Cost of falls and fractures in long-term care

Fall Prevention in Long-Term Care
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Outline

1. Background
2. Cost of falls – a systematic review
3. Cost of femoral fractures in long-term care – an incidence-based cost-of-illness study
4. Conclusion
Background
Economic burden of fall-related injuries

- **Injuries** caused by different mechanisms are a considerable **health challenge**.

- After motor vehicles, **falls** are the **second largest contributor** to the **economic burden of injuries** with respect to lifetime costs in the USA and Australia.

- In the **elderly**, falls actually represent the **leading** contributor.

- Within many countries, the fall related burden of disease and costs is expected to increase due to **demographic changes**.

- **Fractures** are the **economically most relevant** consequences of falls.
Falls and fractures in nursing home residents

- Nursing home residents have a particular high risk of falls and fractures compared to community-dwelling people.

- Femoral fractures are very frequent in nursing home residents.

- Over 90% of all femoral fractures in old age are fall-related.

- Femoral fracture lead to high direct costs.

- Nursing home residents are often neglected in service utilisation and costing studies.

→ The purpose of our research was
  - to review the cost of falls reported in the international literature
  - to determine the initial and long-term direct costs of incident femoral fractures in nursing home residents aged 65+ in Germany
Cost of falls – a systematic review
Search strategy

- Use of the following databases (until July 2009):
  - PubMed, CRD*, CDSR**
- Unrestricted search with the following terms:
  - (slip OR slips OR trip OR trips OR fall OR falls) AND (cost* OR expen* OR economic* OR burden)
  - Hand search of reference lists of studies
- Inclusion criteria:
  - One of the primary objectives of the original study was to determine costs of falls
  - The study presented quantitative estimates of costs of falls specified for old age (60+)
  - Quantitative estimates referred to national costs or costs on the individual level
- Exclusion criteria:
  - Intervention studies (e.g. RCTs, economic evaluations)
  - Other languages than English or German

*Centre for Reviews and Dissemination, **Cochrane Database of Systematic Reviews
Classification and analyses

- Hierarchal classification of results with respect to:
  - Setting (all, nursing home, hospital, community und traffic)
  - National total costs
  - Costs on the individual level:
    - costs per faller
    - costs per fall
- For national costs the share of fall-related costs in total health care expenditures, in gross domestic product (GDP) and per inhabitant was calculated.
- If appropriate, cost data were inflated to the year 2006 and converted to USD PPP (purchasing power parities).
Flow chart of the search and retrieval process

PubMed (n=5,772)  
CRD (n=427)  
CDSR (n=999)

Articles retrieved and reviewed for inclusion/exclusion (n=319)

Studies excluded after screening of title and abstract (n=6,818)

Bibliographic screening (n=45)

Studies excluded (n=329), of this n=46 intervention studies, n=24 other languages

Included studies (n=35)

Excluded from analyzing (n=3)

Analyzed studies (n=32)
Year of publication

![Bar chart showing the absolute number of publications by year of publication from 1989 to 2009. The x-axis represents the years 1989 to 2009, and the y-axis represents the absolute number of publications, ranging from 0 to 6. The chart shows a peak in publications in 2005, with lower numbers in other years.]
Study region

![Bar chart showing the absolute number of publications by study region: Europe, USA, Australia, and Jamaica. The USA has the highest number of publications, followed by Europe, Australia, and Jamaica.]
Economic perspective

Absolute number of publications

Society | Payer | Provider | Other
Setting (population)

![Bar chart showing absolute number of publications by setting.]

- **Mixed**: Highest absolute number of publications.
- **Nursing home**, **Hospital**, **Community**, **Traffic**: Low absolute number of publications.
Other study characteristics

- **Costing approach:**
  - \textbf{n=31 bottom up}, \textbf{n=1 Top Down}
  - \textbf{n=28 prevalence-based}, \textbf{n=4 incidence-based}
  - \textbf{n=22 fall-related treatment costs}, \textbf{n=10 other}

- **Identification of falls:**
  - \textbf{in: n=12 providers}, \textbf{n=9 database}, \textbf{n=11 other}
  - \textbf{with: n=17 ICD-9 E/ICD-10}, \textbf{n=6 self-report}, \textbf{n=9 other}

