Admission From Nursing Home Residence Increases Acute Mortality After Hip Fractures

Pim A. D. van Dijk, BSc¹, Arjan G. J. Bot, MD, PhD¹, Valentin Neuhaus, MD¹, Mariano E. Menendez, MD¹, Mark S. Vrahas, MD²,³, and David Ring, MD, PhD¹

Abstract

Background: Little is known about the effect of preinjury residence on inpatient mortality following hip fracture. This study addressed whether (1) admission from a nursing home residence and (2) admission from another hospital were associated with higher inpatient mortality after a hip fracture. Methods: Using the National Hospital Discharge Survey database, we analyzed an estimated 2,124,388 hip fractures discharges, from 2001 to 2007. Multivariable logistic regression analysis was performed to identify whether admission from a nursing home and admission from another hospital were independent risk factors for inpatient mortality. Our primary null hypothesis is that there is no difference in inpatient mortality rates after hip fracture in patients admitted from a nursing home, compared to other forms of admission. The secondary null hypothesis is that there is no difference in inpatient mortality after hip fracture in patients whose source of admission was another hospital, compared to other sources of admission. Results: Almost 4% of the patients were admitted from a nursing home and 6% from another hospital. The mean age was 79 years and 71% were women. The majority of patients were treated with internal fixation. Admission from a nursing home residence (odds ratio [OR] of 2.1, confidence interval [CI] 1.9-2.3) and prior hospital stay (OR 3.4, CI 3.2-3.7) were associated with a higher risk of inpatient mortality after accounting for other comorbidities and type of treatment. Conclusions: Patients transferred to an acute care hospital from a long-term care facility or another acute care hospital are at particularly high risk of inpatient death. This subset of patients should be considered separately from patients admitted from other sources. Level of Evidence: Prognostic level II.

Keywords

patient language, disability, pain, patient self-efficacy

Introduction

Hip fractures are prevalent in the geriatric population and are associated with increased utilization of health care resources and high rates of mortality and disability.¹⁻³ Hip fracture risk increases exponentially with age⁴ and the number of fractures and their associated expenditure is projected to increase 3- to 8-fold in the next 20 years.⁵,⁶

Most nursing home residents are older adults with multiple medical conditions that have trouble living independently.⁷ Previous research showed that the risk of hip fracture in nursing home residents³,⁸⁻¹⁰ is at least 2 to 3 times higher than in community dwellers of the same age and sex.² This higher incidence may partly be explained by a higher number of falls in institutionalized elderly patients.¹¹ An Australian study¹² of 666 patients compared mortality rates in patients with hip fractures who were nursing home residents at the time of the injury to community dwellers and concluded that nursing home residence conferred greater odds of mortality in the postinjury period.¹² On the other hand, a study conducted by Poor and colleagues¹³ concluded that residential status prior to sustaining a hip fracture was not a predictor for increased in-hospital mortality. However, this study was conducted in 1989 (study time period 1978-1989) with a cohort of only 131 patients.¹³

This study addressed whether (1) preinjury source of admission from a nursing home residence and (2) admission from another hospital were associated with higher inpatient mortality after a hip fracture.

¹ Orthopaedic Hand and Upper Extremity Service, Harvard Medical School, Massachusetts General Hospital, Boston, MA, USA
² Harvard Medical School, Massachusetts General Hospital, Boston, MA, USA
³ Partners Orthopaedic Trauma Service, Massachusetts General Hospital, Boston, MA, USA

Corresponding Author:
David Ring, Orthopaedic Hand and Upper Extremity Service, Massachusetts General Hospital, Yawkey Center, Suite 2100, 55 Fruit Street, Boston, MA 02114, USA.
Email: dring@partners.org
Methods

Data for this study were obtained from the National Hospital Discharge Survey (NHDS) database. The NHDS is a national probability survey conducted by the National Center for Health Statistics (NCHS), Centers for Disease Control and Prevention and collects annually medical and demographic information since 1965. The data are collected from inpatients discharge records from more than 500 general and children’s hospitals in the United States, excluding exclusive federal, military, and Veterans Administrations hospitals. All of the hospitals were nonfederal and short stay (less than 30 days on average) or with a general specialty, and the hospitals had 6 or more beds staffed for patient use.

Medical information was based on the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) of the NHDS database. The deidentified NHDS data are free and available online. Therefore, no institutional review board approval was necessary for this study.

We included all adult patients (older than 18 years) with a hip fracture (femoral neck and pertrochanteric) between 2001 and 2007 in the data set (Table 1). The NHDS collected type of admission and source of admission since 2001, which was the reason for selecting this time frame.

