important to understand as they relate to this study.

Using the GRASP system, a Registered Nurse (RN) identifies key functional care nursing needs and treatments that each patient will require. So, the GRASP values represent a professional nursing assessment of the amount of nursing care resources that a patient will

require in the immediate future. The system is prospective, not retrospective so there is an element of judgement involved by the RN. The PCH value represented the number of hours of direct nursing care that each patient needed over twenty-four hours. For example, each functional area was assessed; bathing, toileting, diet, mobility and it was determined that a particular patient needed the assistance of one nurse to be able to complete each of those functions. The PCH value that was entered for that patient reflected the sum of all the areas the nurse would be assisting with. It was a measure of the amount of nursing resources consumed by the patient. However, since the values were prospective they were based on the average amount of time it took to do the tasks as opposed to the time it actually took for that patient. The same GRASP instrument was used to assess every PWA per unit and the rules for using it applied consistently. Therefore, the PCH value reflected a relative picture of how much nursing care one patient was assessed to need in comparison to other patients.

The actual nursing care hours (NCH) assigned to each patient from the PCH assessment were also obtained. This is where paper records were used to augment the hospital-computerized data. Actual hours of nursing care were only available at the unit level. In order to get the information to the patient level, the actual assignment records were used. For each day of hospitalization for each PWA in the study it was determined who was assigned to care for them. A tally of RN and ancillary staff hours was made and the final total hours entered into the study database as the NCH value. Charge nurses who were on the unit but not assigned to particular patients were spread into the total.

On the medical/surgical nursing units where nurses cared for more than one patient a decision needed to be made regarding how to split the nurses time. If a RN was assigned to

care for six patients, one had to decide whether to evenly spread her time among the six or whether to allot some patients more attention than others. It was decided to spread the RN's time among the assigned patients based on their acuity dependent on the researcher's previous experience. Focus group discussions with the nursing staff that took place concurrently with this study reinforced this experience. So, the formula used to compute the actual hours of nursing care (NCH) per patient per shift was determined to be x = (1/(total pts assigned to staff))*staff hours*(patient PCH/average PCH). The hours per each shift were added to get total NCH for the stay. Fortunately, the staffing patterns were not so variable as to make this calculation unfeasible. It was laborious to compute this value for each PWA in the study, however the author felt it was important to have the data to the individual level of detail.

Outcome (Dependent) Variables

LOS and disposition were taken directly from the hospital data. The operational definitions used for disposition were the following:

Home:	discharged alive to home with no skilled nursing needs.
Homecare:	discharged to home with skilled nursing care referral. Skilled nursing needs could include IV therapy, safety checks, respiratory treatments, wound care, etc.
SNF:	discharged to a SNF for restorative care or hospice.
Expired:	patient expired while hospitalized.

Nursing cost per day and nursing cost per case were computed. Initial analysis of the cost data confirmed that nursing costs vary more from unit to unit than within units. The mix of skill levels used to care for the study population also varied by unit rather than within unit with the exception of the use of attendants. Given this information, the average cost per skill

level per unit was applied to the individual NCH hours to get the nursing cost data. For example, if the patient stayed in the ICU for three days and then spent two days in the HIV nursing unit, the total nursing cost would be represented by the following equation. Nursing cost = (3 * the average RN cost for ICU * #NCH hours on ICU) + (2 * the average nursing cost for the HIV unit * #NCH hours on the HIV unit).

Aim 2: Regressions

Regression Procedures

The procedures to meet Aim 2 were: 1) to use the descriptive data from Aim 1 to design an appropriate model for regression of each outcome variable, 2) to complete a power analysis for each model, and 3) to conduct regression on the selected outcomes and to complete tests for statistical significance to determine which factors best predict the selected outcome.

First, a correlation matrix was constructed for all the variables in the dataset. Categorical variables were recoded as needed based on an analysis of the descriptive data. Appendix C presents the correlation matrix variables. The variables were assessed for potential multi-colinearities and only one of a pair of these variables that were highly correlated with each other was in the regression model. Additional criteria for a variable's inclusion in the model included: 1) that each variable be a unique correlate for one theoretical concept and 2) that the alternative hypotheses for each variable be represented in at least 5 % of the sample (n=20), thereby providing sufficient variability within the variable to affect the model. Models for each equation are presented in Table 4 with the hypothesized direction of influence of the variable on the dependent factor being designated by a '+', '-', 'o' for no

influence, or a blank if the variable is not included in one particular model. Independent variables are listed in the hypothesized order of contribution to R^2. Sex was a variable that was excluded from all models because there were so few alternate cases in the population. There were 8 women as opposed to 309 men.

Table 4. Hypothesized Direction of Factor Influence.

Independent	Dependent LOS n=308	Total Cost N=308	Homecare n=250	SNF n=250	Expiration n=308
Sociodemographic					
Age	+	+	+	+	+
White	o	o	o	o	o
Disease Related					
# Comorbid conditions	+	+	-	+	+
ICD 9 of PCP	+	+	+	+	+
Hx Drug/ETOH	+	+	-	+	+
Hx dementia	+	+	o	+	+
Disease Stage	+	+	o	o	+
Number of Admissions	o	o	o	o	+
Provider					
% HIV Unit	o	o	o	o	o
Mean PCH	+	+	o	o	o
Mean NCH	+	+	o	o	o
MD Experience	o	-	o	o	-
Other Dependent					
LOS			o	o	o

Adequacy of sample size for each model was estimated using the following calculations. All calculations used a 2-tailed alpha curve at .05 and a conventional power estimate at medium effect size (Cohen & Cohen, 1983). 1) LOS and mortality models with 22 and 20 degrees of freedom respectively and sample size of 309 yield a power estimate of >. 9 and will detect an increase of 5% variance beyond that of other variables. 2) The homecare model with 20 degrees of variance and sample size of 250 yield a power estimate of >. 9 as well (Cohen & Cohen, 1983).

A logistic regression approach was used to determine predictors of expiration, homecare, as they are dichotomous variables (Glantz & Slinker, 1990). The model equation was expressed as logit $P = b0 + b_1x_1 + b_2x_2 + ... + b_kx_k$. The Maximum Likelihood Estimation (MLE) procedure was used to estimate those predictors most likely to fit the pattern of the data. Then, the Likelihood ratio test used to test the overall fit of the model. Although it had been hypothesized that certain variables would become the best predictors, the statistical procedure was not hierarchical, rather step-wise where the model chose the best fitting variables.

The two models used to predict LOS and cost were completed with a multiple regression procedure using ordinary least squares. Each model equation was expressed as $y = b0 + b_1x_1 + b_2x_2 + ... + b_kx_k + \hat{I}$. Standard errors were assessed and the degree of multicollinearity in the variables examined. The incremental sum of squares provided information about the amount of new information about the dependent variable contained in each independent variable. Finally, the R^2 for each dependent variable (LOS and cost) was determined as a measure of goodness of fit for each model. The distributions of Nursing Costs exhibited heteroscedasticity on assessment of the initial plot of actual to predicted residuals with variance increasing for the higher values. Therefore, the nursing cost model was run using the log-normal distribution of nursing cost per case. This corrected for the distribution and modeled a solution with a better fit to the data. Table 5 presents a summary of the variables used in the regression model statements. It lists the regression variable name, a description of the variable and how it was computed.

The following issues arise as potential threats to the validity of this study and potential difficulties. 1) The sample is not stratified by AIDS disease category in order to maintain statistical power however, by keeping ICD-9 code as an independent variable, the relative influence of the specific AIDS diseases will be determined. 2) The study sample is representative of AIDS patients with the means to obtain private insurance and is not reflective of low-income patients.

Although this study only encompasses one setting, and may have limited generalizability to other AIDS populations, it is considered significant because of the unique integrated system advantages of the staff model HMO. These advantages include equitable access to services for members, access to information for providers, and efficiencies of size that enable contracting advantages for pharmaceuticals and materials. This study provides comprehensive, timely information about the cost of hospitalized AIDS care that may serve as a benchmark for other providers. The integrated system setting also provides controls that will allow the determination of outcome predictors. This information can then be used to target system interventions that will enhance patient outcomes.

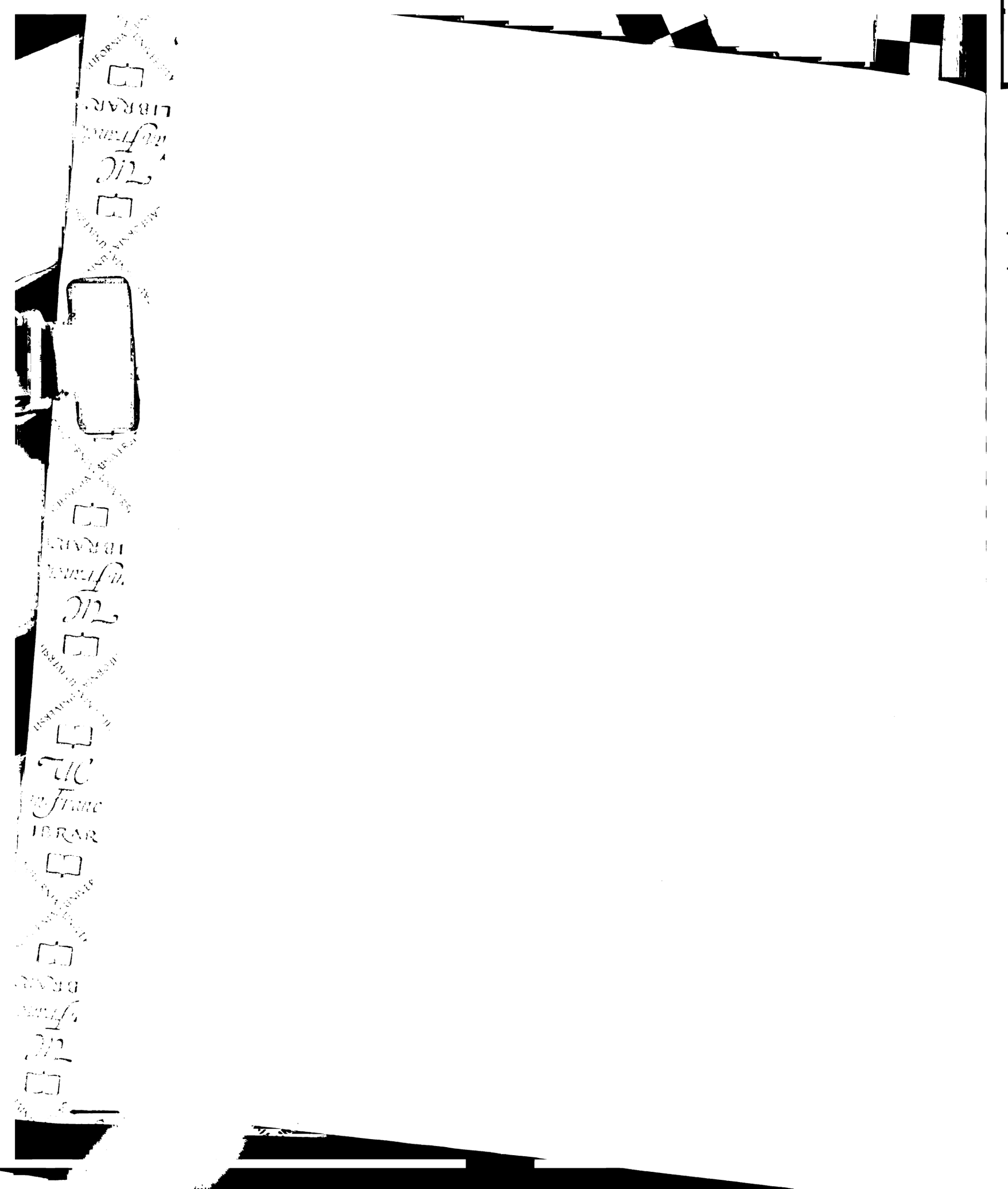


Table 5. Variables Included in Regression Analysis

Dependent Variables	**Type**	**Description**	**Note on Computation**
Length of Stay (LOS)	Continuous	Length of Stay for most recent hospitalization.	Discharge date - admit date + 1. In whole days.
Total Nursing Cost	Continuous	Total nursing cost per individual.	Sum of per day nursing cost which is based on nursing unit labor cost by skill and actual assigned skill mix per individual.
Expired	Dichotomous	Death occurred during hospitalization.	1=expired, else=0
DC Other	Dichotomous	PWAs discharged alive whose disposition was other than home.	1 = Discharged to Homecare or Skilled Nursing Facility 0 = Discharged to home.
Independent Variables	**Type**	**Description**	**Note on Computation**
Sociodemographic			
Age	Continuous	Age of PWA on admission	
Caucasian	Dichotomous	Ethnicity	1 = yes 0 = Any other ethnic group
Disease Status			
Comorbidity	Continuous	Number of comorbid conditions during hospitalization	Count of search of all unique ICD9 coded conditions.
ICD9 PCP	Dichotomous	Coded diagnoses included PCP	1 = yes 0 = no
Drug or ETOH Use	Dichotomous	Presence of ICD9 codes for one or more of these: drug use, ETOH use.	1 = yes 0 = no
Dementia	Dichotomous	Presence of ICD9 code for Dementia at any time during hospitalization	1 = yes 0 = no
Disease Stage	Categorical	Disease Stage	raw data (see chap 3)
Multiple Admissions	Continuous	Total admissions during the study period.	Count of Admission Dates that were during study year.
Provider Related			
HIV Unit	Continuous	Percent of hospitalization spent on the HIV nursing unit	# days on HIV/LOS Based on room ID data.
XPCH	Continuous	Mean Projected nursing Care Hours per day. Based on GRASP™ System	Average of daily PCH values during most recent hospitalization (see Chap. 3)
XNCH	Continuous	Mean actual direct Nursing Care Hours per day.	Average of daily NCH values during most recent hospitalization (see Chap. 3)
Physician Experience with AIDS	Continuous	Physician experience with other hospitalized PWAs during study period.	Count of number of other PWAs with the same primary MD for each individual.

