# Inter-Hospital Transfers of Patients with Systemic Lupus Erythematosus: Characteristics, Predictors, and Outcomes

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*ABSTRACT*. ***Objective.*** To describe the reasons for inter-hospital transfers of patients with systemic lupus erythematosus (SLE), to identify predictors of transfers, and to compare the risk of in-hospital mortality between patients who were transferred and those not transferred.

***Methods.*** Data on acute care hospitalizations of patients with SLE in New York and Pennsylvania in 2000–2002 were obtained from state health planning agencies. We identified inter-hospital transfers from discharge and admission codes, and categorized the major reason for transfer (rehabilitation, procedure, or continued medical care). Patient and hospital characteristics were examined as predictors of transfers. We used a matched cohort design with propensity adjustment to compare in-hospital mortality between patients transferred for continued medical care and those who were not transferred.

***Results.*** We identified 533 inter-hospital transfers in 490 patients, 524 of which involved one transfer per hospitalization episode. Of these 524 transfers, 122 (23.3%) were for rehabilitation, 158 (30.1%) were for procedures, and 244 (46.6%) were for continued medical care. Patient characteristics and transfer destinations varied among these groups. Transfers for continued medical care were more common among younger patients, those who were more severely ill, had an emergency or urgent admission, or were hospitalized in a smaller, rural or non-teaching hospital, or in Pennsylvania, and were less common among those at proprietary hospitals. In the matched cohort analysis, the risk of in-hospital mortality was 2.25 times higher (95% confidence interval 1.31, 3.85; p = 0.004) among those transferred compared with those who were not transferred. This risk differed with the experience of the attending physician at the receiving hospital: among patients of physicians who treated 3 or fewer patients with SLE per year, this risk was 2.5 times higher (95% CI 1.42, 4.36; p = 0.002), while among patients of physicians who treated more than 3 patients with SLE per year, this risk was 0.56 times (95% CI 0.06, 5.12; p = 0.62) that of matched controls.

***Conclusion.*** Patient and transferring hospital characteristics vary with the reason for transfer. Transfers for continued medical care are associated with higher risks of in-hospital mortality, but these risks may differ with the SLE-related experience of the attending physician at the receiving hospital. (J Rheumatol 2006;33:1578–85)

*Key Indexing Terms:*
SYSTEMIC LUPUS ERYTHEMATOSUS PATIENT TRANSFER HOSPITAL MORTALITY

Up to 29% of patients with systemic lupus erythematosus (SLE) are hospitalized each year[1,2]. Most hospitalizations end with a discharge to home, but occasionally hospitalization results in an inter-hospital transfer. Although there are many possible reasons for inter-hospital transfers, a primary reason is for the patient to obtain specific services, levels of care, or treatments either not available at the transferring hospital or capable of being provided more efficiently at another site[3-7].

Patients who are transferred for treatment of ongoing acute medical problems are often severely ill. In studies of general medical or surgical patients, risks of in-hospital mortality were 2 to 5 times higher among transfer patients than among patients who were not transferred[5-9]. These studies compared mortality between transferred patients and those directly admitted to the receiving hospital. However, to examine the effects of inter-hospital transfer, the appropriate comparison group would be patients from the transferring hospital who were similar to the transferred patients, but who were not transferred.

The characteristics and outcomes of inter-hospital transfers of patients with SLE have not been examined previously, but transfers may constitute a subgroup at high risk for mortality.

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Given our recent findings suggesting that the risk of in-hospital mortality of patients with SLE is inversely related to the volume of inpatients with SLE cared for by the attending physician, we sought to learn if physician volume was also associated with risks of mortality among transfer patients, or if hospital volume was associated with patient outcomes[10]. If outcomes vary among physicians or hospitals, it would be important to know if existing patterns of inter-hospital transfers preferentially involve transfers to physicians or hospitals with better outcomes. We examined these questions, the clinical diagnoses associated with transfers, and predictors of transfers, in a population-based study of patients with SLE.

## MATERIALS AND METHODS

*Sources of data.* Data for patients hospitalized in New York or Pennsylvania in 2000–2002 were obtained from the New York State Department of Health Statewide Planning and Research Cooperative System and the Pennsylvania Health Care Cost Containment Council. All acute-care, nonfederal hospitals are mandated to provide these agencies with a discharge abstract for each patient. The abstracts were prepared from medical and billing records by trained abstractors. Abstracts included information on demographic characteristics, admitting diagnosis [defined as the reason for admission, by International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes[11]], principal discharge diagnosis (defined as the condition chiefly responsible for the hospitalization), additional discharge diagnoses (up to 8 in Pennsylvania and up to 14 in New York), major procedures, source of admission (e.g., physician referral, transfer from a hospital), type of admission (elective, urgent, emergency), disposition (e.g., discharge home, discharge to another hospital, death), hospital identifier, and attending physician identifier (by license number). The attending physician was defined in both datasets as the physician primarily responsible for the patient during the hospitalization. Each dataset also included unique patient identifiers, which allowed identification of repeated hospitalizations. Information on the type of hospital unit (e.g, intensive care unit, general medical floor) to which the patient was admitted was not available.

