RESEARCH LETTERS

Hospitalization Rates and In-Hospital Mortality Among Centenarians

The number of Americans at least 100 years old is expected to grow dramatically over the coming years. In December 2010, 71,991 centenarians lived in the United States, almost double the number there were 20 years ago.1,2 By 2050, the number of centenarians is expected to reach 601,000, a 735% increase.2 Despite the growing numbers, the health care use of this population remains largely unexamined. In particular, the rates and outcomes of hospitalization for persons 100 years or older are unknown. The goal of this study was to determine rates of hospital admission as well as in-hospital all-cause and diagnosis-specific mortality in patients 100 years or older.

Methods. We conducted a cross-sectional analysis of 2004-2008 hospital discharge information from the Healthcare Cost and Utilization Project Nationwide Inpatient Sample (HCUP-NIS). The HCUP-NIS, a 20% stratified sample of acute hospital admissions, is the largest all-payer inpatient database in the United States.3 Sampling weights are used to generate national estimates. We selected all patients 100 years or older included in the HCUP-NIS from 2004 through 2008. Admissions missing mortality data (<0.01%) were excluded. We calculated the 10 most common principal discharge diagnoses and grouped them based on International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes (eTable; http://www.archinternmed.com). Comorbidity was measured using the age-independent Charlson Comorbidity Index, which incorporates 19 medical conditions, including dementia, cardiovascular disease, cerebrovascular disease, pulmonary disease, renal disease, diabetes mellitus, and malignant disease, and classified as mild (Charlson score, 0-1), moderate (Charlson score, 2-4), and severe (Charlson score, ≥5).4 We calculated rates of utilization, all-cause mortality, and disease-specific mortality. Data analysis and treatment were performed using SAS statistical software (version 9.2; SAS Institute Inc). This study was exempted by the institutional review board of Yale University because HCUP-NIS is a public database with no personal identifying information.

Results. Over the 5-year period, there were 134,527 admissions for persons 100 years or older. The number increased from 24,750 admissions in 2004 to 29,099 admissions in 2008, an 18% increase. The mean (SD) age was 101.46 (4.29) years (range, 100-124 years). Most patients were female (80.1%); 57.0% had mild comorbidity, 39.3% had moderate comorbidity, and 3.7% had severe comorbidity. The overall mortality rate for hospitalization among those 100 years or older was 10.58%. All-cause mortality and disease-specific mortality are reported in the Table. Only 1.8% received an endotracheal tube during hospitalization; 56.0% of these individuals died during the hospitalization.

Comment. We describe the rate of admissions and inhospital all-cause and disease-specific mortality for patients 100 years or older. The 2008 hospital admission rate was 59 per 100 centenarians based on US Census Bureau data.5 The 18% increase in admissions over the study period suggests that hospitalizations among centenarians will be an increasingly common event. Among the 10 most frequent reasons for hospitalization, sepsis, aspiration pneumonia, and acute myocardial infarction were associated with a high risk of mortality, but even among these diagnoses, most centenarians survived the hospitalization.

Our study expands on limited prior data in centenarians. Krishnan et al6 reported an all-cause mortality rate of 12.2% using HCUP-NIS data from a decade ago, although their study focused on knee and hip arthroplasty in nonagenarians and centenarians. The lower mortality rate in the current study may reflect differing study populations, changes in decisions about hospitalization, or improved hospital care for geriatric patients. Kent et al7 and Wilson et al8 studied mortality in centenarian

