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# ED Falls: A Longitudinal Analysis of ED Revisits and Hospitalizations between Patients who Fell and Patients who did not Fall



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# ED Falls: A Longitudinal Analysis of ED Revisits and Hospitalizations between Patients who Fell and Patients who did not Fall

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**Funding:** none
**Conflict of Interest:** none
**Acknowledgements:** none

**Abstract:**

Objective: Older adult falls are a national issue comprising 3 million emergency department (ED) visits and significant mortality. We sought to understand whether ED revisits and hospitalizations for fallers differed from non-fall patients using a longitudinal, statewide cohort of patients.

Design: A 5 year, longitudinal observational analysis using the non-public Patient Discharge Database and the Emergency Department Data from the California Office of Statewide Health Planning and Development to assess outcomes for fallers and non-fall patients, defined as anyone who did not carry a fall diagnosis during this time period.

Setting: 2005-2010 non-public Patient Discharge Database and the Emergency Department Data from the state of California.

Participants: Older adults 65 years and older

Main Outcome Measure: ED revisits and hospitalizations for fallers and non-fall patients,

Results: Patients who came to the ED with an index visit of a fall were more likely to be discharged home after their fall (61.1% vs 45.0%, p <0.001). Patients who came to the ED for non-fall related visit were more likely to be hospitalized (52.6% vs 35.7%, p<0.001). Fallers who were discharged or hospitalized after their index visit were more likely to come back to the ED for a fall related complaint compared to non-fallers (median time: 151 days vs 352 days, p<0.001 and hospitalized: 45 days vs 119 days, p<0.01) and fallers who were initially discharged also returned to the ED sooner for a non-fall related complaint (median time: 325 days vs 352 days, p<0.001).

Conclusion: Fall patients tend to be discharged home more often, but returned to the ED sooner compared to their non-fall counterparts. Given a faller's rates of ED revisits and hospitalizations, EDs should consider a fall as a poor prognostic indicator for future healthcare utilization.

**Strengths and Limitations of This Study:**

- Our study suggests that older adults who fall tend to be discharged home more often
- All fallers who were discharged or hospitalized returned to the ED sooner compared to their non-fall counterparts for both a fall related and non-fall related complaint.
- The use of administrative data limits our understanding of other associated variables such as comorbidities.
- The nature of the data does not allow us to understand the reason for fall, which is important for fall prevention purposes.

## Background

Falls from older adults comprise nearly 3 million ED visits annually and account for 10% of all ED visits among those greater than age 65.[1,2] Mortality from falls increased by 110% from 1999-2016[3] and will rise as the population ages.

Adverse event rates for older patients who present to the ED after a fall is high. Over 70% of these patients are discharged after their ED visit, with the remaining 30% admitted to the hospital.[1] Approximately, 36%-44% of patients who come to the ED after experiencing a fall experience a subsequent adverse event, including recurrent falls, ED visits or death within one year.[4,5] However, it is not clear whether these adverse event rates are higher than those of non-fall patients. Identifying such patients can help risk stratify when deciding disposition, referring to outpatient services and recommending enrollment into community based falls-prevention programs. To date, most studies on ED fall patients listing high adverse event rates are limited to one or few sites, are cross sectional or have no controls.[2,5]

We sought to explore whether the rate of ED revisits and hospitalizations among older fall patients differ significantly from non-fall patients in a large statewide cohort of ED patients that could be tracked longitudinally, with a specific interest on revisits for fall-related complaints. Targeting at-risk older adults, particularly those discharged to home or home health care, is an underexplored, cost-effective mechanism with potential to reduce ED revisits and improve patient care.

## Methods

Data Sources

To determine the rate of ED revisits and hospitalizations for elderly patients who present to the ED after a fall, we used de-identified, patient-level data for the 2005-2010 non-public Patient Discharge Database (PDD) and the Emergency Department Data (EDD) from the California Office of Statewide Health Planning and Development (OSHPD). The PDD captures demographic and clinical data for all admissions to non-Department of Veterans Affairs hospitals in California. The EDD provides data on all ED encounters, including those patients discharged from the ED. We also used hospital utilization data to capture hospital characteristics.

We included all adult patients aged 65 and older that were seen in the ED. Fall patients were defined as patients who came for a fall-related complaint between 1/1/2005-12/31/2010 with the International Classification of Disease (ICD) E codes E880.x-E888.x included anywhere in their visit. (See Figure 1) Non-fall patients were defined as all older patients seen in the ED between 1/1/2005-12/31/2010 with any other diagnosis. The censor time for death was 12/31/2011. The decision to use patient-level in lieu of visit-level data stemmed from the need to look at both patient characteristics and longitudinal outcomes on disposition and revisits. As such, we obtained data including age, sex, ethnicity/race, payer type, and whether the visit was at a teaching vs. nonteaching hospital. We calculated income based on zipcode as a proxy[6] and then examined disposition of the patient from the ED or after hospitalization (ED death, or

discharge from ED or hospital to an acute care facility, skilled nursing home, or home with visiting nurse). This study was exempted by our institutional review boards.

Patient and Public Involvement

This research was done without patient or public involvement. Patients were not invited to comment on the study design and were not consulted to develop patient relevant outcomes or interpret the results. Patients were not invited to contribute to the writing or editing of this document for readability or accuracy.

Outcomes

We examined the frequency of various dispositions from the ED between geriatric fall and non-fall patients. Our primary outcome was disposition and the median time to ED revisits for a fall between fall and non-fall patients. Our secondary outcome was the median time to an ED revisit for any reason between fall and non-fall patients. We also examined the frequency of at least one ED revisit for a fall as well as an ED revisit for any reason at 7 and 30 days, 6 months and 1 year among fall and non-fall patients. We also performed a Kaplan-Meyer analysis for time to revisit for any reason, controlling for age, sex, race, insurance, teaching and median income. For the sake of brevity, we termed those older adult patients who presented for a fall-related complaint as “fallers” and those who did not fall as a “non-fallers.”

Statistical Analysis

We calculated differences in demographics using Wilcoxon, t or $\chi 2$ test where appropriate. We calculated Kaplan-Meier survival curves for time to ED revisit controlling for age, sex, race, insurance, teaching hospital, and median income.

All analyses were completed using SAS 9.4.

