

## HOSPITALIZATION OF NURSING HOME PATIENTS IN CHICAGO, U.S.A.

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A ten month prospective clinical survey was conducted at a teaching community hospital on 326 admissions of 243 patients from 32 nursing homes in the Chicago area. Infection was found to be the most frequent cause of admission (51.2%). Skin and adjacent tissue infection (17.5%), pneumonia (13.8%), urinary tract infection (12.6%), and septicemia (6.7%) were the major categories of infection. A total of 59.5% of the patients had infection as a primary and/or secondary diagnosis.

Using 132 nursing home patients without either primary or secondary diagnosis of infection as the control group, independent risk factors of development of all types of infection were assessed by employing a stepwise logistic regression analysis. The presence of foreign body, especially the indwelling urinary catheter, was the risk factor for every category of infection. Immobility was also a variable associated with all infections, except pneumonia. In addition, diabetes mellitus was a risk factor for skin and adjacent tissue infection, and advanced age for pneumonia. Mechanisms underlying these risk factors need further research.

**Key words:** *Nursing home, Hospitalization, Risk Factors for Hospitalization, Immobility, Foreign Bodies.*

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### INTRODUCTION

In the United States, there are more than one million elderly institutionalized, at any one time, in nursing homes (1,2). These individuals are frequently hospitalized for medical care because of various acute illnesses. Chronic clinical conditions in the aged, such as immobility, incontinence, foreign body placement, associated medical conditions, etc., may further enhance the risk of a patient's morbidity and mortality. There have been studies of diseases and risk factors of nursing home patients (3-7).

However, few reports provide prospective clinical data based upon hospitalized nursing home patients, allowing patient examination by investigators and assuring comprehensive data collection. Ideally, investigation should involve a large number of nursing homes to avoid bias of patient populations, such as in Veterans Administration hospitals, or by the different levels in the quality of nursing care.

At Columbus Hospital, a community teaching hospital affiliated with Northwestern University Medical School, patients from 32 nursing homes in the Chicago area are admitted for

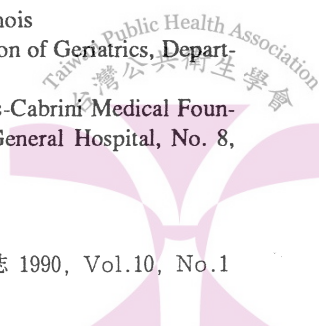
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acute care. We, therefore, carried out a ten month prospective survey of causes of admissions and clinical conditions of hospitalized nursing home patients. Demographic data, disease spectrum, associated illnesses and physical conditions and medications given at nursing homes were studied. The relationship between specific clinical conditions and the development of various categories of infection in this group of patients was investigated using both bivariate and multivariate analysis.

## MATERIALS AND METHODS

Nursing home patients admitted to Columbus Hospital from July, 1984 to May, 1985 were chosen for the study. Only patients admitted every third day were studied to lessen the work load for the investigators. A total of 243 patients with 362 admissions were involved in the study. Readmissions occurring within two weeks of release from the previous hospitalization were counted as one hospitalization. Thus, after combining readmissions, there were a total of 326 hospitalizations involving 243 patients: 54 patients had two admissions, nine had three, one had four, and two had five admissions. Analysis of data based on either 326 admissions or 243 patients did not produce discrepant results. To determine the male to female ratio among nursing home populations, 469 residents from three randomly selected nursing homes were surveyed.

The following definitions were employed. Primary diagnosis was the most important clinical problem for which the patient was admitted. Secondary diagnoses were defined as the problem(s) other than the primary diagnosis which required substantial diagnostic and therapeutic efforts. Associated conditions were clinical diseases not requiring major diagnostic or therapeutic efforts. Thus, a urinary tract infection (UTI) or a decubitus ulcer could be classified as a primary, a secondary diagnosis, or an associated condition. Skin and adjacent tissue infection (SATI) included decubitus ulcers which had worsened. The diagnosis of myocardial infarction was based on the electrocardiographic findings and cerebrovascular accident (CVA) upon neurological signs. Impaired

mental status was diagnosed by detection of any of the following: disorientation, poor memory, impaired judgment, inability to conduct a conversation appropriate for educational and social background, inability to cooperate or follow orders, and indifference or unawareness of changes in surroundings.

Primary and secondary diagnoses were made by the house staffs and confirmed or modified by the investigators for this study. Pertinent physical signs were checked by the investigators after admission. The mental status was evaluated by the investigators in repeated visits. Patient mobility was staged as ambulatory, chair-bed confined, or bedridden. Incontinence of feces were recorded if noted in the nursing home report and confirmed by the hospital nursing staff. The presence of foreign bodies was recorded upon admission.