Chapter 4: Findings

This chapter reports the findings by study aim: (1) To describe the demographic, disease specific characteristics, nursing costs per case, utilization, and disposition following hospitalization of PWAs from one HMO hospital. (2) To identify the predictors of LOS, mortality, and discharge disposition (to home versus home care, discharge to a SNF, or other acute care). First, the descriptive findings are presented and interesting relationships between variables are presented and discussed. Then, the predictive equations for Aim 2 are shown and discussed.

Population

Size

The study population consists of all hospitalized PWAs from the San Francisco medical center of a Bay area HMO. This Northern California HMO carried a total AIDS caseload of approximately 1,850 persons during a 12 month period in 1993-94 with San Francisco medical center physicians caring for approximately 46% of those persons (see Figure 1). The HIV+ caseload for the same period was approximately 5,500 (No table shown) (KFH Department of Research, 1995). The study population of 318 PWAs represents a hospitalization rate of 37% of the 850 HMO members with AIDS cared for by the San Francisco facility. So, the study population represents about 17% of all PWAs enrolled in the Northern California health plan.

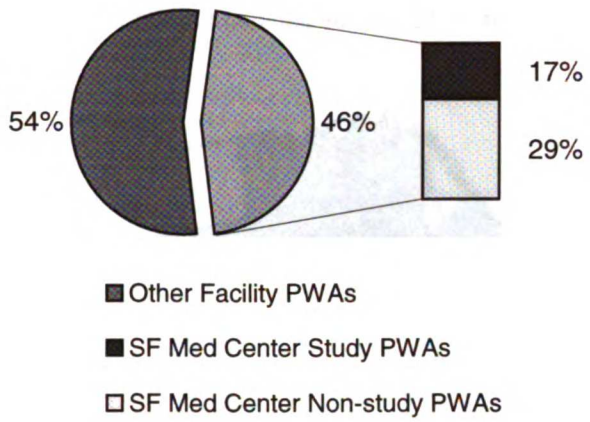


Figure 1. Northern California HMO PWAs. N=1,850

Residence

Of the study population hospitalized with AIDS from September 1993 to August 1994, 90% lived in San Francisco. The maps in Figure 2 and Figure 3 present the distribution of study PWAs by neighborhood in San Francisco and in the Bay Area respectively. The Castro and Noe Valley neighborhoods clearly have a high concentration of San Francisco hospitalized patients with 71 (24%). The Haight and Hayes Valley corridor have the next highest concentration of patients. The less densely populated outer areas of the city have very few cases.

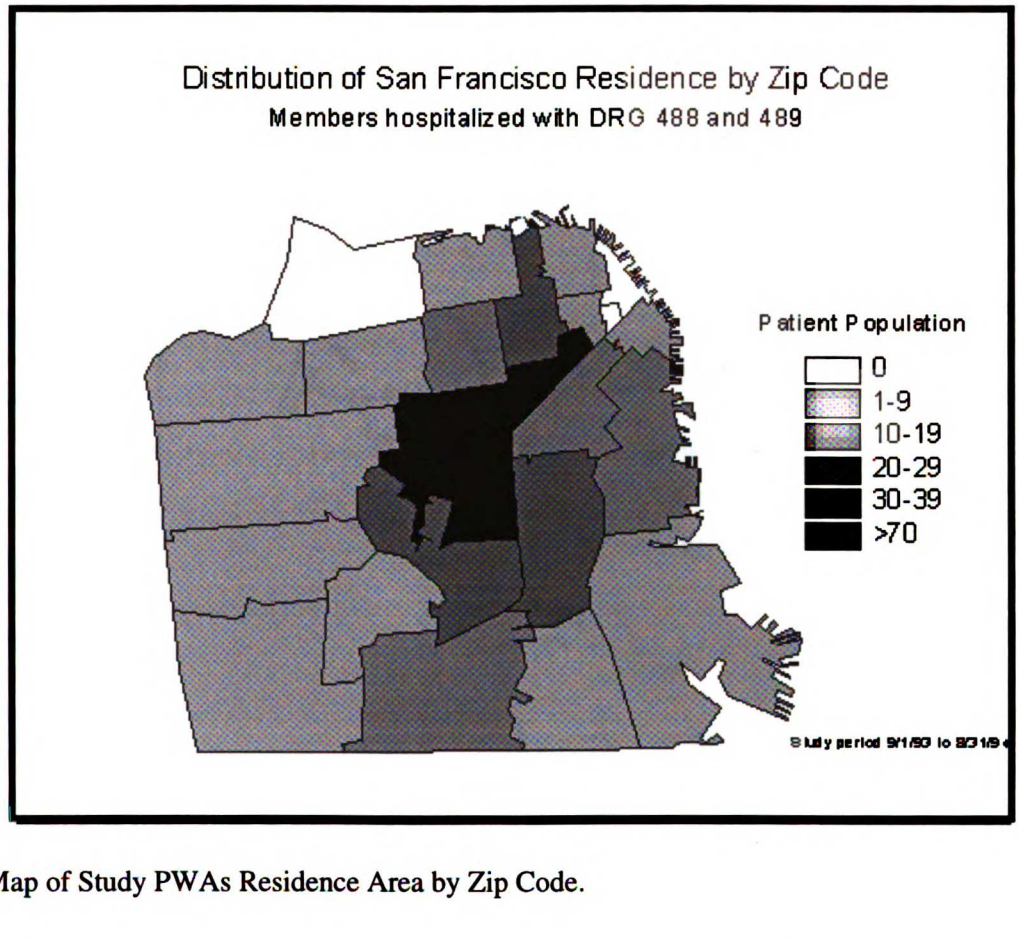


Figure 2. Map of Study PWAs Residence Area by Zip Code.

This HMO hospital was part of a large HMO with other sites in Northern California. Patients were usually cared for by their local hospital but could be transferred to San Francisco for specialty services or choose to have their primary care in San Francisco by physicians experienced in AIDS care. The eighteen patients that lived outside San Francisco illustrated this treatment pattern. Similarly, there may have been a few individuals that lived in San Francisco who received care and were hospitalized outside of the city and are therefore, not included in this study.

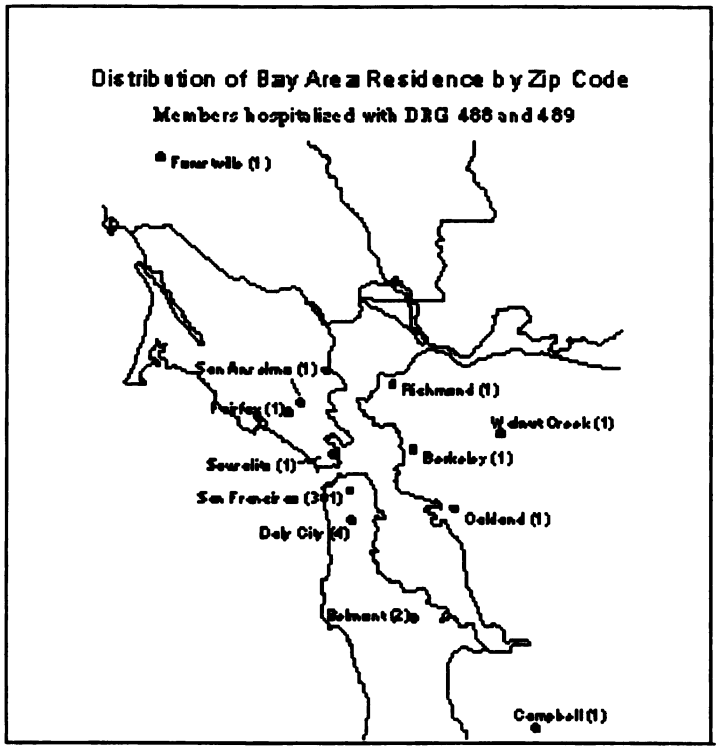


Figure 3. Location of Residence of PWAs in the Bay Area

Comparison to San Francisco PWAs.

These hospitalized San Francisco residents comprise 5% of the population of all persons living with AIDS in the city of San Francisco during 1994. The study population resembles the population of PWAs in the city of San Francisco in gender only. The study population is older, predominantly white, and able to afford HMO coverage; either through an employer or by self-payment (Table 6). As expected, there were no patients funded by Medi-CAL or public programs in the study population as the HMO did not have contracts with the City of San Francisco or the State of California to care for patients as plan members at that time. However, if a Medi-CAL patient presented to the Emergency Department they would have received care. Table 6 presents the sociodemographic statistics for San

Francisco and the study population during the same time period. The only variable on which the two populations are alike is gender. Also, note the shift in age groups as the HMO group had no pediatric cases and 18% study PWAs over age 49 compared to San Francisco's 10%.

Table 6. Sociodemographics of PWAs living in San Francisco vs. hospitalized PWAs in an HMO, 1993 - 1994.

Site	PWAs in San Francisco *		PWAs Hospitalized in Sample HMO	
Variable	N	%	n	%
Total PWAs	6994	100%	317	100%
Gender				
Male	6681	96%	309	97%
Female	313	4%	8	3%
Age				
13-19	15	<1%	0	0%
20-24	164	2%	1	<1%
25-29	791	11%	10	3%
30-39	3267	47%	125	40%
40-49	2096	30%	123	39%
50-59	533	8%	48	15%
60 +	128	2%	10	3%
Race/Ethnicity				
White	5140	73%	267	84%
Black	905	13%	25	8%
Latino	732	11%	16	5%
Asian/Pacific Islander	186	3%	9	3%
Native American	31	<1%	0	0%
Insurance				
Medi-CAL	469	7%	0	0%
Private Insurance/HMO	2061	29%	288	91%
No coverage	1316	19%	0	0%
Publicly Funded Programs (trials)	572	8%	0	0%
Medicare	-	-	25	8%
Missing	2576	37%	4	1%

Note. * Source: San Francisco Dept. of Health, Office of AIDS.

Source of infection and sexual orientation were not available for this study. However, the geographic distribution of the population in the predominantly gay districts of San Francisco and the gender and age of the study group suggests that there are a large number of gay men in the study. Anecdotal information from the nursing staff supports this

assumption. These findings are consistent with the characteristics of the San Francisco PWA population as reported by the San Francisco Dept. of Health Office of AIDS and the San Francisco Gay Men's Health Study (Osmond et al., 1994),(Samuel et al., 1993).

Sociodemographic and Economic Variables

Gender

As expected, the great majority (98%) of the study population was male. There were only eight women in the study. A summary of characteristics of these women is presented later under Other Notable Descriptive Findings.

Age

The overall age distribution for the study is shown in Figure 4. The distribution is skewed toward the older age groups. There was no one hospitalized under 24 years of age and the oldest person was 66 years old on admission; a spread of 42 years. Half of the study population was middle aged; between 34 and 42 years old. Lastly, there is an interesting but unexplainable gap in the number of 44 year olds.

This finding is very different from both the San Francisco and national age distribution of PWAs. The national population of urban PWAs is showing a trend to younger single males (CDC). In this study only the Asian ethnic group had a large percentage of persons younger than 30 years old. The bar graph in Figure 5 of the cross of age and ethnicity shows that Asians were younger than any other group. Over 65% were younger than 40. Asians had the largest percent of cases in the 25-29 age group with 11 percent. Comparatively, only three and four percent of Caucasians and Latinos are in the 25-29 age

group. The distribution of ages of Caucasians and Latinos are the same with most cases evenly distributed from 30 - 49 with a few cases at the tails. African Americans are the oldest with over 60% of cases older than 40 years and none younger than age 30.

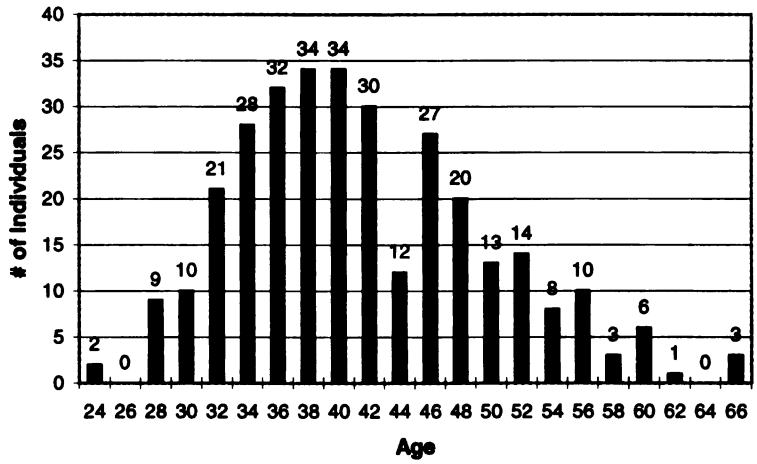


Figure 4. Age Distribution for Study PWAs, n=317.

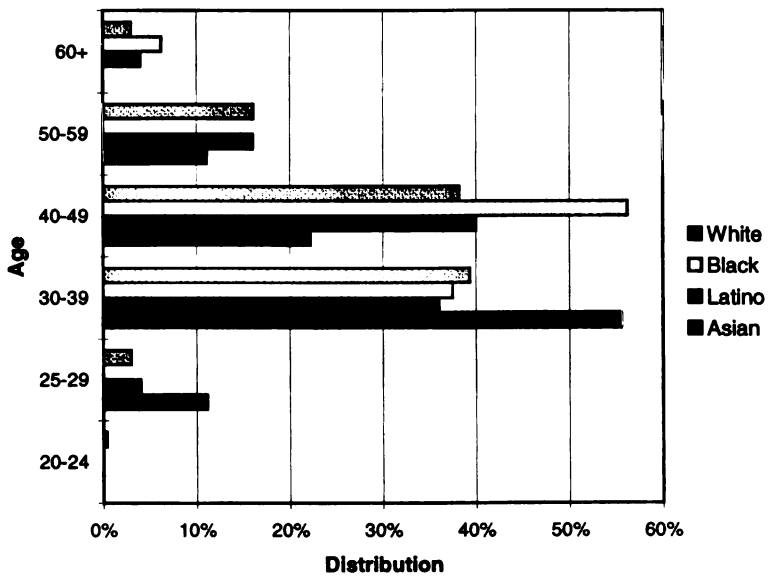


Figure 5. Age Groups by Ethnicity for Study PWAs.