We divided the patients into 3 groups, based on their source of admission: admission from a nursing home, admission from a hospital, and a rest group including all other sources of admission (physician referral, clinical referral, Health Maintenance Organization referral, emergency department [ED], and court/law enforcement).

All comorbidities, treatments, and adverse events, based on the ICD-9 codes, were listed (Tables 2-4). The ICD codes for wound-related complications as well as for the complications acute renal failure, ventricular arrhythmias and arrest, iatrogenic hypotension, pulmonary embolism, acute myocardial infarct, fat embolism, new mental disorder, pneumonia and pulmonary congestion, deep venous thrombosis, intubation and mechanical ventilation, transfusion, and conversion disorder were used to identify the complications (Table 4).

We reported means and standard deviations of continuous baseline variables. Frequencies and percentages were used for baseline categorical variables and presence of comorbidities or complications in baseline, comorbidities for the entire cohort.

Based on the sample size, we assumed normality of the data. We compared patients admitted from a nursing home with patients admitted from another hospital (comparison 1) and patients admitted from a nursing home with patients admitted from other sources (comparison 2). We used independent samples t test for both comparisons for continuous outcomes and chi-square test (or Fisher exact test when applicable) for categorical parameters.

In order to find whether admission from a nursing home was an independent risk factor for death when corrected for confounders, we entered all variables that were significantly different in bivariate analysis and were present in at least 2% of the population in a backward likelihood ratio multivariable logistic regression.

Results

The cohort consisted of an estimated number of 2 124 388 patients. Seventy-one percent were female, and the mean age was 79 years (range 18-99). Nearly 4% of the patients were admitted from a nursing home and 6% from a hospital (Table 1).

Patients admitted from a nursing home were older and had fewer days of inpatient care compared to patients admitted from a hospital, but more days of care compared to patients admitted from another source.

The inpatient mortality rate was 3.3% in the total cohort, but the inpatient mortality of patients admitted from a nursing home (3.9%) was significantly greater than for patients transferred from a hospital (P < .001) or another source (P < .001; Table 1).

Comorbidities were present in 76% of the patients with a hip fracture. Patients admitted from a nursing home had significantly more comorbidities than patients admitted from another hospital (P < .001) and from another source (P < .001; Table 2).

Patients admitted from another hospital had significantly more additional injuries compared to patients admitted from another hospital or patients admitted from other sources (Table 3).

Most of the patients with a hip fracture were surgically treated with internal fixation (54%) or prosthetic arthroplasty (32%). The remainder 14% had nonoperative treatment of the hip fracture. Patients admitted from a nursing home had more adverse events compared to patients transferred from a hospital or other source of admission. Transfusion and acute postoperative anemia were the most common adverse events in all 3 groups. Patients from a nursing home also had more acute renal failure, pulmonary embolism, and inducement disorder, acquired during the admission compared to both the patients admitted from another hospital and the patients with other sources of admission.

Admission from a nursing home (β = 0.74, P < .001, odds ratio [OR] 2.1, confidence interval [CI] 1.9-2.3) or from a hospital resulted in an increased risk of death (β = 1.2, P < .001, OR 3.4, CI 3.2-3.7), when controlling for demographics, comorbidities, treatment, and adverse events (model fit: Omnibus test of model coefficients: chi-square = 511 943, P < .001, Nagelkerke R² = 0.86).

Both internal fixation (β = −1.7, P < .001, OR 0.18, CI 0.18-0.19) and prosthetic arthroplasty (β = −1.5, P < .001, OR 0.23, CI 0.22-0.24) were associated with decreased risk of inpatient mortality in comparison to nonoperative treatment.

The strongest risk factor for inpatient mortality was pulmonary insufficiency (OR 20), and osteoporosis was associated with a better outcome (OR 0.22) after internal fixation. Factors associated with increased risk of mortality were older age, hypertension, hospitals up to 200 beds compared to large hospitals (>500 beds), chronic pulmonary disease, chronic renal disease, congestive heart failure, atrial fibrillation, dementia, nutritional deficiency, malignancy, acute renal failure, pneumonia or pulmonary congestion, pulmonary insufficiency, and concomitant fracture of neck or trunk. Factors associated with decreased risk of inpatient mortality were female sex,
Table I. Baseline Statistics.