Studies represent, on the one hand, \textbf{large populations} (up to \textbf{n=445.152}) or number of cases, since registers and databases were used; on the other hand, populations are often \textbf{not exclusively specified}, since data was gathered through multiple sources.
Cost of falls by country (prevalence-based)

Share of total health care expenditures in %

USA


Cost per inhabitant in USD PPP

0  150  300  450  600  750  900

Share of total health care expenditure

Per inhabitant
Cost components

- **Direct costs** within a country occurred especially:
  - in higher age groups
  - in females
  - in hospitals / long-term care
  - for fractures, especially for:
    - non-fatal falls: lower extremity, upper extremity, torso
    - fatal falls: traumatic brain injury, lower extremity, torso

- **Indirect costs** due to morbidity and mortality played a less important role in this age group (16% - 33% of the total costs).
Cost of falls in nursing homes

- Only 3 studies (Carroll et al. 2008, Sorensen et al. 2006, Nurmi et al. 2002)
- National direct costs (hospital and nursing home) in the USA in 2003:
  - 4,200 - 5,700 million USD
  - 0.25 – 0.34% of total health care expenditure / 0.04 – 0.05% of GDP
  - 128 - 159 USD per inhabitant 65+
- Costs per faller in the USA in 2006: 6.665 USD
- Costs per fall in 2006:
  - USA
    - 1.596 USD (hospital and nursing home)
    - 2.073 USD (all costs - taxonomy/expert panel)
  - Finland
    - 1.059 USD (hospital, ED, outpatient care)
Quality of the publications
(Drummond et al. 1996)

- Economic perspective stated:
  - explicitly 22%, 56% context, 22% unclear
- Identification of falls:
  - in the majority through the health care system (e.g. E-codes), missing less severe falls
  - different or no definition of falls (partly including intentional falls)
  - Most studies had no direct patient contact
- Measurement of costs:
  - 92% inpatient treatment
  - 80% outpatient care
  - 68% ED
  - 48% long-term care and ambulatory nursing
- Time horizon (94%) and pricing year (72%) stated
- Uncertainty analyses:
  - 29% statistical measure of precision (SD, SE, CI, etc.)
  - 19% sensitivity analyses
Conclusions

- **Falls** cause relevant costs.

- Only **three** studies dealt exclusively with nursing home residents.

- Focus up until now on falls with **severe** consequences.

- Future research should concentrate more on costs of falls in **long-term care** and hospitals, including falls requiring **little or no medical attention**.
Costs of femoral fractures in long-term care – an incidence-based cost-of-illness study
Purpose

The purpose of this study was to determine:

- initial and long-term direct costs of incident femoral fractures in nursing home residents aged 65+ in Germany, for the first time
Sample

- Nursing home population:
  - **Retrospective** dataset of the **sickness fund** Allgemeine Ortskrankenkasse Bavaria
  - Age **65** years and older
  - Residents of / newly admitted to a **nursing home** between 1st January 2006 and 31st December 2006
  - **Level of care** (1 to 4) in the long-term care insurance (measure of the **need of care** and the degree of **functional ability**)
  - Exclusion of **special facilities** (e.g. for apallic syndrom)

- Identification of femoral fractures:
  - **S72** ICD-10 hospital discharge diagnoses
  - **Index admission** between 1st January and 31st December 2006
  - No inpatient care for S72 **one year** before
Costing approach I

- Incidence-based, bottom-up cost-of-illness study
- Measurement of fracture-related direct costs from a payer perspective:
  - Inpatient care (index admission, transfer to another clinic, rehabilitation, re-hospitalisations within 12 months)
  - Nursing home care (change in level of care within 90 days, additional costs until death or the end of 2008)
  - Ambulatory care (pharmaceuticals, non-physician providers and medical supply within 3 months)
- Additional costs for nursing home and ambulatory care were determined with a before/after design.
- Costs beyond 2006 were discounted with a rate of 5%.
## Costing approach II

<table>
<thead>
<tr>
<th>Initial hospital episode in 2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consisting of:</td>
</tr>
<tr>
<td>- index admission</td>
</tr>
<tr>
<td>- transfer to another clinic</td>
</tr>
<tr>
<td>- inpatient rehabilitation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Before/after Design:</th>
</tr>
</thead>
<tbody>
<tr>
<td>- change in level of care</td>
</tr>
<tr>
<td>- ambulatory care</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Re-hospitalizations:</th>
</tr>
</thead>
<tbody>
<tr>
<td>- due to S72</td>
</tr>
</tbody>
</table>

- The use of the incident approach can derive estimates about the economic burden which could be prevented.