Ethnicity

As stated earlier, Caucasians comprise the predominant ethnic group of the study population. A pie chart of the ethnic makeup of the population is in Figure 6. The proportion of the study population that is African American and Latino is only one half the proportion of San Francisco's African American and Latino PWAs.

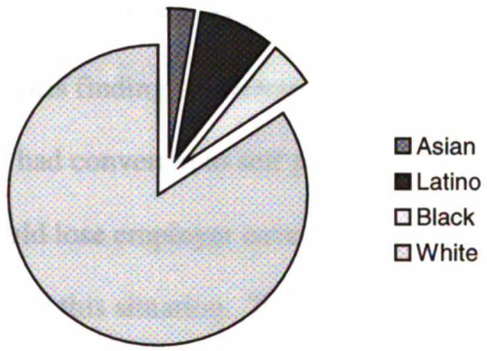


Figure 6. Ethnicity of Study Population.

Marital Status

Marital status was another demographic that was captured for this study. As expected the great majority of the patients were listed as single (92%). Those who were married constituted five percent of the study PWAs with three percent missing data (no table). The extent to which there were single individuals living in committed relationships that were listed as single is unknown and there is no other source of data on living arrangements. During the time frame of this study, admissions procedures did not account for the possibility

of persons living in committed relationships. The procedures now allow for the married category to include those members living as domestic partners or in committed relationships.

Payor Source

The source of payment for each PWA was also collected. The predominant source of payment for health plan dues for the study population was via employer plans (see Figure 7). There were two other sources of payment for this group; self payment and Medicare. Only 12 members (4 %) of the study population were self pay while there were 25 members (8 %) who had Medicare coverage. This finding is interesting as it was expected that there may have been more members that had converted to self payment. The rationale being that as a PWA gets more ill that he would lose employer coverage and convert to self payment. However, the data do not support this situation. The number of PWAs with Medicare coverage is also surprising, but fits the age distribution of the study group. It's notable that there was no one with Medi-Cal coverage in this group.

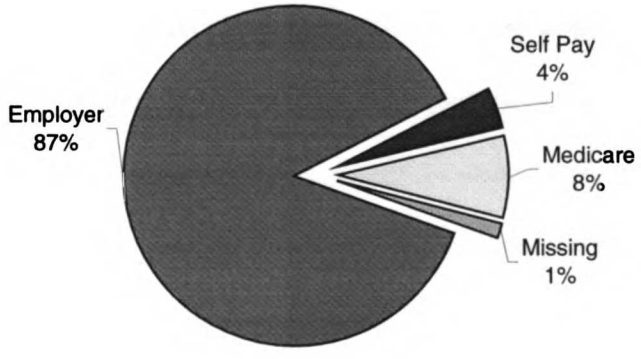


Figure 7. Payor Source of PWA HMO Membership.

Admit Month

Finally, month of admission was tracked to determine any seasonal patterns to the admissions during the study year (September 1 to August 31). One month, April, had higher numbers of admissions than the rest of the year with 15% of all admissions. The winter holiday season of November to January, the month of March, and the month of August had the next highest admission rates with 9-10% of all admissions per month. The remaining months had 5-6 % of all admissions per month (no figure). This pattern was similar to the pattern for all admissions at the study hospital when the study population was compared to all hospital admissions.

Disease Condition and Health Status Variables

Comorbid Conditions

The pattern of AIDS diseases and number of comorbid conditions in the study population reflect end-stage disease where an individual with AIDS is burdened by multiple diseases and conditions. Recall from chapter 3 that this factor is a count of all the conditions coded from the medical record upon discharge which are used to determine DRG. The average number of AIDS related conditions and other notable symptoms or diseases present in each case was six with a minimum of two comorbid conditions and a maximum of 25. The most frequent number of comorbid conditions was also six. 80% of the study population of PWAs had more than three conditions or diagnoses (see Figure 8).

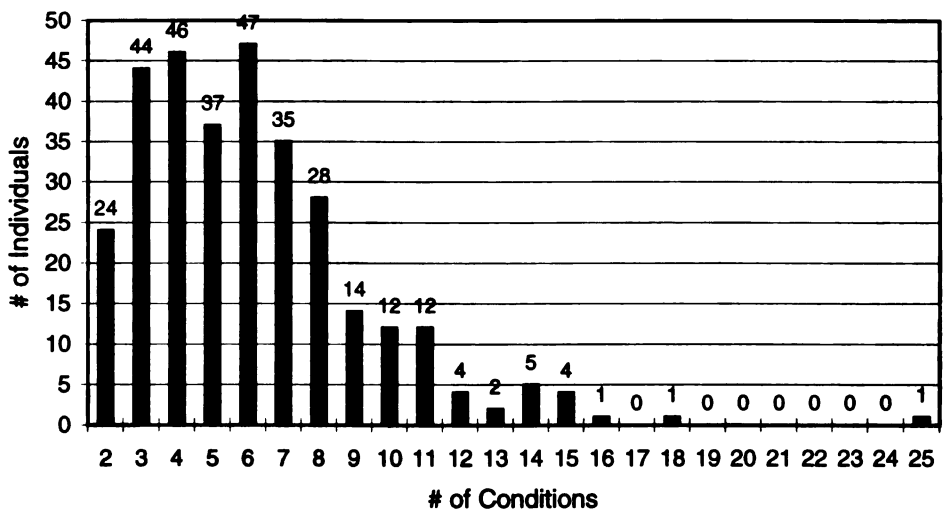


Figure 8. Comorbid Conditions

ICD-9 Diagnoses

Table 7 presents the frequency of ICD-9 coded discharge diagnoses by category. The 16 distinct categories as defined by the ICD-9 codebook give a picture of the physiologic systems most affected by the cluster of AIDS comorbid conditions. For the 317 PWAs, there were 1,941 separate diagnoses and conditions that were coded. Over 40% of the codes were for Infectious and Parasitic Diseases (ICD-9 0049 to 1363). The top three physiologic systems affected were 1) Endocrine, Nutritional, Metabolic, and Immune Diseases or conditions (2449 - 2771), 2) Respiratory Diseases (4619 - 51889), and 3) Diseases of the Blood and Blood-forming Organs (2800 - 2880). Symptoms, Signs and Ill-defined Conditions (78009 - 7994) was the next most frequently used category. The remaining categories covered less than 30% of the diseases and conditions for this population.

Table 7. ICD-9 Codes Used to Represent PWA Illnesses.

ICD-9 Category	ICD-9 Codes	Description of Disease & Condition Codes	Frequency	%	Cumulative %
1	0049 - 1363	Infectious & Parasitic Diseases	859	44.3	44.3
3	2449 - 2771	Endocrine, Nutritional, Metabolic, & Immunity	200	10.3	54.6
8	4619 - 51889	Respiratory System	120	6.2	60.8
4	2800 - 2880	Blood & Blood-forming Organs	112	5.8	66.6
13	78009 - 7994	Symptoms, Signs, & Ill-defined Conditions	101	5.2	71.8
6	3210 - 38900	Nervous System & Sense Organs	98	5.0	76.8
9	5280 - 5789	Digestive System	90	4.6	81.4
2	1550 - 23770	Neoplasms	84	4.3	85.7
7	4000 - 4589	Circulatory System	79	4.1	89.8
5	2912 - 3110	Mental Disorders	62	3.2	93
16	E8490 - E9504	External causes	46	2.4	95.4
10	5845 - 60889	Genitourinary System	33	1.7	97.1
11	6802 - 7080	Skin & Subcutaneous Tissue	22	1.1	98.2
14	8730 - 9998	Injury & Poisoning	13	0.7	98.9
15	V071 - V643	Factors other than Diseases in other categories	13	0.6	99.5
12	71100 - 73026	Musculoskeletal & Connective Tissue	9	0.5	100.0

Note. All Diagnostic Codes of 317 cases = 1,941 codes

126 or 40% of the study patients presented with PCP, the most frequent principle diagnosis and found in the category of infectious and parasitic diseases (ICD-9 1363)(see Table 8).

Table 8. Most Frequent Principal Diagnoses (n=317).

Principle Diagnosis ICD-9 Code #	Description	PWAs	%	cum %
1363	PCP	126	40	40
0785	CMV	24	8	48
482	Other pneumonias	19	6	54
1175	Cryptococcosis	16	5	59
0318	Mycobacterial pneumonia	12	4	63
2765	Volume Depletion	12	4	67
2028	Lymphoma	11	3	70
All Others	All other diagnoses	97	30	100

A cross tabulation of comorbidity with this principle diagnosis reveals that the majority of people with PCP were ill with more than two other diseases (see Table 9). This would

suggest that for the majority of cases that PCP is just one of many diseases for which the person was hospitalized. Other high frequency principal diagnoses include; Cytomegalovirus (0785), Cryptococcosis (1175), other Mycobacterium diseases (0318) and bacterial pneumonias in addition to other pneumonias.

Table 9. Cross tabulation of Code for PCP with Number of comorbid conditions (n=126).

	2 comorbid conditions	**3-5 comorbid conditions**	**6-8 comorbid conditions**	**>8 comorbid conditions**
1363 (PCP)	11 (8.73 %)	51 (40.47 %)	44 (34.92 %)	20 (15.87 %)

The only symptom to be a frequent principle diagnosis was volume depletion (ICD-9 2765) which resulted in the most frequently ordered procedure; transfusion of packed cells (9904). Frequent treatments include venous catheterization (3893), insertion of vascular access devices (8607), and incision of lung (331) for chest tube placement. Frequent diagnostic procedures include head CT (8703), bronchoscopy (3322, 3323), and endoscopy of the lung and GI tract (3324, 3327, 4513, 4414, 4525). A complete frequency table of principal diagnoses and procedures is in Appendix A. This appendix captures the complete spectrum of diseases and conditions found in the study population. It is clear that the people with AIDS present a challenging and complicated set of conditions for treatment and symptom management.

Smoking, ETOH, Drug Use

To supplement the picture found in this hospitalized population, several specific codes were searched as potential mediators to patient outcomes. Patient history of smoking, alcohol, and drug use was minimal. Only 16 (5%) members of the population had a

significant smoking history, 22 (7%) had a history of alcohol abuse, and there were 7 (2%) individuals with a history of drug use or abuse.

Dementia

The presence of dementia on admission, a potential factor driving the need for high levels of nursing care, was documented in 28 individuals (8%).

Disease Stage

One additional health status variable was disease stage. Values for this variable were taken from the patient's most recent admission during the study period. Disease stage was classified into three major categories. Almost three-quarters of the patients were assigned a disease stage of minimal severity with no or less risk of developing complications (Table 10 and Figure 9). Patients with a moderate risk of severity comprised 13% of the study population, while 16% had the most severe disease with multiple site involvement and poor prognosis.

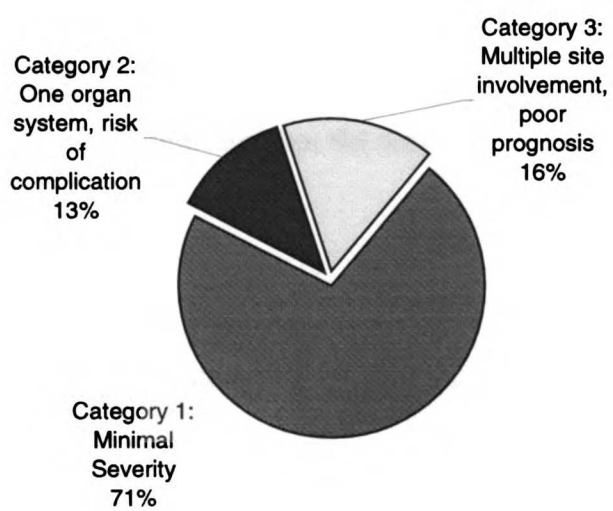


Figure 9. Disease Stage of Study Population.

Table 10. Disease Stage

Stage/Definition	n	%
Minimal severity, no complications		
1.0 – minimal severity	186	58.5%
1.1 - no complications	38	11.9%
1.2 – one organ system, increased risk of complication	3	0.9%
Subtotal	227	71.3%
One organ system w/ significant increased risk of complication		
2.0 – min. severity	2	0.6%
2.1 - no complications	2	0.6%
2.2 – increased risk complications	10	3.1%
2.3 – poor prognosis	1	0.3%
2.4 – death	25	7.9%
Subtotal	40	12.7%
Multiple site involvement, poor prognosis		
3.0 – minimal severity	36	11.3%
3.1 - no complications	3	0.9%
3.2 – increased risk complication	11	3.5%
3.3 – generalized systems involvement, poor	1	0.3%
Subtotal	51	16.0%
TOTAL	318	100%

The large number of patients with a minimal severity rating does not appear to match the comorbid condition data. Also, there is a low correlation (0.23) between disease stage and the number of comorbid conditions. Table 11 presents a cross tabulation of disease stage with number of comorbid conditions. It appears that these two variables are measuring different aspects of illness. It is expected that a PWA with a large number of comorbidities would also have a high severity indicator, but the data only support that presumption for the most severely ill.

Multiple Hospitalizations.

Although, the focus of this study was on the most recent hospitalization for each person during the study year, data regarding the total number of hospitalization episodes during the study period and total days of hospitalization for each patient during the study year were collected. The mean number of hospital episodes during the study year was 1.6

with a standard deviation of .9. The range of hospital episodes was 1 to 5. 60 percent of the study population had only one hospital episode during the year, 25% were admitted twice and the remaining 15% had more than 2 admissions with 1 missing value (see Table 10).

Table 11. Crosstabulation of Disease Stage with number of comorbid conditions (n=126).

Dx Stage	Comorbidity			
	< 5	**5 - 8**	**> 8**	**Totals**
1	**85**	**104**	**26**	**215**
	29.5%	36.1%	9.0%	74.7%
	39.5%	48.4%	12.1%	
	80.9%	77.6%	53.1%	
2	12	13	6	31
	4.2%	4.5%	2.1%	10.8%
	38.7%	41.9%	19.4%	
	11.4%	9.7%	12.2%	
3	8	17	17	42
	2.8%	5.9%	5.9%	14.6%
	19.1%	40.5%	40.5%	
	7.6%	12.7%	34.7%	
Totals	105	134	49	288
	36.5%	46.5%	17.0%	100.0%

Note. N=288, women and outliers excluded, 21 individuals missing Dx Stage.

