Extended Use of Indwelling Urinary Catheters in Postoperative Hip Fracture Patients

Heidi Wald, MD,*† Anne Epstein, PhD,* and Andrew Kramer, MD*†

Background: Indwelling urinary catheters are used postoperatively in hip fracture care. Their use beyond the immediate postoperative period may result in excess nosocomial infections.

Objectives: The objectives of this study were to explore the relationship between extended indwelling urinary catheterization and outcomes for patients sustaining hip fracture discharged to skilled nursing facilities (SNFs), and to describe patient and hospital predictors of extended indwelling urinary catheterization.

Research Design: The authors conducted a retrospective cohort study.

Subjects: This study consisted of Medicare admissions to SNFs of patients discharged from a hospital with a primary diagnosis of hip fracture in 2001 (n = 111,330).

Measures: Dependent variables were the presence of urinary catheter at SNF admission and the patient-specific 30-day outcomes of rehospitalization for urinary tract infection, rehospitalization for sepsis, discharge to the community, and mortality. Independent variables were demographic, clinical, and hospital characteristics.

Results: Thirty-two percent of hip fracture discharges to SNFs had urinary catheters. These patients had greater odds of rehospitalization for urinary tract infection (adjusted odds ratio [AOR] 1.6, P < 0.001) and death (AOR 1.3, P < 0.001) at 30 days than patients without catheters after adjusting for patient characteristics such as age and comorbid conditions. Western region and urban location were associated with a higher likelihood of having an indwelling urinary catheter, whereas northern region and teaching hospital status were associated with a lower likelihood of having an indwelling urinary catheter.

Conclusions: Extended use of indwelling urinary catheters postoperatively is associated with poor outcomes. The likelihood of having an indwelling urinary catheter at hospital discharge after hip fracture is associated with hospital characteristics in addition to patient characteristics. This practice variation deserves further study.

Key Words: hip fracture, elderly, postoperative care, urinary catheter, nosocomial infection

(Med Care 2005;43: 1009–1017)
between extended urinary catheterization and fatal and non-
fatal outcomes among patients sustaining hip fracture dis-
charged to skilled nursing facilities (SNFs); and 2) to describe
patient and hospital characteristics that are associated with
extended indwelling urinary catheterization among patients
sustaining hip fracture discharged to SNFs.

METHODS

Sample
The study sample was comprised of all Medicare ad-
misions to SNFs from acute care hospitals with a primary
diagnosis of hip fracture between January 1, 2001, and
December 31, 2001. The International Classification of Dis-
eases, 9th Revision, Clinical Modification (ICD9-CM) codes
for hip fracture (820.0, 820.01, 820.02, 820.03, 820.09,
820.20, 820.21, 820.22, and 820.8) identified hip fracture
admissions. Patients less than 65 years of age, those who had
previous SNF or rehabilitation admission for hip fracture in
the calendar year, those who did not have surgical repair of
the hip, and those missing information on presence of urinary
catheter were excluded.

Data Sources
The Data Analysis PRO Skilled Nursing Facility Na-
tional Stay File Version 4.0 (DataPRO) was used to obtain
information about patient characteristics, the index hospital-
ization, and the SNF stay.14 The DataPRO file contains linked
hospital stay claims, SNF claims, Minimum Data Set (MDS),
and the Medicare Online Survey, Certification and Reporting
(OSCAR) database in a single record for each SNF admission
in the year 2001 (n = 1,816,126). The MDS is a component
of the federally mandated, periodic, comprehensive clinical
assessment of residents of nursing facilities.15 The construct-
ion of the DataPRO file is described in detail elsewhere.14

Information about hospitals was obtained from the
2001 Healthcare Cost and Utilization Project (HCUP) Na-
tionwide Inpatient Sample (NIS).16 The NIS is a discharge
data set containing all discharges from a 20% representative
sample of hospitals from 33 participating states. The Data-
PRO file was linked to the 986 sampled hospitals using the
American Hospital Association (AHA) and Medicare Hospi-
tal ID numbers through a crosswalk file provided by the
AHA. Additional hospital facility characteristics were ob-
tained from the AHA Guide to the Healthcare Field, 2002–
2003, which reports the results of the AHA Annual Survey of
Hospitals from 2001.17

Variables

Outcomes
Patient-specific outcomes occurring up to 30 days from
SNF admission. Rehospitalization for sepsis was determined
by the presence of ICD-9 code 038 listed as the primary
diagnosis for a qualifying rehospitalization claim within 30
days of SNF admission. Discharge to the community at 30
days was determined from the discharge status from the SNF
claim or the MDS discharge status code item R.3.a. Mortality
was determined from the Medicare Enrollment Database.

