# Healthcare spending for non-fatal falls among older adults, USA

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## ABSTRACT

**Background** The older adult (65+) population in the USA is increasing and with it the number of medically treated falls. In 2015, healthcare spending attributable to older adult falls was approximately US$50 billion. We aim to update the estimated medical expenditures attributable to older adult non-fatal falls.

**Methods** Generalised linear models using 2017, 2019 and 2021 Medicare Current Beneficiary Survey and cost supplement files were used to estimate the association of falls with healthcare expenditures while adjusting for demographic characteristics and health conditions in the model. To portion out the share of total healthcare spending attributable to falls versus not, we adjusted for demographic characteristics and health conditions, including self-reported health status and certain comorbidities associated with increased risk of falling or higher healthcare expenditure. We calculated a fall-attributable fraction of expenditure as total expenditures minus total expenditures with no falls divided by total expenditures. We applied the fall-attributable fraction of expenditure from the regression model to the 2020 total expenditures from the National Health Expenditure Data to calculate total healthcare spending attributable to older adult falls.

**Results** In 2020, healthcare expenditure for non-fatal falls was US$80.0 billion, with the majority paid by Medicare.

**Conclusion** Healthcare spending for non-fatal older adult falls was substantially higher than previously reported estimates. This highlights the growing economic burden attributable to older adult falls and these findings can be used to inform policies on fall prevention efforts in the USA.

**WHAT IS ALREADY KNOWN ON THIS TOPIC?**

⇒ The older adult population in the USA continues to grow and with it the number of fall-related emergency department visits, hospitalisations and deaths. In 2015, the total healthcare spending in the USA attributable to non-fatal older adult falls was estimated to be US $49.5 billion.

**WHAT DOES THIS STUDY ADD?**

⇒ Total healthcare spending attributable to non-fatal older adult falls was approximately US$80.0 billion in 2020, comprising US$53.3 billion for Medicare, US$3.5 billion for Medicaid and US$23.2 billion for private/out of pocket/other.

**HOW MIGHT THIS STUDY AFFECT RESEARCH, PRACTICE, OR POLICY?**

⇒ Our findings highlight the increased economic burden of falls on healthcare spending. With the ageing population and rising number of fatal and non-fatal falls among older adults, expanding fall prevention efforts in clinical and community settings can reduce healthcare spending, injury and death.

## INTRODUCTION

In the USA, the older adult (age 65 and older) population is growing rapidly and is projected to increase to 74 million by 2030.[1] As the population ages, the increasing prevalence of chronic diseases and complex medical conditions will impact healthcare utilisation and expenditures substantially.[2 3] Falls are a leading cause of injuries and injury death among older adults.[4 5] In 2020, older adult falls resulted in 3 million emergency department visits, 1 million hospitalisations and over 36 000 deaths, which is higher than previous year's estimates.[4 5] The age-adjusted rate of non-fatal fall injuries has increased 1.5% per year between 2016 to 2019.[6]

The financial burden of falls is also large. In a study ranking healthcare utilisation and spending for 100 health conditions, falls (all ages) ranked fifth in personal healthcare spending with an estimated US$87.4 billion in 2016; 56.5% of that spending was attributable to older adults.[7] In a previous study by Florence *et al* (2017) that estimated the fraction of healthcare expenditures attributable to falls across payer types, the authors found that 6.0% of Medicare spending (95% CI 1.9% to 10.0%), 8.0% of Medicaid spending (95% CI −2.0% to 18.0%) and 5.0% of private/out-of-pocket healthcare spending (95% CI 1.2% to 8.8%) were attributable to older adult falls.[8] These results totalled US$49.5 billion in 2015 for annual costs of non-fatal falls among older adults, including US$28.9 billion for Medicare and US$8.7 billion for Medicaid.[8]

As both the proportion of older adults in the USA and the rate of falls increased since 2015,[5 6] we updated estimates of the total healthcare expenditures associated with non-fatal falls using similar methods to Florence *et al*.[8] With this update, we aim to call attention to the growing economic burden of falls among the community-dwelling ageing population and how more widely integrated fall prevention measures can reduce healthcare spending amounts.