| Parameter                      | Total          | Nursing Home | Hospital | Other Admission<sup>a</sup> | P<sup>b</sup> | Other Admission<sup>a</sup> | P<sup>b</sup> |
|-------------------------------|----------------|--------------|----------|----------------------------|-------------|----------------------------|-------------|
| N (%)                         | n %            | n %          | n %      | n %                        |             | n %                        |             |
| **Sex**                       |                |              |          |                            |             |                            |             |
| Male                          | 610,655        | 29           | 24,133   | 31                         | 37,129      | 30                         | <.001       |
| Female                        | 1,513,733      | 71           | 54,245   | 69                         | 87,667      | 70                         | <.001       |
| Age, ± SD (range), years      | 79 ± 13 (18-99)| 82 ± 12 (21-99)| 78 ± 14 (18-99)| <.001                      | 79 ± 13 (18-99)| <.001                      |
| Age groups, years             |                |              |          |                            |             |                            |             |
| <60                           | 162,302        | 7.7          | 3,427    | 4.4                        | 9,570       | 7.7                        | <.001       |
| 60-70                         | 188,728        | 8.9          | 3,908    | 5.0                        | 13,574      | 11                         | <.001       |
| 70-80                         | 508,423        | 24           | 15,011   | 19                         | 34,887      | 28                         | <.001       |
| >80                           | 1,264,935      | 60           | 5,603    | 72                         | 66,765      | 54                         | <.001       |
| **Geographic region**         |                |              |          |                            |             |                            |             |
| Northeast                     | 404,415        | 19           | 17,679   | 23                         | 18,828      | 15                         | <.001       |
| Midwest                       | 582,904        | 27           | 25,482   | 33                         | 44,958      | 36                         | <.001       |
| South                         | 768,461        | 36           | 20,217   | 26                         | 42,307      | 34                         | <.001       |
| West                          | 368,608        | 17           | 15,000   | 19                         | 18,703      | 15                         | <.001       |
| **Hospital size (beds)**      |                |              |          |                            |             |                            |             |
| 6-99                          | 598,710        | 28           | 24,139   | 31                         | 41,525      | 33                         | <.001       |
| 100-199                       | 547,266        | 26           | 19,729   | 25                         | 25,450      | 20                         | <.001       |
| 200-299                       | 430,463        | 20           | 12,202   | 16                         | 21,143      | 17                         | <.001       |
| 300-499                       | 378,132        | 18           | 15,541   | 20                         | 23,490      | 19                         | <.001       |
| 500 and over                  | 169,817        | 8            | 6,767    | 9                          | 13,188      | 11                         | <.001       |
| **Comorbidities**             |                |              |          |                            |             |                            |             |
| No                            | 520,293        | 25           | 16,805   | 21                         | 33,488      | 27                         | <.001       |
| Comorbidities present         | 1,604,095      | 76           | 61,573   | 79                         | 91,308      | 73                         | <.001       |
| **Complications**             |                |              |          |                            |             |                            |             |
| No                            | 1,192,132      | 56           | 41,087   | 52                         | 84,488      | 68                         | <.001       |
| Complications present         | 932,256        | 44           | 37,291   | 48                         | 40,308      | 32                         | <.001       |
| **Days of care, ± SD (range), days** | 6.75 ± 5.9 (1-253)| 7.2 ± 5.2 (1-34)| 9.2 ± 6.5 (1-60)| <.001| 6.6 ± 5.9 (1-253)| <.001|
| **Discharge status**          |                |              |          |                            |             |                            |             |
| Routine/discharged home       | 342,684        | 16           | 9,592    | 12                         | 38,491      | 31                         | <.001       |
| Left against medical advice   | 3158           | 0.1          | 30       | 0.0                        | 22          | 0                          | <.001       |
| Discharged/transferred to short-term facility | 315,581 | 15 | 920,88 | 12 | 18,333 | 15 | <.001 | 288,040 | 15 |
| Discharged/transferred to long-term facility | 1,066,085 | 50 | 47,428 | 61 | 46,113 | 37 | <.001 | 972,544 | 51 |
| Alive, disposition not stated | 275,730        | 13           | 76,422   | 10                         | 16,615      | 13                         | <.001       |
| Dead                          | 69,423         | 3.3          | 3,091    | 3.9                        | 35,202      | 2.8                        | <.001       |
| Not reported                  | 51,727         | 2.4          | 1,387    | 1.8                        | 1,702       | 1                          | <.001       |
| Mortality                     | 69,423         | 3.3          | 3,091    | 3.9                        | 35,202      | 2.8                        | <.001       |

Abbreviations: HMO, Health Maintenance Organization; SD, standard deviation.
<sup>a</sup>Other sources of admission (physician referral, clinical referral, HMO referral, Emergency room, and court/law enforcement/other).
<sup>b</sup>Difference between nursing home and other admission.
geographic region (northeast or midwest compared to west), 200 to 300 bed hospitals compared to large hospitals (>500 beds), diabetes, osteoporosis, new mental disorder, concomitant fracture of radius, and ulna and transfusion (Table 5).