Catheter Presence
Urinary catheterization at admission to the SNF was
determined from the 5-day (admission) MDS assessment
item H.3.d. Section H addresses resident continence. Item H.3.d
consists of a checkbox for presence of indwelling catheter
and is distinguished from other urinary appliances such as
eternal (condom) catheters and intermittent catheters.

Covariates
Patient level independent risk factors are listed in Table
1 and include the following: patient characteristics, fracture
type, surgical procedure, hospital length of stay (LOS), co-
morbid conditions, inhospital complications and diagnoses
justifying a chronic indwelling urinary catheter. The latter
were determined based on clinical considerations guided
by published guidelines that consider complicated urinary
retention to be the major indication for chronic indwelling
catheters.18 Comorbidity was measured by the Charlson-
Deyo index.19

Also included were the postfracture functional status
(obtained from the admission MDS at the SNF) determined
by 5 individual measures of activities of daily living
(ADLs)20 as well as the modified Barthel Index, a com-
posite measure of function obtained by summing ADL
scores.21 The modified Barthel Index is scored from 0 to 90,
with higher numbers reflecting higher levels of function.
Finally, postoperative cognitive function was determined
at the admission MDS assessment from the Cognitive
Performance Scale (CPS) score. The CPS is a validated
measure derived from 5 individual measures on the MDS
reflecting cognitive function. It is scored from 0 to 6; higher
numbers reflect poorer cognition.22

For the outcomes rehospitalization for UTI, rehospi-
talization for sepsis, and discharge to community, several
additional covariates were included in the predictive mod-
els based on previous work23,24: marital status, cancer,
hypertension, renal failure, musculoskeletal disease, dys-
phagia, feeding tube, assistance with eating, bedbound,
and do-not-resuscitate status. The overall rehospitalization
rate for each SNF, generated from the 2001 DataPRO file,
was also included in the rehospitalization for UTI and
rehospitalization for sepsis models because this rate varies
with SNF characteristics.25,26

Hospital characteristics included size, urban location,
geographic region, teaching status, and ownership. Geo-
graphic region categories were northeast, south, west, and
midwest, with midwest serving as the reference category.
Ownership categories were government, not-for-profit, and
for-profit hospitals, with the latter serving as the reference

© 2005 Lippincott Williams & Wilkins
TABLE 1. Characteristics of Patients With Hip Fracture Discharged to a Skilled Nursing Facility (n = 111,330)