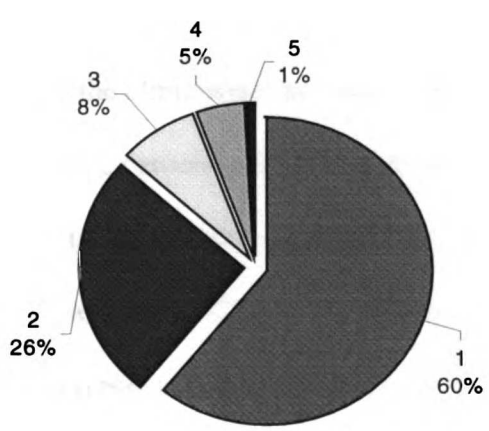


Figure 10. Total Episodes of Hospitalization.

The distribution of the average of total days of hospitalization for the study year is in Figure 11. 35% of the study population had an overall length of stay of 5-8 days of hospitalization, but 47% were hospitalized for longer than 8 days.

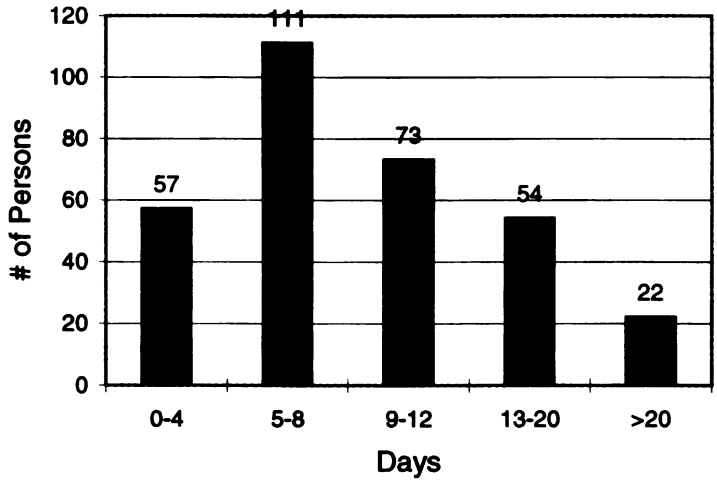


Figure 11. Total Year Hospital Days for all Episodes of Hospitalization, 93-94.

Provider Variables

Source of Admission

Urgent admissions from the clinic were the most frequent type of admission with 94 percent. Only seven admissions (2 percent) came through the Emergency Department, and there were 12 elective admissions (4 percent)(see Figure 12). Admit type is one indicator of the managed care system. The low use of Emergency Department services and ability to screen hospital admissions via clinic visits is characteristic of the staff model HMO.

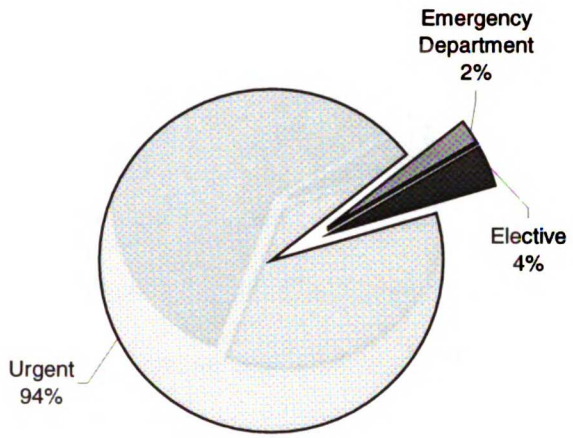


Figure 12. Source of Admission

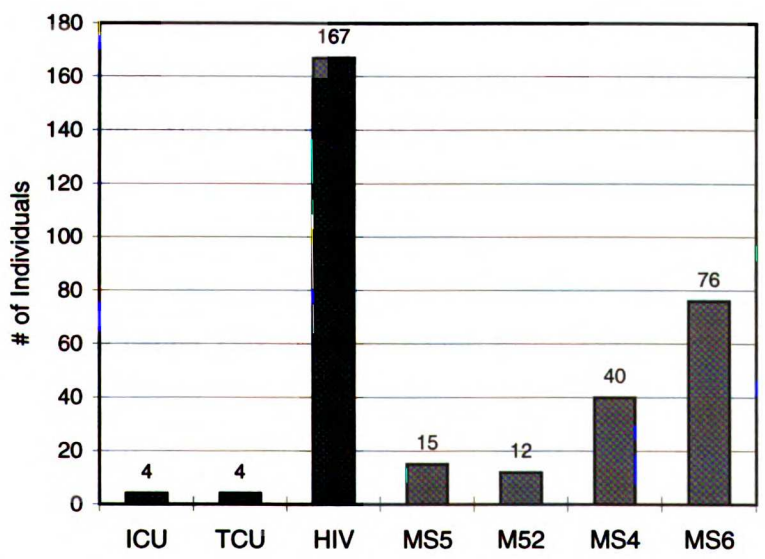


Figure 13. Patient Placement by Admit Unit

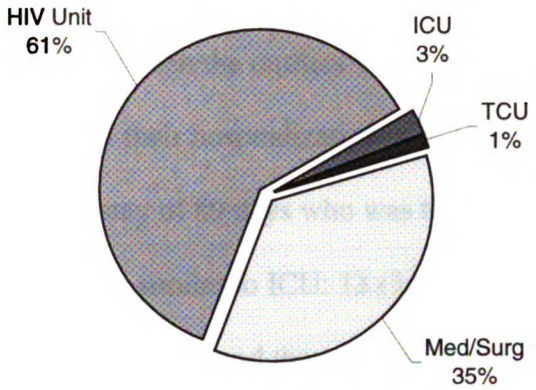


Figure 14. Distribution of Patient Days by Nursing Unit

Nursing Unit Type

The great majority of cases were admitted to medical/surgical level of care versus intensive care. Of those, most were admitted to the HIV unit (see Figure 13). The practice of patient placement at the study hospital was to admit PWAs to the designated HIV/AIDS unit if a room was available. The designated AIDS unit had 16 semi-private and 2 private beds for AIDS, Hospice, and overflow Medicine patients. PWAs were admitted or transferred to other medical-surgical units for the following reasons; need for a private room for r/o Tuberculosis or Dementia, lack of rooms on the HIV/AIDS unit, or personal request to be off the HIV/AIDS unit. In an effort to maximize patient/family comfort semi-private rooms were often blocked out to create private rooms. Also, PWAs would not be placed in a room with a non-AIDS patient.

The study population received the majority of their care on one of the Medical/Surgical level units. 96% of the total 4,520 patient days were in Med-Surg or HIV

units. Critical care resources if needed were utilized for short periods of time. Only four percent of the study sample (16) spent any time at all in the ICU (see Figure 14). Critical care length of stay was only 2 days when the outliers were excluded. There were two individuals who spent over 85% of their hospitalization in ICU. One of these was also the patient with the longest length of stay of 89 days who was then discharged alive to home. Use of Transitional care (TCU) was similar to ICU: 13 (3.8%) patients were transferred to TCU at some point in their hospitalization and there was one person who spent their total length of stay in TCU.

Utilization of AIDS Nursing Unit

The utilization of Medical-Surgical beds breaks into three groups: persons that spent the majority of their stay in the HIV/AIDS unit, persons that spent most of their stay on a general med-surg unit, and a group that moved around between units. Forty percent (132) of the study population spent their stay (>85% of LOS) on the HIV/AIDS unit, 36% (114) were never on the unit while the remaining 24% (72) spent a large percentage of time on more than one type of nursing unit. As stated previously, patients with AIDS were generally admitted to the HIV unit if a bed was available. Clearly, the goal of admitting all PWAs to the HIV/AIDS unit was not achieved when only 40% of the study population spent the majority of their stay on that unit.

However, the differences in nursing care between the HIV/AIDS unit and the other Med-Surg units was not perceived by nursing to be significantly different. The units were in close physical proximity to each other, the nursing management was the same, the nursing staff floated from unit to unit, and care protocols developed by the HIV/AIDS staff were

shared hospital wide. The main difference between the HIV/AIDS unit and other Med-Surg units from the patient perspective was the atmosphere and concentration of AIDS volunteers, AIDS literature, privacy of a separate family lounge, and camaraderie for patients and significant others.

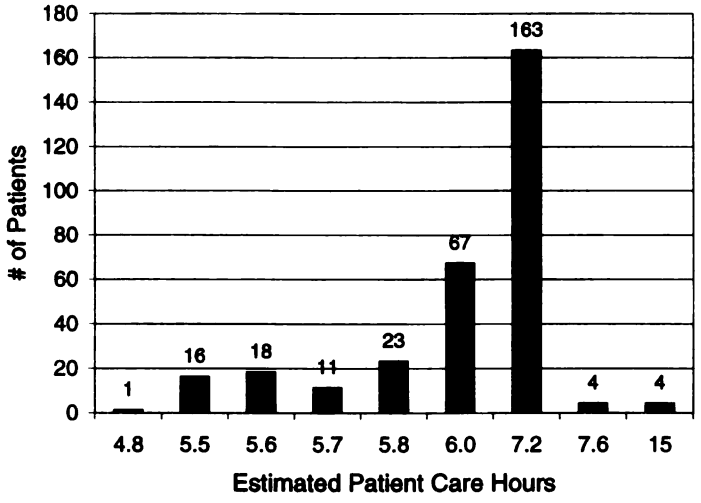


Figure 15. Nursing Workload Score on Admission.

Projected Nursing Workload on Admission.

Figure 15 presents the nursing workload scores for the study population upon admission. On admission, the average projected need for nursing care (PCH) as determined by the nursing staff was 6.69 hours of care. 53% of the study population was admitted with a PCH score of 7.2 hours of nursing care. That is, upon admission, the RN caring for the patient selected nursing tasks that indicate a projected need for approximately 7 hours of nursing care in 24 hours. This represents an approximate direct nursing care staff to patient ratio of 1:3. In comparison, during the same period, the average PCH for the remaining medical/surgical patients was 6.4 hours of care. About 40% of the study patients were

admitted with scores of 6.0 hours or less indicating a need for nursing care at a ratio of about 1:4 nursing staff to patients.

Only 1 % of the study population was admitted with a score higher than 12.0 hours at a nurse to patient ratio of 1:2. The four ICU cases had scores of 15.0 on admission. Generally speaking, patients requiring 12 or more hours of nursing care are admitted to one of the critical care levels; either TCU or ICU. The admission criteria for these units however, are based on medical criteria primarily while nursing needs are factored in, but not explicitly part of, the decision.

It should be noted that the PCH score on admission is directly related to the level of care and nursing unit where the patient is admitted. A patient admitted to an ICU as a result of medical judgement will automatically be given a PCH score that correlates to the increased frequency of vital signs monitoring and use of equipment that goes with intensive care nursing.

Average Nursing Workload During Hospitalization.

The mean PCH score represents the patient's need for nursing care over the entire length of stay. Figure 16 presents the distribution of those scores which is an indicator of the number of hours of nursing care it is projected that each patient will require in a 24 hour period. The categories are based on the natural distribution of the data in the study population. One third of the patients fall in the 6.5 to 7.4 range for hours of nursing care in a day with very few observations at the tails of the distribution. 70% of the population have PCH that would be equivalent to a nursing staff to patient ratio of 1:3.

This percentage was almost 20% higher than the number that were estimated to receive this level of care on admission. There could be possible reasons for this finding; the process used to get the admission score, the admit PCH did not capture the entire scope of nursing care that would be required during that stay, or patients had higher needs for nursing care after admission. Further examination of the admit data revealed that a majority of the patients were assigned a default value on admission. Meaning that the patient was admitted to the unit and the nursing staff did not assign an admit PCH so the default value was automatically assigned. An alternative explanation could be that the admit value reflected the need for assessment and diagnostic phase while average encompassed treatment phase of hospitalization.

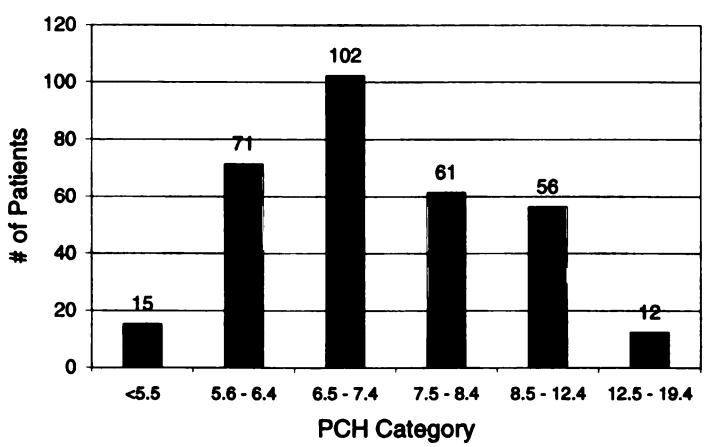


Figure 16. Mean Projected Nursing Workload Score (PCH).

One on One Nursing Care

The need for one on one (attendant) unskilled nursing care reflects the use of very costly nursing services. Patients requiring attendants received a minimum of 18 hours of

nursing care in 24 hours. This comprises at least two nursing staff assigned to the patient: 1) A certified nursing assistant who is assigned to the patient's bedside and can not leave the patient alone and 2) A RN who is assigned this patient in addition to others. Attendants may be hospital employees or Registry employees. Attendants are provided following a nursing and medical assessment for a patient who requires constant observation and basic, time intensive nursing care for those at risk for harming themselves due confusion or dementia. The most frequent tasks include but are not limited to ensuring that a patient: has oxygen therapy as ordered, does not climb out of bed, and does not remove intravenous tubing or other catheters. 20 patients had at least one shift of attendant care during hospitalization and the total number of attendant shifts was 127. This total represents almost .5 of a full time equivalent (FTE) or approximately $16,225 of nurse aide time alone without including the RN time, costing approximately another $12,000.