### Discussion

A considerable number of patients sustaining a hip fracture are admitted from either a nursing home or another acute care hospital, but the influence of preinjury residency on in-hospital outcomes is incompletely understood. Given the growing geriatric population and corresponding rise in the independent nursing home market, there is interest in addressing the impact of preoperative residential status on inpatient mortality following hip fractures. This study addressed whether (1) admission from a nursing home residence and (2) admission from another hospital were associated with higher mortality after a hip fracture.

The present study has several limitations associated with the utilization of administrative databases. First, ICD-9 codes were used to retrieve hip fracture discharges, as well as the corresponding treatment and subsequent adverse events. Because of the extensive sample size of our study, we cannot exclude the possibility of misclassification of the codes—as provided in Table 2.

### Table 2. Comorbidities.

| Parameter                  | Total n | % | Nursing Home n | % | Hospital n | % | Other Admission n | % |
|----------------------------|---------|---|-----------------|---|------------|---|------------------|---|
| Hypertensive disease       | 887205  | 42 | 27031  | 35 | 53908  | 43 | 806266  | 42 |
| Diabetes mellitus          | 299786  | 14 | 10490  | 13 | 19767  | 16 | 269529  | 14 |
| Obesity                    | 14150   | 0.7| 654  | 0.8 | 705  | 0.6 | 12791  | 0.7 |
| Chronic pulmonary disease  | 378807  | 18 | 15861  | 20 | 23215  | 19 | 339731  | 18 |
| Chronic renal disease      | 55096   | 2.6| 2231  | 2.8 | 2058 | 1.6 | 50807  | 2.6 |
| Chronic liver disease      | 12061   | 0.6| 540  | 0.7 | 1067 | 0.9 | 10454  | 0.5 |
| Congestive heart failure   | 339855  | 16 | 14124  | 18 | 18956  | 15 | 306775  | 16 |
| Atrial fibrillation        | 308568  | 15 | 10833  | 14 | 13888  | 11 | 283847  | 15 |
| Chronic alcoholism         | 16395   | 0.8| 745  | 1.0 | 630  | 0.5 | 15020  | 0.8 |
| Dementia                   | 71018   | 3.3| 4918  | 6.3 | 3515 | 2.8 | 62585  | 3.3 |
| Osteoporosis               | 218674  | 10 | 4976  | 6.3 | 3175 | 12 | 199403  | 10 |
| Nutritional deficiency     | 56625   | 2.7| 3419  | 4.4 | 3881 | 3.1 | 49325  | 2.6 |
| Malignancy                 | 81156   | 3.8| 2438  | 3.1 | 7149 | 5.7 | 71569  | 3.7 |

Abbreviation: HMO, Health Maintenance Organization.

* Other sources of admission (physician referral, clinical referral, HMO referral, emergency department, and court/law enforcement/other).

* Difference between nursing home and other admission.

### Table 3. Additional Injuries.

| Parameter                  | Total n | % | Nursing Home n | % | Hospital n | % | Other Admission n | % |
|----------------------------|---------|---|-----------------|---|------------|---|------------------|---|
| Skull fracture             | 8748    | 0 | 23  | 0.0 | 144  | 0.1 | 8581  | 0.4 |
| Neck or trunk fracture     | 44679   | 2.1| 1690 | 2.2 | 3175 | 2.5 | 39814 | 2.1 |
| Clavicle fracture          | 6151    | 0.3| 685  | 0.9 | 663  | 0.5 | 4803  | 0.2 |
| Scapula fracture           | 1273    | 0.1| 0  | 0.0 | 267  | 0.2 | 1006  | 0.1 |
| Humerus fracture           | 33816   | 1.6| 2398 | 3.1 | 2632 | 2.1 | 28786  | 1.5 |
| Radius/ulna fracture       | 53590   | 2.5| 1106 | 1.4 | 3425 | 2.7 | 48559  | 2.5 |
| Femur fracture             | 10768   | 0.5| 164 | 0.2 | 645  | 0.5 | 9959  | 0.5 |
| Tibia/fibula fracture      | 6550    | 0.3 | 489  | 0.6 | 193  | 0.2 | 5868  | 0.3 |
| Ankle fracture             | 4145    | 0.2 | 416  | 0.6 | 0  | 0.0 | 3729  | 0.2 |
| Tarsal/metatarsal fracture | 4394    | 0.2| 480  | 0.6 | 101  | 0.1 | 3813  | 0.2 |
| Multiple fractures         | 148543  | 7.0 | 5944 | 7.6 | 9709 | 7.8 | 132890 | 6.9 |
| Pelvic fracture            | 25895   | 1.2| 676  | 0.9 | 1834 | 1.5 | 23385 | 1.2 |
| Proximal humerus fracture  | 29394   | 1.4 | 2311 | 2.9 | 1648 | 1.3 | 25435 | 1.3 |
| Head trauma                | 13763   | 0.6 | 249  | 0.3 | 782  | 0.6 | 12732 | 0.7 |
| Chest and abdominal trauma | 12597   | 0.6 | 426  | 0.5 | 1918 | 1.5 | 10253 | 0.5 |

Abbreviation: HMO, Health Maintenance Organization.