<table>
<thead>
<tr>
<th>Demographics</th>
<th>Catheter (n = 35,933)</th>
<th>No Catheter (n = 75,397)</th>
<th>Data Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age in years (mean)</td>
<td>84.4*</td>
<td>83.6</td>
<td>SNF</td>
</tr>
<tr>
<td>Female (%)</td>
<td>78.2</td>
<td>78.2</td>
<td>SNF</td>
</tr>
<tr>
<td>White (%)</td>
<td>95.3*</td>
<td>94.6</td>
<td>SNF</td>
</tr>
<tr>
<td>Married (%)</td>
<td>26.4</td>
<td>26.7</td>
<td>MDS</td>
</tr>
<tr>
<td>Fracture type</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Femoral neck (%)</td>
<td>30.2</td>
<td>30.1</td>
<td>HOSP</td>
</tr>
<tr>
<td>Intertrochanteric (%)</td>
<td>52.0*</td>
<td>51.0</td>
<td>HOSP</td>
</tr>
<tr>
<td>Surgery type</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Hemi-)arthroplasty (%)</td>
<td>39.5*</td>
<td>37.2</td>
<td>HOSP</td>
</tr>
<tr>
<td>Other repair (%)</td>
<td>62.6*</td>
<td>64.5</td>
<td>HOSP</td>
</tr>
<tr>
<td>Hospital length of stay (LOS)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOS in days (mean)</td>
<td>7.0*</td>
<td>6.6</td>
<td>HOSP</td>
</tr>
<tr>
<td>LOS 3 d (%)</td>
<td>9.9</td>
<td>9.5</td>
<td>HOSP</td>
</tr>
<tr>
<td>LOS 4-8 d (%)</td>
<td>69.2*</td>
<td>73.1</td>
<td>HOSP</td>
</tr>
<tr>
<td>LOS 9-13 d (%)</td>
<td>24.0*</td>
<td>22.2</td>
<td>HOSP</td>
</tr>
<tr>
<td>LOS ≥14 d (%)</td>
<td>6.7*</td>
<td>4.7</td>
<td>HOSP</td>
</tr>
<tr>
<td>Comorbidities†</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dementia (%)</td>
<td>32.6*</td>
<td>29.8</td>
<td>SNF, HOSP</td>
</tr>
<tr>
<td>Chronic respiratory condition (%)</td>
<td>20.5*</td>
<td>19.2</td>
<td>SNF, HOSP</td>
</tr>
<tr>
<td>Heart failure (%)</td>
<td>21.7*</td>
<td>17.1</td>
<td>SNF, HOSP</td>
</tr>
<tr>
<td>Diabetes mellitus (%)</td>
<td>17.2*</td>
<td>16.4</td>
<td>SNF, HOSP</td>
</tr>
<tr>
<td>Stroke (%)</td>
<td>3.7*</td>
<td>3.1</td>
<td>SNF, HOSP</td>
</tr>
<tr>
<td>Complications‡</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UTI (%)</td>
<td>15.9*</td>
<td>13.5</td>
<td>SNF, HOSP</td>
</tr>
<tr>
<td>Pressure ulcer (%)</td>
<td>31.8*</td>
<td>23.6</td>
<td>SNF, HOSP</td>
</tr>
<tr>
<td>Coma (%)</td>
<td>0.6*</td>
<td>0.8</td>
<td>SNF, HOSP</td>
</tr>
<tr>
<td>Delirium (%)</td>
<td>2.5</td>
<td>2.4</td>
<td>SNF, HOSP</td>
</tr>
<tr>
<td>Justifiable indications for catheter§</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urinary retention (%)</td>
<td>5.3*</td>
<td>2.3</td>
<td>SNF, HOSP</td>
</tr>
<tr>
<td>Bladder outlet obstruction (%)</td>
<td>0.7*</td>
<td>0.3</td>
<td>SNF, HOSP</td>
</tr>
<tr>
<td>Quad-, para-, hemiparesis (%)</td>
<td>1.0*</td>
<td>0.6</td>
<td>SNF, HOSP</td>
</tr>
<tr>
<td>Multiple sclerosis (%)</td>
<td>0.2*</td>
<td>0.1</td>
<td>SNF, HOSP</td>
</tr>
<tr>
<td>Other neurogenic bladder (%)</td>
<td>0.8*</td>
<td>0.3</td>
<td>SNF, HOSP</td>
</tr>
<tr>
<td>Prostate disease (%)</td>
<td>2.6*</td>
<td>2.0</td>
<td>SNF, HOSP</td>
</tr>
<tr>
<td>Function</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modified Barthel score (mean)</td>
<td>29.4*</td>
<td>32.8</td>
<td>MDS</td>
</tr>
<tr>
<td>Transfer (% independent)</td>
<td>0.2*</td>
<td>0.9</td>
<td>MDS</td>
</tr>
<tr>
<td>Toilet (% independent)</td>
<td>0.4*</td>
<td>1.4</td>
<td>MDS</td>
</tr>
<tr>
<td>Walk hall (% independent)</td>
<td>0.2*</td>
<td>0.6</td>
<td>MDS</td>
</tr>
<tr>
<td>Bowel incontinence (% continent)</td>
<td>54.2*</td>
<td>62.9</td>
<td>MDS</td>
</tr>
<tr>
<td>Bladder incontinence (% continent)</td>
<td>—</td>
<td>47.3</td>
<td>MDS</td>
</tr>
<tr>
<td>Mobility self (% independent)</td>
<td>2.2*</td>
<td>6.5</td>
<td>MDS</td>
</tr>
<tr>
<td>CPS score (mean)</td>
<td>2.1*</td>
<td>1.7</td>
<td>MDS</td>
</tr>
<tr>
<td>Outcomes at 30 d</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rehospitalization for UTI</td>
<td>5.8*</td>
<td>3.1</td>
<td>REHOSP</td>
</tr>
<tr>
<td>Rehospitalization for sepsis</td>
<td>1.5*</td>
<td>1.0</td>
<td>REHOSP</td>
</tr>
<tr>
<td>Discharge to community</td>
<td>27.4*</td>
<td>33.4</td>
<td>SNF, MDS</td>
</tr>
<tr>
<td>Mortality</td>
<td>6.4*</td>
<td>3.5</td>
<td>MEDICARE</td>
</tr>
</tbody>
</table>

*P < 0.01.

†P = 0.02.

‡Comorbidities were determined from any current or historic ICD-9 codes.

§Complications of hip fracture were determined from ICD-9 codes from the index hospitalization or SNF stay.

Justifiable indications for catheterization were determined from any current or historic ICD-9 codes, with the exception of urinary retention which was determined from historic ICD-9 codes only.

