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## The direct costs of fatal and non-fatal falls among older adults – United States

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### ABSTRACT

**Introduction:** This study sought to estimate the incidence, average cost, and total direct medical costs for fatal and non-fatal fall injuries in hospital, ED, and out-patient settings among U.S. adults aged 65 or older in 2012, by sex and age group and to report total direct medical costs for falls inflated to 2015 dollars. **Method:** Incidence data came from the 2012 National Vital Statistics System, 2012 Healthcare Cost and Utilization Project-Nationwide Inpatient Sample, 2012 Health Care Utilization Program National Emergency Department Sample, and 2007 Medical Expenditure Panel Survey. Costs for fatal falls were derived from the Centers for Disease Control and Prevention's Web-based Injury Statistics Query and Reporting System; costs for non-fatal falls were based on claims from the 1998/1999 Medicare fee-for-service 5% Standard Analytical Files. Costs were inflated to 2015 estimates using the health care component of the Personal Consumption Expenditure index. **Results:** In 2012, there were 24,190 fatal and 3.2 million medically treated non-fatal fall related injuries. Direct medical costs totaled \$616.5 million for fatal and \$30.3 billion for non-fatal injuries in 2012 and rose to \$637.5 million and \$31.3 billion, respectively, in 2015. Fall incidence as well as total cost increased with age and were higher among women. **Conclusion:** Medically treated falls among older adults, especially among older women, are associated with substantial economic costs. **Practical application:** Widely implementing evidence-based interventions for fall prevention is essential to decrease the incidence and healthcare costs associated with these injuries.

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### 1. Introduction

Falls are the leading cause of both fatal and non-fatal injuries among people aged 65 and older (Centers for Disease Control and Prevention). The high incidence, long-term effects, and significant costs associated with fall related injuries (Hornbrook, Stevens, Wingfield, et al., 1994) present a significant burden to our health care system (Hodgson & Cohen, 1999). As many as 20% of falls result in serious injuries that may require prolonged medical care including hospitalization and rehabilitative services (Alexander, Rivara, & Wolf, 1992).

Numerous studies have calculated the cost of fall related injuries (Alexander et al., 1992; Stevens, Corso, Finkelstein, et al., 2006; Carroll, Slattum, & Cox, 2005; Englander, Hodson, & Terregrossa, 1996; Ellis & Trent, 2001; Roudsari, Ebel, Corso, et al., 2005; Shumway-Cook, Ciol, Hoffman, et al., 2009; Finkelstein, Chen, Miller, et al., 2005; Rizzo, Friedkin, Williams, et al., 1998; Mahoney, Glysch, Guilfoyle, et al., 2005; Bohl, Fishman, Ciol, et al., 2010). The incidence and costs of fatal and non-fatal falls by treatment setting, sex, and age were reported in 2006 by Stevens et al (Stevens et al., 2006). They reported that 63% of fall related costs were for hospitalizations, 21% were for emergency department (ED) visits and 16% were for outpatient visits. They also found that total costs for women at every treatment setting were higher. Cost estimates, from Stevens et al., have been used widely to report the total costs of falls but did not report average costs of falls by treatment setting, sex, or age group. Additionally they have not been adjusted for the increases in the senior population.

The number of Americans over the age of 65 is increasing. In 2000, one in eight Americans was aged 65 or older, by 2013 this proportion had grown to one in seven, and by 2050 that proportion will grow to one in every five or an estimated 84 million older adults (Wiener & Tilly, 2002). This study updates the estimates calculated by Stevens et al (Stevens et al., 2006). by adjusting for inflation and the aging U.S. population. Specifically we estimate the costs of fatal and non-fatal falls among persons aged 65 years and older using updated incidence data to calculate average and overall costs stratified by treatment setting (hospitalizations, ED visits, office-based and outpatient visits), sex, and age group.

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## 2. Methods

The incidence of falls was calculated using multiple data sources because no single data set included fatal falls, hospitalizations, emergency department visits, hospital outpatient visits, and office-based visits. All analyses were limited to adults aged 65 years and older. Sample weights were applied to generate nationally representative estimates.

### 2.1. Fatal falls

The incidence of fatal falls in 2012 was obtained using the Centers for Disease Control and Prevention's Web-based Injury Statistics Query and Reporting System (Centers for Disease Control and Prevention) (WISQARS). WISQARS uses data from the National Vital Statistics System (i.e., death certificates). The WISQARS system also estimates the costs of fatal falls by totaling the average cost per fall death by place of death (on-scene/at home, dead on arrival at a hospital, in a hospital ED, in a hospital after inpatient admission, in a nursing home [including skilled nursing facilities], in a hospice). Depending on the place of death, included payments are: cost of a coroner or medical examiner, transport, ED cost, hospitalization cost, nursing home costs and hospice costs. A detailed description of the methodology has been described previously (Lawrence, 2014). All fatal medical costs were computed for total costs stratified by sex and age group. To further estimate 2015 costs, we inflated the 2012 costs using the health care component of the personal consumption expenditures (PCE) price index (<http://bea.gov/index.htm>). PCE includes medical care services paid by employers through employer-provided health insurance and medical care services paid for by government programs like Medicaid and Medicare (McCully, Moyer, & Stewart, 2007).