* Other sources of admission (physician referral, clinical referral, HMO referral, emergency department, and court/law enforcement/other).

* Difference between nursing home and other admission.
by the NHDS—examined in this study. Miscoding could potentially lead to an under- or overestimation of the importance of risk factors. Nonetheless, misclassification errors take place in similar frequency in all comparison groups in large-scale studies. There is an assumption that the database codes “transfer from nursing home” will be applied whether or not the patient goes through the ED. Second, this study was limited to inpatient outcomes after hip fracture; therefore, information regarding complications and mortality rates following hospital discharge, as well as readmission rates due to an adverse event, remains undetected. In addition, the NHDS does not measure functional status, which is another limitation.

The influence of hospital size to mortality stays unclear, hospitals up to 200 beds compared with >500 increase the risk of mortality, while hospitals with 200 to 300 beds compared with >500 beds decrease the risk of inpatient mortality.

The percentage of patients with dementia (3.3%) in the group of patients admitted from a nursing home seems relatively low, this could be underreported. Therefore, the only conclusions that can be drawn from this study are those concerning inpatient mortality.

Our finding that hip replacement or internal fixation is associated with a lower risk of mortality compared to nonoperative treatment is likely due to the fact that nonoperative treatment corresponded with end-of-life care, but it was not possible to determine this from the database. The present study indicates that hip fracture-related mortality rates were significantly higher among patients admitted to US hospitals compared to a non-nursing home preinjury residential status. The overall mortality rate was 3.3% for the entire study cohort, which is consistent with the findings of Bhattacharyya et al. who noted a 3.1% inpatient mortality rate for patients treated for a hip fracture between 1995 and 1997. Particularly, the baseline mortality rate for patients admitted from a nursing home was 3.9%, compared to 3.3% and 2.8% mortality rates for patients admitted from other sources (ie, from home) or from a hospital, respectively.

In a study conducted by Roche et al., 13% of all patients admitted to hospital with a hip fracture between 1999 and 2003 were nursing home residents. A recent study from Newman et al. found an 8.3% of patients admitted from a long-term nursing home among patients with a hip fracture. The overall percentage of hospitalized patients admitted from a nursing home in our study was nearly 4%. This difference in the percentage of nursing home residents admitted to hospital might be explained because the aforementioned authors excluded patients aged less than 60 years old, while we did not (which formed 7.6% of our cohort). Admission from a nursing home was deemed an independent risk factor for in-hospital death in our 7-year cohort. A prior hospital stay in another facility immediately before hospital admission for the hip fracture was also associated with an increased risk of inpatient