## METHODS

### Medicare Current Beneficiary Survey (MCBS)

To estimate the effect of non-fatal falls on direct medical spending, we combined data from the 2017, 2019 and 2021 survey waves of the MCBS Cost Supplement files to increase analytic power. The MCBS is a nationally representative longitudinal cohort survey of Medicare beneficiaries where each respondent is followed for 4 years. It combines a survey of Medicare beneficiaries with Medicare administrative data from billing files that include Medicare payments for services provided. Data include demographic characteristics, living arrangements, health status and physical functioning. Information on total individual spending was included by payer (Medicare, Medicaid and private/out of pocket/other) and service type (hospital, physician/other provider, dental, prescription drugs and other). Other included other health, residential and personal care; home healthcare; durable medical equipment; and other non-durable medical products. Information about these groupings is described next.

### Sample

We excluded respondents who were under age 65, resided in long-term facilities or nursing homes, died during the survey year, lived in Puerto Rico, were currently employed or were on a managed care plan due to capitated payments for these plans. We excluded respondents that were institutionalised due to proxy report of self-reported falls that may not be reliable measures. The 2017, 2019 and 2021 samples, representing the ever-enrolled population in the cost supplement files, included 9211, 9883 and 8603 respondents, respectively. After applying the exclusion criteria, the sample sizes for 2017, 2019 and 2021 were 3235, 3098 and 2866 respondents making the combined sample size 9199.

### Regression estimates for healthcare spending

We used regression models to estimate the association of falls with healthcare expenditures while adjusting for demographic characteristics and health conditions in the model. Using the MCBS data, we ascertained falls using the survey question 'Have you fallen down in the past year?', dichotomised as fall or no-fall and 'How many times have you fallen in the past year?' reported as a count of number of falls in the past year. Descriptive analyses of the number of falls, demographic characteristics and health conditions were conducted among those with and without a fall in the past year and can be found in table 1. Demographic characteristics included sex, race, age, income, education and region. Health conditions included self-rated general health, Alzheimer's disease, body mass index, cancer, congestive heart failure, dementia, diabetes mellitus, emphysema, asthma, chronic obstructive pulmonary disease, high blood pressure, legally blind, myocardial infraction, osteoporosis/soft bones, other heart conditions and stroke/brain haemorrhage. We identified the health conditions based primarily on previous studies that identified these conditions as associated with either an increased risk of falls or high healthcare expenditures.[7 9] We used $\chi^2$ tests to examine differences in characteristics and conditions among older adults who reported at least one fall and those reporting no falls in the prior year. To portion out the share of total healthcare spending attributable to falls, we used generalised linear models (GLM) (gamma family, log-link). To account for distributional issues around large numbers of observations with zero mass (ie, no medical expenditures), we used a two-part model. The first part of the model used logistic regression to estimate the probability of a positive medical expenditure, and the second part used a GLM for positive expenditures. Separate regression models were estimated by payer type and service type.

SAS V.9.4 (SAS Institute) was used to create and manage datasets. Stata V.17 (Stata Corp LP) was used for all analyses. Cross-sectional survey weights and replicate weights from the cost supplement were used on the pooled 2017, 2019 and 2021 data to account for the complex survey design and to produce nationally representative estimates. Replicate weights were used

**Table 1** Characteristics of older adults (aged ≥65 years) according to whether they reported falling in the past year: Medicare Current Beneficiaries Survey, 2017, 2019 and 2021, USA

