Pesticide biomonitoring in residents living near agricultural land: Overview of study methodology

KS Galea¹, L MacCalman¹, K Jones², J Cocker², P Teedon³, JW Cherrie¹ and M van Tongeren¹

1. Centre for Human Exposure Science, IOM, Edinburgh
2. HSL, Buxton
3. School of Engineering and the Built Environment, Glasgow Caledonian University
Background

• Currently a lack of information on pesticide exposure for residents and bystanders in Britain

• Previous study by Sleeuwenhoek et al
  • regulatory methods appropriate for farm workers.
  • methods may underestimate bystander exposure
  • no measurements collected for residents
  • need to check current tools sufficiently conservative

• DEFRA funded new study
  • Started 1st Oct 2010, due for completion end Jan 2014
  • Led by IOM, in collaboration with Health and Safety Laboratory (HSL) and Glasgow Caledonian University
Aims

• Determine if spray events lead to increased exposure in residents

• Statistical analyses of urinary metabolites, comparing levels
  • Following spray events
  • Background within and out with season

• Compare urinary metabolite concentration with internal exposure estimates provided by regulatory risk assessment (RRA)
Survey strategy

- 3 agricultural regions: East Lothian, Kent, Norfolk
- Recruit farmers - Obtain info on pesticide usage
- Recruit residents living within 100m of fields
- Collect urine samples
  - Weekly samples during and out with spraying season
  - Reactive samples (1 and 2 days after spray) if receive sufficient notice from the farmer
- Urine sample analysis
  - Urine samples collected 1 and 2 days after spraying event
  - Background within the spraying season (n=3)
  - Background outside the spraying season (n=3)
The challenges - there were many...

- Several locations and diverse communities
- Lack of knowledge of locality specifics
- Relatively short biological half-life of modern pesticide compounds / metabolites
- Anticipated reluctance to participate
- Sample collections over sustained period
- ‘Attrition’ and research fatigue....

- CRITICAL – engagement with farmers, without them, no study!

*ISBM 2013, Manchester, Sept 2013*
Use of community researchers

“researchers / a research resource recruited from the community under study. ....bring with them knowledge ['cultural capital'] of that area or community which researchers from outside would not have or would need considerable effort to learn ... ... useful when investigating sensitive areas: ......., ..... help avoid the pitfalls and beartraps”.

Paul Teedon, Glasgow Caledonian University

What do they bring?

- Greater awareness, trust, connection and knowledge with local areas and communities
Pesticides of interest

- Selected on basis of availability of urinary marker and likelihood of application
- In 2011 & 2012 collected urine samples relevant to spray events involving:

<table>
<thead>
<tr>
<th>Active ingredient</th>
<th>Analyte(s)</th>
<th>Analytical Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlormequat</td>
<td>Chlormequat (parent)</td>
<td>SPE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LC-MS/MS</td>
</tr>
<tr>
<td>Captan</td>
<td>cis-1,2,3,6-Tetrahydrophthalamide</td>
<td>SPE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LC-MS/MS</td>
</tr>
<tr>
<td>Penconazole</td>
<td>4-(2,4-Dichlorophenyl)5-(H-1,2,4-triazol-1-yl)pentoic acid</td>
<td>Solvent extraction</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LC-MS/MS</td>
</tr>
<tr>
<td>Chlorpyrifos</td>
<td>3,5,6-Trichlorpyridinol</td>
<td>Acid hydrolysis</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Solvent extraction</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GC-MS</td>
</tr>
<tr>
<td>Cypermethrin</td>
<td>cis-2,2-Dichlorovinyl-3,3-dimethylcyclopropane-1-carboxylic acid</td>
<td>Enzyme hydrolysis</td>
</tr>
<tr>
<td></td>
<td>trans-2,2-Dichlorovinyl-3,3-dimethylcyclopropane-1-carboxylic acid</td>
<td>SPE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LC-MS/MS</td>
</tr>
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ISBM 2013, Manchester, Sept 2013
Population recruited, samples collected

<table>
<thead>
<tr>
<th></th>
<th>2011</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Proposed</td>
<td>Actual</td>
</tr>
<tr>
<td>Farms &amp; orchards</td>
<td>10</td>
<td>14</td>
</tr>
<tr>
<td>Residents</td>
<td>75</td>
<td>139</td>
</tr>
</tbody>
</table>

- 909 urine samples collected during 2011, with 2,384 urine samples collected in 2012

<table>
<thead>
<tr>
<th>Spray event samples</th>
<th>2011</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlormequat</td>
<td>31</td>
<td>250</td>
</tr>
<tr>
<td>Captan</td>
<td>28</td>
<td>244</td>
</tr>
<tr>
<td>Penconazole</td>
<td>13</td>
<td>83</td>
</tr>
<tr>
<td>Chlorpyrifos</td>
<td>6</td>
<td>54</td>
</tr>
<tr>
<td>Z-Cypermethrin</td>
<td>0</td>
<td>50</td>
</tr>
</tbody>
</table>
Information collected inc.

- Background questionnaire
  - Weight, height, date of birth
  - Pesticide exposure - occupational / para-occ. / home usage

- Questionnaire for each urine sample
  - Activities (and where)
  - Pesticide exposure - occupational / para-occ. / home usage
  - Consumption of home grown product

- Spray records
  - Start / finish time
  - Weather conditions
  - Product sprayed, quantities applied and spray method
Regulatory Risk Assessments

• Primary focus on current approach
  • Spray drift adults, breathing zone 8 m
  • Adults and children, 24hr vapour exposure
  • Children dermal, hand to mouth, object to mouth, from average drift fallout in adjacent area

• RRA completed for each relevant spray event to obtain an estimate of the internal dose
• PK model used to estimate amount excreted in urine given this internal dose
• Estimated urinary levels compared to that obtained from the urine samples
• Allows some evaluation of whether the RRA over or under estimates levels actually found in urine
Statistical analysis will...

- Summarise urinary metabolite levels obtained during spray season and investigate whether any recorded factors have an effect on the levels

- Differences in levels obtained within and outwith spray season

- Estimate exposure based on urinary levels

- Determine estimates of long-term exposure by combining exposure from spray events, within season and outwith season backgrounds
Current status of project

- Sample and data collection completed
- RRA completed
- Sample analysis to be completed Sept 2013
- Project end date Jan 2014
- Dissemination activities to follow
Conclusions so far..

• Primarily due to involvement of CRs, recruitment & data collection very successful

• Effective strategy for capturing substantial amounts of data to address study aims and objectives

• Built foundations for effective dissemination and feedback of research outputs and capacity built for future studies
Further information

- Project website
  - www.pesticidebiomonitoring.org

- Published study protocol

- Email: karen.galea@iom-world.org