Before being released publicly, the data were subjected to extensive reliability and consistency checks, and data fields with excessive error rates were returned for correction[12,13]. To protect confidentiality, patients were anonymous, and comparison of discharge abstracts with medical records was not possible. However, reabstraction studies of the Pennsylvania data demonstrated high concordance of diagnoses with the correct diagnosis-related group codes[13].

For this study, we identified all acute-care hospitalizations of patients age 18 years or older who had SLE (ICD-9-CM 710.0) as any of their discharge diagnoses. From these 40,668 hospitalizations (23,197 in New York and 17,471 in Pennsylvania), we excluded 2671 hospitalizations related to childbirth and those for which patient identifiers were missing. The remaining subset included 37,997 elective, urgent, or emergency hospitalizations in 18,495 patients (10,674 in New York and 7821 in Pennsylvania). Among these hospitalizations, we identified transfers by matching disposition codes indicating a transfer with admission codes indicating acceptance of a transfer, by month, year, and day of week (in New York) or by quarter, year, and day of week (in Pennsylvania). Using this process, we identified 533 inter-hospital transfers.

The National Institutes of Health Office of Human Subjects Protection determined that the protocol was exempt from human subjects review.

*Study variables.* Information on patient age, sex, race, and medical insurance was included in the discharge abstracts. Medical insurance status was categorized as private insurance, Medicare, public insurance other than Medicare, no insurance, or unknown type, based on the expected principal source of payment. Patient income was estimated using the median household income of the ZIP code of residence, based on the 2000 U.S. Census. Information on specific manifestations of SLE and comorbid medical conditions was derived from the discharge diagnoses, and was used to compute the SLE Comorbidity Index[14]. The SLE Comorbidity Index is a weighted sum of 14 medical conditions, developed for use with administrative data as a disease-specific measure of severity of illness. It has been shown to predict in-hospital mortality and to discriminate risks accurately among patients[14].

Physician volume was categorized into 3 groups, based on the average annual number of urgent or emergency hospitalizations of patients with SLE for which each physician was the attending of record over the 3-year period: less than one hospitalization per year (low volume), 1–3 hospitalizations per year (moderate volume), or more than 3 hospitalizations per year (high volume)[10]. Hospital volume was computed as the average annual number of emergency or urgent hospitalizations of patients with SLE over the 3-year study period. High volume hospitals were considered those with more than 50 hospitalizations of patients with SLE per year[15]. Each hospital was also classified by location (urban if located within a Standard Metropolitan Statistical Area, or rural), number of beds (fewer than 100, 100–299, 300–499, or 500 or more), teaching status (whether or not the hospital sponsored an approved residency program), and ownership (private nonprofit, proprietary, or public). Academic medical centers were defined as hospitals with primary affiliations with medical schools. All others were considered community hospitals.

The outcome of interest was in-hospital mortality. Information on post-discharge mortality and cause of death was not available.

*Identification of patient subgroups.* Among the reasons for inter-hospital transfers are transfers for inpatient rehabilitation, or for surgical or diagnostic procedures not available at the transferring hospital. Because the characteristics and outcomes of these patients likely differ from those of patients transferred for continued medical treatment, we first separated these groups[4,16,17]. Based on predefined lists of diagnoses and procedures, we identified patients transferred for inpatient rehabilitation by their admitting and discharge diagnosis codes at the receiving hospital. We identified patients transferred for procedures by matching the discharge diagnosis at the transferring hospital with the principal procedure code at the receiving hospital. For example, if a patient had a principal discharge diagnosis of unstable angina at the transferring hospital and a principal procedure code of coronary artery bypass surgery at the receiving hospital, the transfer was considered to be for having the surgery. All transfers for which there was no clinical link between the discharge diagnosis and the principal procedure across hospitals, and which were not for rehabilitation, were considered to be for continued medical treatment.

*Predictors of transfers.* Subsequent analysis was limited to the subgroup of patients transferred for continued medical treatment. We compared the characteristics of patients who were transferred (N = 244) to those who were not transferred (N = 35,513). The predictors included patient demographic and clinical characteristics, and characteristics of the admitting hospital. Statistical comparisons were performed using logistic regression analysis, implemented as generalized estimating equations to account for repeated hospitalizations of patients and clustering by hospital[18].