Clinical information was entered into a computerized data base after the initial evaluation. Independent risk factors for the development of all types of infections were assessed by stepwise logistic regression analysis on the IBM PC/XT microcomputer as designed by McGee (8). The P-value of a discrete variable was examined bivariate using the chi-square test; for continuous variables, i.e., age, student's t-test was used. Variables with  $P < 0.1$  in the bivariate analysis were considered as covariates in the regression analysis to include all potentially related factors in the evaluation.

The odds ratio, or the ratio of probability of the occurrence of infection with the risk factor present to the probability of occurrence of infection with the factor absent, was used to evaluate effects of risk factors.

The probability(P) for an individual to develop an infection was calculated as follows:

$$P = \frac{1}{1 + e^{-(B_1 X_1 + B_2 X_2 + \dots + B_n X_n + k)}}$$

where,

$B_i$  = regression coefficient for the risk factor number  $i$

$X_i$  = presence (=1) or the absence (=0) of the risk factor number  $i$

$K$  = coefficient constant

$e$  = base of natural logarithms

## RESULTS

The age of the patients ranged from 27 to 102 years with a mean age of 75.4  $\pm$  14.0 (S.D.) and the median age was 78.0. Of 243 patients, 66.7% were Caucasian, 31.7% were Black, and 1.6% were of other ethnic origins. Women comprised 66.3% of admissions. Of 469 residents in 3 nursing homes surveyed for the sex distribution, 79.9% were female.

Primary diagnoses of 326 admissions are shown in Table 1. Infection was the major cause for hospitalization, constituting the reason for 51.2% of all admissions. Gastrointestinal disorders, falls, surgical disorders and neurological disorders each accounted for approximately 7% of all admissions. Of these, gastrointestinal bleeding, fractures and CVA were the most common diagnoses. The 8 cases of gastrointes-

tinal disorders other than bleeding included fecal impaction, dehydration due to vomiting or diarrhea, and oral lesions. Surgical disorders included hernias, cholelithiasis, feeding gastrostomy or jejunostomy tube insertions, bowel obstruction, rectal fistula, and benign prostatic hypertrophy, etc. Neurological disorders other than CVA included seizures, syncope, neuropathy, and drug-induced lethargy. Neoplasms documented included colon, lungs, breast, head and neck, skin and central nervous system. Miscellaneous diagnoses included respiratory failure, asthma, arthritis and abnormal blood glucose levels, etc. None caused admission of more than 5 patients.

There was a total of 30 patients less than 60 years of age. All were placed in nursing homes because of mental retardation, psychiatric or neurological disorders. The primary diag-

Table 1. Frequency of primary diagnoses

	No. of Admissions	Frequency
Infections	167	51.2%
Skin and adjacent tissue infection (SATI)	57	17.5%
Pneumonia	45	13.8%
Urinary tract infection (UTI)	41	12.6%
Septicemia	22	6.7%
Others	2	0.6%
Gastrointestinal disorders	24	7.4%
Bleeding	16	4.9%
Others	8	2.5%
Falls	23	7.1%
Fracture	16	4.9%
Contusion	7	2.1%
Surgical Disorders	23	7.1%
Neurological Disorders	22	6.7%
Cerebrovascular accident (CVA)	13	4.0%
Others	9	2.7%
Cardiovascular disorders	18	5.5%
Congestive heart failure	7	2.1%
Vascular occlusions	5	1.5%
Others	6	1.8%
Neoplasms	18	5.5%
Psychiatric Disorder	8	2.5%
Miscellaneous	23	7.1%
<b>TOTAL</b>	<b>326</b>	<b>100.0%</b>

noses of these younger patients were evenly distributed and, in contrast to the older patients, only 10 of 36 (27.8%) admissions in this subgroup were due to infection.

Secondary diagnoses, associated conditions and histories of important clinical conditions are shown in Table 2. A total of 94 cases (28.8%) had at least one secondary diagnosis, and 19 (5.8%) had two. UTI was the most common secondary diagnosis and, overall, infection was a secondary diagnosis in 69 patients. A total of 194 patients (59.5%) had infection as a primary and/or secondary diagnosis. Three hundred and three admissions (93%) had one or more secondary diagnoses, associated conditions or a medical history of a significant illness, 244 (74.9%) had two, 152 (46.7%) had three and 66 (20.3%) had four.