**Results**

The fall cohort predominantly consisted of females who were 79.5 years compared to the non-fall cohort who were primarily men with an average age of 74.7 years ($p<0.001$). Fallers were also predominantly non-Hispanic white (71.3% vs 63.1%, $p<0.001$), seen primarily in non-teaching hospitals (92.5% vs 90.9%, $p<0.001$) with Medicare as their primary insurance (87% vs 80.9%, $p<0.001$). While non-fallers also predominantly used Medicare as their primary payer, they notably had a higher mix of non-Medicare primary payers, including commercial insurers (private), Medicaid and self-pay, compared to fallers. (Table 1). Overall, fallers made approximately 4.78 visits per patient while non-fallers made 3.30 visits per patient. (Table 2)

Patients who came to the ED with an index visit of a fall were more likely to be discharged home after their fall (61.1% vs 45.0%, $p<0.001$) or sent directly to a skilled nursing facility (SNF) or an acute care facility from the ED (1.5% vs 0.3%, 0.2% vs 0.04%, respectively, $p<0.001$). Patients who came to the ED for non-fall related visit were more likely to be hospitalized (52.6% vs 35.7%); however, fallers who were admitted were more often transferred to a SNF or an acute care facility post-hospitalization compared to non-fallers (47.5% vs 13.9% and 8.5% vs

4.9%, respectively, p<0.001) whereas non-fallers were more often discharged home post-hospitalization (61.3% vs 23.3%, p<0.001). (Table 3)

Fallers who were discharged after their index visit were more likely to come back to the ED for both a fall and non-fall related complaint compared to non-fallers (median time 151 days and 325 days vs 352 days, p<0.001). (Table 3)

Fallers who were initially hospitalized returned to the ED sooner for another fall related complaint compared to non-fall patients (45 days vs 119 days, p<0.001) but non-fallers returned earlier to the ED for any reason (excluding falls) compared to fallers (119 days vs 242 days, p<0.001). (see Table 3) Furthermore, based on a Kaplan-Meyer analysis, non-fallers had a lower probability of returning to the ED compared to fallers at each time point after adjusting for age, sex, race, insurance, teaching, median income. (Figure 2 and Table 4).

It is worth noting that we could not calculate the rate of ED return amongst non-fallers for a fall related visit as this would have placed them into the fallers cohort.

**Discussion**

Older adults who present to the emergency department with a fall between 2005-2010 were more likely to be older, female, non-Hispanic white, covered by Medicare and primarily present to community facilities as compared to those patients who presented to the ED for a non-fall related complaint. Furthermore, fall patients were discharged home more often, but returned to the ED sooner for both a fall and non-fall related complaint compared to their non-fall counterparts (p<0.001). This study is unique in that it is the first statewide, longitudinal study examining disposition and ED revisits of patients who came to the ED for a fall and compared fallers to all other older adults using a statewide database of approximately 3.8 million patients, but similar outcomes to a retrospective cohort study looking at fall related 30-day readmissions using the Hospital Cost and Utilization Project data[7].

This database shows that fallers appear to be a high-risk patient population who return to the ED much sooner than patients who did not fall for a second fall related complaint regardless of whether they were admitted or discharged from their index ED visit. Often, fallers may minimize their reason for falling and are reluctant to engage in fall prevention efforts on their own.[8] Also, most EDs do not do a comprehensive fall evaluation, thus missing many opportunities to address the risk factor that lead to the fall or prevent future falls.[9, 10] Although this study does not delineate the underlying reason for a fall, our findings suggest that this patient population warrants close evaluation, workup, and follow-up to assess their reasons for falling and potential intervention.

Among hospitalized patients, non-fallers returned to the ED sooner than fallers for any other non-fall related reason (P<0.001). This may be due to a sicker case-mix of non-fall patients reflected through the higher percentage of Medicaid amongst non-fallers or the higher

percentage of non-fallers being treated at teaching hospitals containing tertiary services,[11, 12] or that more non-fallers were discharged home without services post-hospitalization. However, this difference warrants further investigation.

**Limitations**

There were many limitations to this study including those inherent to the retrospective nature of this analysis. First, it is possible that what we classified as an index visit for a fall may not have been the actual first visit for a fall. Although some index visits for a fall may have occurred outside the state of California, we expect this number to be minimal. Second, because we are using administrative data, we have limited understanding of other important variables including functional status, comorbidities and relative frailty of patients, which could contribute to the observed result. Third, as with any administrative dataset, there are potential errors due to miscoding, data linkage and missing data. However, these would not bias our study unless these errors were distributed unevenly across both categories of patients, which would be unlikely. Furthermore, while the dataset is statewide, results cannot be generalized across the entire country or other healthcare systems. Last, we do not have a reason for the fall, which is often important for fall prevention and may provide a better sense as to why patients who presented initially for a fall-related complaint are returning to the ED sooner than patients who did not fall.

**Conclusion**

This epidemiological study suggests that patients who fall are a sick patient population who are more likely to return to the ED for a second fall regardless of whether they are discharged or admitted and are more likely to return for any reason if discharged. Given the increasing rates of falls over time,[2] providers should recognize the significance of a fall as a risk factor for future healthcare utilization. Multiple studies have shown the benefit of multifactorial falls prevention interventions to decrease the rates of recurrent falls[13,14] with a recent Cochrane review underscoring the benefit of exercise and physical therapy based programs as a particularly beneficial modality to decrease the rate of injurious falls.[15] Further studies should look at the cause of falls as an indicator for outcomes and EDs should consider urgently referring discharged fall patients to physical therapy or exercise program and evidence-based falls prevention programs.

**Contribution Statement**

KNS and SL conceived the initial study. FL undertook the statistical analysis. KNS and SL drafted the manuscript and FL, HE and ET contributed substantially to its revision. KNS takes responsibility for the paper as a whole.