There was no particular group of patients that required attendants. A cross tabulation of those requiring attendants shows varied ages, sex, and ethnicity. There was also no apparent pattern to unit placement and use of attendants. Need was shared almost evenly between the HIV and Med-Surg units and one ICU patient who also required an attendant. The only diagnosis with a possible association to the need for attendants was Dementia. Of the 20 patients that required attendants, six (33%) had a diagnosis of dementia. Diagnoses of the remaining two-thirds were varied and it is apparent that those patients with attendants were quite ill. The most notable finding was that all of the patients with attendants had more than four comorbid conditions. The three patients that had sitters for more than three days also had more than 10 comorbid conditions.

Nursing Care Hours

Assignment records were used to reconstruct the number of hours of nursing care received by each PWA per day during hospitalization. These actual hours of nursing care (NCH) reflect the actual staffing available on the nursing units and contrast to the projected hours as determined by the workload measurement system. It was expected that the actual hours of care be close to or less than the projected hours. The mean hours of direct nursing care each PWA received during hospitalization was 9.43 hours per day. This score had a standard deviation of 5.15 and a standard error of .29. The minimum score was 6.2 hours of care per day and the maximum was 30.0 hours of nursing care; a range of 23.8. The distribution of nursing care hours per patient day are in Figure 17.

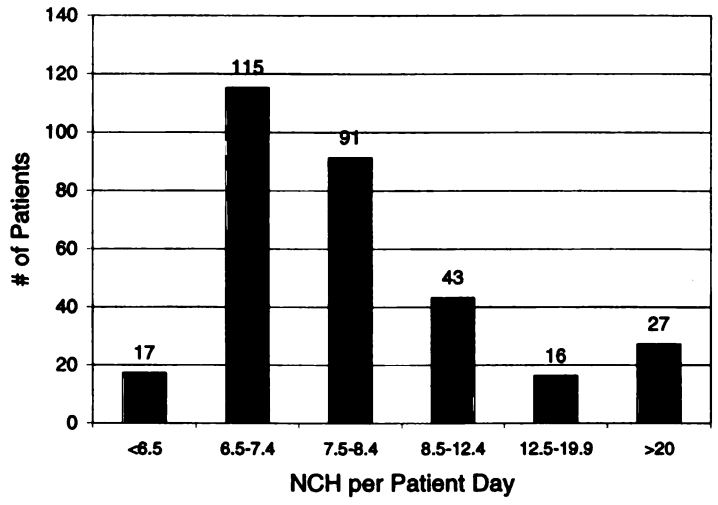


Figure 17. Mean Nursing Care Hours per Day for Hospitalized PWAs.

If actual nursing staffing is based on the PCH score then the PCH and NCH values would be highly correlated. It was expected that since PCH is used to determine the actual

hours of care (NCH) that there would be a correlation between PCH and NCH. However, the correlation is very low (r= 0.07). On average, actual hours of nursing care exceeded projected hours by 20%. Table 12 presents the comparison of PCH and NCH values.

Table 12. Comparison of Projected and Actual Nursing Care Hours for Hospitalized PWAs (R=0.07).

Variable	N	Mean	SD	SE	Min	Max
PCH	317	7.63	2.05	0.12	4.9	18.7
NCH	317	9.43	5.15	0.29	6.2	30.0

Physicians

A total of 59 physicians from five different services acted as attending physicians for the hospital episodes of the study population. Physicians from the Department of Medicine cared for over 80% of the patients. Other departments of physicians caring for patients included Hospice (14%), Surgery (2%), Neurology (<1%), and Orthopedics (<1%).

There were 29 physicians who cared for three or fewer patients during the year suggesting that their experience in caring for hospitalized PWAs was limited. Yet, there was also a small group of physicians with a large caseload of hospitalized patients. 11 physicians, all from the Department of Medicine, cared for 10 or more patients during the study period and as a group they served as the attending physician for almost half (49%) of all the patients admitted during the study year.

Outcome Variables

Length of stay

The average LOS was 10.3 days during the study period with a standard deviation of 8.06. The LOS distribution (see Figure 18) did not represent the stay for the majority of the population because of some very high outliers. The minimum LOS was 1 day and the maximum was 87 days. The most frequent LOS was only 3 days and over 60 people stayed between three and four days. There were 12 individuals whose stay was greater than two standard deviations from the mean, with the maximum value of 87 days. If these outliers are excluded, then the new distribution has a mean of 9.1 days which is not a large change statistically. Cross tabulation of LOS by number of comorbid conditions and mean nursing care hours do not reveal strong relationships between either of these variables and LOS.

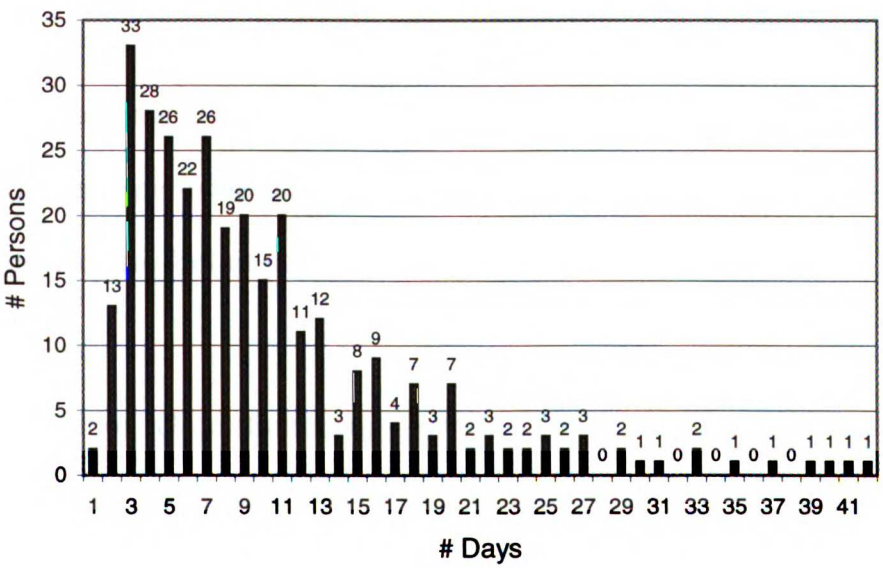


Figure 18. Distribution of LOS for Study PWAs.

Nursing Cost per Case

Direct nursing costs per patient per day were variable. All costs are reported in 1994 dollars. The mean cost per day was $229 and the standard deviation was $95. The lowest cost per day was $145 and the highest was $685 with a range of $540. Cost per patient per day varied most closely with mean nursing care hours as would be expected, however since skill mix also plays a factor in the cost there is not a direct relationship between cost of care and the hours of care delivered.

The total direct nursing cost for each person was calculated to be a mean of $2,139. The minimum and maximum were $200 and $28,870 respectively and the standard deviation was $2,340. As with length of stay where there were a number of short stay patients, the most frequent total direct nursing cost was $861 per day which was significantly lower than the mean. The total direct nursing cost for the most recent episode of hospitalization for this patient population was $660,980. Estimated year direct nursing costs for all hospital episodes for the study sample in 1994 dollars was 1.06 million. If the average hospital costs for ancillary (indirect) personnel and nonproductive nursing time are also added, then the total nursing cost to care for this patient population for one year was $1,421,371.

Disposition

The disposition (place of discharge) of the 251 patients discharged alive was to home (165), homecare; which is to home with skilled nursing care visits (65), or a SNF (21) depending on the level of care required. In order to receive home nursing care, the patient had be homebound and meet requirements for skilled nursing care. For example, RN care was usually required to care for an intravenous or implantable catheter for medication

administration, to complete dressing changes, or to monitor the effectiveness of pain medication. Nurse aide assistance was also available for those needing assistance to carry out the activities of daily living for a limited period of time. Skilled nursing facility services were available to bedbound patients with no ability to care for themselves that did not need acute medical care. All of the above services were part of the health plan coverage and patients continued to be followed by their primary physician after hospitalization. Figure 19 presents the disposition of the study population at time of discharge from the most recent hospitalization during the study period.

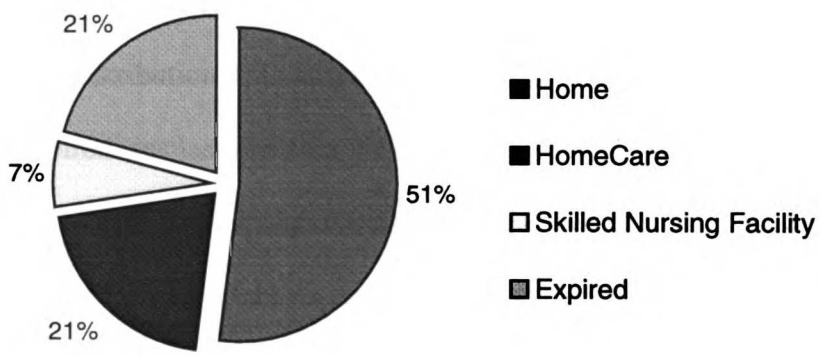


Figure 19. Disposition of PWAs following Hospitalization, 1994.

Expirations

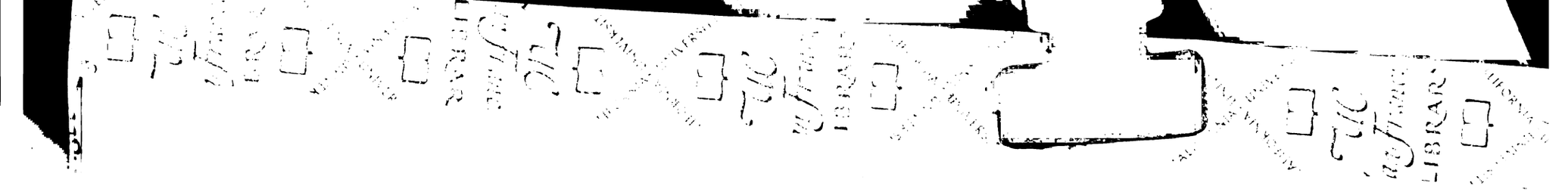
There were 66 hospital deaths during the study period. Information about members of the study population that may have expired elsewhere was not available, but health plan statistics are available. As of June 30, 1994 there had been a total of 6,380 health plan members meeting the CDC definition of AIDS since the epidemic began in 1981 (Center for

Disease Control, 1992). As of that same date 4,534 (71%) had died or left the health plan. The known case fatality rate as of June 1994 was 60% compared to 62% for the whole state of California (Internal Report, Division of Research, 1994). The two-year death rate for all AIDS cases in the health plan at the time of the study was 80%. If the death rate was consistent, by June 1996, 80% of the persons diagnosed with AIDS during the study period would have expired. The four-year death rate as of June 1994 was 95.

Dependent Variable Interaction

There was one dependent to dependent variable relationship that had a significant chi-square value; Disposition by Length of Stay (LOS) was significant at .0 5. There was a trend where the great majority (>70%) of PWAs who had the shortest length of stay were discharged to home. The distribution of LOS for those members who were discharged to other types of care or expired was less clear-cut though. Almost 50% of the members discharged to home care or SNF had lengths of stay between 5 and 12 days. There was no discernible pattern of LOS for those members who expired in the hospital.

Since total nursing cost is the sum of nursing costs per day of stay, LOS was correlated with total nursing cost for this population of hospitalized PWAs, r= 0.851, p= 0.0001. With this correlation in mind, it was expected to find a significant chi-square distribution between total cost of nursing care and disposition. The pattern of the distribution was similar to that of Disposition and LOS.



Other Notable Descriptive Findings

Women

Closer examination of the eight women in this population revealed the following: The women with AIDS hospitalized during the study were predominantly middle aged with seven age 30-49 and one women who was over 60 years of age. Two of the women were black and the rest white. Seven stated they were single. All eight had health plan membership via their employer and lived in San Francisco.

On admission their projected need for nursing care ranged from 5.6 to 7.2 hours of care with one third requiring seven hours of care which is slightly more nursing care that required for the men. This is about a one nurse to three patient ratio. Only two women had fewer than four comorbid conditions. Four had 4-6 comorbidities, and two had more than seven. But all eight women were categorized with a disease stage of 1.0 (low severity). Seven women had only one episode of hospitalization during the study period and the remaining women had two.

This small group of women presented a variety of diseases and histories. There were five different principal diagnoses. Three women had a principal diagnosis of PCP, about the same percentage as for the whole study sample. Only 1 woman was hospitalized for AIDS lymphoma, the remainder had infectious diseases. Notable medical histories included; four women with history of drug use, two with history of ETOH use and no smokers. The woman with septicemia was also coded as having AIDS dementia. However, she did not require attendant care.

Only three of the women were cared for by physicians admitting more than 10 AIDS cases per year. Also, one woman spent the majority of her hospitalization on the HIV unit. The rest were on other medical-surgical units. They were not admitted to ICU or TCU and there were no sitter cases for the women. The disposition for these women was as follows; three routine discharges, two were transferred to a SNF, one person was sent home with homecare services follow-up and there were two expirations. There does not appear to be any pattern to the dispositions in relation to any of the above variables. However, this sub-sample of women is too small to make any conclusions.

Relationships of Interest

Comorbidity and Disease Stage

If Disease Stage, which is a subjective measure, is reflective of the level if illness you would expect to see a relationship between the number of comorbid conditions and disease stage. This appears to be true to a certain extent. Table 11 presents the cross tabulation of comorbidity by disease stage. The chi square is significant.

The three measures of comorbidity, disease stages, and projected hours of nursing care each appear to be measuring different aspects of patient illness. The Pearson r coefficients for the 3 pair of variables are lower than expected, ranging from .216 to .368. Cross tabulations of these variables also demonstrate that projected nursing needs do not necessarily reflect either disease stage or number of comorbid conditions. Interestingly, as the number of comorbidities rises, the need for hours of nursing care does not rise. Although a patient may be managing with complex and numerous physiological conditions, the nursing care needed to treat that complexity doesn't necessarily increase.