*Matched cohort analysis.* To determine if transfer was associated with patient outcomes, we compared in-hospital mortality between patients who were transferred for continued medical care and patients who were not transferred. To do this, we performed a matched cohort study. The study group of interest was the transferred patients. From the pool of patients who were not transferred, controls were selected who matched the transferred patients on key characteristics. Because selection for transfer is related to characteristics of the patient and the transferring hospital, more accurate comparisons can be made if the transferred patients are matched with patients who had a similar likelihood of transfer, based on their clinical and hospital characteristics, but who for whatever reason were not transferred. This adjustment for the propensity of transfer helps decrease the influence that selection for transfer may have on the outcome[19-21]. We then compared in-hospital mortality between the transferred patients and the matched controls.

To identify controls, we limited potential controls to patients who had the same range of principal discharge diagnoses as the transferred patients (i.e., a group match; N = 23,890). Because some potential controls had more than one eligible hospitalization, we randomly selected one hospitalization of each potential control (N = 13,296). Second, we used these patients and the transferred patients to develop propensity models to estimate the likelihood of inter-hospital transfer among patients with the same range of discharge diagnoses. We developed non-parsimonious logistic regression models, with transfer status as the dependent variable and patient and hospital characteristics as independent variables. We tested quadratic forms of the continuous independent variables and first-order interactions between variables to optimize prediction. Because the strength of association of some predictors was found to differ between transfers occurring early or later in the course of the hospitalization, we developed separate propensity models for patients with lengths of stay of 0, 1, or 2 days (or who were transferred in this timeframe), and those with lengths of stay greater than 2 days. The model for short lengths of stay included as independent variables patient age, race, type of admission, SLE Comorbidity Index, state, rural location, teaching status, and bed-size of the transferring hospital, and the presence of renal failure, respiratory failure, or stroke among the discharge diagnoses. The model for longer lengths of stay included as independent variables patient age, race, insurance type, type of admission, SLE Comorbidity Index, state, rural location, bed-size, and academic medical center status of the transferring hospital, and the presence of nephritis, stroke, seizures, and respiratory failure among the discharge diagnoses. Both models accurately discriminated between patients who were and those who were not transferred (c statistics of 0.84 and 0.83) and fit the data well ($p = 0.85$ for the Hosmer-Lemeshow goodness-of-fit test for the model of short lengths of stay; $p = 0.35$ for the model of longer lengths of stay). Using these models, we calculated a propensity score for each patient. In both the short stay and longer stay subgroups, the propensity scores stratified patients by transfer status well. Within quintiles of propensity scores, transferred patients and controls were well matched on demographic and clinical features, indicating good matching across the range of likelihood of transfer.

Third, we individually matched each transferred patient with up to 3 controls, on principal discharge diagnosis (by exact match on 3-digit ICD-9-CM code), length of stay (short or longer, as defined above), and propensity score. Matching was done using the logit of the propensity score, first to within 1/4 of a standard deviation (± 0.35 logits), and successively relaxed to 1/2 of a standard deviation and then 3/4 of a standard deviation as needed to obtain matches. Using this procedure, 139 transferred patients were matched to 3 controls, 24 were matched to 2 controls, and 42 were matched to one control. Adequate matches with a similar propensity for transfer and the same discharge diagnosis and length of stay could not be found for 39 transferred patients, and these were excluded from the analysis of in-hospital mortality.

Fourth, we compared the likelihood of in-hospital mortality between the 205 transferred patients and their 507 matched controls. We used logistic regression analysis, with mortality as the dependent variable, transfer status as the independent variable of interest, and age and the SLE Comorbidity Index as covariates. This analysis was implemented using generalized estimating equations to account for the matched groups and clustering of patients by hospital. We hypothesized that outcomes of inter-hospital transfers would vary based on the characteristics of the receiving hospital or physician. Based on prior studies, we hypothesized that patients transferred to high volume physicians would have lower mortality than patients who were not transferred, and that the mortality experience of these patients would differ from that of patients transferred to physicians with less experience treating SLE. We also compared mortality by strata of receiving hospital characteristics (academic medical centers versus community hospitals; bed-size > 500 versus bed-size ≤ 500, and low volume hospitals versus high volume hospitals).

All analyses were performed using SAS programs (version 8.2, Statistical Analysis Systems, Cary, NC, USA). All tests were 2-tailed, and p values less than 0.05 were considered statistically significant.

## RESULTS

We identified 533 inter-hospital transfers in 490 patients. Twenty-eight patients were transferred during 2 separate hospitalizations, and 6 patients were transferred during 3 separate hospitalizations. Of the 533 transfers, 524 involved a single transfer (hospital A to hospital B), while 2 were second transfers (hospital A to hospital B to hospital C), and 7 were transfers back to the originating hospital (hospital A to hospital B to hospital A). Of these 9 second transfers, 2 were for rehabilitation, and 4 were for treatment of medical problems that developed during a rehabilitation hospitalization. For ease of interpretation, we limited subsequent analyses to the 524 single-transfer episodes (in 490 patients). SLE was the principal discharge diagnosis in 45 of the 524 transfers.

