SWORD: THORs cutting edge in trends estimation of new cases of work-related ill-health

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THOR
(The Health & Occupation Reporting Network)

SWORD
(Surveillance of Work-related and Occupational Respiratory Disease)
Chest Physicians

OPRA
(Occupational Physicians Reporting Activity)
Occupational Physicians

EPIDERM
(Occupational Skin Surveillance)
Dermatologists

+ others.... e.g. THOR-GP (General Practitioners)
THOR surveillance schemes for UK WRIH

**Aims:** Accurate estimation of incidence trends in WRIH

Therefore schemes aim for:

- **High participation rate** - by any physician who might see such cases
- **High response rates:**
  1. Reminder system to prompt non-responders
  2. Participants asked to report even when they have seen no new cases ("zero case report")

### Table 1 Participation in the SWORD project

<table>
<thead>
<tr>
<th>Reporting frequency</th>
<th>No of chest physicians</th>
<th>No of occupational physicians</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monthly</td>
<td>277*</td>
<td>57*</td>
</tr>
<tr>
<td>Quarterly</td>
<td>66</td>
<td>68</td>
</tr>
<tr>
<td>Bi-annually</td>
<td>3</td>
<td>83</td>
</tr>
<tr>
<td>Annually</td>
<td>8</td>
<td>153</td>
</tr>
<tr>
<td>Total</td>
<td>354</td>
<td>361</td>
</tr>
</tbody>
</table>

*Including 34 physicians (16 chest and 18 occupational) who report monthly through colleagues.

Early Trends – 1994

Figure 1. Estimated annual number of cases by diagnostic category (1990–1994).

Figure 2. Occupational asthma: trends in attributed agent: 1989–1994.

Figure 3. Mesothelioma: proportional contribution of reported occupation by year of birth (males): 1989–1994, all cases.

Multilevel Modelling – 2008

**Multilevel Modelling – McNamee 2008 paper**

<table>
<thead>
<tr>
<th></th>
<th>SWORD: all*</th>
<th>SWORD: core†</th>
<th>SWORD: sample†</th>
</tr>
</thead>
<tbody>
<tr>
<td>All respiratory</td>
<td>n = 7439</td>
<td>n = 6188</td>
<td>n = 1251</td>
</tr>
<tr>
<td></td>
<td>+0.3% (−0.9 to 1.6)</td>
<td>+1.1% (−0.2 to 2.5)</td>
<td>−4.3% (−7.2 to −1.3)</td>
</tr>
<tr>
<td>Occupational asthma</td>
<td>n = 1445</td>
<td>n = 1289</td>
<td>n = 156</td>
</tr>
<tr>
<td></td>
<td>−1.9% (−5.2 to 1.4)</td>
<td>−0.4% (−4.2 to 3.6)</td>
<td>−13.0% (−20.2 to −5.3)</td>
</tr>
</tbody>
</table>

*Models included calendar year, reporter type, month of year and new member. †Models included calendar year, month of year or season and new member.

**Figure 2** Percentage change (95% CI) in annual incidence of asthma compared to 1999: (A) SWORD,

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Multilevel Modelling – McNamee 2008 paper

- Accounts for clustering of trends within reporters
- Allows for adjustment of measured confounding factors
- Allows for investigation of trends in specific work-related ill-health and specific exposures (in terms of occupation)
- Also, allows for the investigation of the presence of bias (Reporter fatigue)
  - Trends in non-response
    - Increased by 7–9% per membership year
  - Trends in zero-response
    - Increased by 2–3% per membership year

ZINB 2017: Reporter Fatigue & Excess Zeros

Scenario where false zeros might arise:
   Reporter too busy / too tired / on holiday...
      ....Receives a reminder that he/she has not responded.
         ......Still busy.....decides to send back a ‘zero case’ report

Hypothesis:

   This behavior:
      - might increase with membership time (‘reporting fatigue’)***
      - might be more common in holiday months (August/December)

***If true, there would be a false trend towards lower incidence rates over time
ZINB: Reporter Fatigue & Excess Zeros

• Use the Neg Bin to predict the expected number of zeros assuming the same mean and compare Observed v Expected?
• ZI – assumes the zeros are split into two processes a ‘false’ zero and a true zero.
### ZINB: Reporter Fatigue & Excess Zeros

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td><strong>Percent AIC change</strong></td>
<td>-2.3%  -16.9%  -4.5% -13.2%</td>
<td>-2.6% -14.9%</td>
<td></td>
</tr>
<tr>
<td><strong>Membership Yr OR (95% C.I)</strong></td>
<td>1.14* (1.06,1.22) 1.09* (1.05,1.12) 1.48* (1.25,1.75) 0.99 (0.97,1.01)</td>
<td>1.04 (0.94,1.14) 1.05* (1.02, 1.08)</td>
<td></td>
</tr>
<tr>
<td><strong>Peak Hol(Aug/Dec)</strong></td>
<td>1.13 (0.70, 1.83) 1.34 (0.94,1.90) 2.35* (1.27,4.37) 1.25* (1.04,1.51)</td>
<td>1.40 (0.79, 2.46) 1.19 (0.90, 1.58)</td>
<td></td>
</tr>
</tbody>
</table>

**Graph:**
- **X-axis:** Scheme Membership Year
- **Y-axis:** Prob of Excess Zero
- Lines represent the following:
  - **EPIDERM-Core**
  - **EPIDERM-Sample**
  - **OPRA-Core**
  - **OPRA-Sample**
  - **SWORD-Core**
  - **SWORD-Sample**
### ZINB: Reporter Fatigue & Excess Zeros

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<tr>
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</thead>
<tbody>
<tr>
<td><strong>AIC improved Model Fit?</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Member Yr Increase Sig?</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td><strong>Estimated % Change in Incidence per Calendar Year</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Standard NB</strong></td>
<td>-2.8%*</td>
<td>-1.8%*</td>
<td>-5.9*</td>
</tr>
<tr>
<td><strong>Zero Inflated NB</strong></td>
<td>-2.4%*</td>
<td>0.0%</td>
<td>-4.8%*</td>
</tr>
<tr>
<td><strong>Overall Standard NB</strong></td>
<td>-2.6%*</td>
<td>-1.1%*</td>
<td></td>
</tr>
<tr>
<td><strong>Overall Zero Inflated NB</strong></td>
<td>-2.3%*</td>
<td>-1.7%*</td>
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</tr>
</tbody>
</table>

* = Significant at the 5% level
Is the incidence of occupational asthma (as reported by chest physicians to SWORD) increasing?
SWORD

• SWORD (and all THOR schemes) contain a wealth of high quality informative data on new cases of work-related ill-health and their occupational causes in the UK

• As with all data it needs to be interpreted and applied cautiously in order to be truly effective

• 30 years of work has resulted in wealth of experience across the THOR team members past and present on estimating the trends and associated biases within the data.

• However, there is plenty still to do....
Thank you!

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