**Data Sharing:**

Data may be obtained from a third party but are not publicly available. The data are not publicly available but can be obtained through written request to the California Office of Statewide Health Planning and Development

**Table 1. Demographics of elderly patients who present to ED after fall**

| | Fall (N=997524) | NonFall (N=2805508) | P value |
|---|---|---|---|
| Age | 79.5 ± 8.3 | 74.7 ± 7.9 | <0.001 |
| Sex | | | |
| Male | 336060 (33.7%) | 1298346 (46.3%) | <0.001 |
| Female | 661152 (66.3%) | 1506065 (53.7%) | |
| Other | 312 (0.0%) | 1097 (0.0%) | |
| Ethnicity/race | | | |
| Non-Hispanic White | 710852 (71.3%) | 1770408 (63.1%) | <0.001 |
| Non-Hispanic Black | 38699 (3.9%) | 167215 (6.0%) | |
| Hispanic | 133594 (13.4%) | 433837 (15.5%) | |
| Asian | 26611 (2.7%) | 145804 (5.2%) | |
| Other | 68661 (6.9%) | 220746 (7.9%) | |
| Unknown | 19107 (1.9%) | 67498 (2.4%) | |
| Median income | 67290 ± 24323 | 66563 ± 24330 | <0.001 |
| Payer type (Primary Insurance) | | | |
| Self pay | 14471 (1.5%) | 57962 (2.1%) | <0.001 |
| Medicare | 867863 (87.0%) | 2269251 (80.9%) | |
| Medicaid | 19220 (1.9%) | 106590 (3.8%) | |
| Commercial Insurance and Commercial HMO | 82435 (8.3%) | 331897 (11.8%) | |
| Other | 13301 (1.3%) | 39099 (1.4%) | |
| Missing | 30 (0.0%) | 170 (0.0%) | |
| Teaching Hospital | | | |
| No | 922366 (92.5%) | 2550886 (90.9%) | <0.001 |
| Yes | 75158 (7.5%) | 254622 (9.1%) | |

**Table 2. Fall versus Non-Fall Generalized Visit Patterns**

| | Fall patients | Non fall patients | Total |
|---|---|---|---|
| Number of patients | 997524 | 2805508 | 3803032 |
| Total visits | 4769880 | 9245450 | 14015330 |
| # visits per patient | 4.78 ± 5.18 [1]<br>3 (2 – 6) [2] | 3.30 ± 3.58<br>2 (1 -4) | 3.69 ± 4.12<br>2 (1 -5) |
| # visits for fall | 1.53± 1.05<br>1 (1 -2) | NA | 0.40 ± 0.86<br>0 (0 -1) |
| %revisit for fall | 291025<br>(29.17%) | | |

[1]Mean ± std

[2]median (IQR)

**Table 3. Disposition after initial ED visit for all patients, Time to ED Revisit for a Fall and Time to ED Revisit for Any Reason**

| | Frequency of Disposition Type after Initial ED Visit | | | Median Time to ED Revisit amongst Fall patients | | | | Median Time to ED revisit for Non-Fall Patients | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Index Visit: Fall | Index Visit: Nonfall | | Reason for ED Revisit: Fall | | Reason for ED Revisit: Any Reason | | Reason for ED Revisit: Any Reason | | |
| | n | days | P value | n | days | n | days | n | days | P value |
| Discharge home from ED | 609822 (61.13%) | 1263272 (45.03%) | <0.001 | 437197 | 151.0 | 191925 | 325.0 | 524237 | 352.0 | <0.001 |
| Discharge With home health service from ED | 1519 (0.15%) | 1453 (0.05%) | | 993 | 58.0 | 432 | 114.0 | 623 | 83.0 | |
| Directly to Skilled Nursing Facility from ED | 15387 (1.54%) | 9081 (0.32%) | | 11456 | 71.0 | 5247 | 137.0 | 5087 | 111.0 | |
| Directly to Acute Care (IRF, LTCH) from ED | 2007 (0.20%) | 1166 (0.04%) | | 1509 | 59.0 | 771 | 96.0 | 654 | 97.0 | |
| ED death | 521 (0.05%) | 12208 (0.44%) | | 0 | | 0 | | 0 | | |
| Other | 11819 (1.18%) | 43910 (1.57%) | | 9321 | 30.0 | 5403 | 9.0 | 24444 | 47.0 | |
| Blank | 101 (0.01%) | 220 (0.01%) | | 76 | 68.5 | 41 | 67.0 | 98 | 1.0 | |
| Hospitalization after ED visit | 356348 (35.72%) | 1474198 (52.55%) | <0.001 | 269385 | 45.0 | 109751 | 242.0 | 956264 | 119.0 | <0.001 |
| Then to Acute Care (IRF, LTCH) after hospitalization | 30363 (8.52%) | 72214 (4.90%) | | 28514 | 5.0 | 12452 | 69.0 | 64385 | 4.0 | |
| Then to SNF after hospitalization | 169084 (47.45%) | 204991 (13.91%) | | 134491 | 40.0 | 53465 | 246.0 | 150005 | 35.0 | |
| Then to residential care after hospitalization | 4181 (1.17%) | 11056 (0.75%) | | 3338 | 64.0 | 1645 | 137.0 | 7950 | 86.0 | |

| | Frequency of Disposition Type after Initial ED Visit | | | Median Time to ED Revisit amongst Fall patients | | | | Median Time to ED revisit for Non-Fall Patients | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Index Visit: Fall | Index Visit: Nonfall | | Reason for ED Revisit: Fall | | Reason for ED Revisit: Any Reason | | Reason for ED Revisit: Any Reason | | |
| | n | days | P value | n | days | n | days | n | days | P value |
| Discharge home after hospitalization | 83178 (23.34%) | 903245 (61.27%) | | 61352 | 119.0 | 25276 | 313.0 | 594246 | 192.0 | |
| Discharge home with health services after hospitalization | 47871 (13.43%) | 200618 (13.61%) | | 35425 | 99.0 | 14819 | 272.0 | 129308 | 148.0 | |
| Invalid/blank | 64 (0.02%) | 178 (0.01%) | | 41 | 9.0 | 17 | 67.0 | 91 | 7.0 | |
| Other | 3551 (1.00%) | 16484 (1.12%) | | 2556 | 17.0 | 1207 | 85.0 | 10279 | 44.0 | |

***Any Reason excludes any visit pertaining to a fall**

**Table 4: Time to ED revisit, fall vs. nonfallers, adjusted for age, sex, race, insurance, teaching, median income.**

| Days | Fall | Nonfall |
|---|---|---|
| 7 | 0.88 | 0.94 |
| 30 | 0.78 | 0.87 |
| 182 | 0.57 | 0.74 |
| 365 | 0.45 | 0.66 |
| 1826 | 0.18 | 0.38 p=0.00 |