*Diagnoses associated with inter-hospital transfers*. Based on diagnosis and procedure codes, we classified 122 (23.3%) as transfers for inpatient rehabilitation, and 158 (30.1%) as transfers for procedures (Table 1). Most of the transfers for rehabilitation followed hospitalizations for orthopedic surgery, medical illnesses, or strokes. Of the 158 transfers for procedures, 150 were for cardiovascular procedures. We classified

*Table 1*. Reasons for inter-hospital transfers (N = 524).

| Reason for transfer | N | % |
|---|---|---|
| Rehabilitation | 122 | 23.3 |
| After orthopedic surgery | 52 | 9.9 |
| After medical illness | 37 | 7.1 |
| After stroke | 17 | 3.2 |
| After other surgery | 14 | 2.7 |
| Alcohol dependence | 2 | 0.4 |
| Procedures | 158 | 30.1 |
| Cardiac catheterization | 53 | 10.1 |
| Percutaneous coronary angioplasty | 53 | 10.1 |
| Coronary artery bypass surgery | 19 | 3.6 |
| Cardiac valve surgery | 12 | 2.3 |
| Other cardiovascular procedures | 13 | 2.5 |
| Other surgery | 8 | 1.5 |
| Continued medical care | 244 | 46.6 |
| SLE or its complications | 78 | 14.9 |
| SLE | 31 | 5.9 |
| Acute or chronic renal failure | 13 | 2.5 |
| Seizures | 12 | 2.3 |
| Other | 22 | 4.2 |
| Cardiovascular disease | 60 | 11.5 |
| Cerebrovascular accident | 13 | 2.5 |
| Coronary artery disease | 9 | 1.7 |
| Congestive heart failure | 8 | 1.5 |
| Other | 30 | 5.8 |
| Gastrointestinal disease | 31 | 5.9 |
| Abdominal pain | 8 | 1.5 |
| Pancreatitis | 7 | 1.3 |
| Other | 16 | 3.1 |
| Infection | 27 | 5.1 |
| Sepsis or bacteremia | 7 | 1.3 |
| Endocarditis | 6 | 1.1 |
| Other | 14 | 2.7 |
| Pulmonary disease | 13 | 2.4 |
| Respiratory failure | 7 | 1.3 |
| Other | 6 | 1.1 |
| Psychiatric disease | 4 | 0.8 |
| Malignancy | 3 | 0.6 |
| Miscellaneous | 28 | 5.3 |

SLE: systemic lupus erythematosus.

the remaining 244 transfers (46.6%) as being for continued medical care. These transfers were associated with a wide variety of principal diagnoses, with only 78 transfers associated with SLE.

Patients transferred for rehabilitation were older, more commonly had elective admissions, had long lengths of stay prior to transfer, and often were transferred from larger to smaller hospitals and from teaching to non-teaching hospitals (Table 2). Patients transferred for procedures were also older, often had emergency admissions, and were transferred most often from smaller to larger hospitals and from non-teaching to teaching hospitals. There were no deaths among those transferred for rehabilitation, and only 2.5% of patients transferred for procedures died at the receiving hospital.

Patients transferred for continued medical care were somewhat younger, and most had emergency admissions to the transferring hospital (Table 2). These patients were transferred from 149 different hospitals, and were transferred to 66 different receiving hospitals. Although the most common transfer scenario was from a smaller to a larger hospital, from a non-teaching to a teaching hospital or to an academic medical center, and from a low volume to a high volume hospital, sizable proportions of transfers also occurred between hospitals with similar SLE-related volume, between teaching hospitals,

*Table 2.* Patient demographic and transferring hospital characteristics, by category of transfer. Individual patients may be represented in more than one diagnosis category and may contribute more than one transfer within a category. Data on transfers for rehabilitation were based on 116 patients, data on transfers for procedures were based on 151 patients, and data on transfers for continued medical care were based on 232 patients. Values for age are mean ± standard deviation; values for length of stay and SLE Comorbidity Index are median (25th and 75th percentiles); all other values are N (%).