| Characteristic | No Fall* | Fall* | P value† |
|---|---|---|---|
| Reported fall, % | 75.5 | 24.5 | |
| Number of falls, % | | | |
| 1 | | 50.4 | |
| 2 | | 24.3 | |
| 3 | | 10.8 | |
| 4 | | 4.5 | |
| 5 | | 3.3 | |
| ≥6 | | 6.7 | |
| Female, % | 54.4 | 58.6 | 0.02 |
| White, non-Hispanic, % | 85.9 | 90.0 | <0.001 |
| Age, average | 77.9 | 79.2 | <0.001 |
| Income, average, US$ | 65 429 | 58 822 | <0.001 |
| Education, % | | | 0.02 |
| < High school | 10.0 | 12.6 | |
| High school graduate | 24.3 | 23.1 | |
| Some college | 29.3 | 31.8 | |
| College graduate | 36.3 | 32.5 | |
| Region, % | | | 0.94 |
| Northeast | 17.5 | 16.5 | |
| Midwest | 22.2 | 22.8 | |
| South | 38.8 | 38.6 | |
| West | 21.5 | 22.1 | |
| Self-rated general health, % | | | <0.001 |
| Excellent | 19.5 | 11.0 | |
| Very good | 36.7 | 28.2 | |
| Good | 29.7 | 35.0 | |
| Fair | 11.1 | 19.3 | |
| Poor | 2.9 | 6.6 | |
| Health conditions, % | | | |
| Alzheimer's disease | 1.7 | 3.3 | 0.01 |
| BMI (mean) | 27.6 | 27.8 | <0.001 |
| Overweight | 37.1 | 34.5 | 0.09 |
| Obese | 29.9 | 34.4 | 0.41 |
| Cancer | 40.7 | 45.3 | <0.001 |
| Congestive heart failure | 5.8 | 11.2 | <0.001 |
| Dementia | 2.0 | 5.1 | <0.001 |
| Diabetes mellitus | 28.1 | 38.6 | <0.001 |
| Emphysema, asthma, COPD | 17.1 | 25.9 | <0.001 |
| High blood pressure | 61.6 | 71.0 | <0.001 |
| Legally blind | 0.5 | 0.9 | 0.10 |
| Myocardial infraction | 8.5 | 13.9 | <0.001 |
| Osteoporosis/soft bones | 17.6 | 24.3 | <0.001 |
| Other heart conditions | 25.2 | 34.5 | <0.001 |
| Stroke, brain haemorrhage | 8.3 | 14.8 | <0.001 |

*Weighted data reported.
†P value based on $\chi^2$ test.
BMI, body mass index; COPD, chronic obstructive pulmonary disease.

with the balanced repeated replication method to account for correlations in the pooled 2017, 2019 and 2021 data.[10]

### Fall-attributable fraction of expenditure

Using the regression results, we then estimated the percentage of expenditures associated with falls by calculating the attributable fraction of expenditures (AFE) for falls. An AFE is the percentage of total expenditures attributable to a specific condition or risk, in this study the fall-related attributable fraction of expenditures (FAFE). The FAFE is calculated by first obtaining the predicted amount of total expenditures from the model using the observed values of all independent variables and population weights to produce a total expenditure estimate for the sampled population. After this value is calculated, we then predicted expenditures with the value of the falls variable set to zero, and all other independent variables at their observed values again weighted to population totals. The final calculation of the FAFE is ((predicted expenditures at observed values − predicted expenditures with falls=0)/predicted expenditures at observed values). Standard erros for the FAFE were calculated using bootstrap methods with 1000 replications for calculating CIs.

### National Health Expenditure Accounts

Overall healthcare spending was estimated using the National Health Expenditure Accounts (NHEA), which are produced by the Centers for Medicare and Medicaid Services.[11] The NHEA reflects the official measure of total healthcare consumption in the USA. Spending is broken down according to type of service (eg, hospital care, professional services, home healthcare) and type of payer (eg, Medicare, Medicaid, private health insurance, out of pocket, other). This study used the 2020 NHEA for overall healthcare spending by type of service and payer and the 2020 health expenditures by age and gender to estimate the share of expenditures among those aged 65 and older.

### Healthcare spending estimates

To determine overall expenditure levels, multiple steps were involved. First, the percentage of total expenditures for age 65+ was calculated using the 2020 age and gender tables for both overall and by payer type. That percentage was then multiplied by the total national health expenditure category minus the other third-party payers to find an estimate of total healthcare expenditures among those aged 65 and older. These calculations were done for each of the NHEA categories including hospital care; physician and clinical services; other professional services; dental services; other health, residential, and personal care; home healthcare; prescription drugs; durable medical equipment; and other non-durable medical products. Additionally, the calculations were done for different payers including Medicare, Medicaid and private health insurance, out of pocket and other. The final step took the FAFE from the regression model and multiplied it by total expenditures in the category for those aged 65 and older. For example, the FAFE for hospital expenditures was multiplied by the total expenditures for hospitals among those aged 65 and older. CIs were calculated by using the upper and lower CI from the FAFE and multiplying by the expenditures in the category. The physician/other providers category comprised physician and clinical services and other professional services. Other comprised other health, residential and personal care; home healthcare; durable medical equipment; and other non-durable medical products.

