The ecological fallacy of the role of age in chronic disease and hospital demand
THE DEMAND FOR PREHOSPITAL EMERGENCY SERVICES IN AN AGING SOCIETY

CHARLES E. MCCONNEL and ROSEMARY W. WILSON

Fig. 1. EMS incidents per 1,000 population due to trauma and medical conditions by age group, Dallas, Texas, 1990.
Exploring Patterns of Health Service Use in Older Emergency Department Patients

S. Nicole Hastings, MD, Carolyn Horney, Lawrence R. Landerman, PhD, Linda L. Sanders, MPH, Michael B. Hocker, MD, and Kenneth E. Schmader, MD

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Older adults who have visited the ED are a prime example of a population in need of improved methods of evaluating patterns of previous health care use. Adults aged 65 years and over were chosen as the target population for this study because they are among the most frequent utilizers of care in hospital EDs.⁴
Predictors of health care utilization in the chronically ill: a review of the literature

Angela G.E.M. de Boer *, Wouter Wijker,
Hanneke C.J.M. de Haes

Department of Medical Psychology, Academic Medical Center, University of Amsterdam,
PO Box 22700, 1000 DE Amsterdam, The Netherlands

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3.1.1. Age and sex

The majority of studies investigated the effect of age on either hospital utilization (32 studies) or physician visits (15 studies). Approximately half of the studies and analyses (18/32) that investigated hospital utilization by the chronically ill reported no relationship between hospital utilization and age [14,17,20(3), [21,22,27,30,34,40,41](2),[43,46,52,59,66]. Ten studies reported that older patients had a higher hospital utilization [19][1],[20,31,35,37,41,51,56–58] and four studies [24,32,39,50] found that younger patients are higher users of hospital services. Projects concerned with physician visits also found ambiguous results: seven studies reported no relationship between age and physician visits [23,25,38,39,44,54,55], while the other eight studies showed that older patients visit their doctors more often than younger patients [16,30,45,48,49,60,61,64].
Caveats of previous studies

- Confounding by morbidity
- Finding an equivalent point of reference in life-course at which to compare
- Ill-defined outcome measures (short-term, ignore trends, focussed on re-admission)
Defining **cardinal events** in chronic disease:

A two-year ‘rolling’ clearance period.

Align by cardinal event:
### Cardinal events, 2004-2008

(non-Aboriginal nor Torres Strait Islander)

<table>
<thead>
<tr>
<th>Condition</th>
<th>Total number of cardinal events</th>
<th>Number of cardinal events (% of total cardinal events)</th>
<th>Age in males</th>
<th>Age in females</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>First event</td>
<td>Second event</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Second event</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Third event</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Males</td>
<td>Females</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>Mean</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heart failure</td>
<td>10399 (97)</td>
<td>10045 (3)</td>
<td>5404 (52.0)</td>
<td>4995 (48.0)</td>
</tr>
<tr>
<td>Type 2 Diabetes</td>
<td>8334 (96)</td>
<td>7972 (4)</td>
<td>4687 (56.2)</td>
<td>3647 (43.8)</td>
</tr>
<tr>
<td>COPD</td>
<td>8872 (94)</td>
<td>8333 (6)</td>
<td>4748 (53.5)</td>
<td>4124 (46.5)</td>
</tr>
<tr>
<td>Cataract with diabetes</td>
<td>9175 (98)</td>
<td>8964 (2)</td>
<td>4512 (49.2)</td>
<td>4663 (50.8)</td>
</tr>
<tr>
<td>Asthma</td>
<td>9775 (97)</td>
<td>9462 (3)</td>
<td>4864 (49.8)</td>
<td>4911 (50.2)</td>
</tr>
<tr>
<td>Dialysis</td>
<td>888 (97)</td>
<td>862 (3)</td>
<td>589 (66.3)</td>
<td>299 (33.7)</td>
</tr>
</tbody>
</table>
LOcal regrESSion (LOESS)

• Kernel smoothing method that essentially fits local polynomial regressions and joins (smoothes) them together

• Does not require any assumptions about the parametric relationship between variables

• Allows 95% confidence intervals to be simply generated using bootstrap techniques

• Computationally intensive
Cohort of patients: Type 2 diabetes – additional diagnosis

Inpatient days

ED presentations
Day 1066 - 1146
Day 1426 - 1502
Day 1789 - 1868
Day 2164 - 2252

Major peaks & troughs before & after Christmas

Day 1061-1159
Day 1423-1502
Day 1789 - 1869
Day 2154 - 2256
Inpatient days – the ratchet effect

A. Heart failure ($n_0=10399$)  

B. Type 2 Diabetes ($n_0=8334$)  

C. COPD ($n_0=8872$)  

D. Dialysis ($n_0=888$)  

E. Diabetic cataract ($n_0=9175$)  

F. Asthma ($n_0=9775$)
Emergency presentations— the ratchet effect

A. Heart failure ($n_0=10399$)  
B. Type 2 Diabetes ($n_0=8334$)  
C. COPD ($n_0=8872$)  
D. Dialysis ($n_0=888$)  
E. Diabetic cataract ($n_0=9175$)  
F. Asthma ($n_0=9775$)
Compression of morbidity (Fries, NEJM 1980)

Figure 1. Possible scenarios for future morbidity and longevity. Present lifetime morbidity, portrayed as the shaded area, contrasted with three possible future scenarios. See text for discussion.
Survival

Heart failure

Type 2 diabetes

COPD
Type 2 diabetes

- n₀ = 1450
- n₀ = 1662
- n₀ = 2042
- n₀ = 2343
- n₀ = 837
Type 2 diabetes – additional diagnosis

Additional Type 2 Diabetes – Inpatient days per year, non-Aboriginal

Additional Type 2 Diabetes – ED presentations per year, non-Aboriginal

\[ n_0 = 8295 \quad n_0 = 11362 \quad n_0 = 13673 \quad n_0 = 11910 \quad n_0 = 3685 \]
Mean ED utilisation of **individuals** with chronic disease

- < 55 2.0 ED presentations per year
- 55-64 1.6 ED presentations per year
- 65-74 1.2 ED presentations per year
- 75-84 1.0 ED presentations per year
- >=85 1.0 ED presentations per year

### Mean ED utilisation of individuals in **age groups** with increasing chronic disease prevalence

- < 55 10% with chronic disease (Mean ED = 10% of 2.0)
- 55-64 20% with chronic disease
- 65-74 40% with chronic disease
- 75-84 70% with chronic disease
- >=85 90% with chronic disease
Conclusions

1. Cardinal events can be used to define a time-unbiased reference event in disease progression.

2. Cardinal events can mark a marked transition in health care utilisation (ratchet effect).

3. Older people with chronic disease have fewer ED presentations than younger people with chronic disease.

4. Older people with chronic disease transiently use more inpatient days than young people with chronic disease.

5. Chronic disease management programs should target those with chronic disease, not the aged.
Contributors

School of Primary, Aboriginal and Rural Health Care UWA

David Whyatt
Raji Tenneti
Sarah Bolt
Alistair Vickery

School of Mathematics and Statistics UWA

Julie Marsh
Laura Firth
Kevin Murray
Berwin Turlach

School of Population Health UWA

Anna Kemp

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