### Table 4. Treatment and Complications.

| Parameter                              | Total       | Nursing Home | Hospital      | Other Admission^a | P    | Other Admission^b | P   |
|----------------------------------------|-------------|--------------|---------------|-------------------|------|-------------------|-----|
| Treatment                              | n           | %            | n             | %                 | P    | n                 | %   | P^b          |
| Internal fixation                      | 146,608     | 54           | 36,435        | 47                | <.001| 44,563            | 36  | <.001        |
| Replacement                            | 670,076     | 32           | 22,769        | 29                | <.001| 24,246            | 19  | <.001        |
| Surgery-related complications          |             |              |               |                   |      |                   |     |             |
| Wound complications                    | Present     | 31,132       | 1.5           | 934               | .001 | 12,831            | 1.0 | <.001       |
| Hematoma                               | Present     | 24,366       | 1.1           | 934               | .04  | 482               | .4  | <.001       |
| Disruption wound                       | Present     | 1,387        | 0.1           | 0                 | .01  | 145               | .01 | <.001       |
| Postoperative infection                 | Present     | 5,785        | 0.3           | 0                 | .6   | 699               | .6  | <.001       |
| Acute postoperative anemia             | Present     | 37,501       | 18            | 13,676            | 17   | 17,060            | 14  | <.001       |
| General complications                  |             |              |               |                   |      |                   |     |             |
| Complications not elsewhere classified | Present     | 93,563       | 4.4           | 2,566             | 3.3  | 4,399             | 3.5 | <.001       |
| Acute renal failure                    | Present     | 58,699       | 2.8           | 3,373             | 4.3  | 2,507             | 2.0 | <.001       |
| Ventricular arrhythmias and arrest     | Present     | 5,911        | 0.3           | 87                | 0.1  | 391               | 0.3 | <.001       |
| Iatrogenic hypotension                 | Present     | 5,751        | 0.3           | 0                 | 0    | 989               | 0.8 | <.001       |
| Pulmonary embolism                     | Present     | 14,968       | 0.7           | 1,489             | 1.9  | 471               | 0.4 | <.001       |
| Acute myocardial infarction            | Present     | 37,841       | 1.8           | 1,635             | 2.1  | 2,498             | 2.0 | <.1         |
| Fat embolism                           | Present     | 1,871        | 0.1           | 0                 | 0    | 0                 | X   | <.001       |
| Induced mental disorder                | Present     | 50,009       | 2.4           | 3,934             | 5.0  | 2,409             | 1.9 | <.001       |
| Pneumonia and pulmonary congestion    | Present     | 89,358       | 4.2           | 3,378             | 4.3  | 2,825             | 2.3 | <.001       |
| Pulmonary insufficiency                | Present     | 48,615       | 2.3           | 1,527             | 1.9  | 1,069             | 0.9 | <.001       |
| Deep venous thrombosis                 | Present     | 18,822       | 0.9           | 1,062             | 1.4  | 2,771             | 2.2 | <.001       |
| Intubation and mechanical ventilation  | Present     | 35,952       | 1.7           | 892               | 1.1  | 1,651             | 1.3 | <.001       |
| Transfusion                           | Present     | 476,815      | 22            | 17,117            | 22   | 14,309            | 12  | <.001       |
| Conversion                             | Present     | 5,971        | 0.3           | 0                 | 0    | 161               | 0.1 | <.001       |

Abbreviation: HMO, Health Maintenance Organization.

^aOther sources of admission (physician referral, clinical referral, HMO referral, emergency department, and court/law enforcement/other)

^bDifference between nursing home and other admission

---

van Dijk et al, 2017

127
death, and this risk was higher than that of patients admitted from nursing homes.

In conclusion, a source of hospital admission other than home prior to sustaining a hip fracture was found to be a reliable predictor for increased inpatient mortality while controlling for other factors, such as comorbidities, sex, and age. Therefore, preinjury residential status, including not only admissions from a nursing home but also from other hospitals, should be taken into account when assessing outcomes following hip fractures.

Patients transferred to an acute care hospital from a long-term care facility or another acute care hospital are at higher risk of inpatient death. This subset of patients should be considered separately from patients admitted from other sources.

**Authors’ Note**

This study was approved by the institutional review board of the Massachusetts General Hospital. The IRB reviewed our protocol and decided that this study was exempt from IRB approval because we worked with deidentified data. The study was performed at the Orthopaedic Hand and Upper Extremity Service, Massachusetts General Hospital, Boston, USA.

**Declaration of Conflicting Interests**

The author(s) declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: Arjan G.J. Bot: “AnnaFonds Travel grant” (Dutch Orthopaedic travel grant); “VSB-fonds” a nonmedical study grant; “Prins Bernhard Cultuurfonds, Banning-de Jong fonds” a nonmedical study grant for excellent Dutch students. Valentin Neuhaus: Gottfried und Julia Bangerter-Rhyner-Stiftung, Switzerland. David Ring: Consultant, Wright Medical, Skeletal Dynamics, and Biomet. Mark E. Vrahas: Expert testimony: Law firms, no current, Stock options: Dividends; Travel/accommodations/meeting expenses unrelated to activities listed: CME teaching. David Ring: Study Specific Grants; Skeletal Dynamics (pending); Honoraria: AO North America, AO