**Table 2** Non-fatal falls-attributable fraction of expenditures and associated healthcare spending according to payer: 2017, 2019 and 2021, Medicare Current Beneficiary Survey and 2020 National Health Expenditure Accounts, USA

| Payer | Attributable fraction, % (95% CI) | 2020 Healthcare spending, billion $ (95% CI) |
|---|---|---|
| Medicare | 9.0 (5.3 to 12.8) | 53.3 (31.1 to 75.6) |
| Medicaid | 3.1 (–11.0 to 17.2) | 3.5 (–12.2 to 19.2) |
| Private/out of pocket/other | 6.8 (3.8 to 9.7) | 23.2 (13.2 to 33.2) |
| Total | | 80.0 (32.1 to 128.0) |

### Patient and public involvement

It was not appropriate or possible to involve patients or the public in the design, conduct, reporting or dissemination plans of our research.

## RESULTS

The percentages of older adults who reported a fall in 2017, 2019 and 2021 were 24.6%, 23.2% and 23.6%, respectively (data not shown).

In the combined 2017/2019/2021 MCBS survey waves, 24.5% of older adults reported a fall and 49.6% of those reported recurrent falls (two or more falls) (table 1). The average age of older adults who fell was older than those without a fall (79.2 vs 77.9; p <0.001). Those who fell were more likely to be women and of white, non-Hispanic race/ethnicity and had a significantly higher prevalence of all chronic conditions, except being legally blind, overweight and obese. Older adults with a reported fall also reported poorer general health compared with those who did not fall.

The FAFE for older adult varied by payer from 9.0% (95% CI 5.3% to 12.8%) for Medicare expenditures, 3.1% (95% CI −11.0% to 17.2%) for Medicaid expenditures and 6.8% (95% CI 3.8% to 9.7%) for private/out of pocket/other expenditures (table 2). These fractions, applied to the NHEA, resulted in an estimated total of US$80.0 (95% CI US$32.1 to US$128.0) billion in 2020 for falls-attributable healthcare expenditures. This comprised US$53.3 (95% CI US$31.1 to US$75.6) billion for Medicare, US$3.5 (95% CI -US$12.2 to US$19.2) billion for Medicaid and US$23.2 (95% CI US$13.2 to US$33.2) billion for private/out of pocket/other expenditures.

Healthcare expenditure attributable to older adult falls varied by service type: 14.4% (95% CI 9.1% to 19.6%) for hospital (US$50.8 billion in healthcare spending; 95% CI US$32.3 to US$69.3 billion), 7.3% (95% CI 4.7% to 9.9%) for physician/other provider (US$19.0 billion in healthcare spending; 95% CI US$12.2 to US$25.7 billion), 4.2% (95% CI 0.4% to 8.0%)) for dental (US$1.4 billion in healthcare spending; 95% CI US$0.1 to US$2.7 billion), 0.2% (95% CI −5.3% to 5.6%) for prescription drugs (US$0.2 billion in healthcare spending; 95% CI −US$6.4 to US$6.8 billion) and 19.7% (95% CI 12.8% to 26.7%) for other (US$33.2 billion in healthcare spending; 95% CI US$38.5 to US$80.3 billion) (table 3). The FAFE for Medicaid expenditure and prescription drug expenditures were not significant, likely due to low expenditure in these categories. The estimated total by payer differed from that by type of service due to different models used to calculate the FAFE; however, the CIs for the totals overlapped.