Disease Stage is the only categorical variable with a statistically significant Chi Square ($p = 0.006$) when compared to patient disposition. This appears to be skewed by a large number of individuals in one cell. There are three categories of disposition: 1) discharge to home, 2) other discharge (to home care or SNF), and 3) expiration. Over 75% of the members discharged to home were categorized with a disease stage of 1.0 to 1.3. However, almost 70% of the total sample was categorized with a disease stage of 1.0 - 1.3. One would expect that members discharged to home care or SNF would also have a high disease stage but only 35% of these members were staged >2.0. 56% of the members that expired while hospitalized also were categorized with a disease stage <2.0. Therefore, it is unclear what this variable is indicating when out of context with the other variables. Either the physicians are inconsistently applying the levels of disease stage or there are a significant number of individuals who expired in the hospital with a low level of disease.

Mean Nursing Hours per Day and Disposition

The cross tabulation of NCH and disposition shows a relationship between these variables ($p < .01$), although not a direct relationship. The majority of PWAs receiving lower mean NCH were discharged home. Sixty eight percent (56) PWAs with an average NCH <7.0 were discharged home. Those PWAs whose mean NCH was in the middle (7.1 – 10) also had mixed dispositions. While about half (47%) of these were discharged home, 30% were discharged to home with nursing care or to a SNF while the remaining 22% expired in the hospital. Interestingly, the PWAs who required the most intensive nursing care with mean NCH >16 either went home or expired in the hospital. As noted above, high nursing hours could have been at a very skilled 1:1 RN level in the ICU or less skilled nursing aide

and RN care. Only two PWAs with an NCH >16 were discharged to home with nursing care or SNF.

Aim 2: Regressions

The second research question of this study was to examine factors associated with LOS, expiration, and disposition of the study sample. Three types of factors were hypothesized to be associated with the outcomes: sociodemographic, disease condition and health status, and provider related factors.

Table 13. Distribution of Study Variables Used in Regressions

Variable	Variable Name	n	Mean	SD	Min	Max	Skewness
Age	AGE	309	42.03	8.06	24.0	67.0	0.55
Caucasian	WHITE	309	0.84	0.36	0.0	1.0	-1.91
# Comorbidities	CO_MOR	309	6.09	3.04	2.0	18.0	1.02
ICD9 PCP	PCP	309	0.40	0.49	0.0	1.0	0.42
Hx of Drugs, ETOH	SDE	309	0.07	0.25	0.0	1.0	3.45
Hx Dementia	SDEMEN	309	0.09	0.30	0.0	1.0	3.23
Disease Stage	DXSTAGE	309	1.49	0.76	1.0	3.3	1.23
Mean PCH	XPCH	309	7.63	2.05	4.9	18.7	2.64
Mean NCH	XNCH	309	9.43	5.15	6.2	30.0	2.68
% of Stay HIV	PCNT_HIV	309	0.47	0.42	0.00	1.00	-0.06
MD Experience w/ AIDS	MD_EXP	309	9.93	6.10	1.0	22.0	0.52
Nsg. Cost PPD	DOLRPPD	309	229.48	94.99	145.0	685.0	2.51
Total Number of Admissions	TNUM_ADM	309	1.60	0.90	1.0	5.0	1.60

Note. N=309, males only

Factor Selection

Variables from each of the three groups were selected for input as factors into the regression model following analysis of the descriptive data. Table 13 presents a summary of the distribution of the independent variables that could be selected as factors for the regression sub-sample of men only.

The correlation matrix in Appendix C was used to determine variables to be included in the regression equations. The models that were tested included only those variables that represented discrete concepts that were tested for collinearity and found to be not highly correlated. Every variable also had complete data for each individual; there were no missing values.

Sociodemographic Factors

Age and ethnicity were chosen from all possible variables to represent sociodemographic. Marital status, zip code, and payor source were not chosen for the models because they did not add significant meaningful information.

Disease Related Factors

Number of comorbid conditions, disease stage, history of ETOH or drug use, dementia, and presence of PCP were the disease related factors. Provider factors included PCH, NCH, percent of stay on HIV unit, physician experience and total number of hospital admissions during the study year. There was a relationship between the patients that spent their hospitalization on the HIV unit versus other nursing units so only one of these factors was included.

Models

The sample of 297 for the regression analysis consists of male PWAs only, who had a LOS value that was within two standard deviations of the mean. As stated in Chapter 3, the sample size of 297 provides sufficient power to detect a moderate effect size. The significance test for the effects was a two-tailed test. The model statements were each tested

for tolerance and fit. LOS and Total Nursing Cost, both continuous dependent variables, were tested using Ordinary Least Squares. Expired and Discharge to SNF or Homecare were tested using a Logit model. The natural log of nursing cost was used to normalize the distributions. This improved the fit of the model and coefficient estimates.

Findings

Results of the regression models that were tested are shown in Table 14 and Table 15. The models for LOS and Total Nursing cost tested using Ordinary Least Squares are presented in Table 14. The outcomes models tested using Logit, likelihood of Expiration and type of Disposition, are shown in Table 15. The coefficients listed for each variable reflect that variable's individual contribution to the model.

Length of Stay

Notably, the complete model for LOS explains 25% of the variance ($R^2 = 0.2471$) in Length of Stay and is significantly predictive ($p<0.001$). Two variables are statistically significant factors in explaining length of stay; comorbidity which is a disease related factor ($p<0.001$) and mean PCH ($p<0.001$), a provider related factor. The T value for each factor was 4.8 and 4.6 respectively. LOS increased by .56 days as the number of comorbid conditions increased and by .87 as the mean projected nursing care hours increased.

The sociodemographic factors did not predict LOS. Neither age nor ethnicity mattered more than disease related issues. Of the disease related factors the number of comorbid conditions was the determinant factor in predicting LOS. The more conditions a person were burdened with the longer their length of stay. A history of drug or alcohol use was very close to being statistically significant factor as well with a p value of 0.063. None

of the remaining disease related variables (presence of dementia, principal diagnosis of PCP, or disease stage) were significant in predicting LOS.

Table 14. OLS Regression Coefficients for PWAs, 1994.

Model	OLS	
Dependent Variable	LOS	Total Nursing Cost (log)
N	297	297
	Coefficient	Coefficient
	(SE)	(SE)
Intercept	-.850	-2390.087**
	(0.722)	(0.000)
Sociodemographic & Economic		
Age	0.004	3.286
	(0.920)	(0.691)
Caucasian	-0.554	-114.683
	(0.502)	(0.514)
Disease Condition & Health Status		
Dementia	-1.219	-547.660**
	(0.250)	(0.016)
History of Drug, ETOH use	-2.278	-440.935
	(0.064)	(0.092)
Number of Comorbid	0.561**	110.681**
conditions	(0.000)	(0.000)
Disease Stage	0.641	249.284*
	(0.147)	(0.008)
Principle	0.978	272.958*
Diagnosis PCP	(0.136)	(0.050)
Total # Admissions	-0.450	-132.645
	(0.194)	(0.073)
Provider Related		
% LOS on AIDS Unit	1.088	92.281
	(0.187)	(0.599)
Mean Actual Nursing Care	-0.075	-5.337
Hours (NCH)	(0.260)	(0.705)
Mean Projected Nursing Care	0.868**	432.567**
Hours (PCH)	(0.000)	(0.000)
MD Experience	0.025	12.674
	(0.644)	(0.267)
F	7.96**	22.24**
R2	0.25	0.48
Adjusted R2	0.22	0.46

Note. *p<. 05, **p<. 01

PCH was the only provider-related factor that was significant in predicting LOS. Neither Physician experience with AIDS, admission to the AIDS nursing unit, nor total NCH were predictors.

Table 15. Logit Regression Coefficients for PWAs, 1994.

Model	Logit (MLE)	
Dependent Variable	Expired	DC to SNF or Homecare
N	297	245 (excluding expirations)
Intercept	-7.088**	-4.70**
	(0.000)	(0.000)
Sociodemographic & Economic		
Age	0.026	0.009
	(0.201)	(0.656)
Caucasian	-0.206	0.083
	(0.628)	(0.847)
Disease Condition & Health Status		
Dementia	-0.956	-0.230
	(0.130)	(0.679)
History of Drug, ETOH use	-0.309	0.422
	(0.670)	(0.478)
Number of Comorbid conditions	0.042	0.068
	(0.495)	(0.280)
Disease Stage	0.573*	-0.007
	(0.009)	(0.978)
Principle	0.712*	-0.367
Diagnosis PCP	(0.043)	(0.295)
Total # Admissions	0.362*	0.231
	(0.034)	(0.177)
Provider Related		
% LOS on AIDS Unit	-1.191*	-0.046
	(0.010)	(0.919)
Mean Actual Nursing Care	0.040	-0.068
Hours (NCH)	(0.189)	(0.165)
Mean Projected Nursing Care	0.303*	0.305*
Hours (PCH)	(0.006)	(0.013)
MD Experience	0.037	0.019
	(0.177)	(0.516)
Resource Utilization		
LOS	0.024	0.112**
	(0.414)	(0.000)
Chi Square	52.741**	64.875**

Note. *p< .05, **p< .01

Total Nursing Cost

The model predicting total direct nursing cost of the last (most recent) hospital episode was significant and actually described 48% of the variance in nursing costs ($p<0.001$). In addition to comorbidity ($p<0.001$) and mean PCH ($p<0.001$) there were three other variables that were statistically significant in predicting nursing costs. They were presence of dementia ($p<0.05$), disease stage ($p<0.05$), and a principal diagnosis of PCP ($p<0.05$). Presence of dementia had the effect of having reduced nursing costs by $547 for the most recent hospitalization. However, an increase in disease stage corresponded to an increase in nursing cost of $249 and having a principal diagnosis of PCP increased cost by $272.

The sociodemographic variables were not factors in this model. Of the disease condition and health status variables, prior history of drug or ETOH use was not a factor in costs, nor was the number of previous admissions. No provider related factors other than PCH were significant either. It's interesting that mean nursing care hours were not a significant factor in total nursing costs.

Expired During Hospitalization

The model was statistically significant in predicting the likelihood of expiration while hospitalized ($p<0.001$). Five factors provided significantly useful information for predicting expiration at the $p<0.05$ level. The five factors are: disease stage, mean PCH, principal diagnosis of PCP, time spent on the AIDS nursing unit, and total number of admissions during the study year. PWAs with a principal diagnosis of PCP were 2.03 times more likely to expire while hospitalized than those with other principal diagnoses. PWAs with a high

disease stage were 1.77 times more likely to expire than those with a lower disease stage. More frequent admissions during the study year meant likelihood of expiration was 1.44 times more likely. Having a high average PCH meant a 1.35 times greater likelihood of expiration.

Interestingly, PWAs that spent less of their hospitalization on the AIDS unit were slightly more likely to expire; 0.3 times more likely. Also, the number of comorbid conditions was not a factor that was useful in predicting likelihood of expiration.

Discharge to SNF or Homecare

The model significantly predicted the likelihood that a PWA would be discharged to either home nursing care or a SNF ($p<0.001$). Only one factor was significant in predicting the need for additional care following discharge and that was PCH ($p< .05$). A high mean PCH resulted in a 1.35 times more likely need for additional nursing care following discharge. Interestingly, another dependent variable, LOS was also a significant predictor of the need for additional nursing care. PWAs with long lengths of stay were 1.12 times more likely to be discharged with home nursing care or to a SNF. No other factor predicted a need for follow-up care. It is surprising that the disease related factors which were significant in the other models were not factors in the need for additional nursing care post hospitalization.

In summary, different factors affected the types of outcomes. The number of comorbid conditions is the most significant factor affecting LOS and cost, yet its not a factor in predicting expiration or need for nursing care post hospitalization. PCH is the only variable that was a significant contributor to all four models.

Chapter 5: Discussion and Conclusion

Sociodemographic and Economic Data

In the State of California, the demographics of the most recent 25,000 cases of AIDS, from 1994 to 1997, demonstrate a larger percentage of minority and women PWAs than the study population (Sun & Jungkeit, 1997). The demographic data of this study describe a population that consists predominantly of white middle aged men with AIDS. This is not unexpected. The health plan and hospital is located in an urban area but to have membership in the health plan means that the population is predominantly middle class by default because their employers provide health care coverage. However, there was no evidence of differing outcomes by ethnicity or age which is a positive outcome for the health plan. This finding is slightly different from the finding of Chaisson et al who found no difference in long-term survival due to ethnicity but did find that older age reduced chance of survival (Chaisson et al., 1995).

Disease Condition and Health Status

The pattern of AIDS diseases and number of comorbid conditions reflect end-stage disease. Comorbid conditions provides additional information to other severity measures when the majority of the population is thought to be in the "very ill' category as is the case with hospitalized PWAs. Measuring comorbid conditions is more specific than disease stage and allows examination of severity when it is not feasible to apply the Severity Classification for AIDS (Turner et al., 1989) or other measures to the data. Other advantages to using comorbidity are that it facilitates examination of patient variability within DRGs, is

readily available in the coding data, and does not require special data collection procedures or prospective data collection.

The crosstabulation of comorbidity and disease stage had a significant Chi Square indicating that the two correlates were measuring different aspects of illness. One possible explanation for the difference is that disease stage classification had an element of subjective judgement in the process and reflects an impression of severity (see Chapter 3). In contrast, the number of comorbid conditions is an objective count of diagnosed conditions. So, these variables could be measuring different aspects of disease with comorbid conditions being more reflective of quantity of disease(s) or a measure of disease burden versus severity of disease.

The conceptualization of comorbidity and disease stage as indicators of severity of illness bears further delineation. They may better reflect the concept of disease burden. Neither indicator reflects the full dimensions of nursing care yet there was a correlation between comorbidity and PCH. Clearly, the relationships between the various indicators; comorbidity, disease stage, and PCH needs further examination. For example, severity was found to be a determinant for in hospital mortality by Horner, Stone, Turner (Horner et al., 1996). While in the current study of PWAs disease stage was a better indicator of expiration and comorbidity was a better predictor of LOS and cost.

Provider Related Data

The findings of this study were consistent with Fahs et al in finding no difference in patient outcomes due to the type of nursing unit the patient stayed on only as related to LOS and cost of nursing care (Fahs et al., 1992). Patients who spent the majority of their stay on the AIDS unit were less likely to expire while hospitalized. This finding bears further

examination. A secondary finding of interest from this study is the many patients who moved from room to room and unit to unit several times during their hospitalization. The influence of consistency in nursing care could contribute to the lower expiration rate for those that stayed on the HIV unit, however there should be further study in this area. Other possible alternate explanations include: Could the nursing care on that unit be qualitatively different to prevent hospital expirations? Or is there a pattern of utilization for those patients that avoid hospital expiration such as discharging PWAs to hospice when death is imminent?