**Citations:**


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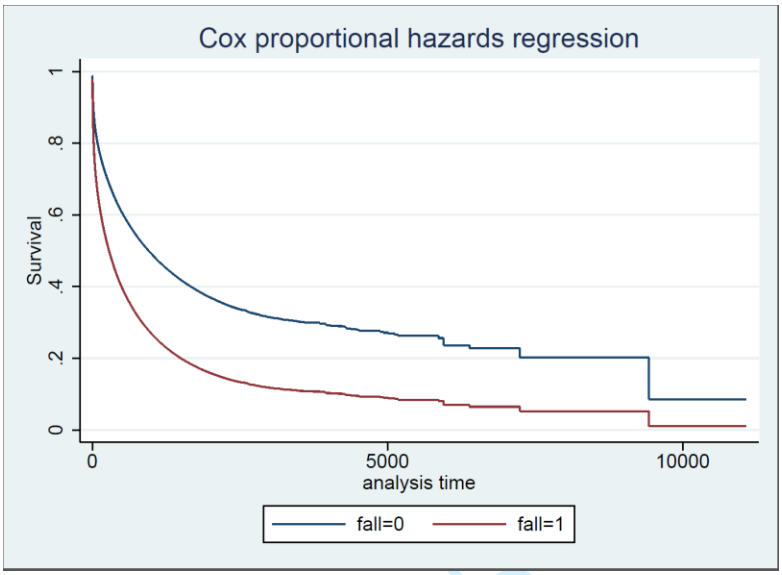
**Figure 1: Diagnostic E-Codes**

- E880 Accidental fall on or from stairs or steps
- E881 Accidental fall on or from ladders or scaffolding
- E882 Accidental fall from or out of building or other structure
- E883 Accidental fall into hole or other opening in surface
- E884 Other accidental falls from one level to another
- E885 Accidental fall on same level from slipping tripping or stumbling
- E886 Fall on same level from collision, pushing, or shoving, by or with other person
- E887 Fracture, cause unspecified
- E888 Other and unspecified fall

**Figure 2: Kaplan-Meyer Survival Curve, Time to ED revisit for Any Reason**



STROBE Statement—Checklist of items that should be included in reports of ***cohort studies***

| | Item No | Recommendation | Page No |
|---|---|---|---|
| **Title and abstract** | 1 | (*a*) Indicate the study's design with a commonly used term in the title or the abstract<br>(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found | 2 |
| **Introduction** | | | |
| Background/rationale | 2 | Explain the scientific background and rationale for the investigation being reported | 2 |
| Objectives | 3 | State specific objectives, including any prespecified hypotheses | 2 |
| **Methods** | | | |
| Study design | 4 | Present key elements of study design early in the paper | 2, 3 |
| Setting | 5 | Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection | 2, 3 |
| Participants | 6 | (*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up<br>(*b*) For matched studies, give matching criteria and number of exposed and unexposed | 2, 3 |
| Variables | 7 | Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable | 2, 3 |
| Data sources/ measurement | 8* | For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group | 2, 3 |
| Bias | 9 | Describe any efforts to address potential sources of bias | 2, 3 |
| Study size | 10 | Explain how the study size was arrived at | 2, 3 |
| Quantitative variables | 11 | Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why | 2, 3 |
| Statistical methods | 12 | (*a*) Describe all statistical methods, including those used to control for confounding<br>(*b*) Describe any methods used to examine subgroups and interactions<br>(*c*) Explain how missing data were addressed<br>(*d*) If applicable, explain how loss to follow-up was addressed<br>(*e*) Describe any sensitivity analyses | 2, 3 |
| **Results** | | | |
| Participants | 13* | (a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed<br>(b) Give reasons for non-participation at each stage<br>(c) Consider use of a flow diagram | 3 |
| Descriptive data | 14* | (a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders<br>(b) Indicate number of participants with missing data for each variable of interest<br>(c) Summarise follow-up time (eg, average and total amount) | 3, 6 |
| Outcome data | 15* | Report numbers of outcome events or summary measures over time | 3, 6 |

| | | | |
|---|---|---|---|
| Main results | 16 | (*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included<br>(*b*) Report category boundaries when continuous variables were categorized<br>(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period | 3, 6, 7, 8 |
| Other analyses | 17 | Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses | 3, 6, 7, 8 |
| **Discussion** | | | |
| Key results | 18 | Summarise key results with reference to study objectives | 4 |
| Limitations | 19 | Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias | 4 |
| Interpretation | 20 | Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence | 4 |
| Generalisability | 21 | Discuss the generalisability (external validity) of the study results | 4, 5 |
| **Other information** | | | |
| Funding | 22 | Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based | 5 |

*Give information separately for exposed and unexposed groups.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at http://www.strobe-statement.org.

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# Emergency Department Falls: A Longitudinal Analysis of Revisits and Hospitalizations between Patients who Fell and Patients who did not Fall

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# Emergency Department Falls: A Longitudinal Analysis of Revisits and Hospitalizations between Patients who Fell and Patients who did not Fall

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**Abstract:**

Objective: Older adult falls are a national issue comprising 3 million emergency department (ED) visits and significant mortality. We sought to understand whether ED revisits and hospitalizations for fallers differed from non-fall patients through a secondary analysis of a longitudinal, statewide cohort of patients.

Design: We performed a secondary analysis using the non-public Patient Discharge Database and the Emergency Department Data from the California Office of Statewide Health Planning and Development. This is a five-year, longitudinal observational dataset which was used to assess outcomes for fallers and non-fall patients, defined as anyone who did not carry a fall diagnosis during this time period.

Setting: 2005-2010 non-public Patient Discharge Database and the Emergency Department Data from the state of California.

Participants: Older adults 65 years and older

Main Outcome Measure: ED revisits and hospitalizations for fallers and non-fall patients

Results: Patients who came to the ED with an index visit of a fall were more likely to be discharged home after their fall (61.1% vs 45.0%, p <0.001). Fallers who were discharged or hospitalized after their index visit were more likely to come back to the ED for a fall related complaint compared to non-fallers (median time: 151 days vs 352 days, p<0.001 and hospitalized: 45 days vs 119 days, p<0.01) and fallers who were initially discharged also returned to the ED sooner for a non-fall related complaint (median time: 325 days vs 352 days, p<0.001).

