Use of acute hospital beds does not increase as the population ages: results from a seven year cohort study in Germany

R Busse, C Krauth, F W Schwartz

Objectives: (1) To compare the number of hospital days used by survivors with those by persons in their last, second last, and third last year of life in relation to age; (2) to analyse lifelong hospital utilisation in relation to life expectancy.

Design: Cohort study using a 10% sample (stratified by age and sex) of persons insured by one sickness fund.


Subjects: 69 847 survivors (with a minimum of three more years to live), 1385 persons in last, 1368 in second last, and 1333 in third last year of life.

Results: The number of days spent in hospital in the last year of life was lowest for the young (24.2 days under age 25) and the old (23.2 days at age 85+) and was greatest at ages 55–64 (40.6 days). The ratio of days to survivors was highest at age 35–44 (31.0) and fell continuously thereafter to 4.3 at age 85+. Similar patterns were seen for hospital days in the second and third year before death, except that peaks were at 35–44 years (22.5 and 13.7 days respectively). Calculated lifelong number of hospital days increased with age from 54.8 (death at age 20) to 201.0 (age 90). Numbers of hospital days per year of life, averaged over the entire lifespan, were stable at 2.0–2.2 for deaths between age 50 and 90 (and up to 2.7 at age 20).

Conclusions: Lifelong hospital utilisation for persons who die at 50 or later is directly proportional to the number of years lived. These data contradict results from cross sectional studies that suggest an exponential rise in health care costs as longevity increases. They have important implications for projections of future health care expenditure.
The average number of hospital days per year of life was calculated by dividing those cumulative number of hospital days by the number of years lived.

RESULTS

Hospital days per year

The average number of hospital days for persons in their final year of life increased from 24.2 days (~24 years) to a peak of 40.6 days in 55–64 year-olds. Above that age, the average number fell continuously to 23.2 days (85+ years). For survivors, the number increased steadily. The ratio of hospital days for those in the last year of life compared with survivors was around 30 at ages up to 44 years and fell continuously thereafter to 4.3 at 85+ years. Utilisation curves for persons in their second and third last year peaked at 35–44 years. Ratios of hospital days of deceased to survivors were much higher for young decedents in the last, second last, and third last year of life (table 2).

Admission to hospital

In every age group, at least 50% of persons in their last year of life were admitted to hospital at least once. Young decedents had generally the lowest rates. At around 80%, the rate was highest between 55 and 84 years of age while it dropped to 70% above that age. Percentages in the second and third last year of life were about one half and one third as high in all age groups. Rates of deceased persons on admission increased continuously with age, however. Again, ratios of deceased to survivors were highest for young decedents (table 3).

Length of stay

Persons with any hospital stays in their last year of life spent between 30 and 60 days there with the shortest total stays in the oldest age groups. Similarly, younger decedents were treated longer than older decedents in their second and third last year of life. Like admission rates, treatment duration for survivors increased continuously with age. Ratios of deceased to survivors were again higher for younger deceased and approached 1 with increasing age (table 4).

Of the two factors influencing the average number of hospital days, the admission rate to hospital had a larger impact than length of stay in the last two years of life. In the third last year, total length of stay was, however, the main determinant of hospital utilisation of younger decedents (tables 3 and 4).

Table 1 Number of persons included in study

<table>
<thead>
<tr>
<th>Age (y)</th>
<th>Survivors (male/ female)</th>
<th>Persons in their 3rd last year of life (male/ female)</th>
<th>Persons in their 2nd last year of life (male/ female)</th>
<th>Persons in their last year of life (male/ female)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-24</td>
<td>22271 (12776/ 9495)</td>
<td>28 (23/ 5)</td>
<td>25 (20/ 5)</td>
<td></td>
</tr>
<tr>
<td>25–34</td>
<td>15919 (11619/ 4300)</td>
<td>40 (30/ 10)</td>
<td>52 (42/ 10)</td>
<td></td>
</tr>
<tr>
<td>35–44</td>
<td>11927 (8599/ 3328)</td>
<td>88 (75/ 13)</td>
<td>89 (78/ 11)</td>
<td></td>
</tr>
<tr>
<td>45–54</td>
<td>9685 (6872/ 2813)</td>
<td>147 (118/ 29)</td>
<td>138 (109/ 29)</td>
<td></td>
</tr>
<tr>
<td>55–64</td>
<td>6149 (4205/ 1944)</td>
<td>269 (229/ 40)</td>
<td>257 (216/ 41)</td>
<td></td>
</tr>
<tr>
<td>65–74</td>
<td>2956 (1657/ 1299)</td>
<td>333 (238/ 95)</td>
<td>330 (244/ 86)</td>
<td></td>
</tr>
<tr>
<td>75–84</td>
<td>838 (372/ 466)</td>
<td>326 (171/ 155)</td>
<td>323 (169/ 154)</td>
<td></td>
</tr>
<tr>
<td>85+</td>
<td>102 (4/ 61)</td>
<td>104 (46/ 56)</td>
<td>171 (91/ 80)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>69847 (46141/ 23706)</td>
<td>1333 (930/ 403)</td>
<td>1385 (969/ 416)</td>
<td></td>
</tr>
</tbody>
</table>
Lifelong hospital utilisation
Table 5 shows that the lifelong number of hospital days increased steadily from 54.8 for those dying at age 20 to 201.0 for those dying at age 90. The number of hospital days before the last years of life increased by about 10 days for every 10 years lived for persons dying at or before 50 while the increase was more than 30 days for every additional 10 years of life for decedents after age 70. This increase was, however, to a large extent compensated as persons dying at 40 used twice as many hospital resources in their last three years of life as those dying at 90 (70.9 and 34.6 days, respectively).