Utilization of Emergency Department and ICU services was very low for this population. The low use of Emergency Department services and ability to screen hospital admissions via clinic visits is characteristic of the staff model HMO. The ICU finding may reinforce expectations that costly services may be under utilized within a managed care system. However, there was no evidence that this low utilization contributed to poor outcomes. It is possible that the evidence can be interpreted to indicate the judicious use of critical care services for short periods of time to stabilize life-threatening conditions. Further investigation is required to examine the care practices that contribute to low ICU days.

The measure used to obtain PCH needs was a powerful factor in determining outcomes. This score is a linear representation of the amount of time the nursing staff spends assisting patients with various aspects of care. There are three components to the instrument; an activities of daily living or functional status component, a nursing treatments component, and an indirect care component that reflects tasks completed on the unit in the patient's behalf (i.e. the narcotics count). It is proposed that the fact that the PCH incorporates both functional status and treatments allows this factor to demonstrate such significant predictor of hospital outcomes.

The nursing care hours needed to care for this patient population is higher than that for other medical patients. The average need for nursing care (PCH) was 7.6 hours of care per day. That is the equivalent of a 1 RN to every 3 patients ratio. The average actual hours of care (NCH) provided was 9.6 hours of care per day. The equivalent patient ratio would be 1 RN to 2 to 3 patients. Thus, nursing care for AIDS on the medical/surgical level nursing units was substantially higher than for typical medical/surgical patients (usually 1 RN to 4-5 patients or about 6.0 hours of direct care). The data suggest the actual nursing care requirements for this population were unpredictable and/or underestimated. Although the projected measure of nursing care needs was an excellent predictor of outcomes, projections of actual staffing for which the measure was designed was problematic.

The finding of a small correlation between PCH and NCH bears further comment. Almost all case costing studies involve breaking down aggregate costs based on predetermined assumptions about how nursing care is administered at the patient level. The methodology used here of determining costs based on patient care assignments weighted by acuity should be replicated to examine the relationship between these predetermined assumptions and actual nurse to patient assignment making. Clearly, unit level staffing averages do not always translate to the patient level of analysis. So, spreading nursing hours evenly across patients is not an ideal approach. The strategy used here, to spread costs based on acuity and assignments was one attempt to determine actual costs at the level of the individual. However, it would be better to record the actual hours of care in future studies.

It was an expectation at the time of the study that all primary physicians in this HMO were capable of caring for PWAs. The culture of this organization encouraged sharing of clinical information between and among physicians. However, the extent of collegial

consulting by this group of physicians was not measurable. So it is not known if the physicians admitting very few PWAs received assistance from the more experienced physicians.

The expectation was that more experienced MDs might have different patterns of utilization. Cross tabulations of number of PWAs per physician by the outcome variables of Disposition, LOS, and Cost showed no difference. There are two possible interpretations of this finding: 1) this physician group did a very good job of keeping all MD staff current in AIDS care or 2) physician experience was not a factor in the selected outcomes.

Outcomes of Hospitalization

Cost and LOS

The estimated nursing cost per case of $2,140 is markedly less than previous reports (Kelly et al., 1989), (Scitovsky et al., 1986), (Bennett et al., 1991), (Seage et al., 1990), (Bennett et al., 1992b). Although comparing nursing costs to studies that did not specifically measure nursing is problematic, a cautionary comparison can be made using Bennett's estimate that room and board is 60% of total costs. Using this value, the costs of room and board per patient day from previous studies (adjusted to 1994 dollars) ranges from $440 to $1,265. Given the above, this study's finding of $229 per day for nursing care ($257 for room and board) is still significantly lower than previous findings. This suggests that HMOs with their own hospitals are able to achieve cost savings over standard hospitals.

The predictors of nursing cost were correlates for severity of illness. It was not surprising that comorbidity, disease stage, and PCH were predictors of cost. Interestingly, presence of dementia and PCP were also predictive. The use of PCP prophylaxis since the period of this study has made an impact in current hospital utilization. But, further

exploration of nursing care related to AIDS dementia could result in cost savings for both this disease and non-AIDS related dementia care.

The mean LOS of 10 days is comparable to the findings of Bennett in LA and Seage. (Bennett et al., 1991), (Seage et al., 1990). The median LOS of 3 days has not been reported elsewhere. This provides further evidence of the managed care system incentives and their success at decreasing utilization. Comorbidity and PCH were the best predictors of LOS. The number of illnesses a person was being treated for certainly added to the complexity of the treatment plan and provided the potential for added time to diagnose and treat those conditions. Since the PCH score reflected treatments as stated earlier, it also makes sense that this score predicted LOS.

Disposition

No other published AIDS research reports the level of care upon discharge as an outcome of hospitalization. 26% of the study population required some form of follow-up nursing care. The use of home nursing and SNF services reflects this HMOs belief in providing a continuum of services and relates to the low hospital utilization. These findings also reinforces the perception that the treatment of AIDS has moved closer to the chronic care model which requires integrated provision of services across the continuum (Morrison, 1993). Its notable that PCH is a predictor of the need for continued nursing care. This may be related to the ADL component of the PCH score. It may be possible to use this information to plan discharge needs in the future once more work is done to analyze the components of the instrument that contributed to post hospital needs.

Mortality

During the study year there were about 1,600 deaths from AIDS in San Francisco County (Creeger, Ito, & Sun, 1997). The study case fatality rate during hospitalization of 21% is very low compared to the State of California case fatality rate for the same time period of 62%. Clearly, PWAs expired outside the hospital and its unfortunate these data were not available so the rates can't be directly compared. The current mortality rate for all AIDS cases in San Francisco County is 69%(Sun & Jungkeit, 1997). Although there is hope that the development of PCP prophylaxis therapy and the use of the multiple drug therapy has impacted the utilization of hospital days since this study was completed, the literature is mixed. The rates of hospitalization and types of diseases that result in hospitalization decreased, as observed following the use of zidovudine (Gail, Rosenberg, & Goedert, 1990). However, Colford et al found no improvement in survival for PWAs following the diagnosis of PCP despite the availability of prophylaxis treatments (Colford et al., 1997).

Comorbidity was not a predictor of hospital expiration yet disease stage and PCH were. This finding provides further evidence that preexisting generic measures may be valuable for predicting in-hospital mortality. The instrument used to measure projected nursing care hours includes an ADL or functional status component. Others have demonstrated the utility of functional status measures for predicting mortality (Davis et al., 1995; Fleishman & Crystal, 1998; Justice, Aiken, Smith, & Turner, 1996), The role of previous admissions in predicting expiration makes more sense. If a PWA has been admitted to the hospital multiple times through the year, their disease is clearly progressing to the point of becoming life threatening. The finding that patient placement on the dedicated

AIDS unit resulted in less likelihood of expiration while hospitalized is compelling. Clearly, there were patient benefits realized as a result of this policy.

Study Limitations

Threats to the validity of the study primarily relate to internal and external validity. The threats to internal validity are measurement and the lack of other potential modifiers to the selected outcomes. These threats came from the decision to use a retrospective design using pre-existing measures. The overlap of the concepts of comorbidity, disease stage, and projected nursing hours may be perceived as a lack of conceptual clarity. The methodology used to get case level nursing care hours and costs was both labor intensive and potentially problematic. Additional work is required in this area to refine and validate the method used. Also, there is emerging evidence that organizational characteristics other than nurse staffing may have considerable influence on patient outcomes (Aiken et al., 1994) ,(Aiken et al., 1996b), (Aiken et al., 1997b). Measuring factors such as nurse autonomy, nurse physician relations, and critical thinking skills was beyond the feasibility of this study. However, it would be helpful for future research to incorporate measures that reflect the full scope of nursing care delivery.

The threats to external validity are generalizability and replication, which are common threats in a natural experiment design. This study was conducted in a unique environment that would be difficult to replicate. Because the progression from HIV infection to AIDS can take several years, the pattern of syndromes experienced by the study population may not reflect current patterns of infection (Hessol et al., 1994). The predominantly white, middle aged study population is not reflective of the entire population of PWAs. Finally, the HMO hospital that was the site of the study reflects a particular

arrangement of the staff model HMO having exclusive ownership of the hospital facility. In many managed care systems across the country, the medical practice groups share hospital privileges with physicians from other groups. Therefore, the hospital systems in those hospitals reflect heterogeneous physician practices.

Contributions

There are several contributions because of this study:

1. Disease related factors have a greater influence on the outcomes of hospitalization than either individual or system related factors. How ill a person was as measured both by morbidity and projected needs for nursing care was a determinant of length of stay, disposition, and cost of care. Projected needs for nursing care and disease stage were predictors of in-hospital mortality. Age, ethnicity, actual nursing hours, and physician experience had no bearing on those outcomes given all the other factors. This finding was consistent with previous research. With so many patients staying fewer than five days, its hypothesized there was less opportunity for provider related factors to have a real influence on the outcomes of that admission.
2. The cost of nursing care for this population of PWAs was comparatively less than previous reports of AIDS care costs. This low cost was attributed to the managed care system and its inherent utilization pressures. Further, nursing costs were determined to the case level based on actual nurse assignment records. This included cost of nursing attendant care used as a strategy to address the safety and high acuity needs of this population.
3. Actual use of nursing resources at the level of the individual had little relationship to the predicted needs for nursing care. On average, patients received more direct hours of

nursing care than were predicted. This population also received more hours of nursing care than the typical medical/surgical patient.

4. The measure of projected needs for nursing care may be more valuable as an assessment of severity of illness than as a staffing tool. The nursing care needs measure used by the study hospital (GRASP) was a valuable predictor of the outcomes of interest; particularly length of stay and disposition. However, the low correlation between the projected needs and actual hours of care delivered is troublesome. It is possible to determine from these data that the methodology underpredicts actual care needs for this patient population.
5. This study expanded the evaluation of outcomes to include the level of care following hospitalization rather than focusing only on mortality and length of stay. There was a demonstrated need for both skilled nursing care at home as well as long-term subacute (SNF) care for PWAs. Expanding these services for PWAs has the potential for resulting in lower hospital utilization and costs.

Implications for Practice, Education, and Research

As health care provider's experience with AIDS moves forward it is clear that in the transition from an acute urgent response to chronic care that hospitals must adjust to the change as well (Fee & Krieger, 1993). As hospital episodes are avoided because of new pharmaceutical treatments it will become extremely difficult for institutions to maintain the experience with AIDS care that previous patient volume facilitated. As of 1998, the previous average census of PWAs at the study hospital has dropped from 18 to 1 or 2. The efficiencies in length of stay and costs demonstrated by the findings of this study will almost certainly be difficult to maintain when the staff loses the benefit of consistent experience.

The medical treatment of AIDS is ever-changing so what can be taken from this study? Clearly, patients with end-stage disease present with multiple problems stemming from comorbidity. This is what separates AIDS nursing care from the care of the typical medical/surgical patient. Nurses caring for these patients need to have excellent assessment skills and be able to care for and differentiate between demanding symptoms. This study documented the many symptoms and diseases present in PWAs. If its assumed that the skills and experiences gained by nurses working in a dedicated AIDS unit were one of the factors inherent in the difference in mortality, then these skills may be difficult to transfer using traditional educational techniques. Nursing service providers and educators may need to evaluate the creative use of strategies such as simulated patient care scenarios as one method for skills transfer.

Cost and utilization reduction strategies need to account for variability due to patient disease severity or comorbidity. There is evidence that significant variation within a DRG group also exists. Large hospital systems such as those found in the managed care industry will be interested in reducing the variability of cost and utilization across sites. Only methods that account for differences in patient populations and severity (risk-adjustment) will be valid for comparisons across sites.

This study examined nursing and medical system factors in context with person and disease factors by measuring representative correlates of the whole system of hospital care. The outcomes model was helpful for identifying aspects of the whole system. The use of preexisting measures facilitated comprehensive measurement of key factors of hospital care and demonstrated the predictive ability of generic measures in determining the outcomes of hospitalized PWAs. The difficulty inherent in presenting and measuring so many factors

reflects the complexity of health care. Despite these difficulties, it's important to continue to evaluate nursing within the context of the whole system. As the findings from this study demonstrate, the time and energy spent evaluating structural issues such as skill mix may not be a significant factor in patient outcomes given the environment. Future research should continue to develop the methods to allow evaluation of the performance of nursing strategies within the context of the sites of care.