### Table 5. Logistic Regression for Predictors of Mortality After Hip Fractures. a

| Predictor                                      | β     | Wald     | P       | Odds Ratio | Lower | Upper |
|-----------------------------------------------|-------|----------|---------|------------|-------|-------|
| Pulmonary insufficiency                       | 3.0   | 5039     | <.001   | 20         | 19    | 22    |
| Nutritional deficiency                       | 2.3   | 3536     | <.001   | 10         | 9.4   | 11    |
| Pneumonia or pulmonary congestion            | 1.8   | 2991     | <.001   | 6.1        | 5.7   | 6.5   |
| Admission from hospital compared to other admission | 1.2   | 853      | <.001   | 3.4        | 3.2   | 3.7   |
| Fracture of neck and trunk                   | 1.1   | 410      | <.001   | 3.0        | 2.7   | 3.3   |
| Acute renal failure                          | 0.89  | 737      | <.001   | 2.4        | 2.3   | 2.6   |
| Malignancy                                    | 0.88  | 573      | <.001   | 2.4        | 2.2   | 2.6   |
| Atrial fibrillation                           | 0.86  | 1853     | <.001   | 2.4        | 2.3   | 2.5   |
| Admission from nursing home compared to other admission | 0.74  | 266      | <.001   | 2.1        | 1.9   | 2.3   |
| Number of beds 6-99 compared to >500         | 0.63  | 740      | <.001   | 1.9        | 1.8   | 2.0   |
| Chronic pulmonary disease                     | 0.60  | 870      | <.001   | 1.8        | 1.8   | 1.9   |
| Chronic renal disease                         | 0.52  | 175      | <.001   | 1.7        | 1.6   | 1.8   |
| Congestive heart failure                      | 0.51  | 619      | <.001   | 1.7        | 1.6   | 1.7   |
| Dementia                                      | 0.34  | 55       | <.001   | 1.4        | 1.3   | 1.5   |
| Number of beds 100-199 compared to >500      | 0.25  | 117      | <.001   | 1.3        | 1.2   | 1.3   |
| Hypertension                                  | 0.12  | 44       | <.001   | 1.1        | 1.1   | 1.2   |
| Age                                           | 0.053 | 3430     | <.001   | 1.1        | 1.05  | 1.06  |
| Days of care                                  | -0.0030 | 5.6   | .02     | 1.00       | 0.99  | 1.00  |
| Geographic south compared to west             | -0.05 | 2.9      | .09     | 0.95       | 0.90  | 1.01  |
| Transfusion                                   | -0.22 | 126      | <.001   | 0.80       | 0.77  | 0.83  |
| Female sex                                    | -0.38 | 467      | <.001   | 0.68       | 0.66  | 0.70  |
| Induced mental disorder                       | -0.40 | 24       | <.001   | 0.67       | 0.57  | 0.78  |
| Diabetes mellitus                             | -0.63 | 424      | <.001   | 0.53       | 0.50  | 0.56  |
| Fracture of radius and ulna                   | -0.73 | 176      | <.001   | 0.48       | 0.43  | 0.54  |
| Number of beds 200-299 compared to >500      | -0.83 | 1267     | <.001   | 0.44       | 0.42  | 0.46  |
| Geographic northeast compared to west         | -1.1  | 1947     | <.001   | 0.32       | 0.30  | 0.33  |
| Geographic midwest compared to west           | -1.3  | 2496     | <.001   | 0.26       | 0.25  | 0.28  |
| Hip replacement                               | -1.5  | 3937     | <.001   | 0.23       | 0.22  | 0.24  |
| Osteoporosis                                  | -1.5  | 1611     | <.001   | 0.22       | 0.20  | 0.24  |
| Hip internal fixation                         | -1.7  | 5714     | <.001   | 0.18       | 0.18  | 0.19  |
| Constant                                      | -2.7  | 1177     | <.001   |            |       |       |

Abbreviations: CI, confidence interval; N, number of patients in the cohort.

a Variables included in the regression: admission from nursing home, admission hospital, age, sex, geographic region, hospital size, discharge status, hypertension, diabetes, fracture of radius ulna, chronic pulmonary disease, chronic renal disease, congestive heart failure, atrial fibrillation, dementia, osteoporosis, nutritional deficiency, malignancy, acute posthemolytic anemia, acute renal failure, induced mental disorder, pneumonia or pulmonary congestion, pulmonary insufficiency, transfusion, hip replacement, hip internal fixation, and fracture of neck and trunk.
International; Royalties Received: Wright Medical; Royalties Contracted; Biomet: Skeletal Dynamics; Stock Options: Illuminos. Mark E. Vrahas: Grants: Aona: OREF: NIH; Funding for Hand Surgery Fellowship: AO North America.

Funding
The author(s) received no financial support for the research, authorship and/or publication of this article.