- Cost of all **incident** femoral fractures in nursing home residents in **2006** and **costs** in **future years** until death.
## Population

<table>
<thead>
<tr>
<th>Age, mean (range)</th>
<th>Total population (n=60,091)</th>
<th>Incident cases (n=1,525)</th>
<th>Residents without (n=58,566)</th>
<th>P-value* (column 3+4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age classes, n (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>65-74</td>
<td>84 (65-109)</td>
<td>85 (65-100)</td>
<td>84 (65-109)</td>
<td>0.000</td>
</tr>
<tr>
<td>75-84</td>
<td>22,695 (38)</td>
<td>537 (35)</td>
<td>22,158 (38)</td>
<td></td>
</tr>
<tr>
<td>85+</td>
<td>29,816 (50)</td>
<td>881 (58)</td>
<td>28,935 (49)</td>
<td></td>
</tr>
<tr>
<td>Sex n (%) ♀</td>
<td>47,548 (79)</td>
<td>1,306 (86)</td>
<td>46,242 (79)</td>
<td>0.000</td>
</tr>
<tr>
<td>Level of care, n (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>19,526 (33)</td>
<td>479 (31)</td>
<td>19,047 (33)</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>24,806 (41)</td>
<td>735 (48)</td>
<td>24,071 (41)</td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>15,759 (26)</td>
<td>311 (20)</td>
<td>15,448 (26)</td>
<td></td>
</tr>
</tbody>
</table>

*T-test for age, χ²-test for age classes, sex and level of care.
## Service use per incident femoral fracture

<table>
<thead>
<tr>
<th>Services</th>
<th>Number of residents with incident femoral fracture</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All (n=1,525)</td>
</tr>
<tr>
<td>Initial episode</td>
<td></td>
</tr>
<tr>
<td>Index admission</td>
<td>1,525 (100)</td>
</tr>
<tr>
<td>Clinic transfer</td>
<td>10 (0.7)</td>
</tr>
<tr>
<td>Rehabilitation</td>
<td>185 (12.1)</td>
</tr>
<tr>
<td>Re-hospitalisations (e.g. revisions, 1 year)</td>
<td>63 (4.1)</td>
</tr>
<tr>
<td>Nursing home care (increased level of care)</td>
<td>270 (17.7)</td>
</tr>
</tbody>
</table>

* $\chi^2$-test.
## Mean costs in EUR per incident femoral fracture

<table>
<thead>
<tr>
<th>Cost components</th>
<th>All (n=1,525)</th>
<th>in %</th>
<th>Male (n=219)</th>
<th>Female (n=1,306)</th>
<th>P-value* (column 4+5)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Initial episode</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Index admission</td>
<td>6,659</td>
<td>81.6</td>
<td>6,716</td>
<td>6,650</td>
<td>0.745</td>
</tr>
<tr>
<td>Clinic transfer</td>
<td>43</td>
<td>0.5</td>
<td>59</td>
<td>40</td>
<td>0.627</td>
</tr>
<tr>
<td>Rehabilitation</td>
<td>402</td>
<td>4.9</td>
<td>493</td>
<td>387</td>
<td>0.248</td>
</tr>
<tr>
<td><strong>Re-hospitalisations</strong></td>
<td>260</td>
<td>3.2</td>
<td>461</td>
<td>227</td>
<td>0.079</td>
</tr>
<tr>
<td>(e.g. revisions, 1 year)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Nursing home care</strong></td>
<td>574</td>
<td>7.1</td>
<td>405</td>
<td>603</td>
<td>0.077</td>
</tr>
<tr>
<td>(increased level of care)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Ambulatory costs</strong> (3 months)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pharmaceuticals</td>
<td>58</td>
<td>0.7</td>
<td>30</td>
<td>63</td>
<td>0.410</td>
</tr>
<tr>
<td>Non-physician providers</td>
<td>121</td>
<td>1.5</td>
<td>84</td>
<td>128</td>
<td>0.000</td>
</tr>
<tr>
<td>Medical supply</td>
<td>41</td>
<td>0.5</td>
<td>76</td>
<td>36</td>
<td>0.094</td>
</tr>
<tr>
<td><strong>Total costs</strong></td>
<td>8,160</td>
<td>100</td>
<td>8,325</td>
<td>8,132</td>
<td>0.489</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>3,830</td>
<td></td>
<td>3,959</td>
<td>3,808</td>
<td></td>
</tr>
</tbody>
</table>