The frequency of immobility, bowel incontinence, use of a foreign body and impaired mental status are presented in Table 3. There

Table 2. Frequency of secondary diagnoses, associated conditions and important medical histories among 326 admissions

<u>Secondary Diagnosis:</u>	<u>No. of Cases</u>
All types	94 (28.8%)
UTI	45 (13.8%)
Pneumonia	14 ( 4.3%)
SATI	12 ( 3.7%)
Congestive heart failure	9 ( 2.8%)
Neoplasms	5 ( 1.5%)
Others	26 ( 8.0%)
<u>Associated Conditions:</u>	
Chronic heart disease	134 (41.1%)
Psychosis	65 (19.9%)
SATI	62 (19.0%)
Diabetes mellitus	59 (18.1%)
UTI	51 (15.6%)
Chronic lung disease	36 (11.0%)
<u>Important Medical History:</u>	
CVA	77 (23.6%)
Myocardial infarction	70 (21.5%)
Hypertension	67 (20.6%)
Seizure	40 (12.3%)
Neoplasms	27 ( 8.3%)

Table 3. Frequency of immobility, incontinence, foreign body placement and impaired mental status among 326 admissions

	<u>No. of Cases</u>
<u>Mobility:</u>	
Ambulatory	100 (30.7%)
Chair-bed confined	111 (34.0%)
Bedridden	115 (35.3%)
<u>Incontinence</u>	223 (68.4%)
<u>Foreign Bodies:</u>	
All types	157 (48.2%)
Urinary catheter	127 (39.0%)
Gastro-or jejunostomy tubes	54 (16.6%)
Nasogastric tubes	20 ( 6.1%)
Others	21 ( 6.4%)
<u>Impaired Mental Status</u>	256 (78.5%)

was a significant correlation between immobility and the requirement for a foreign body ( $P<0.001$ ). A foreign body was present in 14.0%, 42.3%, and 83.5% of patients who were ambulatory, chair-bed confined, and bedridden, respectively, and 4.0%, 36.0%, and 72.2% had an indwelling urinary catheter. Immobility was associated with a history of CVA or myocardial infarction. Among ambulatory, chair-bed confined and bedridden patients, the frequency of CVA was 4.0%, 25.2%, and 40.0% ( $P<0.001$ ), respectively, and for myocardial infarction 10%, 25.2% and 27.8% ( $P=0.003$ ), respectively. Twenty patients had a history of both CVA and a myocardial infarction, 14 were bedridden, and the remaining six were limited to chair-bed confinement. Impaired mental status was detected in a high proportion of the patients and the advanced impairment was the most important cause for immobility and foreign body placement. Of the mentally impaired patients, 80.9% were incontinent, 42.2% were nonambulatory and 57.0% had some form of foreign body.

All but three patients had been receiving medication at nursing homes with an average of 4.5 agents per patient. 36.2% received one to three agents, 47.2%, four to six, 12.9%, seven to nine and 2.8%, ten to nineteen drugs. Cardiovascular medications, including diuretics, were



the most frequently prescribed drugs; 47.2% of patients were receiving such treatment. Sedatives, hypnotics, and tranquilizers had been given to 40.2%, laxatives to 31.9%, and anti-peptic ulcer drugs to 16.0% of patients. Sedatives, hypnotics, tranquilizers and laxatives were prescribed as *pro re nata* orders. Therefore, patients may or may not have been receiving these medications.

To identify risk factors for the development of infection, clinical variables of 194 admissions with either a primary or secondary diagnosis of infection were compared with those of 132 admissions without this diagnosis. Variables analyzed included: impaired mental status, bedridden or chair-bed mobility, bedriddenness alone, presence of all types of foreign bodies, presence of indwelling urinary catheter, presence of feeding tube or the urinary catheter, incontinence, age, male sex, each category of medication given at nursing homes and individual associated conditions or medical histories listed in Table 2. The categories of medications included: cardiovascular drugs, sedative-hypnotic-tranquilizers, laxatives, anti-peptic ulcer drugs, anticonvulsants, non-steroidal anti-inflammatory agents, bronchodilators, anti-Parkinsonism medications, anti-diarrheals, anti-depressants, and glucocorticoids. By bivariate analysis, the first nine variables and the history of CVA or myocardial infarction were significantly correlated with the development of all types of infection. P-value was 0.001 or less for each item with the exception of 0.031 for the history of myocardial infarction.