Conclusion: Fall patients tend to be discharged home more often after their index visit, but returned to the ED sooner compared to their non-fall counterparts. Given a faller's rates of ED revisits and hospitalizations, EDs should consider a fall as a poor prognostic indicator for future healthcare utilization.

**Strengths and Limitations of This Study:**

- This is the first statewide, longitudinal secondary data analysis examining disposition and ED revisits of patients who came to the ED for a fall and compared fallers to all other older adults using a statewide database of approximately 3.8 million patients
- The use of administrative data limits our understanding of other associated variables such as comorbidities and true identification of a patient's index visit for a fall.
- The nature of the data does not allow us to understand the reason for fall, which is important for fall prevention purposes.

## Background

Falls from older adults comprise nearly 3 million ED visits annually and account for 10% of all ED visits among those greater than age 65.[1,2] Mortality from falls increased by 110% from 1999-2016[3] and will rise as the population ages.

Adverse event rates for older patients who present to the ED after a fall is high. Over 70% of these patients are discharged after their ED visit, with the remaining 30% admitted to the hospital.[1] Approximately, 36%-44% of patients who come to the ED after experiencing a fall experience a subsequent adverse event, including recurrent falls, ED visits or death within one year.[4,5] Previous community based falls-prevention have helped prevent ED use and future hospitalizations. For instance, Mikolaizak et al found that older fallers who adhered to a paramedic initiated assessment and intervention had fewer falls and fall-related ED presentations at 6 months.[6] The PROFET trial showed that a multifactorial intervention for ED falls patients decreased recurrent falls and the odds of hospital admission at 12 months.[7] However, it is not clear whether these adverse event rates are higher than those of non-fall patients. Identifying such patients can help risk stratify when deciding disposition, referring to outpatient services and recommending enrollment into community based falls-prevention programs. To date, most studies on ED fall patients listing high adverse event rates are limited to one or few sites, are cross sectional or have no controls.[2,5]

We sought to explore whether the rate of ED revisits and hospitalizations among older fall patients differ significantly from non-fall patients in a large statewide cohort of ED patients that could be tracked longitudinally, with a specific interest on revisits for fall-related complaints. We hypothesized that fallers would revisit the ED and have more hospitalizations than their non-fall counterparts. Targeting at-risk older adults, particularly those discharged to home or home health care through community-based interventions or non-pharmacological clinical trials, is an underexplored, cost-effective mechanism with potential to reduce ED revisits and improve patient care.

## Methods

### Data Sources

To determine the rate of ED revisits and hospitalizations for elderly patients who present to the ED after a fall, we used de-identified, patient-level data for the 2005-2010 non-public Patient Discharge Database (PDD) and the Emergency Department Data (EDD) from the California Office of Statewide Health Planning and Development (OSHPD). The PDD captures demographic and clinical data for all admissions to non-Department of Veterans Affairs hospitals in California. The EDD provides data on all ED encounters, including those patients discharged from the ED. We also used hospital utilization data to capture hospital characteristics.

We included all adult patients aged 65 and older that were seen in the ED. Fall patients were defined as patients who came for a fall-related complaint between 1/1/2005-12/31/2010 with the International Classification of Disease (ICD) E codes E880.x-E888.x included anywhere in their visit. (See Figure 1) Non-fall patients were defined as all older patients seen in the ED between

1/1/2005-12/31/2010 with any other diagnosis. The censor time for death was 12/31/2011. More specifically, if a patient had non-fall visit before the fall visit for those aged>65, that specific non-fall visit was not counted. However, if he/she had a non-fall visit after a fall visit, that was counted. For patients who never had a fall visit, all of their non-fall visits were counted.

The decision to use patient-level in lieu of visit-level data stemmed from the need to look at both patient characteristics and longitudinal outcomes on disposition and revisits. As such, we obtained data including age, sex, ethnicity/race, payer type, and whether the visit was at a teaching vs. nonteaching hospital. We calculated income based on zipcode as a proxy[8] and then examined disposition of the patient from the ED or after hospitalization (ED death, or discharge from ED or hospital to an acute care facility, skilled nursing home, or home with visiting nurse). This study used de-identified data but was approved by the institutional review board.

Patient and Public Involvement

This research was done without patient or public involvement. Patients were not invited to comment on the study design and were not consulted to develop patient relevant outcomes or interpret the results. Patients were not invited to contribute to the writing or editing of this document for readability or accuracy.

Outcomes

We examined the frequency of various dispositions (e.g. where the patient was discharged to) from the ED between geriatric fall and non-fall patients. Our primary outcome was disposition and the median time to ED revisits for a fall between fall and non-fall patients. Our secondary outcome was the median time to an ED revisit for any reason between fall and non-fall patients. We also examined the frequency of at least one ED revisit for a fall as well as an ED revisit for any reason at 7 and 30 days, 6 months and 1 year among fall and non-fall patients. We also performed a Kaplan-Meyer analysis for time to revisit for any reason, controlling for age, sex, race, insurance, teaching and median income. For the sake of brevity, we termed those older adult patients who presented for a fall-related complaint as “fallers” and those who did not fall as a “non-fallers.”

Statistical Analysis

We calculated differences in demographics using Wilcoxon, t or $\chi 2$ test where appropriate. We tested for differences of Frequency of Disposition Type after Initial ED Visit between fall and non-fall patients using $\chi^2$ test. To access the median times to the ED revisits, we used a Cox model with a type 3 test of the effect of the 8-way classifications. To access survival rate to ED revisit, we fit a Cox model for the association of fall vs. non-fall with time to each event, adjusting for age, sex, race, insurance, teaching hospital, and median income. All analyses were completed using SAS 9.4.