References
1. Hannan EL, Magaziner J, Wang JJ, et al. Mortality and locomotion 6 months after hospitalization for hip fracture: risk factors and risk-adjusted hospital outcomes. *JAMA*. 2001;285(21):2736-2742.
2. Martinez-Reig M, Ahmad L, Duque G. The orthogeriatrics model of care: systematic review of predictors of institutionalization and mortality in post-hip fracture patients and evidence for interventions. *J Am Med Dir Assoc*. 2012;13(9):770-777.
3. Rapp K, Becker C, Lamb SE, Icks A, Klunk J. Hip fractures in institutionalized elderly people: incidence rates and excess mortality. *J Bone Miner Res*. 2008;23(11):1825-1831.
4. Melton LJ III, Therneau TM, Larson DR. Long-term trends in hip fracture prevalence: the influence of hip fracture incidence and survival. *Osteoporos Int*. 1998;8(1):68-74.
5. Cummings SR, Rubin SM, Black D. The future of hip fractures in the United States. Numbers, costs, and potential effects of postmenopausal estrogen. *Clin Orthop Relat Res*. 1990;(252):163-166.
6. Schneider EL, Guralnik JM. The aging of America. Impact on health care costs. *JAMA*. 1990;263(17):2335-2340.
7. Ahmed AA, Hays CI, Liu B, et al. Predictors of in-hospital mortality among hospitalized nursing home residents: an analysis of the National Hospital Discharge Surveys 2005-2006. *J Am Med Dir Assoc*. 2010;11(1):52-58.
8. Cummings RG. Nursing home residence and risk of hip fracture. *Am J Epidemiol*. 1996;143(12):1191-1194.
9. Norton R, Campbell AJ, Reid IR, et al. Residential status and risk of hip fracture. *Age Ageing*. 1999;28(2):135-139.
10. Ooms ME, Vlaasen P, Lips P, Nauta J, Bouter LM, Valkenburg HA. The incidence of hip fractures in independent and institutionalized elderly people. *Osteoporos Int*. 1994;4(1):6-10.
11. Kron M, Loy S, Sturm E, Nikolaus T, Becker C. Risk indicators for falls in institutionalized frail elderly. *Am J Epidemiol*. 2003;158(7):645-653.
12. Harris IA, Yong S, McEvoy L, Thorn L. A prospective study of the effect of nursing home residency on mortality following hip fracture. *ANZ J Surg*. 2010;80(6):447-450.
13. Poor G, Atkinson EJ, O’Fallon WM, Melton LJ III. Determinants of reduced survival following hip fractures in men. *Clin Orthop Relat Res*. 1995;(319):260-265.
14. Dennison C, Pokras R. Design and operation of the National Hospital Discharge Survey: 1988 redesign. *Vital Health Stat 1*. 2000; (39):1-42.
15. Bhattacharyya T, Iorio R, Healy WL. Rate of and risk factors for acute inpatient mortality after orthopaedic surgery. *J Bone Joint Surg Am*. 2002;84-A(4):562-572.
16. Mmetsoudis SG, Gonzalez Della Valle A, Becslides MC, Gaber L, Sculco TP. In-hospital complications and mortality of unilateral, bilateral, and revision TKA: based on an estimate of 4,159,661 discharges. *Clin Orthop Relat Res*. 2008;466(11):2617-2627.
17. Lemoshow S, Teres D, Klar J, Avrunin JS, Gehlbach SH, Rapoport J. Mortality Probability Models (MPM II) based on an international cohort of intensive care unit patients. *JAMA*. 1993;270(20):2478-2486.
18. Tracey F, Crawford VL, Montgomery EA, Gilmore DH, Beringer TR. Comparison of nursing home residents admitted from home or hospital. *Ulster Med J*. 1995;64(2):137-141.
19. Orces CH, Alamgir AH. Trends in hip fracture-related mortality in Texas, 1990-2007. *South Med J*. 2011;104(7):482-487.
20. Clague JE, Craddock E, Andrew G, Horan MA, Pendleton N. Predictors of outcome following hip fracture. Admission time predicts length of stay and in-hospital mortality. *Injury*. 2002;33(1):1-6.
21. Hu F, Jiang C, Shen J, Tang P, Wang Y. Preoperative predictors for mortality following hip fracture surgery: a systematic review and meta-analysis. *Injury*. 2012;43(6):676-685.
22. Holvik K, Ranhoff AH, Martinsen MI, Solheim LF. Predictors of mortality in older hip fracture inpatients admitted to an orthogeriatric unit in Oslo, Norway. *J Aging Health*. 2010;22(8):1114-1131.
23. Mmetsoudis SG. Limitations associated with the analysis of data from administrative databases. *Anesthesiology*. 2009;111(2):449; author reply 50-51.
24. Tseng VL, Yu F, Lum F, Coleman AL. Risk of fractures following cataract surgery in Medicare beneficiaries. *JAMA*. 2012;308(5):493-501.
25. Roche JJ, Wenn RT, Sahota O, Moran CG. Effect of comorbidities and postoperative complications on mortality after hip fracture in elderly people: prospective observational cohort study. *BMJ*. 2005;331(7529):1374.
26. Neuman MD, Silber JH, Magaziner JS, Passarella MA, Mehta S, Werner RM. Survival and functional outcomes after hip fracture among nursing home residents. *JAMA Intern Med*. 2014;174(8):1273-1280.