### 2.2. Non-fatal falls

To calculate the incidence and cost of non-fatal falls, we include data from hospitalizations, ED visits, and office-based and outpatient visits. For hospitalizations, we used the Healthcare Cost and Utilization Project-Nationwide Inpatient Sample (HCUP-NIS), which includes hospital discharge data from 44 states and covers over 95% of the U.S. population. The HCUP-NIS dataset does not distinguish between initial admissions and readmissions; therefore, some records may be for the same injury. We used HCUP's query system to determine readmission rates by initial diagnosis and adjusted incidence downward to account for readmissions. Records were excluded if they indicated that the patient had died during their hospitalization.

For ED visits, we used the HCUP-Nationwide Emergency Department Sample (NEDS), which includes discharge data for a stratified sample of 950 U.S. hospital-based EDs located in 30 states. ED visits that resulted in hospitalizations were excluded. Records were included if they indicated a live discharge, an injury diagnosis in any of the first three diagnosis fields, and an external cause of injury (E-code) of falls. When an E-code was missing, it was imputed using information from cases with the same diagnosis and sex. For example, if 95% of hip fracture diagnoses in women over 65 (after weighting) had an E-code for falls then we imputed a falls E-code among 95% of the women over 65 who had no E-code listed. We used 2012 data because it was the most recent data available for both ED visits and hospitalizations at the time of analysis.

For office or outpatient visits, we used the Medical Expenditure Panel Survey (MEPS). MEPS is a nationally representative survey of approximately 25,000 non-institutionalized persons that can describe the use of health services among the U.S. population. The external cause of an injury (e.g., fall, fire, poison) was not included in MEPS after 2007. To address this issue, we followed the method described by Englander (Englander et al., 1996). We assumed that the rate in which older adults sought medical care and from whom they received their medical care (e.g., an ED, or medical office) had not changed over time. Therefore we took the proportions of older adults treated in office and outpatient settings in 2007 and applied it to the 2012 census data (<https://www.census.gov/population/age/data/2012.html>). This gave us a 2012 estimate of patients who sought medical care for a fall in an office or outpatient setting by sex and age group (Englander et al., 1996). Outpatient and office visits for an injury that also required an ED visit or hospitalization were excluded based on work by Finkelstein (Finkelstein, Corso, & TR, 2006).

Costs were calculated using claims data from 1998 and 1999 Medicare fee-for-service 5% Standard Analytical Files and reported previously by Finkelstein et al (Finkelstein et al., 2005). Costs included payment information for all covered services for hospital inpatient, outpatient, skilled nursing, home health, hospice, physicians/supplier services, and durable medical equipment. This dataset, while old, includes out-patient and doctor's office visits and allows us to estimate the cost of falls at multiple treatment sites and capture the cost of a medically treated fall regardless of severity.

We adjusted the non-fatal medical costs for inflation using the 2012 health care component of the PCE price index (McCully et al., 2007). All non-fatal medical costs were computed for total costs and costs stratified by treatment setting, sex, and age group. We produced 2015 estimates of direct and total costs of non-fatal falls by then inflating 2012 costs using the 2015 health care component of the PCE index.

## 3. Results

### 3.1. Fatal falls

In 2012, 24,190 adults aged 65 and older died from an unintentional fall. (Table 1) More women died from a fall compared to men (13,239 and 10,951) but the incidence of fall-related death increased with age among both sexes. One-third of all fall-related deaths occurred in women aged 85 and older.

On average, a fatal fall cost \$25,487. When comparing between men and women, the average cost of a fall death was slightly higher for women. Among age groups, the average cost declined for those 85 and older. However, because of the higher incidence of fall-related death among women 85 and older the total medical costs were higher for these women. Women aged 85 and older accrued one-third of total costs. For men and women combined, fatal falls were an estimated \$616.5 million in direct medical costs.

### 3.2. Non-fatal falls

Table 2 shows the non-fatal incidence and costs of falls by treatment setting, sex, and age group. In 2012, there were an estimated 3.2 million non-fatal fall injuries; over half (1.76 million falls) were treated in EDs. The total cost of non-fatal falls was \$30.3 billion and hospitalizations accounted for 57% (\$17.2 billion) of the total costs. The average cost of a non-fatal fall was \$9463. The average cost of a hospitalization, ED visit, and an office-based or outpatient visit was \$29,562, \$4673, and \$5625, respectively.

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