**Results**

The fall cohort predominantly consisted of females who were 79.5 years compared to the non-fall cohort who were primarily men with an average age of 74.7 years ($p<0.001$). Fallers were also predominantly non-Hispanic white (71.3% vs 63.1%, $p<0.001$), seen primarily in non-teaching

hospitals (92.5% vs 90.9%, p<0.001) with Medicare as their primary insurance (87% vs 80.9%, p<0.001). While non-fallers also predominantly used Medicare as their primary payer, they notably had a higher mix of non-Medicare primary payers, including commercial insurers (private), Medicaid and self-pay, compared to fallers. (Table 1). Overall, fallers had a total of 4.76 million visits between 2005-2011 orapproximately 4.78 visits per patient while non-fallers made 9.24 million visits in this time span or approximately 3.30 visits per patient). (Table 2a) and 2b)

Patients who came to the ED with an index visit of a fall were more likely to be discharged home after their fall (61.1% vs 45.0%, p<0.001) or sent directly to a skilled nursing facility (SNF) or an acute care facility from the ED (1.5% vs 0.3%, 0.2% vs 0.04%, respectively, p<0.001). Patients who came to the ED for non-fall related visit were more likely to be hospitalized (52.6% vs 35.7%); however, fallers who were admitted were more often transferred to a SNF or an acute care facility post-hospitalization compared to non-fallers (47.5% vs 13.9% and 8.5% vs 4.9%, respectively, p<0.001) whereas non-fallers were more often discharged home post-hospitalization (61.3% vs 23.3%, p<0.001). (Table 3)

Fallers who were discharged after their index visit were more likely to come back to the ED for both a fall and non-fall related complaint compared to non-fallers (median time 151 days and 325 days vs 352 days, p<0.001). (Table 3)

Fallers who were initially hospitalized returned to the ED sooner for another fall related complaint compared to non-fall patients (45 days vs 119 days, p<0.001) but non-fallers returned earlier to the ED for any reason (excluding falls) compared to fallers (119 days vs 242 days, p<0.001). (see Table 3) Furthermore, based on a Kaplan-Meyer analysis, non-fallers had a lower probability of returning to the ED compared to fallers at each time point after adjusting for age, sex, race, insurance, teaching, median income. (Figure 2 and Table 4).

It is worth noting that we could not calculate the rate of ED return amongst non-fallers for a fall related visit as this would have placed them into the fallers cohort.

**Discussion**

Older adults who present to the emergency department with a fall between 2005-2010 were more likely to be older, female, non-Hispanic white, covered by Medicare and primarily present to community facilities as compared to those patients who presented to the ED for a non-fall related complaint. Furthermore, fall patients were discharged home more often, but returned to the ED sooner for both a fall and non-fall related complaint compared to their non-fall counterparts (p<0.001). This study is unique in that it is the first statewide, longitudinal secondary data analysis examining disposition and ED revisits of patients who came to the ED for a fall and compared fallers to all other older adults using a statewide database of approximately 3.8 million patients, but similar outcomes to a retrospective cohort study looking at fall related 30-day readmissions using the Hospital Cost and Utilization Project data.[9]

This database shows that fallers appear to be a high-risk patient population who return to the ED much sooner than patients who did not fall for a second fall related complaint regardless of whether they were admitted or discharged from their index ED visit. Often, fallers may minimize their reason for falling and are reluctant to engage in fall prevention efforts on their own.[10] Also, most EDs do not do a comprehensive fall evaluation, thus missing many opportunities to address the risk factor that lead to the fall or prevent future falls.[11, 12] Although this study does not delineate the underlying reason for a fall or reason for their return ED visit, our findings suggest that this patient population warrants close evaluation, workup, and follow-up to assess their reasons for falling and potential intervention.

Among hospitalized patients, non-fallers returned to the ED sooner than fallers for any other non-fall related reason (P<0.001). This may be due to a sicker case-mix of non-fall patients reflected through the higher percentage of Medicaid amongst non-fallers or the higher percentage of non-fallers being treated at teaching hospitals containing tertiary services,[13, 14] or that more non-fallers were discharged home without services post-hospitalization. However, this difference warrants further investigation.

**Limitations**

There were many limitations to this study including those inherent to the retrospective nature of this analysis. First, it is possible that what we classified as an index visit for a fall may not have been the actual first visit for a fall. Although some index visits for a fall may have occurred outside the state of California, we expect this number to be minimal. Second, because we are using administrative data, we have limited understanding of other important variables including functional status, comorbidities and relative frailty of patients, which could contribute to the observed result. Third, as with any administrative dataset, there are potential errors due to miscoding, data linkage and missing data. However, these would not bias our study unless these errors were distributed unevenly across both categories of patients, which would be unlikely. Furthermore, while the dataset is statewide, results cannot be generalized across the entire country or other healthcare systems. Last, we do not have a reason for the fall, which is often important for fall prevention and may provide a better sense as to why patients who presented initially for a fall-related complaint are returning to the ED sooner than patients who did not fall.

**Conclusion**

This epidemiological study suggests that patients who fall are a sick patient population who are more likely to return to the ED for a second fall regardless of whether they are discharged or admitted and are more likely to return for any reason if discharged. Given the increasing rates of falls over time,[2] providers should recognize the significance of a fall as a risk factor for future healthcare utilization. Multiple studies have shown the benefit of multifactorial falls prevention interventions to decrease the rates of recurrent falls[7,15] with a recent Cochrane review underscoring the benefit of exercise and physical therapy based programs as a particularly beneficial modality to decrease the rate of injurious falls.[16] While the most recent STRIDE trial

did not show a benefit for community based falls prevention for at risk individuals, it did not assess prevention activities for ED patients after a fall and it also acknowledges that behavior modification through exercise, one of the most important interventions for future fall prevention, was not underscored.[17,18] Qualitative data indicates that patients who present to the ED may have more willingness for falls prevention[19] and programs should continue to capitalize on this motivation for secondary fall prevention strategies.[20] Further studies should also look at the cause of falls and patients' associated comorbidities as indicators for outcomes. EDs should also consider urgently referring discharged fall patients to physical therapy or an evidence-based exercise and/or falls prevention program.

**Contribution Statement:** KNS and SL conceived the initial study. FL undertook the statistical analysis. KNS and SL drafted the manuscript and FL, HE and ET contributed substantially to its revision. KNS takes responsibility for the paper as a whole.

**Funding:** None

**Competing Interests:** None

**Data Sharing:** Data may be obtained from a third party but are not publicly available. The data are not publicly available but can be obtained through written request to the California Office of Statewide Health Planning and Development.