The average numbers of hospital days per year of life were therefore stable at 2.0 to 2.2 for persons dying between ages 50 and 90 while they were higher for persons dying at younger ages: up to 2.7 at age 20 (table 5).

DISCUSSION
We conclude that the relation between health care costs and age is not as simple as “common knowledge” suggests. The most costly patients are those who die young: If only the last year of life is counted, the 45–64 year-olds have the highest number of hospital days; if the last three years are taken into account, the 35–44 year-olds accumulate the highest hospital utilisation. If the ratio of hospital days for deceased persons versus survivors of the same age is used as a criterion, persons up to 44 years of age are most expensive.

These results are generally in line with previous studies done in the USA, Canada, and the Netherlands: regarding hospital utilisation in the last year(s) of life in relation to age at death, these studies show maximums in age groups below 65, 70–74, and 75–84. As far the ratio of hospital days of deceased to survivors is concerned, maximums are always in the youngest age groups included in the studies. Only data from one study from the UK provide a very different picture with hospital days in the last year of life increasing progressively with age or at least to age 85–89. The median of hospital days in this study is comparatively low for age groups up to about 75 years in international comparison but the rate of hospital admissions is not particularly low. Therefore, the shorter length of stay in the UK has apparently affected the younger age groups more than the older ones.

The age span covered by our study is, however, considerably wider than all these previous studies, which, except for the Dutch one, excluded persons below age 45 or—mostly—65. Other problems complicating direct comparisons result from the fact that partly the units of measurement are different.
(that is, expenditure versus days) and the time of the studies varies from the mid-1970s to the late 1980s. The latter aspect is relevant as studies with two different sets of cross sectional data show that the peak in hospital days for persons in their last year of life has shifted to younger age groups: In British Columbia, 75–79 year-olds had higher number of hospital days than those who die older. These patterns suggest that hospital utilisation is directly proportional to the number of years lived.

Table 5  Number of hospital days over total (virtual) life span and average number of hospital days per year of life lived according to age at death

<table>
<thead>
<tr>
<th>Person dying at the age of . . .</th>
<th>20</th>
<th>30</th>
<th>40</th>
<th>50</th>
<th>60</th>
<th>70</th>
<th>80</th>
<th>90</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital days before last three years of life</td>
<td>10.1 (18)</td>
<td>20.2 (27)</td>
<td>30.0 (30)</td>
<td>42.4 (39)</td>
<td>62.2 (51)</td>
<td>86.2 (60)</td>
<td>120.9 (70)</td>
<td>166.4 (83)</td>
</tr>
<tr>
<td>Days in 3rd last year</td>
<td>9.3 (17)</td>
<td>13.4 (18)</td>
<td>13.7 (14)</td>
<td>11.0 (10)</td>
<td>6.9 (6)</td>
<td>9.0 (6)</td>
<td>8.5 (5)</td>
<td>5.1 (5)</td>
</tr>
<tr>
<td>Days in 2nd last year</td>
<td>11.2 (20)</td>
<td>12.0 (16)</td>
<td>22.5 (22)</td>
<td>15.5 (14)</td>
<td>12.4 (10)</td>
<td>12.4 (9)</td>
<td>11.4 (7)</td>
<td>6.3 (5)</td>
</tr>
<tr>
<td>Days in last year</td>
<td>24.2 (44)</td>
<td>28.6 (39)</td>
<td>34.7 (34)</td>
<td>39.2 (36)</td>
<td>40.6 (33)</td>
<td>36.4 (25)</td>
<td>31.8 (18)</td>
<td>23.2 (12)</td>
</tr>
<tr>
<td>Total</td>
<td>54.8 (100)</td>
<td>74.2 (100)</td>
<td>100.9 (100)</td>
<td>108.1 (100)</td>
<td>122.1 (100)</td>
<td>144.0 (100)</td>
<td>172.6 (100)</td>
<td>201.0 (100)</td>
</tr>
<tr>
<td>Average number of days per year of life</td>
<td>2.7</td>
<td>2.5</td>
<td>2.5</td>
<td>2.2</td>
<td>2.0</td>
<td>2.1</td>
<td>2.2</td>
<td>2.2</td>
</tr>
</tbody>
</table>

Percentages shown in parentheses.

**Key points**

- The correlation between age and hospital utilisation is complex as the percentage of dying persons with high numbers of hospital days increases with age.
- However, persons who die young “consume” more hospital days in their last years of life than those who die older.
- According to these German data, lifelong hospital utilisation is directly proportional to the number of years lived.
- An aging population might therefore have less impact on health care costs than generally expected.
- While this study expands our knowledge based on previous studies, further confirmation is needed from other countries and health care systems.

**REFERENCES**

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