[The modified Barthel Index is a 90-point scale with higher numbers reflecting higher levels of function. CPS indicates cognitive performance scale. Scores on CPS can range from 0 to 6 with higher numbers reflecting worsening cognitive impairment.

SNF, skilled nursing facility claim; MDS, Minimum Data Set; HOSP, qualifying hospital claim; REHOSP, qualifying rehospitalization claim; MEDICARE, Medicare Enrollment Database; UTI, urinary tract infection; ICD-9, International Classification of Diseases, 9th Revision.]
category. Also included were measures of hip fracture care (eg, case volume) and the presence of specialized geriatric or rehabilitation services.

Analysis

Bivariate comparisons for patient characteristics were conducted between patients with and without indwelling urinary catheters at the time of SNF admission. The Fisher exact test was used for categorical variables and the Wilcoxon rank-sum test was used for continuous variables.

Outcomes

To assess the outcome–catheter relationship, logistic regression related catheter presence to each of the 4 outcomes, controlling for patient characteristics. The choice of independent variables from the patient level risk factors was driven by clinical hypotheses and informed by prior work. Variable reduction was done based on the significance of the variable in the model as well as on minimizing multicollinearity in the models. The fit of the model for each outcome was assessed by evaluating the area under the receiver-operating characteristic (ROC) curve (or C-statistic) for which a value of 1.0 is ideal, whereas a value of 0.5 is no better than chance alone.

Model of Catheter Presence

To account for the clustering of observations in the 523 hospitals, a hierarchical random-effects model was used to predict the risk of having an indwelling urinary catheter for an extended period postoperatively controlling for patient and hospital characteristics. This model was estimated using the subset of patients sustaining hip fracture who had been discharged to an SNF from one of the hospitals for which NIS data were identifiable. The choice of independent variables from patient- and hospital-level risk factors was driven by clinical hypotheses. Variable reduction occurred based on variable contribution to the model and on minimizing multicollinearity in the model. Two SNF measures were also included in this model (number of days to first MDS assessment for each patient and the observed-to-expected 30-day discharge-to-community ratio for hip fracture admission to each SNF) because these properties might be related to the chance of the SNF removing the catheter before administration of the MDS. The goodness of fit of this model was assessed by 2 measures. First, the scaled deviance adjusted for degrees of freedom was calculated with desirable values near one. Second, a pseudo R-square was calculated by comparing log likelihood of the full model with the log likelihood of an intercept only model. Statistical analyses were conducted with SAS version 8.02.

RESULTS

Patient Characteristics

In 2001, there were 126,163 patients greater than 65 years of age admitted to SNFs after hospitalization for a primary diagnosis of hip fracture. After excluding patients treated medically for hip fracture (n = 8898) and 5935 patients with missing data on catheter presence (4.9%), 111,330 patients were included in the initial analyses. The mean age of the sample was 84 years (standard deviation [SD] 7.1). Seventy-eight percent of the patients were female and 95% were white. Fifty-one percent experienced intertrochanteric fractures and 30% experienced femoral neck fractures. The mean hospital length of stay for these patients was 6.7 days (SD 4.5).

Table 1 presents the characteristics of the patients sustaining hip fracture stratified by presence of indwelling urinary catheter at the time of admission to an SNF. Thirty-two percent of hip fracture discharges to SNFs had urinary catheters at admission. MDS assessment. Although the demographics of the 2 groups of patients were similar, patients who had indwelling urinary catheters at admission to an SNF were sicker than patients whose catheters were removed before SNF admission. As might be expected, patients with indwelling urinary catheters were more likely to experience comorbidities and had more complications of hip fracture during the episode of care. In particular, the catheterized patients had higher rates of previous ulcers (31.8% vs. 23.6%) and UTIs (15.9% vs. 13.5%). Catheterized patients were also more likely to have a diagnosis potentially justifying long-term catheterization; however, the absolute rates of these disorders were low, totaling 10.6% of catheterized patients (vs. 5.6% of patients whose catheters were removed). Catheterized patients were more dependent in 6 individual ADLs. This was reflected in lower scores on the modified Barthel Index (29.4 vs. 32.8). Catheterized patients also received higher CPS scores (2.1 vs. 1.7), indicating lower cognitive performance.

Outcomes

Table 2 presents the results of the logistic regression models for each of the outcomes studied. Among postoperative patients sustaining hip fracture discharged to SNFs, the odds of rehospitalization for UTI within 30 days of SNF admission are 58% higher for patients with extended indwelling urinary catheters than for patients without catheters, the odds of rehospitalization for sepsis are 22% higher, and the odds of discharge to the community are 7% lower, all after adjustment for patient characteristics. Patients with extended indwelling urinary catheters also have 31% greater odds of death at 30 days. The fit of the logistic regression models for each outcome was good with C-statistics of 0.71, 0.75, 0.83, and 0.77 for rehospitalization for UTI, rehospitalization for sepsis, discharge to the community, and mortality, respectively.