| Characteristic | Transfers for Rehabilitation, n = 122 (%) | Transfers for Procedures, n = 158 (%) | Transfers for Continued Medical Care, n = 244 (%) |
|---|---|---|---|
| Age, yrs | 54.8 ± 17.4 | 56.4 ± 12.6 | 45.4 ± 15.6 |
| Female | 106 (86.9) | 137 (86.7) | 209 (85.7) |
| Ethnicity | | | |
| White | 81 (66.4) | 113 (71.5) | 151 (61.9) |
| Black | 25 (20.5) | 32 (20.2) | 68 (27.8) |
| Asian/Pacific Islander | 2 (1.6) | 0 | 1 (0.4) |
| Native American | 0 | 1 (0.6) | 0 |
| Other | 6 (4.9) | 4 (2.5) | 7 (2.9) |
| Unknown | 8 (6.5) | 8 (5.1) | 17 (7.0) |
| Medical Insurance | | | |
| Private insurance | 47 (38.5) | 56 (35.4) | 91 (37.3) |
| Medicare | 53 (43.4) | 68 (43.0) | 91 (37.3) |
| Public insurance | 16 (13.1) | 17 (10.8) | 50 (20.5) |
| No medical insurance | 2 (1.6) | 5 (3.2) | 3 (1.2) |
| Unknown insurance | 4 (3.3) | 12 (7.6) | 9 (3.7) |
| Initial Admission Type | | | |
| Emergency | 68 (55.7) | 130 (82.3) | 182 (74.6) |
| Urgent | 11 (9.0) | 20 (12.7) | 44 (18.0) |
| Elective | 43 (35.2) | 8 (5.0) | 18 (7.4) |
| Length of stay before transfer, days | 8 (5, 14) | 2 (1, 5) | 3 (1, 8) |
| SLE Comorbidity Index | 2 (0, 4) | 3 (0, 4) | 2 (0, 4) |
| Rural hospital | 3 (2.5) | 26 (16.5) | 39 (16.0) |
| Beds < 100 | 2 (1.6) | 17 (10.8) | 13 (5.3) |
| Beds 100–299 | 44 (36.1) | 81 (51.3) | 115 (47.1) |
| Beds 300–499 | 29 (23.8) | 50 (31.6) | 87 (35.7) |
| Beds ≥ 500 | 47 (38.5) | 10 (6.3) | 29 (11.9) |
| Transfer from | | | |
| Smaller to larger bed category | 16 (13.1) | 122 (77.2) | 184 (75.4) |
| Same bed category | 32 (26.2) | 18 (11.4) | 32 (13.1) |
| Larger to smaller bed category | 74 (60.7) | 18 (11.4) | 28 (11.5) |
| Transfer from | | | |
| Nonteaching hospital to nonteaching hospital | 41 (33.6) | 26 (16.5) | 21 (8.6) |
| Nonteaching hospital to teaching hospital | 10 (8.2) | 87 (55.0) | 142 (58.2) |
| Teaching hospital to nonteaching hospital | 57 (46.7) | 9 (5.7) | 9 (3.7) |
| Teaching hospital to teaching hospital | 14 (11.5) | 36 (22.8) | 72 (29.5) |
| Community hospital to community hospital | 63 (51.6) | 79 (50) | 86 (35.3) |
| Community hospital to AMC | 8 (6.6) | 72 (45.6) | 140 (57.4) |
| AMC to community hospital | 45 (36.9) | 4 (2.5) | 7 (2.9) |
| AMC to AMC | 6 (4.9) | 3 (1.9) | 11 (4.5) |

SLE: systemic lupus erythematosus. AMC: academic medical center.

and outside of academic medical centers. There was no evidence of selectivity for the SLE-related volume of the attending physician at the receiving hospital. Only 33 patients transferred for continued medical care (13.5%) had a high volume attending physician at the receiving hospital. In-hospital mortality was 15.1% among those transferred for continuing medical care.

*Predictors of inter-hospital transfers for continued medical care*. Because transfers for rehabilitation or procedures were likely prompted by these specific clinical circumstances, we limited the analysis of predictors to those transferred for continued medical care, for whom transfers might have been more discretionary. Compared to patients who were not transferred, those who were transferred were more likely to be younger, to be of an ethnicity other than Caucasian, African American or Asian/Pacific Islander, and were more severely ill, as measured by the SLE Comorbidity Index (Table 3). The likelihood of transfer was greater for those with an emergency or urgent admission, for those at rural hospitals, and for those at non-teaching, community or low volume hospitals, compared to those at teaching hospitals, academic medical centers or high volume hospitals, respectively. Transfers were also more likely among patients admitted to smaller hospitals. Transfers were less common in New York than Pennsylvania, and for those admitted to publicly owned hospitals (all of which were in New York) or proprietary hospitals, than for those at private nonprofit hospitals. Sex, medical insurance status, household income, and physician volume were not associated with the likelihood of inter-hospital transfer. In the multivariable analysis, age, ethnicity, SLE Comorbidity Index, type of admission, rural location, hospital bed-size, teaching status, state, and proprietary hospital ownership remained significantly associated with the likelihood of inter-hospital transfer (Table 3).