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Appendices

Appendix A: Frequency Table of Principal Diagnoses

Principal Dx	Description	Frequency	Percent	Cumulative %
1363	Pneumocystosis	126	39.7%	39.7%
0785	Cytomegaloviral disease	24	7.6%	47.3%
1175	Cryptococcosis	16	5.0%	52.4%
0318	other specified Mycobacterial diseases	12	3.8%	56.2%
2765	Volume Depletion (dehydration, hypovolemia)	12	3.8%	59.9%
20280	Other lymphomas	11	3.5%	63.4%
1300	Meningoencephalitis due to Toxoplasmosis	8	2.5%	65.9%
2989	Unspecified Psychosis	7	2.2%	68.1%
0072	Coccidiosis	6	1.9%	70.0%
0381	Staphylococcal septicemia	6	1.9%	71.9%
0463	Progressive multifocal leukoencephalopathy	5	1.6%	73.5%
0421	Specified infections due to HIV *	4	1.3%	74.8%
4821	Pneumonia due to Pseudomonas	4	1.3%	76.0%
486	Pneumonia, organism unspecified	4	1.3%	77.3%
7806	Pyrexia of unknown origin	4	1.3%	78.5%
11284	Candidal esophagitis	3	0.9%	79.5%
4829	Bacterial pneumonia unspecified	3	0.9%	80.4%
0093	Diarrhea of presumed infectious origin	2	0.6%	81.1%
03843	Septicemia due to pseudomonas	2	0.6%	81.7%
03849	Septicemia: other gram-neg organisms	2	0.6%	82.3%
0420	HIV with specified conditions **	2	0.6%	83.0%
0429	AIDS, unspecified	2	0.6%	83.6%
1760	Kaposi's sarcoma, skin	2	0.6%	84.2%
1764	Kaposi's sarcoma, lung	2	0.6%	84.9%
1768	Kaposi's sarcoma, other specified sites	2	0.6%	85.5%
2848	Other specified aplastic anemias	2	0.6%	86.1%
2859	Anemia, unspecified	2	0.6%	86.8%
3239	Encephalitis, unspecified cause	2	0.6%	87.4%
4210	Endocarditis, acute and subacute bacterial	2	0.6%	88.0%
481	Pneumococcal pneumonia	2	0.6%	88.6%
4820	Pneumonia due to Klebsiella pheumoniae	2	0.6%	89.3%
4822	Pneumonia due to Hemophius influenzae	2	0.6%	89.9%
4824	Pneumonia due to Staphylococcus	2	0.6%	90.5%
48289	Pneumonia due to other unspecified bacteria	2	0.6%	91.2%
0380	Streptococcal septicemia	1	0.3%	91.5%
0382	Pneumococcal septicemia	1	0.3%	91.8%
03840	Unspecified gram-neg. septicemia	1	0.3%	92.1%
0388	Other specified septicemias	1	0.3%	92.4%
0498	Encephalitis: other	1	0.3%	92.7%
05379	Herpes zoster: with other specified complications	1	0.3%	93.1%
1120	Candidiasis, of mouth	1	0.3%	93.4%
1125	Candidiasis, disseminated	1	0.3%	93.7%
11595	Histoplasmosis, unspecified	1	0.3%	94.0%
1307	Toxoplasmosis of other specified sites	1	0.3%	94.3%
1308	Multisystemic disseminated Toxoplasmosis	1	0.3%	94.6%

1763	Kaposi's sarcoma: gastrointestinal sites	1	0.3%	95.0%
1765	Kaposi's sarcoma: lymph nodes	1	0.3%	95.3%
20001	Reticulosarcoma	1	0.3%	95.6%
20084	Lymphosarcoma: other named variants	1	0.3%	95.9%
2800	Anemia secondary to blood loss (chronic)	1	0.3%	96.2%
2874	Secondary thrombocytopenia	1	0.3%	96.5%
2880	Agranulocytosis	1	0.3%	96.8%
2949	Unspecified organic braim syndrome	1	0.3%	97.2%
3483	Encephalopathy, unspecified	1	0.3%	97.5%
42290	Acute myocarditis, unspecified	1	0.3%	97.8%
48230	Pneumonia: Streptococcus, unspecified	1	0.3%	98.1%
48282	Pneumonia: e coli	1	0.3%	98.4%
48283	Pneumonia: other gram-neg	1	0.3%	98.7%
5589	Other unspecified noninfectious gastroenteritis and colitis	1	0.3%	99.1%
71106	Pyogenic arthritis	1	0.3%	99.4%
7856	Enlargement of lymph nodes	1	0.3%	99.7%
7994	Cachexia	1	0.3%	100.0%

Note. *0421: Includes candidiasis, coccidioidomycosis, cytomegalic inclusions diseas, endocarditis, herpes,histoplasmosis, microsporidiosis, mycobacteriosis, myocarditis, Nocardia, opportunistic mycoses, pneumonis, salmonella, septicemia, strongyloidiasis, tuberculosis.
**0420: Includes candidiasis of lung, coccidiosis, cryptococcosis, pneumocystosis, progressive multifocal leukoencephalopathy, toxoplasmosis.

Appendix B: Frequency Table of Principal Procedures

Principal Procedure	Description	Frequency	Percent	Cumulative Percent
	No procedure noted	119	37.5%	37.5%
9904	Transfusion of packed cells	33	10.4%	47.9%
8703	Computerized axial tomography of head	24	7.6%	55.5%
331	Incision of lung	17	5.4%	60.9%
3893	Venous catheterization	17	5.4%	66.2%
3322	Fiber-optic bronchoscopy	13	4.1%	70.3%
3323	Other bronchoscopy	6	1.9%	72.2%
8607	Insertion of totally implantable vascular access device (VAD)	6	1.9%	74.1%
4011	Biopsy of lymphatic structures	4	1.3%	75.4%
8872	Diagnostic ultrasound of heart	4	1.3%	76.7%
9215	Radioisotope: pulmonary scan	4	1.3%	77.9%
3324	Closed endoscopic biopsy of bronchus	3	0.9%	78.9%
3327	Closed endoscopic biopsy of lung	3	0.9%	79.8%
4131	Biopsy of bone marrow	3	0.9%	80.8%
4513	Other endoscopy of small intestine	3	0.9%	81.7%
4516	Esophagogastruduodenoscopy (EGD) with closed biopsy	3	0.9%	82.6%
8876	Diagnostic ultrasound of abdomen and retropertoneum	3	0.9%	83.6%
9921	Injection of antibiotic	3	0.9%	84.5%
9925	Injection or infusion of cancer chemotherapeutic substance	3	0.9%	85.5%
3404	Insertion of intercostal catheter for drainage	2	0.6%	86.1%
4414	Closed endoscopic biopsy of stomach	2	0.6%	86.8%
4442	Suture of duodenal ulcer site	2	0.6%	87.4%
4525	Closed endoscopic biopsy of large intertine	2	0.6%	88.0%
5491	Percutaneous abdominal drainage	2	0.6%	88.6%
8801	Computerized axial tomography of abdomen	2	0.6%	89.3%
9202	Liver scan and radioisotope funstion study	2	0.6%	89.9%
9229	Other radiotherapeutic procedure	2	0.6%	90.5%
9390	Continuous positive airway pressure (CPAP)	2	0.6%	91.2%
9396	Other oxygen enrichment	2	0.6%	91.8%
9672	Other continuous mechanical ventilation: (96 consectutive hrs or more)	2	0.6%	92.4%
9929	Other nonoperative replacements	2	0.6%	93.1%
346	Scarification of pleura	1	0.3%	93.4%
3491	Thoracentesis	1	0.3%	93.7%
370	Pericerdiocentsis	1	0.3%	94.0%
3949	Other revision of vascular procedure	1	0.3%	94.3%
4223	Other esophagoscopy	1	0.3%	94.6%
4224	Closed (endoscopic) biopsy of esophagus	1	0.3%	95.0%
4573	Right hemicolectomy	1	0.3%	95.3%
5794	Insertion of indwelling urinary catherter	1	0.3%	95.6%
8086	Other local excision or desctuction of lesion of joint:knee	1	0.3%	95.9%
8417	Amputation above knee	1	0.3%	96.2%
8605	Incision with removal of FB from skin and subcutaneous tissue	1	0.3%	96.5%
8622	Excisional debridement of wound, infection, or burn	1	0.3%	96.8%
8838	Other computerized axial tomography	1	0.3%	97.2%
8877	Diagnostic ultrasound of peripheral vascular system	1	0.3%	97.5%
8891	Magnetic resonance imaging of brain and brain stem	1	0.3%	97.8%
8897	Magnetic resonance imaging of other and unspecified sites	1	0.3%	98.1%
8965	Measurement of systemic arterial blood gases	1	0.3%	98.4%
898	Autopsy	1	0.3%	98.7%
9671	Continuous mechanical ventilation < 96 hrs	1	0.3%	99.1%
9915	Parenteral infusion of concentrated nutritional substances	1	0.3%	99.4%
9922	Injection of other anti-infective	1	0.3%	99.7%
9962	Other electric countershock of heart	1	0.3%	100.0%

Appendix C: Correlation Matrix

	ADM_PCH	AGE	CO_MOR	$PPD	DEMEN	DRUG	DXSTAGE	EXPIRED	ETOH	ETHN	HOMECARE	ICD9CAT	LOS	XNCH	XPCH	XALL_LOS
ADM_PCH	1.00	0.03	0.16	0.16	0.00	-0.08	0.02	0.00	0.11	0.00	0.00	0.18	0.06	0.12	0.48	0.06
AGE		1.00	0.03	0.04	-0.03	-0.01	-0.08	0.11	-0.01	0.06	-0.03	0.04	0.00	0.04	0.11	0.01
CO_MOR			1.00	0.01	0.08	0.18	0.23	0.12	0.26	0.03	0.14	0.50	0.42	0.00	0.43	0.37
$PPD				1.00	-0.02	0.00	0.03	0.06	-0.05	0.00	-0.06	-0.01	0.06	0.97	0.08	0.08
DEMEN					1.00	-0.04	-0.02	-0.05	-0.08	0.04	0.05	0.09	0.02	0.00	0.19	0.04
DRUG						1.00	-0.09	-0.07	0.47	0.01	-0.07	0.05	0.02	0.03	0.08	0.02
DXSTAGE							1.00	0.20	0.06	0.00	-0.02	0.00	0.14	0.01	0.22	0.12
EXPIRED								1.00	-0.03	-0.02	-0.26	0.02	0.08	0.06	0.22	0.12
ETOH									1.00	0.01	-0.01	0.15	0.01	-0.04	0.15	-0.03
ETHN										1.00	-0.03	0.04	0.03	0.01	0.04	0.00
HOMECARE											1.00	0.02	0.21	-0.08	0.09	0.20
ICD9CAT												1.00	0.18	-0.01	0.17	0.13
LOS													1.00	0.04	0.33	0.91
XNCH														1.00	0.07	0.05
XPCH															1.00	0.30
XALL_LOS																1.00
MED_ADV																
MONTH																
TNUM_ADM																
PAY_CD																
%_HIV																
%_ICU																
%_MS																
%_SIT																
%_TCU																
SEX																
SNF																
SMOK																
TEN_PT																
TOT_COST																
TOTDAYS																

	MED_ADV	MONTH	TNUM_ADM	PAY_CD	%_HIV	%_ICU	%_MS	%_SIT	%_TCU	SEX	SNF	SMOK	TEN_PT	TOT_COST	TOTDAYS
ADM_PCH	0.00	-0.10	-0.01	-0.02	0.36	0.60	0.06	0.00	0.09	0.05	0.00	0.05	-0.17	0.32	0.04
AGE	0.07	0.01	-0.09	0.00	-0.05	0.06	-0.01	0.09	0.17	-0.04	0.04	-0.06	-0.05	0.00	-0.04
CO_MOR	0.38	-0.10	0.12	0.00	0.04	0.24	0.17	0.24	0.13	-0.06	0.13	0.13	-0.04	0.44	0.36
$PPD	-0.01	0.19	-0.17	-0.01	-0.20	0.16	-0.67	0.02	0.05	0.01	0.03	-0.06	-0.15	0.27	-0.06
DEMEN	0.06	-0.03	0.02	0.02	0.04	-0.04	0.03	0.34	0.02	-0.02	0.09	-0.07	0.00	0.01	0.03
DRUG	0.03	-0.13	-0.05	-0.04	-0.09	-0.03	0.02	0.20	0.07	-0.55	-0.04	0.12	0.00	0.06	-0.04
DXSTAGE	-0.08	-0.11	0.02	-0.06	0.00	0.19	0.11	0.04	0.04	0.10	0.05	0.08	0.03	0.22	0.10
EXPIRED	0.08	0.10	0.07	-0.04	-0.12	0.15	-0.06	0.02	0.12	-0.02	-0.14	-0.05	0.01	0.11	0.15
ETOH	0.06	-0.06	-0.01	-0.06	0.11	0.00	0.08	0.15	0.08	-0.21	0.05	0.78	-0.13	0.03	-0.04
ETHN	0.06	0.06	-0.03	-0.09	0.01	0.00	-0.01	0.04	-0.01	0.05	0.05	0.00	-0.01	0.03	-0.02
HOMECARE	0.03	-0.13	0.09	0.04	0.11	0.04	0.14	-0.01	-0.07	0.03	-0.14	0.05	0.07	0.17	0.22
ICD9CAT	0.60	-0.03	-0.02	-0.04	0.02	0.17	0.08	0.08	0.05	0.01	0.04	0.14	0.04	0.24	0.11
LOS	0.11	0.04	-0.03	-0.01	0.05	0.17	0.15	0.07	0.07	0.01	0.20	0.00	-0.06	0.78	0.67
XNCH	-0.01	0.21	-0.17	0.00	-0.22	0.11	-0.71	0.04	0.05	-0.02	0.03	-0.06	-0.14	0.23	-0.08
XPCH	0.05	-0.10	0.01	-0.04	0.23	0.61	0.21	0.57	0.36	-0.05	0.13	0.02	-0.21	0.58	0.26
XALL_LOS	0.08	0.07	-0.05	-0.01	0.00	0.19	0.10	0.10	0.07	0.01	0.15	-0.06	-0.02	0.72	0.72
MED_ADV	1.00	-0.01	0.19	-0.04	0.02	0.00	0.02	0.04	-0.03	0.01	-0.10	0.07	0.06	0.09	0.20
MONTH		1.00	0.02	-0.06	-0.04	-0.06	-0.25	-0.05	-0.08	0.05	0.02	0.02	0.14	0.01	0.08
TNUM_ADM			1.00	-0.12	0.10	-0.09	0.14	-0.04	-0.05	0.08	-0.02	0.06	0.03	-0.09	0.56
PAY_CD				1.00	0.05	-0.04	0.03	-0.02	-0.03	0.04	-0.05	-0.05	-0.02	-0.03	-0.09
%_HIV					1.00	-0.13	0.38	0.04	-0.09	0.07	0.10	0.16	-0.20	0.01	0.10
%_ICU						1.00	0.06	0.06	0.15	0.03	-0.03	-0.04	-0.08	0.56	0.06
%_MS							1.00	0.07	0.07	0.02	0.10	0.10	0.03	0.10	0.17
%_SIT								1.00	0.24	-0.10	0.06	-0.04	-0.04	0.14	0.05
%_TCU									1.00	-0.02	0.06	-0.02	-0.10	0.20	0.01
SEX										1.00	-0.04	0.04	0.04	0.00	0.07
SNF											1.00	0.10	-0.06	0.14	0.10
SMOK												1.00	-0.06	-0.02	0.00
TEN_PT													1.00	-0.14	-0.01
TOT_COST														1.00	0.48
TOTDAYS															1.00