Hospital Characteristics

Of the 986 hospitals sampled by the NIS in 2001, state regulations restricting identification of hospitals prevented the match between 296 hospitals (30%) and the DataPRO file. Three additional hospitals were eliminated as a result of absence of information in the AHA Guide, along with 123 hospitals with no hip fracture discharges to SNFs. Character-
The effect of presence of urinary catheter on selected outcomes at 30 D in patients with hip fracture discharged to a skilled nursing facility

<table>
<thead>
<tr>
<th>Outcome</th>
<th>No.</th>
<th>Unadjusted OR</th>
<th>P</th>
<th>Adjusted OR</th>
<th>P</th>
<th>C Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rehospitalization for UTI*</td>
<td>110,556</td>
<td>1.92</td>
<td>&lt;0.0001</td>
<td>1.58</td>
<td>&lt;0.0001</td>
<td>0.71</td>
</tr>
<tr>
<td>Rehospitalization for sepsis*</td>
<td>110,556</td>
<td>1.51</td>
<td>&lt;0.0001</td>
<td>1.22</td>
<td>0.001</td>
<td>0.75</td>
</tr>
<tr>
<td>Discharge to community*</td>
<td>110,485</td>
<td>0.75</td>
<td>&lt;0.0001</td>
<td>0.93</td>
<td>&lt;0.0001</td>
<td>0.83</td>
</tr>
<tr>
<td>Mortality*</td>
<td>110,594</td>
<td>1.89</td>
<td>&lt;0.0001</td>
<td>1.31</td>
<td>&lt;0.0001</td>
<td>0.77</td>
</tr>
</tbody>
</table>

*Rehospitalization for UTI and rehospitalization for sepsis covariates included justifiable diagnosis for indwelling catheter, gender, age, race, urban location, Deyo comorbidity index, cancer, stroke, CHF, hypertension, cognitive impairment, delirium, function (modified Barthel), fracture type, renal failure, dysphagia, bedbound, marital status, assistance with eating, musculoskeletal disease, arthroplasty, do not resuscitate order, feeding tube, and overall rehospitalization rate for the SNF.

Discharge to community covariates included justifiable diagnosis for indwelling catheter, gender, age, race, urban location, Deyo comorbidity index, cancer, stroke, CHF, hypertension, cognitive impairment, delirium, function (modified Barthel), fracture type, renal failure, dysphagia, bedbound, marital status, assistance with eating, musculoskeletal disease, arthroplasty, do not resuscitate order, feeding tube.

Mortality covariates included justifiable diagnosis for indwelling catheter, gender, age, race, urban location, Deyo comorbidity index, cancer, stroke, CHF, hypertension, cognitive impairment, delirium, function (modified Barthel), fracture type, arthroplasty, do not resuscitate order.

OR indicates odds ratio; UTI, urinary tract infection; CHF, congestive heart failure; SNF, skilled nursing facility.

Table 2. Effect of Presence of Urinary Catheter on Selected Outcomes at 30 D in Patients With Hip Fracture Discharged to a Skilled Nursing Facility

Table 3. Characteristics of Study Hospitals (n = 523)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily census (mean patients [SD])</td>
<td>134 (145)</td>
</tr>
<tr>
<td>Staffed beds (mean beds [SD])</td>
<td>210 (187)</td>
</tr>
<tr>
<td>Urban location (%)</td>
<td>67.7</td>
</tr>
<tr>
<td>Teaching (%)</td>
<td>21.2</td>
</tr>
<tr>
<td>Region</td>
<td></td>
</tr>
<tr>
<td>Midwest</td>
<td>27.7</td>
</tr>
<tr>
<td>Northeast</td>
<td>22.6</td>
</tr>
<tr>
<td>South</td>
<td>23.9</td>
</tr>
<tr>
<td>West</td>
<td>25.8</td>
</tr>
<tr>
<td>Control</td>
<td></td>
</tr>
<tr>
<td>For-profit</td>
<td>12.6</td>
</tr>
<tr>
<td>Government</td>
<td>14.9</td>
</tr>
<tr>
<td>Not-for-profit</td>
<td>72.5</td>
</tr>
<tr>
<td>Volume hip fracture cases (mean cases [SD])</td>
<td>97 (79)</td>
</tr>
<tr>
<td>Volume hip fracture discharges to SNF (mean discharges [SD])</td>
<td>52 (52)</td>
</tr>
<tr>
<td>Hip fracture length of stay (days [SD])</td>
<td>6.9 (2.3)</td>
</tr>
<tr>
<td>Observed catheterization rate for hip fracture patients discharged to SNF (%)</td>
<td>32.8 (21.1)</td>
</tr>
<tr>
<td>Rehabilitation charges for hip fracture (mean $ [SD])</td>
<td>812 (619)</td>
</tr>
<tr>
<td>In hospital hip fracture mortality (%)</td>
<td>4.3</td>
</tr>
<tr>
<td>Has hospital-based skilled nursing facility* (%)</td>
<td>62.0</td>
</tr>
<tr>
<td>Has adult day services* (%)</td>
<td>14.3</td>
</tr>
<tr>
<td>Has geriatric services* (%)</td>
<td>53.6</td>
</tr>
<tr>
<td>Has rehabilitation services* (%)</td>
<td>30.7</td>
</tr>
</tbody>
</table>