*Table 3*. Predictors of inter-hospital transfer.

| Predictor | Univariable OR | Univariable 95% CI | Univariable p | Multivariable OR | Multivariable 95% CI | Multivariable p |
|---|---|---|---|---|---|---|
| Age, per 10 yrs | 0.82 | 0.75, 0.89 | < 0.0001 | 0.69 | 0.62, 0.76 | < 0.0001 |
| Female | 0.82 | 0.56, 1.19 | 0.29 | — | | |
| White[††] | 1.00 | | | 1.00 | | |
| Black | 0.90 | 0.66, 1.22 | 0.48 | 0.96 | 0.66, 1.39 | 0.83 |
| Asian/Pacific Islander | 0.32 | 0.04, 2.23 | 0.25 | 0.39 | 0.05, 2.70 | 0.34 |
| Other ethnicity/Native American | 0.33 | 0.15, 0.70 | 0.004 | 0.42 | 0.19, 0.93 | 0.04 |
| Unknown ethnicity | 0.86 | 0.52, 1.42 | 0.57 | 1.06 | 0.62, 1.80 | 0.83 |
| Private medical insurance[††] | 1.00 | | | — | | |
| Medicare | 0.85 | 0.63, 1.14 | 0.28 | — | | |
| Public insurance | 0.93 | 0.64, 1.31 | 0.66 | — | | |
| No insurance | 0.48 | 0.16, 1.44 | 0.19 | — | | |
| Unknown insurance | 0.65 | 0.17, 2.43 | 0.53 | — | | |
| Income, per $1000 | 1.00 | 0.99, 1.01 | 0.58 | — | | |
| SLE Comorbidity Index (per 1 unit; range 0–46) | 1.16 | 1.11, 1.21 | < 0.0001 | 1.22 | 1.16, 1.27 | < 0.0001 |
| Elective admission[††] | 1.00 | | | 1.00 | | |
| Urgent admission | 3.38 | 2.07, 5.51 | < 0.0001 | 2.12 | 1.25, 3.61 | 0.006 |
| Emergency admission | 2.91 | 1.89, 4.46 | < 0.0001 | 2.60 | 1.61, 4.18 | < 0.0001 |
| Rural hospital | 2.58 | 1.82, 3.68 | < 0.0001 | 1.75 | 1.17, 2.60 | 0.006 |
| Bed-size | | | | | | |
| ≥ 500[††] | 1.00 | | | 1.00 | | |
| 300–499 | 4.55 | 2.92, 7.08 | < 0.0001 | 3.32 | 1.97, 5.60 | < 0.0001 |
| 100–299 | 5.74 | 3.74, 8.79 | < 0.0001 | 3.04 | 1.63, 5.64 | 0.0004 |
| < 100 | 7.50 | 3.82, 14.70 | < 0.0001 | 3.13 | 1.33, 7.33 | 0.009 |
| Non-teaching hospital (vs teaching hospital) | 3.55 | 2.69, 4.68 | < 0.0001 | 2.19 | 1.48, 3.23 | < 0.0001 |
| Community hospital (vs AMC) | 4.96 | 3.00, 8.18 | < 0.0001 | [†] | | |
| High volume hospital (vs low volume hospital) | 0.31 | 0.22, 0.42 | < 0.0001 | 0.74 | 0.48, 1.14 | 0.18 |
| Attending physician volume > 3 SLE admissions per year[††] | 1.00 | | | — | | |
| Attending physician volume 1–3 SLE admissions per year | 1.22 | 0.82, 1.82 | 0.32 | — | | |
| Attending physician volume < 1 SLE admission per year | 1.14 | 0.77, 1.69 | 0.51 | — | | |
| New York (vs Pennsylvania) | 0.61 | 0.47, 0.80 | 0.0002 | 0.55 | 0.41, 0.75 | < 0.0001 |
| Private nonprofit hospital[††] | 1.00 | | | 1.00 | | |
| Proprietary hospital | 0.45 | 0.18, 1.09 | 0.08 | 0.36 | 0.14, 0.90 | 0.03 |
| Public hospital | 0.25 | 0.09, 0.59 | 0.002 | 0.48 | 0.19, 1.21 | 0.12 |

[†] Not included in the multivariable analysis because all academic medical centers were teaching hospitals. [††] Reference group. SLE: systemic lupus erythematosus; AMC: academic medical center.

Because risks for inter-hospital transfer may differ during the course of the hospitalization, we also examined separate models of predictors of transfers within the first 2 days of hospitalization, and transfers occurring after 2 days. The significant predictors were the same in the stratified analysis as in the group as a whole, and the strengths of associations were similar in both subsets, with 2 exceptions: the association of hospital bed-size with transfer was stronger in the subset with a short length of stay (adjusted odds ratio for bed-size < 100, 100–299, and 300–499 of 4.15, 4.84, and 4.40, respectively, compared to a bed-size of 500 or more) than in those with a longer length of stay (adjusted OR of 2.26, 2.05, and 2.60, respectively), and the association of type of admission with transfer was stronger in the subset with a short length of stay (adjusted OR for emergency admission 3.32, for urgent admission 3.21, compared to an elective admission) than in those with a longer length of stay (adjusted OR for emergency admission 2.37, for urgent admission 1.66). These findings indicated that inter-hospital transfers were more likely at smaller hospitals and for urgent or emergency admissions early in the course of hospitalization than later in the hospitalization, but other patient or hospital characteristics were not associated with the timing of transfer.