**Figure Legend:**

**Figure 1: Falls Diagnostic E-Codes**

**Figure 2: Kaplan-Meyer Survival Curve, Time to ED revisit for Any Reason**

**Table 1. Comparison of Demographics of Elderly Falls patients to Patients who did Not Fall**

| | Fall (N=997524) | Non-Fall (N=2805508) | P value |
|---|---|---|---|
| Age | 79.5 ± 8.3 | 74.7 ± 7.9 | <0.001 |
| Gender | | | |
| Male | 336060 (33.7%) | 1298346 (46.3%) | <0.001 |
| Female | 661152 (66.3%) | 1506065 (53.7%) | |
| Other | 312 (0.03%) | 1097 (0.04%) | |
| Ethnicity/race | | | |
| Non-Hispanic White | 710852 (71.3%) | 1770408 (63.1%) | <0.001 |
| Non-Hispanic Black | 38699 (3.9%) | 167215 (6.0%) | |
| Hispanic | 133594 (13.4%) | 433837 (15.5%) | |
| Asian | 26611 (2.7%) | 145804 (5.2%) | |
| Other | 68661 (6.9%) | 220746 (7.9%) | |
| Unknown | 19107 (1.9%) | 67498 (2.4%) | |
| Median income | 67290 ± 24323 | 66563 ± 24330 | <0.001 |
| Payer type (Primary Insurance) | | | |
| Self-pay | 14471 (1.5%) | 57962 (2.1%) | <0.001 |
| Medicare | 867863 (87.0%) | 2269251 (80.9%) | |
| Medicaid | 19220 (1.9%) | 106590 (3.8%) | |
| Commercial Insurance and Commercial HMO | 82435 (8.3%) | 331897 (11.8%) | |
| Other | 13301 (1.3%) | 39099 (1.4%) | |
| Missing | 30 (0.0%) | 170 (0.0%) | |
| Teaching Hospital | | | |
| No | 922366 (92.5%) | 2550886 (90.9%) | <0.001 |
| Yes | 75158 (7.5%) | 254622 (9.1%) | |

Table 2a: Breakdown of All Visits by Year

| | Fall patients | Non-fall patients | Total |
|---|---|---|---|
| Number of patients | 997524 | 2805508 | 3803032 |
| Total visits | 4769880 | 9245450 | 14015330 |
| 2005 | 491604 | 1310892 | 1802496 |
| 2006 | 554715 | 1258444 | 1813159 |
| 2007 | 615788 | 1234484 | 1850272 |
| 2008 | 687179 | 1280194 | 1967373 |
| 2009 | 746467 | 1315321 | 2061788 |
| 2010 | 807063 | 1370785 | 2177848 |
| 2011 | 867064 | 1475330 | 2342394 |

**Table 2b. Fall versus Non-Fall Generalized Visit Patterns**

| | Fall patients | Non fall patients | Total |
|---|---|---|---|
| Number of patients | 997524 | 2805508 | 3803032 |
| Total visits | 4769880 | 9245450 | 14015330 |
| # visits per patient | 4.78 ± 5.18 [(1)]<br>3 (2 – 6) [(2)] | 3.30 ± 3.58<br>2 (1 -4) | 3.69 ± 4.12<br>2 (1 -5) |
| # visits for fall | 1.53± 1.05<br>1 (1 -2) | NA | 0.40 ± 0.86<br>0 (0 -1) |
| %revisit for fall | 291025<br>(29.17%) | | |

[(1)]Mean ± std

[(2)]median (IQR)

**Table 3. Type of Disposition after Initial ED visit for all patients (a), Time to ED Revisit for Fallers (b) and Time to ED Revisit for Non-Fall Patients (c)**

| | Frequency of Disposition Type after Initial ED Visit (a) | | | Median Time to ED Revisit amongst Fall patients (b) | | | | Median Time to ED revisit for Non-Fall Patients (c) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Index Visit: Fall | Index Visit: Non-fall | | Reason for ED Revisit: Fall | | Reason for ED Revisit: Any Reason | | Reason for ED Revisit: Any Reason | | |
| | N | days | P value | n | days | n | days | n | days | P value |
| Discharge home from ED | 609822 (61.13%) | 1263272 (45.03%) | <0.001 | 437197 | 151.0 | 191925 | 325.0 | 524237 | 352.0 | <0.001 |
| Discharge With home health service from ED | 1519 (0.15%) | 1453 (0.05%) | | 993 | 58.0 | 432 | 114.0 | 623 | 83.0 | |
| Directly to Skilled Nursing Facility from ED | 15387 (1.54%) | 9081 (0.32%) | | 11456 | 71.0 | 5247 | 137.0 | 5087 | 111.0 | |
| Directly to Acute Care (IRF, LTCH) from ED | 2007 (0.20%) | 1166 (0.04%) | | 1509 | 59.0 | 771 | 96.0 | 654 | 97.0 | |
| ED death | 521 (0.05%) | 12208 (0.44%) | | 0 | | 0 | | 0 | | |
| Other | 11819 (1.18%) | 43910 (1.57%) | | 9321 | 30.0 | 5403 | 9.0 | 24444 | 47.0 | |
| Blank | 101 (0.01%) | 220 (0.01%) | | 76 | 68.5 | 41 | 67.0 | 98 | 1.0 | |
| Hospitalization after ED visit | 356348 (35.72%) | 1474198 (52.55%) | <0.001 | 269385 | 45.0 | 109751 | 242.0 | 956264 | 119.0 | <0.001 |
| Then to Acute Care (IRF, LTCH) after hospitalization | 30363 (8.52%) | 72214 (4.90%) | | 28514 | 5.0 | 12452 | 69.0 | 64385 | 4.0 | |
| Then to SNF after hospitalization | 169084 (47.45%) | 204991 (13.91%) | | 134491 | 40.0 | 53465 | 246.0 | 150005 | 35.0 | |