*Defined in AHA Annual Survey of Hospitals, 2001. SD indicates standard deviation; SNF, skilled nursing facility.

The characteristics of the 523 hospitals (53%) that remained in the hospital level analyses are presented in Table 3. The majority of hospitals were urban (67.7%) and not-for-profit (72.5%). Twenty-one percent were teaching hospitals. They were well-distributed among the major U.S. geographic regions. Study hospitals were large with an average of 210 staffed beds (SD 187) and 97 hip fracture cases (SD 79). Fifty-two percent of all patients sustaining hip fracture at study hospitals were discharged to SNFs. The average LOS in study hospitals for all hip fracture discharges was 6.9 days (SD 2.3). The mean observed rate of catheterization at discharge by discharging hospital was 32.8% (SD 21.1).

Predictors of Extended Catheterization

Table 4 presents the results of the hierarchical random-effects model that uses patient and hospital characteristics to predict the risk of having an indwelling urinary catheter at admission to an SNF. The model was estimated using the subset of 19,208 patients sustaining hip fracture who had been discharged to an SNF from one of the 523 hospitals for which NIS data were identifiable (n = 19,208, levels = 523). The patient characteristics of age, female gender, having undergone arthroplasty, a hospital LOS greater than 9 days, and dependence with toileting were all significantly positively associated with extended indwelling urinary catheterization, as were having a chronic respiratory condition, congestive heart failure, pressure ulcer, or justifiable diagnosis for long-term catheterization. The patient characteristics of delirium, adapted Barthel reflecting higher function, and greater number of days from SNF admission to MDS assessment were significantly negatively associated with extended indwelling urinary catheterization.

After accounting for patient characteristics, several hospital characteristics were also predictive of extended indwelling urinary catheterization at an SNF after hip fracture. Most notable was the pattern seen with geographic region. Hospitalization in the west was significantly positively associated with having a catheter, whereas hospitalization in the northeast was significantly negatively associated with having a catheter. Hospitalization in the south had a negative association with the presence of an indwelling urinary catheter that was of borderline significance when compared with the midwest. In addition, urban location was significantly positively associated with having a catheter, whereas being at a teaching hospital was significantly negatively associated with having a catheter. The scaled deviance of the model is 1.21 and the pseudo R-square is 0.054.
Finally, the impact of the presence of several additional hospital-based services on postoperative indwelling catheterization rates at the SNFs was explored. This analysis was completed on the subset of 15,901 discharges from 426 hospitals for which additional information from the AHA survey was available. The services of interest included the presence of a hospital-based SNF, inpatient rehabilitation service, adult day services, and geriatric services. Among these, having a hospital-based SNF was associated with extended indwelling urinary catheterization at SNF (coefficient = 0.2650, \( P = 0.002 \)).

### CONCLUSIONS

#### Outcomes

This study demonstrates an association between extended indwelling urinary catheterization and poor outcomes in older patients sustaining hip fracture discharged to SNFs. In particular, extended indwelling urinary catheterization was associated with 58% higher odds of rehospitalization for UTI, 22% higher odds of rehospitalization for sepsis, 7% lower odds of discharge to home at 30 days, and 31% higher odds of 30-day mortality. Despite models with excellent fit (exceeding those used in coronary artery bypass surgery mortality studies), we cannot conclude that our outcome models fully accounted for confounding between catheterized and uncatheterized patients. Nonetheless, the effects we found with regard to rehospitalization for nosocomial infection and mortality are sizable. Thus, these associations are a cause for concern and warrant further study.