*Matched cohort study.* The matched cohort analysis was used to compare the likelihood of in-hospital mortality between 205 patients who were transferred and 507 matched controls. The groups were closely matched on demographic and clinical characteristics, and in features of the transferring hospital. In-hospital mortality occurred in 29 of the 205 transfer patients (14.1%) and 37 of the 507 controls (7.3%). This proportion was significantly higher in the transfer patients (adjusted OR 2.25; 95% CI 1.31, 3.85; p = 0.004) (Figure 1). However, this association varied with the attending physician volume at the receiving hospital. Among transfer patients admitted by low or moderate volume attending physicians, the risk of mortality associated with transfer was 2.5 times higher than that of the matched controls (crude proportions 15.3% vs 7.0%; adjusted OR 2.50; 95% CI 1.42, 4.36; p = 0.002). Among those admitted by high volume attending physicians, the risk of in-hospital mortality was not statistically different from that of the matched controls, and the point estimate suggested a decreased risk of in-hospital mortality (crude proportions 4.5% vs 9.4%; adjusted OR 0.56; 95% CI 0.06, 5.12; p = 0.62). Risks were similar between low volume and moderate volume physicians. In contrast, risks of in-hospital mortality were higher among those transferred to academic medical centers, large hospitals, and high volume hospitals, compared to those transferred to community hospitals, smaller hospitals, or low volume hospitals, respectively. Transfer patients of high volume physicians were most often admitted to hospitals that were large (77%), high volume (95%), teaching hospitals (95%), or academic medical centers (82%).

## DISCUSSION

Inter-hospital transfers of patients with SLE are heterogeneous. Transfers for rehabilitation tended to involve older

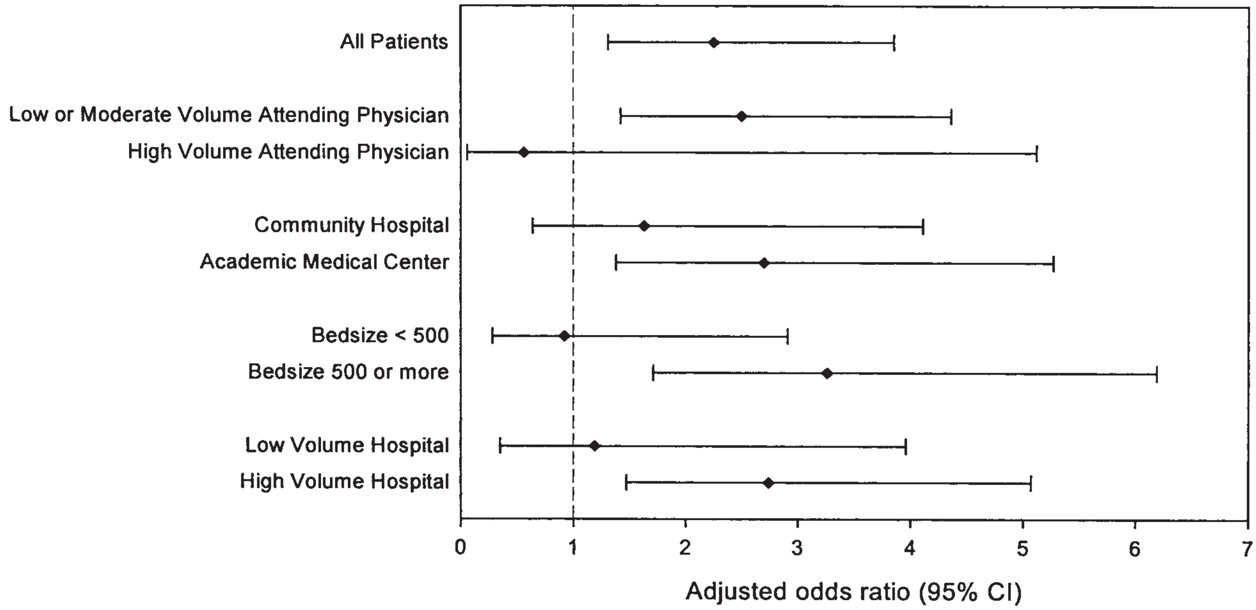


*Figure 1.* Adjusted odds ratios and 95% confidence intervals for the association of inter-hospital transfer and in-hospital mortality, among all patients and in subgroups stratified by physician volume at the receiving hospital, academic medical center status of the receiving hospital, bed-size of the receiving hospital, and hospital volume. Odds ratios were adjusted for patient age and SLE Comorbidity Index, and for the matched grouping and clustering of patients by hospital. A high volume attending physician was defined as the attending physician for an average of more than 3 urgent or emergency hospitalizations per year of patients with SLE, while a low or moderate volume attending physician was the attending physician for an average of 3 or fewer patients per year. A high volume hospital was defined as one with an average of more than 50 urgent or emergency hospitalizations of patients with SLE per year.

patients who were often post-operative, and who moved from larger hospitals to smaller non-teaching hospitals. Transfers for procedures also tended to involve older patients, often admitted emergently with cardiovascular conditions, who moved from smaller hospitals to larger hospitals. In-hospital mortality was rare in both groups. Transfers for continued medical care tended to involve younger patients with a wide variety of diagnoses, who moved from smaller hospitals to larger teaching hospitals or academic medical centers, and had high in-hospital mortality. Ignoring heterogeneity in reasons for transfer would have confounded the analysis of predictors and outcomes of transfers[16].