Each category of infection, 69 with either primary or secondary diagnosis of SATI, 59 with pneumonia, 86 with UTI and 22 with septicemia were separately compared against the 132 admissions without infection. Immobility, incontinence and the presence of foreign bodies were associated with all four categories of infection. In addition, the presence of impaired mental status correlated with SATI, pneumonia and UTI, age with SATI and pneumonia, asymptomatic UTI with SATI and septicemia, uninfectected decubitus ulcers with pneumonia and UTI, and diabetes mellitus with SATI.

In contrast to the above results from bivariate analysis, the stepwise logistic regression

identified risk factors for infections as shown in Table 4. The presence of foreign bodies, especially the indwelling urinary catheter, was a risk factor for every category of infection with odds ratios of 4.56 to 7.99. Immobility was also a significant factor with odds ratios of 3.03 to 5.10. Importantly, the multivariate analysis identified bedriddenness and diabetes mellitus to be associated with the development of SATI, and old age with the occurrence of pneumonia. Using the formula presented in Methods, the probability for a nonambulatory nursing home resident with indwelling urinary catheter to develop any category of infection is 85.7%. The odds ratio for the same patient to develop an infection as compared to an ambulatory patient without a catheter was  $3.03 \times 4.69 = 14.21$ .

## DISCUSSION

This study demonstrated infection to be the direct cause of hospitalization in approximately one half of the admissions. Infection was present as a primary and/or secondary diagnosis in 59.5% of admissions. The study also demonstrated the multiple pathologic conditions in these patients. An important secondary diagnosis was made in 29% of patients. Asymptomatic UTI, SATI, chronic heart disease, and histories of CVA, myocardial infarction and hypertension were each present as a secondary condition in more than 20% of cases. Impaired mental status was detected in nearly 80% of patients and was apparently the cause of nursing home placement for a large proportion. Furthermore, the study identified independent risk factors for each category of infection using a stepwise logistic regression analysis. The presence of a foreign body, especially an indwelling urinary catheter, was correlated with every category of infection. Immobility was also an important risk factor for all infections except pneumonia. Diabetes mellitus was related to SATI and advanced age with pneumonia.

Our investigation also included a survey of medications given prior to admission. Medications were not found to be related to any specific cause of admissions. A better documentation of administration of sedatives, hypnotics and tranquilizers may produce different results.

Table 4. Risk factors, odds ratios and P-values for the occurrence of infection derived by logistic regression analysis. Quartiles (in median and range) of age distribution were used to show increasing odds ratio in old age.

<u>Infection</u>	<u>Risk Factor</u>	<u>B</u>	<u>P-value</u>	<u>K</u>	<u>OR</u>	<u>95% CI of OR</u>
All categories	1. Chair-bed confined or bedridden	1.11	<0.001	-0.87	3.03	1.72-5.34
	2. U catheter	1.55	<0.001		4.69	2.55-8.64
SATI	1. Bedridden	1.55	<0.001	-2.08	4.71	2.09-10.59
	2. U catheter	1.69	<0.001		5.40	2.33-12.56
	3. Diabetes mellitus	1.32	0.002		3.73	1.60-8.72
Pneumonia	1. G or J tube or U catheter	1.59	<0.001	-3.67	4.92	2.42-9.97
	2. Age	0.03	0.039		—	—
	62 (27-68)	—	—		1	—
	75 (69-78)	—	—		1.48	1.03-2.15
	82 (79-85)	—	—		1.82	1.04-3.25
	91 (86-102)	—	—		2.39	1.06-5.53
UTI	1. Chair-bed confined or bedridden	1.53	<0.001	-2.02	4.64	2.09-10.28
	2. U catheter	1.52	<0.001		4.56	2.28-9.13
Septicemia	1. Chair-bed confined or bedridden	1.63	0.042	-4.13	5.10	1.06-24.60
	2. All types of foreign body	2.08	<0.001		7.99	2.40-26.54

B = regression coefficient  
 K = constant for each category of infection  
 OR = odds ratio