In his 2000 review of published literature, Saint estimated that 26% of patients with indwelling catheters for 2 to 10 days will become colonized with bacterial pathogens. Subsequently, 24% of these patients will develop symptomatic UTIs and 3.6% will develop bacteremia. Significantly, bacteremic UTI is known to be a risk factor for death in older patients. Data from the National Nosocomial Infections Surveillance (NNIS) system collected in the late 1980s demonstrated the odds of death in older patients with bacteremic UTI were 5.43 times that of patients with uncomplicated UTI. These data support a causal association between urinary catheterization and mortality in which bacterial colonization, symptomatic UTI, and bacteremia are intermediate steps.

The causal pathway described here is supported by our data and is diagrammed in Figure 1. Our primary finding, that of the association between catheter presence and 30-day mortality (odds ratio [OR] 1.31, \( P < 0.0001 \)), is indicated by the solid line. The majority of patients sustaining hip fracture with symptomatic or bacteremic UTI as the underlying cause of death are likely to be readmitted to the hospital coded as UTI (which includes urosepsis [ICD-9-CM 599.0]) or coded as sepsis. As noted earlier, the results of our outcome models established the association between having an indwelling urinary catheter at SNF admission and rehospitalization for UTI (OR 1.58, \( P < 0.0001 \)) or sepsis (OR 1.22, \( P < 0.001 \)). These findings are indicated by the dotted lines.

Given that bacteremic UTI is a risk factor for death, rehospitalizations for UTI and sepsis, as surrogate measures, should also be associated with 30-day mortality. In fact, when rehospitalization for UTI and rehospitalization for sepsis were included as covariates in our logistic regression model...
Rehospitalization for UTI

OR=1.58
(p<0.0001)

Rehospitalization for sepsis

OR=1.31
(p<0.0001)

Death

OR=1.22
(p=0.0009)

FIGURE 1. Results of the logistic regression model for the outcome of death at 30 days demonstrated that extended catheterization was associated with a 31% increase in the odds of death at 30 days (solid line). This association was attributed to nosocomial infection, identified in our data as rehospitalizations for urinary tract infection (UTI) or sepsis. Rehospitalizations for UTI and sepsis were associated with extended indwelling urinary catheterization (dashed lines) and death at 30 days (dotted lines).

for death at 30 days, both were strongly and significantly associated with death at 30 days (OR 1.25, \( P = 0.0001 \) and OR 5.57, \( P < 0.0001 \)). These results are depicted by the dotted lines. These associations provide additional support for our finding that catheter presence is associated with death at 30 days.

Predictors of Extended Catheterization

Justifiable diagnoses for long-term catheterization (including urinary retention, bladder outlet obstruction, paresis and other causes of neurogenic bladder, and prostate disease) were extremely strong patient-level predictors of extended catheterization, as we might expect, even with potential ICD-9 coding limitations. Other potentially appropriate positive predictors of extended catheterization were toileting assistance, pressure ulcer, and overall function. Delirium reduced the likelihood of extended catheterization, perhaps because of the risk that a delirious patient might inadvertently remove a catheter. Additional predictors such as age, gender, and comorbidity were also understandable surrogates for general condition related to severity of illness or postoperative urinary retention.32

This investigation also identified the association of several important hospital characteristics with extended indwelling urinary catheterization in postoperative patients sustaining hip fracture after adjustment for numerous patient characteristics. Our principle finding, that of regional variation with respect to the risk of having an extended indwelling urinary catheter (with hospitalization in the northeast resulting in a lower likelihood of extended catheterization and hospitalization in the west resulting in a higher likelihood of extended catheterization), is consistent with a sizable database demonstrating regional variation in the use of a range of services in the Medicare population.33 These discrepancies have been attributed to several factors, including differences in patient demographics, medical practice styles, local regulations, and the availability of various technologies or facilities.34 In particular, there exist longstanding, stable differences in hospital LOS among U.S. geographic regions that are not explained by patient characteristics or severity of illness10,35 (historically, LOS in the northeast is the longest; in the west, it is the shortest). Therefore, the LOS variation among hospitals in different regions reflects differing practice for patients with the same severity of illness.

As overall LOS in acute care hospitals in the United States has declined steadily, short LOS has been viewed as a potential contributor to poor outcomes. In 1981, hip fracture LOS was 20.1 days, but by 1999, it was 6.5 days.13,36 An unintended result of this trend is that increasing numbers of patients sustaining hip fracture are discharged from acute care with new medical instabilities that predispose to death, readmission, and poor functional outcomes.37,38 As others have asserted, short LOS may predict the poor performance of processes of care such as the removal of indwelling urinary catheters. Thus, regional variations in LOS may substantially explain the regional variations in the use of extended urinary catheterization we observed.37 In as much as LOS, as a reflection of practice style, contributes to regional variation in catheter use, catheter use deserves further scrutiny.