## DISCUSSION

The updated cost estimates are higher than previously reported estimates with total healthcare spending on non-fatal falls

**Table 3** Non-fatal falls-attributable fraction of expenditures and associated healthcare spending according to type of service: 2017, 2019 and 2021 Medicare Current Beneficiary Survey and 2020 National Health Expenditure Accounts, USA

| Service type | Attributable fraction, % (95% CI) | Healthcare spending, billion $ (95% CI) |
|---|---|---|
| Hospital | 14.4 (9.1 to 19.6) | 50.8 (32.3 to 69.3) |
| Physician/other provider | 7.3 (4.7 to 9.9) | 19.0 (12.2 to 25.7) |
| Dental | 4.2 (0.4 to 8.0) | 1.4 (0.1 to 2.7) |
| Prescription drugs | 0.2 (−5.3 to 5.6) | 0.2 (−6.4 to 6.8) |
| Other* | 19.7 (12.8 to 26.7) | 33.2 (38.5 to 80.3) |
| Total | | 104.6 (76.8 to 184.8) |

*Includes other health, residential and personal care; home healthcare; durable medical equipment; other non-durable medical product.

estimated at US$80 billion in 2020, compared with the previous estimates from 2015 and 2016.[7 8] This may be attributed to a changing population, an increase in number of medically treated falls, and an overall increase in medical spending in the USA. The number of older Americans (age 65+) has increased 14% between 2015 and 2019.[1] In comparison, the U.S. population age 0–64 only grew by 1.4%.[1] The fastest growing subage group within older adults are the 85 and older.[1] Older adults are living longer and often with multiple comorbidities that may contribute to increased frailty and longer hospital stays after fractures.[12] Previous reports indicate that the average cost of treatment increases with age (highest in the 85 and older group), likely due to the increased injury severity and need for hospitalisation.[13–16] Additionally, frailty with advancing age is associated with significantly higher healthcare spending compared with robust or less frail older adults.[17]

A 2019 healthcare cost and utilisation report indicated that per-capita healthcare spending grew approximately 22% between 2015 to 2019 (all ages) and two-thirds of this increase can be explained by growth in prices for healthcare services which increased 18% from 2015 to 2019.[18] The cumulative change in spending per person was highest for outpatient visits with a 31% growth and prescription medications with a 28.4% growth.[18] Additionally, national healthcare expenditures increased 4.1% per capita in 2019, similar to 2018 growth rate, but reflected a faster growth in healthcare use and intensity of healthcare goods and services.[19] These increases in healthcare expenditures largely impact publicly funded programmes. The majority of total spending on older adult falls are paid for by Medicare and Medicaid. Healthcare expenditures on older adult falls comprise 9% of total Medicare spending. Notably, Medicare spending exceeds assets currently and the Medicare Part A funds are projected to be insufficient to cover costs by 2029.[20] Evidence of the effectiveness of fall prevention strategies indicates that further expanding these strategies at the local and national level can help reduce medical expenditures. Currently, falls risk screening and assessment can be conducted and reimbursed as part of the Medicare Annual Wellness Visit. Fall risk screening is a quality measure under the Medicare Access and CHIP Reauthorization ACT, which offers value-based reimbursement for services through a Merit-based Incentive Payment System. However, estimates of screening at the provider level are lacking.

The burden of falls on healthcare systems and healthcare spending will continue to rise if the risk of falls among the ageing population is not properly addressed. Many older adult falls can be prevented by addressing modifiable fall risk factors, including health and functional characteristics. The Centers for Disease Control and Prevention's Stopping Elderly Accidents and Injuries (STEADI) initiative offers healthcare providers tools and resources to manage their older patients' fall risk (www.cdc.gov/steadi). The core components of STEADI are to screen for fall risk, assess modifiable risk factors and intervene using effective clinical and community strategies. The STEADI algorithm recommends annually screening older adults for fall risk using the three key questions or the stay-independent screener due to their high sensitivity in identifying those at risk of a future fall.[21] For older adults screened at risk, a multifactorial assessment is recommended to identify any modifiable risk factors such as gait, strength and balance disorders, home hazards, or concerns with vision or feet and footwear. Providers can then develop an individualised care plan to address modifiable risk factors using evidence-based community and clinical fall prevention interventions such as referral to physical therapy or community-based fall prevention programmes (eg, Tai Chi, Stepping On) for gait, strength and balance exercises.[22 23] Identifying and addressing modifiable risk factors can help reduce falls and lower fall-related healthcare expenditures.[24]