*T-test.
Mean costs in EUR per incident femoral fracture by year of follow up

<table>
<thead>
<tr>
<th>Year</th>
<th>All (n=1,525)</th>
<th>in %</th>
<th>Male (n=219)</th>
<th>Female (n=1,306)</th>
<th>P-value* (column 4+5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total costs</td>
<td>8,160</td>
<td>100</td>
<td>8,325</td>
<td>8,132</td>
<td>0.489</td>
</tr>
<tr>
<td>2006</td>
<td>7,638</td>
<td>93.6</td>
<td>7,832</td>
<td>7,605</td>
<td>0.346</td>
</tr>
<tr>
<td>Inpatient care</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial episode</td>
<td>7,104</td>
<td></td>
<td>7,268</td>
<td>7,077</td>
<td>0.377</td>
</tr>
<tr>
<td>Re-hospitalisations</td>
<td>157</td>
<td></td>
<td>263</td>
<td>140</td>
<td>0.213</td>
</tr>
<tr>
<td>Nursing home care</td>
<td>155</td>
<td></td>
<td>111</td>
<td>163</td>
<td>0.108</td>
</tr>
<tr>
<td>Ambulatory care</td>
<td>221</td>
<td></td>
<td>191</td>
<td>226</td>
<td>0.456</td>
</tr>
<tr>
<td>2007</td>
<td>356</td>
<td>4.4</td>
<td>383</td>
<td>352</td>
<td>0.736</td>
</tr>
<tr>
<td>Inpatient care</td>
<td>103</td>
<td></td>
<td>199</td>
<td>87</td>
<td>0.225</td>
</tr>
<tr>
<td>Nursing home care</td>
<td>254</td>
<td></td>
<td>185</td>
<td>265</td>
<td>0.134</td>
</tr>
<tr>
<td>2008</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nursing home care</td>
<td>165</td>
<td>2.0</td>
<td>110</td>
<td>175</td>
<td>0.115</td>
</tr>
</tbody>
</table>

*T-test.
Strengths and limitations

- Strengths of this study are its **large sample size** with respect to nursing home residents and hip fractures
- Rather **systematic case ascertainment** of hip fractures

- The following points lead to an **overestimation** of costs:
  - No control group (e.g. increased costs due to increasing age)
- The following points lead to an **underestimation** of costs:
  - No data on physician services and transportation
  - Time frame of 3 months for ambulatory care might be too short
  - Difficulties to differentiate between inpatient follow up care due to the incident hip fracture and a new hip fracture
Sensitivity analysis

- The **main cost category** (initial hospital episode) is **well defined**
- The **less important cost categories** are **less certain**:
  - Costs for nursing home care:
    - **variation** of the time frame for **change in level of care** from 90 days to 7 days, reduces mean costs to **149 EUR**.
  - Costs for ambulatory care:
    - exclusion of non-survivors in 3 months ambulatory costs
    - ambulatory **costs of survivors**, are **50% higher** than for survivors and non-survivors together.
Comparison with the literature

- A comparison with other **German data is limited**, since national statistics are not specific enough and other studies are too old.

- Costs for the **index admission** are comparable to **international estimates** of about 7,000 USD (Haentjens et al.).

- **Long-term costs** seem to be **lower** than for **community-dwelling** populations:
  - only in a small fraction of nursing home residents a change in the level of care occurred
  - only the additional costs due to the change in the level of care are accounted for
  - ambulatory costs might be reduced in nursing home residents
Conclusions

- Total costs were 8,160 EUR per incident hip fracture.
- Our study underestimates the true costs to society.
- 87% of the costs were caused by the initial hospital episode and 13% by long-term costs.
- Efforts should be directed to economic evaluations of fall-prevention programmes aiming at reducing fall-related fractures.

→ Bavarian fall and fracture prevention project (BF₂P₂)
Thank you for your attention!