| | **Frequency of Disposition Type after Initial ED Visit** (a) | | | **Median Time to ED Revisit amongst Fall patients (b)** | | | | **Median Time to ED revisit for Non-Fall Patients (c)** | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Index Visit: Fall** | **Index Visit: Non-fall** | | **Reason for ED Revisit: Fall** | | **Reason for ED Revisit: Any Reason** | | **Reason for ED Revisit: Any Reason** | | |
| | N | days | P value | n | days | n | days | n | days | P value |
| Then to residential care after hospitalization | 4181 (1.17%) | 11056 (0.75%) | | 3338 | 64.0 | 1645 | 137.0 | 7950 | 86.0 | |
| Discharge home after hospitalization | 83178 (23.34%) | 903245 (61.27%) | | 61352 | 119.0 | 25276 | 313.0 | 594246 | 192.0 | |
| Discharge home with health services after hospitalization | 47871 (13.43%) | 200618 (13.61%) | | 35425 | 99.0 | 14819 | 272.0 | 129308 | 148.0 | |
| Invalid/blank | 64 (0.02%) | 178 (0.01%) | | 41 | 9.0 | 17 | 67.0 | 91 | 7.0 | |
| Other | 3551 (1.00%) | 16484 (1.12%) | | 2556 | 17.0 | 1207 | 85.0 | 10279 | 44.0 | |

***Any Reason excludes any visit pertaining to a fall**

**Table 4: Survival Time to ED revisit, fall vs. non-fallers, adjusted for age, sex, race, insurance, teaching, median income. (p=0.000)**

| Days | Fall | Non-fall |
|---|---|---|
| 7 | 0.88 | 0.94 |
| 30 | 0.78 | 0.87 |
| 182 | 0.57 | 0.74 |
| 365 | 0.45 | 0.66 |
| 1826 | 0.18 | 0.38 |

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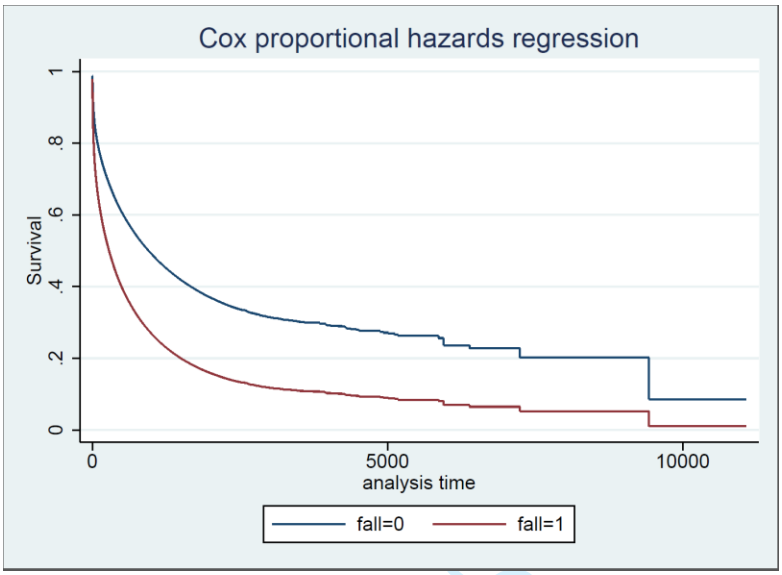
**Figure 1: Diagnostic E-Codes**

- E880 Accidental fall on or from stairs or steps
- E881 Accidental fall on or from ladders or scaffolding
- E882 Accidental fall from or out of building or other structure
- E883 Accidental fall into hole or other opening in surface
- E884 Other accidental falls from one level to another
- E885 Accidental fall on same level from slipping tripping or stumbling
- E886 Fall on same level from collision, pushing, or shoving, by or with other person
- E887 Fracture, cause unspecified
- E888 Other and unspecified fall

**Figure 2: Kaplan-Meyer Survival Curve, Time to ED revisit for Any Reason**



STROBE Statement—Checklist of items that should be included in reports of ***cohort studies***

| | Item No | Recommendation | Page No |
|---|---|---|---|
| **Title and abstract** | 1 | (*a*) Indicate the study's design with a commonly used term in the title or the abstract<br>(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found | 2 |
| **Introduction** | | | |
| Background/rationale | 2 | Explain the scientific background and rationale for the investigation being reported | 2 |
| Objectives | 3 | State specific objectives, including any prespecified hypotheses | 2 |
| **Methods** | | | |
| Study design | 4 | Present key elements of study design early in the paper | 2, 3 |
| Setting | 5 | Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection | 2, 3 |
| Participants | 6 | (*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up<br>(*b*) For matched studies, give matching criteria and number of exposed and unexposed | 2, 3 |
| Variables | 7 | Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable | 2, 3 |
| Data sources/ measurement | 8* | For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group | 2, 3 |
| Bias | 9 | Describe any efforts to address potential sources of bias | 2, 3 |
| Study size | 10 | Explain how the study size was arrived at | 2, 3 |
| Quantitative variables | 11 | Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why | 2, 3 |
| Statistical methods | 12 | (*a*) Describe all statistical methods, including those used to control for confounding<br>(*b*) Describe any methods used to examine subgroups and interactions<br>(*c*) Explain how missing data were addressed<br>(*d*) If applicable, explain how loss to follow-up was addressed<br>(*e*) Describe any sensitivity analyses | 2, 3 |
| **Results** | | | |
| Participants | 13* | (a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed<br>(b) Give reasons for non-participation at each stage<br>(c) Consider use of a flow diagram | 3 |
| Descriptive data | 14* | (a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders<br>(b) Indicate number of participants with missing data for each variable of interest<br>(c) Summarise follow-up time (eg, average and total amount) | 3, 6 |
| Outcome data | 15* | Report numbers of outcome events or summary measures over time | 3, 6 |

| | | | |
|---|---|---|---|
| Main results | 16 | (*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included<br>(*b*) Report category boundaries when continuous variables were categorized<br>(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period | 3, 6, 7, 8 |
| Other analyses | 17 | Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses | 3, 6, 7, 8 |
| **Discussion** | | | |
| Key results | 18 | Summarise key results with reference to study objectives | 4 |
| Limitations | 19 | Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias | 4 |
| Interpretation | 20 | Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence | 4 |
| Generalisability | 21 | Discuss the generalisability (external validity) of the study results | 4, 5 |
| **Other information** | | | |
| Funding | 22 | Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based | 5 |

*Give information separately for exposed and unexposed groups.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at http://www.strobe-statement.org.