Mapping small area cancer mortality: a residential coding story

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SUMMARY During the compilation of an atlas of cancer mortality in England and Wales on a small area scale, one rural district was found to have raised death rates for most sites of cancer. On investigation this proved to be related to the opening in that district of a home for patients terminally ill with cancer. Deaths occurring in the home to patients from outside areas were not consistently transferred back to the deceased’s area of residence. The effect of the transferability status of the home on the district’s cancer rates is described. The Office of Population Censuses and Surveys is now reviewing the procedure for coding the area of residence of deaths in long stay institutions.

An atlas of cancer mortality in England and Wales for the years 1968–78 has recently been produced. The atlas contains 67 cancer maps, including 23 on a small area scale. These small areas are the 1366 local authority areas as constituted before the reorganisation of boundaries in 1974. For the 23 maps presented on this scale it was found that one area, Stone Rural District (RD) in Staffordshire, appeared with high mortality on 19 occasions. This appeared to indicate that an error had possibly occurred in either the data or the analysis—especially since there was no reason to suspect Stone Rural District to be aetologically extreme and the next most frequently occurring area appeared on only 10 maps. It seemed pertinent, therefore, to investigate this finding in detail.

Materials and methods

For each death certified to Stone RD during the 11 years 1968–78 we had available four items of information—year of death, sex, age at death, and the coded underlying cause of death—provided on computer tape by the Office of Population Censuses and Surveys (OPCS). In addition we had, also from OPCS, the population figures by sex and age that had been used in the 1969–73 Area Mortality Decennial Supplement.

Abstracts of death certificates are held on microfilm at OPCS, and a sample of these were examined for deaths in Stone RD. This was particularly to study other details on the abstracts that were not available on the computer tape.

Results

INITIAL ANALYSES

Table 1 shows the standardised mortality ratios (SMRs) for the 23 various cancers (including all cancers combined) that were mapped on a small area scale in the atlas. It also gives figures for all other cancers, non-cancer deaths, and all causes of death. For each individual cancer—except for cancer of the oesophagus in men, cancer of the pancreas in women, and pleural mesothelioma in both sexes—the high SMRs are statistically significant (at the 5% level) compared with national rates and in the top tenth of their respective distributions among the 1366 areas. The SMRs from all other cancers combined, not separately mapped, are similarly high at 226 for men and 248 for women. In total there was an excess of 647 cancer deaths assigned to Stone RD compared with the number expected at national rates, 306 in men and 341 in women. By contrast, the SMRs from non-cancer causes of death in Stone RD are close to 100. Overall mortality, as a consequence of the excess cancer deaths, is 25% above that expected at England and Wales’ rates.

Population figures

Although it seemed improbable that the raised cancer mortality rates could be due to the population figures which we used being incorrect and too small (in the light of the non-cancer SMRs being close to 100) a comparison was made between the 1971 population figures from the census and the OPCS Area Mortality Decennial Supplement. The
numbers in all age groups for each sex were similar and clearly, therefore, the raised cancer SMRs had not been caused by a deficit in the population figures.

**Age-specific mortality ratios**
Another possibility was that the excess might be concentrated in some unusual way in one or more age groups—for example, the elderly. The age-specific mortality ratios for cancer in Stone RD compared with England and Wales were consistently high, however, except at some younger ages when the numbers on which they were based are small.

**Deaths by calendar year**
The first column of table 2 shows the numbers of deaths assigned to Stone RD by calendar year. A striking annual pattern in deaths from cancer is noticeable. Between 1972 and 1973 there was a large rise from 42 to 164, followed by a decline in 1974. This low level, similar to those of 1968 to 1972, continued during 1975 with a small rise during 1976. This was followed by a pronounced increase in 1977, which was sustained into 1978. These changes suggested that the reasons for the raised SMRs may be found by comparing the certificates for deaths from cancer registered in Stone RD during 1973, 1977, and 1978 with the other years.