Differences in patient characteristics by transfer indication have been described previously. For example, while several studies have reported transfers to be more common among uninsured patients or those with public insurance, transfers after acute myocardial infarction (usually for procedures) were more common among patients with private insurance[4–6,22,23]. Similarly, although mortality has uniformly been found to be higher among transferred patients with medical conditions than among directly admitted patients, patients transferred for some surgical procedures tended to have lower mortality than directly admitted patients undergoing the same procedures[9]. This finding may reflect that the transfer patients had to be stable enough for transfer, and were possibly selected as patients who would do well with surgery. Such findings would be obscured if indications for transfer had not been differentiated.

Among patients with SLE, the most important patient-related predictors of transfers for continued medical care were younger age and more severe illness, findings consistent with previous research in other settings[4,9,16]. We did not find the likelihood of transfers to vary by type of medical insurance or estimated income. Several hospital characteristics were important predictors of transfers, including bed-size, rural location, and teaching status, similar to results of a previous study[17]. We also found transfers to occur less commonly among patients admitted to proprietary hospitals, a group that included several large teaching hospitals. Together, these findings suggest that medical indications were the primary motive for transfer for most patients, rather than economic concerns.

Patients with SLE who were transferred for continued medical care were at high risk for in-hospital mortality. Previous studies of outcomes of transfers compared the mortality of transferred patients to that of other patients at the receiving hospital[7-9]. Given that receiving hospitals tend to be larger teaching hospitals, using this comparison group, rather than using patients at the transferring hospital as the comparison group, may have underestimated the benefit of transfer. In our analysis, an increased risk of mortality was present for transferred patients, even in comparison to patients at the transferring hospitals. This may in part be due to interruptions in care during transfer, or delays in diagnosis or treatment that occur during the period of reevaluation at the receiving hospital, but may also reflect incomplete adjustment for severity of illness and other factors that affect mortality[5,6,23].

Mortality risks after transfer were not uniform, but varied with physician volume. Patients admitted in transfer by low or moderate volume physicians had 2.5 times higher risk of mortality with transfer, compared to matched controls, while patients admitted by high volume physicians were on average 44% less likely to die after transfer. Although this decreased risk was not statistically significantly different from that of matched controls, the difference in risk between those admitted by high volume physicians and those admitted by low or moderate volume physicians was substantial. Mortality risks were higher among those transferred to large or high volume hospitals or academic medical centers, likely reflecting selective referral of severely ill patients to these centers. Patients of high volume physicians tended to have lower mortality despite often being admitted to these "high risk" hospitals. These results support our previous findings among directly admitted patients that greater SLE-related experience of the attending physician is associated with lower risks of in-hospital mortality among patients with SLE[10].

The strengths of this study include the large, population-based sample, stratification of patients by indication for transfer, use of patients at the transferring hospital as the comparison group for analysis of mortality, matching with propensity adjustment, and examination of associations of both physician and hospital characteristics with the outcomes of hospitalizations. However, the study was limited in that we relied on administrative data that had recorded a physician diagnosis of SLE rather than on classification criteria. We inferred indications for transfer from diagnosis and procedure codes. Although we used explicit decision rules for this categorization, we may have misclassified some patients. For example, some patients classified as having been transferred for procedures may have been transferred for continuing medical care. However, the nature of the procedures, the characteristics of the transferring and receiving hospitals, and the emergency nature of these admissions all favor the interpretation that the primary purpose of the transfer was to obtain the procedure. We do not know the extent to which non-medical considerations by the patient or his or her family or physicians might have influenced transfer decisions, which could affect identification of predictors of transfer. We examined only one outcome, in-hospital mortality, and did not have information on whether post-discharge mortality differed between groups. Also, we classified physicians based on their current volume of patients rather than on their career experience, and therefore may have misclassified some physicians. Finally, the statistical power of the stratified analysis of physician volume was limited because few transfer patients were admitted by high volume physicians.

The transfer patterns demonstrate the selective referral of patients for continued medical care to large teaching hospitals and academic medical centers, but not to high volume physicians at these centers. Our findings suggest that mortality may be lower if more of these patients were admitted by high volume physicians. Understanding the ways in which patient care differs between high volume and lower volume physicians would help identify specific processes of care associated with improved outcomes.

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