LIMITATIONS

This work has several limitations. First, its observational design curtails our ability to make causative inferences about the relationships studied. In particular, there may be unmeasured patient characteristics associated with catheterization that influence the observed outcome relationships and that differentiate hospital patient populations, thus accounting for the observed differences in catheter use among hospitals. Other factors such as the impact of SNF practices are also difficult to discount despite our effort to control for SNF quality using a measure of observed-to-expected discharge to community.

Second, selection bias may have been introduced because we studied SNF patients only, and not those discharged to acute rehabilitation or home health care. The NIS data from 2001 demonstrate distinct differences in rates of utilization of SNFs for postacute care among patients sustaining hip fracture, ranging from 64% in the west to 53% in the northeast. However, geographic referral pattern variation is likely to have biased our results in a direction opposite to the observed effect. The high use of SNFs in the west may be attributable to the relative scarcity of acute rehabilitation facilities in the west compared with other regions of the country.39 One would expect, therefore, that the SNF patients in the west would be healthier than SNF patients in other regions of the country and have lower rates of extended catheterization. In fact, that result is not supported by our data. In addition, the national sample of hospitals we studied was curtailed as the result of state-specific confidentiality regulations. Therefore, the conclusions about hospital practice are based on a subset of hospitals that may differ from significantly from all U.S. hospitals. Consequently, the gen-
eralizability of our results to all hospitals, particularly smaller ones, is limited.

Finally, catheter presence and the functional and cognitive measures used in this investigation are drawn from the 5-day MDS assessment and predicated on the assumption that the 5-day MDS reflects the patient’s status at the time of transition from hospital to nursing home. In fact, the 5-day MDS assessment occurred anywhere from days 1 to 7 for study patients, with the median being 4 days. We adjusted for this variation in SNF practice by including a “days to MDS” covariate in the hierarchical random-effects model to control for differences in the number of days from SNF admission to the MDS assessment for each patient.

In conclusion, urinary catheterization is a prevalent postoperative process of care that may jeopardize patient outcomes—particularly for the frail, older patient that is typical of the hip fracture population. Among those who are discharged to an SNF for subacute rehabilitation, this work suggests that extended catheterization is associated with a large increase in mortality at 30 days when compared with patients whose catheters are removed before discharge, with increased rates of complicated urinary tract infection as a likely pathway. To the extent that this association has been noted previously in the literature, little attention has been given to it. Although some authors have proposed recommendations for urinary catheter use, to our knowledge, no current guidelines regarding use of postoperative indwelling urinary catheters exist.

Moreover, our results suggest that even in the face of adjustment for patient characteristics, there remain strong associations between hospital characteristics and extended indwelling urinary catheterization. These associations are cause for concern because they suggest unnecessary and potentially harmful variations in practice. Given the observational nature of this work, future work should explore prospectively if reduction in the use of indwelling catheters without justification is associated with improved outcomes and whether unnecessary variations in practice can be diminished.

REFERENCES

14. Kramer AM and DataPRO Project Investigators at the Colorado Foundation for Medical Care, the University of Colorado Health Sciences Center Division of Health Care Policy and Research, Fu Associates Ltd, Stepwise Systems Inc. Skilled Nursing Facilities Prospective Payment System Quality Medical Review Data Analysis PRO: Final Report. Centers for Medicare and Medicaid Services; 2002.
23. Fish RH and DataPRO Project Investigators at the Colorado Foundation for Medical Care, the University of Colorado Health Sciences Center Division of Health Care Policy and Research, Fu Associates Ltd, Stepwise Systems Inc. Findings From Rehospitalization Transfer within 30 Days Analysis: Summary and Selected Results. Centers for Medicare & Medicaid Services; 2002.
24. Eilertsen TB and DataPRO Project Investigators at the Colorado Foundation for Medical Care, the University of Colorado Health Sciences Center Division of Health Care Policy and Research, Fu Associates Ltd, Stepwise Systems Inc. Findings From Analysis of Residents Discharged to the Community. Centers for Medicare & Medicaid Services; 2002.
29. Eilertsen TB and DataPRO Project Investigators at the Colorado Foundation for Medical Care, the University of Colorado Health Sciences Center Division of Health Care Policy and Research, Fu Associates Ltd, and Stepwise Systems Inc. Rehabilitation Data Flag Analysis. Centers for Medicare & Medicaid Services; 2004.