### STUDY OF DEATH CERTIFICATES
Microfilm abstracts of a sample of the deaths from cancer registered in Stone RD were examined by Mrs D Stobart at OPCS (Titchfield). It soon became apparent that the problem was associated with a home for patients terminally ill with cancer. This

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**Table 1** Mortality in Stone Rural District during 1968–78 by cause and sex showing observed and expected* deaths and standardised mortality ratios (SMRs)

<table>
<thead>
<tr>
<th>Cause of death</th>
<th>ICD No (8th rev)</th>
<th>Obs</th>
<th>Exp</th>
<th>SMR</th>
<th>Obs</th>
<th>Exp</th>
<th>SMR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cancer of the:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Oesophagus</td>
<td>150</td>
<td>12</td>
<td>8-5</td>
<td>142</td>
<td>12</td>
<td>5-8</td>
<td>208</td>
</tr>
<tr>
<td>Stomach</td>
<td>151</td>
<td>57</td>
<td>32-6</td>
<td>175†</td>
<td>47</td>
<td>20-4</td>
<td>230†</td>
</tr>
<tr>
<td>Large intestine</td>
<td>153</td>
<td>35</td>
<td>19-6</td>
<td>179†</td>
<td>54</td>
<td>24-5</td>
<td>220†</td>
</tr>
<tr>
<td>Rectum</td>
<td>154</td>
<td>38</td>
<td>14-7</td>
<td>259†</td>
<td>28</td>
<td>11-3</td>
<td>249†</td>
</tr>
<tr>
<td>Pancreas</td>
<td>157</td>
<td>23</td>
<td>13-0</td>
<td>177†</td>
<td>13</td>
<td>10-3</td>
<td>126</td>
</tr>
<tr>
<td>Lung</td>
<td>162</td>
<td>233</td>
<td>119-6</td>
<td>195†</td>
<td>42</td>
<td>26-7</td>
<td>158†</td>
</tr>
<tr>
<td>Pleural mesothelioma</td>
<td>163-0</td>
<td>1</td>
<td>0-6</td>
<td>162</td>
<td>0</td>
<td>0-2</td>
<td>0</td>
</tr>
<tr>
<td>Breast</td>
<td>174</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>160</td>
<td>49-4</td>
<td>324†</td>
</tr>
<tr>
<td>Cervix</td>
<td>180</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>39</td>
<td>10-1</td>
<td>384†</td>
</tr>
<tr>
<td>Uterus</td>
<td>182</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>23</td>
<td>6-4</td>
<td>360†</td>
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<tr>
<td>Ovary</td>
<td>183</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>26</td>
<td>16-0</td>
<td>163†</td>
</tr>
<tr>
<td>Prostate</td>
<td>185</td>
<td>44</td>
<td>19-2</td>
<td>229†</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Bladder</td>
<td>188</td>
<td>28</td>
<td>12-8</td>
<td>219†</td>
<td>12</td>
<td>4-8</td>
<td>252†</td>
</tr>
<tr>
<td>Other cancers‡</td>
<td></td>
<td>136</td>
<td>60-3</td>
<td>226</td>
<td>119</td>
<td>48-0</td>
<td>248</td>
</tr>
<tr>
<td>All cancers</td>
<td>140–209</td>
<td>607</td>
<td>300-8</td>
<td>202†</td>
<td>575</td>
<td>233-8</td>
<td>246†</td>
</tr>
<tr>
<td>All other causes</td>
<td>1097</td>
<td>1058-0</td>
<td>104</td>
<td>844</td>
<td>901-1</td>
<td>94</td>
<td></td>
</tr>
<tr>
<td>All causes</td>
<td>000–999</td>
<td>1704</td>
<td>1358-8</td>
<td>125†</td>
<td>1419</td>
<td>1134-9</td>
<td>125†</td>
</tr>
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</table>

*Based on age-sex-cause specific death rates in England and Wales during 1968–78 and the 1971 population of Stone RD.
†SMR significantly raised compared with national average of 100 for England and Wales, and in the top tenth of distribution among the 1366 local authority areas.
‡These cancers were not mapped on a small area scale in the cancer atlas.'
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home (the Douglas MacMillan Home) opened in January 1973 and until January 1974 was regarded as a long stay institution, after which time deaths occurring there were transferred back by OPCS to the area of the person’s home residence. This continued until December 1976, when it again became a non-transferable institution. It remained so until December 1980, since when it has been regarded as a short stay terminal cancer unit.

