Decade-Long Trends in Mortality Among Patients With and Without Diabetes Mellitus at a Major Academic Medical Center

The prevalence of diabetes mellitus has risen markedly over the past decade and is projected to increase substantially. More than 20% of hospitalized patients are estimated to have diabetes, and individuals with diabetes have historically experienced higher inpatient mortality than individuals without diabetes. Over the past decade, evidence from large clinical trials has prompted recommendations for tighter inpatient and outpatient glucose control, as well as more stringent blood pressure and lipid management, to improve outcomes for patients with diabetes. It is unclear whether the mortality impact of diabetes has changed as a consequence.

**Methods** | We examined 11-year trends in mortality among patients with and without diabetes hospitalized at Yale–New Haven Hospital, a major urban medical center. We obtained approval from the Yale Human Research Protection Program, which provided a waiver of informed consent. We considered all adult, nonobstetric patients with an inpatient discharge between January 1, 2000, and December 31, 2010, in Yale–New Haven Hospital administrative billing data. The primary end point was in-hospital mortality. Diabetes status was defined as a diagnosis of diabetes during the index admission or in any hospital encounter in the year prior to the index admission. Time was measured as the difference between January 1, 2000, and patient admission date, in years. We additionally included an array of covariates based on established associations with in-hospital mortality.

We used a difference-in-differences approach comparing changes over time in in-hospital mortality in patients with vs without diabetes to determine whether patients with diabetes had a different time trend in risk of in-hospital mortality. We constructed multivariate logistic regression models including time in years, diabetes status, and the interaction between time and diabetes status, as well as an array of covariates. We calculated odds of death and confidence intervals for each additional year for patients with diabetes by exponentiating the sum of parameter estimates for time and the diabetes-time interaction term. We used a type I error of 5% (2-sided) to test for statistical significance and obtained point estimates and 95% confidence intervals via the bootstrap method.

**Results** | We included 322,938 hospitalizations, of which 76,758 (23.8%) were from patients with diabetes. The overall mortality rate was 2.3%: 2.7% of patients with diabetes and 2.2% of patients without diabetes. Unadjusted mortality among patients with diabetes decreased from 3.6% in 2000 to 2.2% in 2010 while mortality among patients without diabetes decreased from 2.4% in 2000 to 2.3% in 2010. The Figure shows quarterly in-hospital mortality for patients with and without diabetes from 2000 to 2010.

The Table describes the difference-in-differences regression analyses. Each successive year was associated with a 4.5% reduction in the adjusted odds of mortality (odds ratio [OR], 0.96 [95% CI, 0.95-0.96]) for patients without diabetes compared with an 8.7% reduction for those with diabetes (OR, 0.91 [95% CI, 0.90-0.93]). Patients with diabetes compared with patients without diabetes had a significantly greater decline in risk of adjusted mortality of 4.4% per year (OR, 0.96 [95% CI, 0.94-0.97]). The adjusted odds of mortality among patients with vs without diabetes decreased from 1.20 in 2000 to 0.78 in 2010.

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**Table. Regression Analysis of Mortality Trends for 322,935 Hospitalized Patients With or Without Diabetes Mellitus**

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Odds Ratio (95% CI)</th>
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<tbody>
<tr>
<td>Diabetes</td>
<td>1.21 (1.08-1.36)</td>
</tr>
<tr>
<td>Time, y</td>
<td></td>
</tr>
<tr>
<td>Without diabetes</td>
<td>0.96 (0.95-0.96)</td>
</tr>
<tr>
<td>With diabetes</td>
<td>0.91 (0.90-0.93)</td>
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*C-statistic, 0.92. Model controls for sex, age at time of admission, length of stay in days, race (defined by hospital registration), payer, Elixhauser comorbidity dummy variables (revised to exclude diabetes and to use only secondary diagnosis codes), whether a patient spent a night in the intensive care unit, primary discharge diagnosis grouped using the Clinical Classifications Software (CCS), and service assignment (medicine, neurology, and surgery, including orthopedics and neurosurgery).
In a decade with increasing emphasis and accountability for glycemic control and cardiovascular risk management among patients with diabetes, we found that patients with diabetes have experienced a disproportionate reduction in in-hospital mortality over time and a complete reversal in risk of mortality relative to patients without diabetes. This interesting trend warrants additional study to elucidate its origins. Potential explanations include coincident improvements in inpatient glycemic control, improvements in outpatient glycemic control, improved nonglycemic cardiovascular risk management among patients with diabetes, and/or advances in therapies for diseases that disproportionately affect patients with diabetes.

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Discussion


Functional Impairment and Internet Use Among Older Adults: Implications for Meaningful Use of Patient Portals

Medicare is currently dispensing $30 billion in incentives to health care facilities that adopt the use of electronic medical records (EMRs). In 2014, incentives for “meaningful use” of EMRs will require online access by patients, and reimbursement penalties of up to 5% for nonadoption will begin in 2015.1 Broader use of online patient portals to EMRs is intended to improve care coordination; yet the impact of common problems in Medicare-eligible patients, such as chronic illness or functional impairment, on Internet use is unknown.

Methods

This study was approved by the institutional review board for the University of California, San Francisco. We used the Health and Retirement Study (http://hrsonline.isr.umich.edu), a nationally representative sample of community-dwelling seniors (limited to Medicare-eligible individuals aged ≥65 years, excluding the 3%-6% of all Medicare patients who live in nursing homes), for cross-sectional analysis of Internet use at 2 time points, 2002 and 2010 (Table). Information regarding informed consent is available at the Health and Retirement Study website. We performed descriptive statistics (χ2 or t test) and multivariable regression analysis (modified Poisson) to characterize features of Internet use at each time point.

Results

Overall rates of Internet use doubled from 2002 through 2010 (from 21% to 42%); however, changes in use differed by demographic and health characteristics. Overall, groups with the lowest rates showed the largest relative increases from 2002 through 2010: those with less than a high school education (from 4% to 9%), nonwhite race (from 7% to 21%), functional impairment (from 10% to 23%), poor or fair self-rated health (from 11% to 25%), age 75 years or older (from 12% to 27%), unpartnered status (from 12% to 29%), and any chronic condition (from 19% to 40%) (Table).