G = gastrostomy  
 J = jejunostomy  
 U = urinary

Few reports of hospitalized nursing home patients are comparable to our study because of differences in the design and the purpose of the investigation. However, some similarities were noted. The review by Invine, et al (3) of 128 hospitalized nursing home residents demonstrated that infection was the most important cause of admission, occurring in 27%. In contrast, of the 320 patients admitted from the outpatient clinic, 12% were hospitalized for infection. In a survey of a Veterans Administration nursing home care unit, Franson, et al (4) found that factors potentially associated with increased infection included immobility, acute-care hospitalization in the preceding 28 days, antibiotics given preceding the infection, and the presence of an indwelling urinary catheter. In a pro-

spective study of nosocomial infections in Veterans Administration chronic care facility by Farber, et al (5), pneumonia and asymptomatic UTI accounted for 49% of all infections. Garibaldi and his associates (6) reported that among 532 non-hospitalized nursing home residents, infected decubitus ulcers, conjunctivitis, symptomatic UTI, lower respiratory tract infection, and upper respiratory tract infection were among the most common infections ranging in frequency from 6.0% to 1.5%. Immobility, incontinence of feces and diabetes mellitus were significantly correlated with the occurrence of skin infections. In a study of nursing home-acquired pneumonia, Marrie, et al (7), demonstrated a mortality rate of 40.5%, and a higher prevalence of dementia and CVA as compared to

patients with community-acquired pneumonia.

One goal of this study was to identify risk factors for major causes of hospitalization so that measures can be taken to reduce acute illnesses with a high mortality requiring hospital care. More stringent criteria for hospitalization in the last few years undoubtedly has reduced the number of admissions. However, infection remains the principal cause of hospitalization due to the fact that the elderly patients in nursing homes commonly have conditions which predispose to infections (9-16). Furthermore, most acute infections require intravenous antimicrobial therapy and close observation. Development of more effective new oral antimicrobials may reduce the need for hospital care for infection in the future. Accurate evaluation of clinical variables that contribute to the increased susceptibility of the elderly may lead to the reduction of some of these risk factors.

In this study, nursing home patients hospitalized for non-infectious problems were compared to those with infection to assess risk factors for infection. Alternately, one may employ either all hospitalized patients, elderly patients admitted from the community, or nursing home residents without acute illness for such comparisons. Use of this group for comparisons may identify risk factors specific to the development of infection among nursing home residents. Nursing home patients hospitalized for non-infectious causes potentially have risk factors similar to patients hospitalized for infection.

The lack of association of diabetes mellitus, or old age, with infection other than SATI or pneumonia deserves attention. Diabetes is known to be associated with defective polymorphonuclear cell functions (14) and old age with decreased cellular and humoral immunity (9,14,17,18). However, it has not been clear whether these impairments in host defenses play a major role in the susceptibility to infection of the diabetic or the elderly. If the specific impairment is the most important factor, diabetes mellitus or advanced age should be identified as a risk factor for all bacterial infections. It is likely that age-related functional and structural alterations of the respiratory system are a more important cause for the development of pneumonia in the elderly (16,19-21). These changes

include decreased sensitivity to cough stimuli, less effective cough, the loss of elastic recoil of the lung, increased ventilation-perfusion mismatch, reduced capillary bed and hypoxia. Similarly, neuropathy and compromised circulation to extremities probably contribute more to the development of SATI among diabetics than the malfunction of polymorphonuclear leukocytes.

Immobility and a urinary catheter lead to UTI, septicemia and pressure sores (22-25). However, both immobility and the presence of foreign body are found to be risk factors for nearly every category of infection.

The precise identification of risk factors depends upon the clinical variables evaluated, the use of appropriate controls and adequate sample size. We have confirmed that infection is the most important cause for hospitalization of nursing home residents, and that immobility and foreign body placement are independent risk factors for infection. These factors may be difficult to eliminate in a demented and incontinent elderly patient. Frequent passive exercise and the use of diapers, instead of an indwelling urinary catheter, may be tried. Mechanisms underlying each risk factor need further research in order to render an appropriate medical and nursing care to nursing home patients.

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# 美國芝加哥區養老院病人急症住院 之原因及其危險因子

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吾等在美國芝加哥之一社區教學醫院做前瞻性的臨床研究，調查養老院病人急症住院診治之原因及其危險因子。受調查之住院個案包括 243 位病人之 326 次住院。感染為住院之最常見原因（51.2%）。而皮膚及鄰近組織之感染（17.5%），肺炎（13.8%），尿道感染（12.6%）及敗血症（6.7%）為其主要類別。感染為總共 59.5% 住院病人之入院主因或次要診斷。

以 132 人次無感染症之養老院病人住

院為控制組，吾等以 Stepwise logistic regression analysis 評估每一類別感染症之獨立危險因子。體內異物之存在，尤其是留置導尿管，為每一感染類別之危險因子。不動性亦為和肺炎除外之三類感染症相關的因子。此外，糖尿病和皮膚及鄰近組織感染有關聯；而高年齡則和肺炎之發生有關。這些因子之致病機轉需更進一步之探討，以便給予比類病人適當的醫護。

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