<table>
<thead>
<tr>
<th>Principal Diagnosis</th>
<th>Total Admissions, %b</th>
<th>Mortality, %b</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>100</td>
<td>10.58 (10.59)</td>
</tr>
<tr>
<td>Pneumonia (nonaspiration)</td>
<td>10.02 (10.79)</td>
<td>12.24 (12.27)</td>
</tr>
<tr>
<td>Congestive heart failure</td>
<td>8.66 (8.65)</td>
<td>9.62 (9.55)</td>
</tr>
<tr>
<td>Urinary tract infection</td>
<td>5.42 (5.43)</td>
<td>4.24 (4.11)</td>
</tr>
<tr>
<td>Fracture of the femur</td>
<td>5.25 (5.27)</td>
<td>5.86 (5.90)</td>
</tr>
<tr>
<td>Sepsis</td>
<td>4.68 (4.72)</td>
<td>32.12 (32.20)</td>
</tr>
<tr>
<td>Fluid, electrolyte, or acid-base disorder</td>
<td>3.79 (3.77)</td>
<td>7.63 (7.57)</td>
</tr>
<tr>
<td>Aspiration pneumonia</td>
<td>3.41 (3.41)</td>
<td>21.05 (21.03)</td>
</tr>
<tr>
<td>Acute myocardial infarction</td>
<td>3.2 (3.22)</td>
<td>20.26 (19.89)</td>
</tr>
<tr>
<td>Stroke</td>
<td>2.63 (2.62)</td>
<td>16.46 (16.18)</td>
</tr>
<tr>
<td>Acute renal failure</td>
<td>2.28 (2.28)</td>
<td>16.85 (16.67)</td>
</tr>
</tbody>
</table>

Sampling weights were applied to a 20% sample to generate national estimates (n = 134,527).

*Estimated national percentages using sampling weights. Percentages in parenthesis are results from unweighted 20% sample (n = 27,344).
trauma and surgical intensive care unit patients, respectively, and, not surprisingly, reported higher mortality rates of 19.2% and 22.2%, respectively, in these higher-risk populations. Hip fracture, the only surgical diagnosis among the 10 most common diagnoses in the current study, was associated with a 5.9% hospital mortality rate.

This study has several limitations. Because the HCUP-NIS is an administrative database, we lacked clinical, functional, or other details. Errors in ICD-9-CM coding and documentation are possible, although the error rate has been found to be low in this database. As with any administrative database, ICD-9-CM coding may be biased by the tendency to code diagnoses with higher reimbursement. In addition, determination of a primary diagnosis may be difficult in elderly patients owing to the presence of multiple comorbid conditions. We did not analyze the frequency or outcomes of specific interventions, except endotracheal intubation, during the hospitalization. This is an important topic for future research. Finally, information for each patient was limited to a single hospitalization. We do not have information on posthospitalization events or outcomes, such as readmission, discharge to hospice or long-term care, long-term survival, or change in function.

This study reports data on admission rates, all-cause mortality, and disease-specific mortality in centenarians. Results show a hospitalization rate of over 50 admissions per 100 centenarians; 90% survived the hospitalization. Hospital care may benefit a sizable proportion of even extremely elderly individuals. Given the expanding population of centenarians, it will be important to examine the types of services received and posthospitalization outcomes.

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Published Online: June 18, 2012. doi:10.1001/archinternmed.2012.2155

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Funding/Support: This study was supported in part by the Yale Pepper Center (P30 AG021342) from the National Institute on Aging.

Online-Only Material: The eTable is available at http://www.archinternmed.com.


### Effects of Statins on Energy and Fatigue With Exertion: Results From a Randomized Controlled Trial

No drug is without adverse effect potential, and fatigue and exertional intolerance are adverse effects reported by patients receiving statins.\(^1\)\(^2\) Little direct information is available regarding the typical or average impact of statins on energy or exertional fatigue.

Although many observational reports have cited fatigue and exertional fatigue with statin use, to our knowledge, no randomized trials have addressed this issue to date. Energy and exertional fatigue were measured as tertiary and/or exploratory outcomes in the University of California, San Diego (UCSD) Statin Study, which aimed to examine a range of noncardiac outcomes.\(^3\) We capitalized on these data to evaluate whether moderate-dose statins affected energy and exertional fatigue in a broadly sampled primary prevention population.

**CME available online at www.jamaarchivescme.com and questions on page 1122**

**Methods.** A total of 1016 subjects (692 men 20 years or older and 324 nonprocreative women, with screening low-density lipoprotein cholesterol levels 115-190 mg/dL [to convert to millimoles per liter, multiply by 0.0259] and no cardiovascular disease or diabetes) were randomized equally to 20-mg simvastatin (lipophilic statin), 40-mg pravastatin (hydrophilic statin), or microcrystalline-