Copies of certificates for all deaths with cancer as the underlying cause registered in and assigned to Stone RD during 1972–8 were obtained subsequently from OPCS (Titchfield). Table 2 shows an analysis of these by year of registration, giving the numbers taking place in the Douglas MacMillan Home and the numbers transferred. During 1973 the number of deaths from cancer registered by the registrar of Stone RD increased from 57 to 179. The gradual upward trend thereafter throughout the remaining years associated with the increasing numbers of deaths taking place in the Douglas MacMillan Home. By contrast, there were no major changes in the annual numbers of deaths from cancer that occurred outside the home and were registered in Stone RD.

The impact in 1973 of the home on deaths registered in—but not transferred out of—Stone RD is clear, with an increase from 22 to 148 in one year. Thereafter, these figures were lower in 1974, 1975, and 1976, followed by large increases again in 1977 and 1978 after the change in transferability status. During the three years when the home was regarded as a transferable institution, many deaths were transferred out to the neighbouring area of Stoke-on-Trent County Borough (CB). The numbers of deaths from cancer transferred into Stone RD on residential qualifications, having taken place outside, remained fairly steady over the years.

**Location of the Home**

The figure shows the geographical location of the Douglas MacMillan Home in relation to the boundaries of the main local authority areas involved. The Home is adjacent to the common boundary of Stone RD and Stoke CB. In fact, if the home had been sited on the opposite side of the street it would have been inside the boundary of Stoke-on-Trent CB. Its position just outside the major city of Stoke explains why many of the deaths which occurred there were to Stoke CB residents, and that their large number tends to swamp the numbers of deaths among the numerically smaller population of Stone RD.

**Effects on the death rates**

A recalculation of the SMRs from cancer for Stone RD, omitting the years 1973–4 and 1976–8 when deaths in the Douglas MacMillan Home were regarded as non-transferable, gives values of 84 in men and 83 in women. These figures are much more in line with other rural areas of the country.

**Discussion**

Appropriate rules for area coding of deaths in institutions such as the Douglas MacMillan Home are crucial for the compilation of valid epidemiological mortality rates on a small area scale. The present rules were introduced in 1953 and allowed that deaths in hospitals for the chronic sick (or in mental and mental deficiency hospitals) were allocated to the area of the hospital, rather than transferring the deaths to the area of residence before admission. A modification in 1954 provided that certain chronic sick hospitals which admitted a considerable proportion of acute patients should be treated as general hospitals, and deaths occurring in them should be reallocated to the persons’ area of home residence. A further amendment was introduced in 1956 and 1957 to exclude certain other chronic sick hospitals owing to the short average duration of stay of patients in them.

Particular examples of how this system could lead to undesirable effects on small area mortality statistics were soon reported. Hewitt showed how a
large chronic sick hospital in Eye Municipal Borough in East Suffolk had the effect of producing a five fold apparent increase in local mortality rates during 1953. After the 1954 amendment, the number of deaths allocated to Eye during that year fell to 19 from the figure of 138 in 1953. The Registrar General described a doubling of the death rate in Epsom and Ewell Municipal Borough from 1953 to 1956 due to the presence of several mental hospitals.7

In 1958 the method of classification of deaths in chronic sick, mental, and mental deficiency hospitals was again modified. The main change was that a death within six months of admission to such a hospital should be transferred back to the person's area of previous usual residence.8 This system has continued since then without further amendment.9 The latter publication includes a warning that “in some small areas the number of deaths may have been apparently affected by the opening, closing, or change of use of certain institutions, so that figures may not be comparable with those of earlier years.”

It would seem pertinent, therefore, to review the present position in regard to terminal care homes and other similar institutions. Knowledge of their types, numbers, and locations is important, as is clarification of the procedure and sources of information used for their classification. The OPCS has now embarked on such an investigation (M R Alderson, personal communication), which should help to reduce the difficulties associated with the use of small area mortality statistics.10

We are grateful for the invaluable help and advice given by members of the staff of the Office of Population Censuses and Surveys in carrying out this study, in particular Mrs D Stobart at Titchfield.

References

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