Although our study was modelled in a similar way as the prior analysis by Florence *et al*,[8] there are several differences to note. First, we combined data from 3 years of MCBS surveys to increase analytic power and develop the FAFE by payer and service type. We excluded individuals institutionalised in long-term nursing care, those who were employed and those that died during the survey period from MCBS, consistent with previous methodology.[8] However, we also excluded nursing home facilities and continuing care retirement facilities costs from NHEA which may result in an underestimation. We included covariates in the models for history of ever diagnosed for stroke/brain haemorrhage, myocardial infarction and high blood pressure where in the previous analysis these were limited to diagnosed within the last 12 months.[8] This is due to a change in question structure by MCBS. Additional covariates used in our study and not in Florence *et al* include cancer (excluding skin cancer), Alzheimer's disease and dementia. These additional health conditions were included based on a report about highest healthcare spending by health condition.[7] We believe our estimates, controlling for additional health conditions, are a more accurate approximation of the FAFE of overall health spending attributed to falls.

Our study is subject to several limitations. First, for older adults with Medicare coverage, this study used a sample of community-dwelling older adults who had fee-for-service Medicare coverage and who were not currently employed to calculate a FAFE that was applied to all older adult healthcare spending. Excluded groups, especially those institutionalised in long-term nursing care, likely have different fall rates and healthcare spending and they were not included in our study. Additionally, due to the small sample size of those who died, we did not account for national health expenditures for those who might have died during the study period. This study uses falls data that are obtained by interview and thus it would not be possible to ascertain if the death occurred due to or after a fall. Second, while we created a model that adjusted for a number of comorbidities associated with increased risk of falls or high healthcare expenditures, there could be unmeasured confounders that were not included that would change the estimates. The MCBS asks respondents about their history of ever diagnosed with disease or condition and does not record disease severity. Therefore, there is a

potential for unmeasured confounding due to overall health status beyond just the diagnosis of a comorbidity. Third, our findings indicate that older adults who report falling have on average a worse health status compared with those with no fall. We attempted to control for health status differences by including self-reported health status in our models. One example of such confounding would be the case of a person with diabetes who reports falling. Hypoglycaemia is a risk factor for falls and can occur when diabetic treatment 'over-controls' blood sugar. If hypoglycaemia increases healthcare spending independent of falling, we may overstate the cost of falls. Similar arguments could apply to other comorbidities associated with falls. Fourth, we do not know how or how much our spending estimates are affected by using data after the emergence of COVID-19; however, healthcare spending growth was similar to prepandemic growth.[25]

## Conclusion

In 2020, healthcare spending on non-fatal falls among community-dwelling older adults was estimated at US$80.0 billion, which is higher than previously reported estimates.[7 8] With the growing older adult population in the USA, this increase in healthcare spending highlights a growing economic burden attributable to older adult falls and these findings can be used to inform and evaluate policies on fall prevention efforts nationally.

**Contributors** YKH and GFM accept full responsibility for the work and conduct of the study, had access to the data, and controlled the decision to publish. GFM, RK and CF had full access to all of the data in the study and take responsibility for the integrity of the data and accuracy of the data analysis. YKH and GFM were responsible for drafting of the manuscript:All authors contributed to the study concept and design; interpretation of data; critical revision of the manuscript for important intellectual content; and final review and approval of manuscript.

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**Competing interests** None declared.

**Patient and public involvement** Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

**Patient consent for publication** Not applicable.

**Ethics approval** Institutional Review Board (IRB) approval was not needed for this study as data were obtained from Medicare Current Beneficiary Survey (MCBS) and National Health Expenditure Accounts (NHEA) as aggregate and deidentified.

**Provenance and peer review** Not commissioned; externally peer reviewed.

**Data availability statement** Data are available upon reasonable request. Data may be obtained from a third party and are not publicly available. Medicare Current Beneficiary Survery (MCBS) data are available from the Centers of Medicare and Medicaid Services under data use agreement from https://www.cms.gov/Research-Statistics-Data-and-Systems/Files-for-Order/LimitedDataSets/MCBS. National Health Expenditure Accounts are available to the public and can be accessed from https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData.



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