# Comparing biomonitoring to the UK regulatory exposure assessment approach: An example of residents pesticide exposure

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Note: affiliations cited were at the time project took place

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# Background

- Use of pesticides well regulated in the UK
- Risk assessment: estimated exposure vs. AOEL /ADI

- Applicants measurement data / exposure models
  - Spray drift
  - Pesticide vapour
  - Contact with treated surfaces

- Earlier work - REA methods conservative for farm workers & applicators; may sometimes underestimate bystander exposure; residents not assessed

# Aims of DEFRA funded study

1. Assess exposure to pesticides for residents living <100m from agricultural land and investigate if exposures are elevated following spray events

2. Assess whether exposure methods used in UK pesticides regulatory risk assessment (RRA) process are appropriate by comparing urinary biomarker concentrations with internal exposure estimates provided by RRA

# General survey methodology

- Three agricultural regions
- Farmers – info. on pesticide usage & spray ev
- Pesticides of interest – captan, chlormequat, chlorpyrifos, cypermethrin, penconazole
- Adults & children (4-12 years) living ≤ 100m of fields
  - First morning void urine sample & questionnaire
  - Weekly samples during & outwith spraying season
  - Spray samples - 1 & 2 days after spray event
- Selection of urine samples for analysis
  - 1 and 2 days after relevant spraying event
  - Background within & outwith spray season (up to 3 each)

# Regulatory exposure assessment comparisons

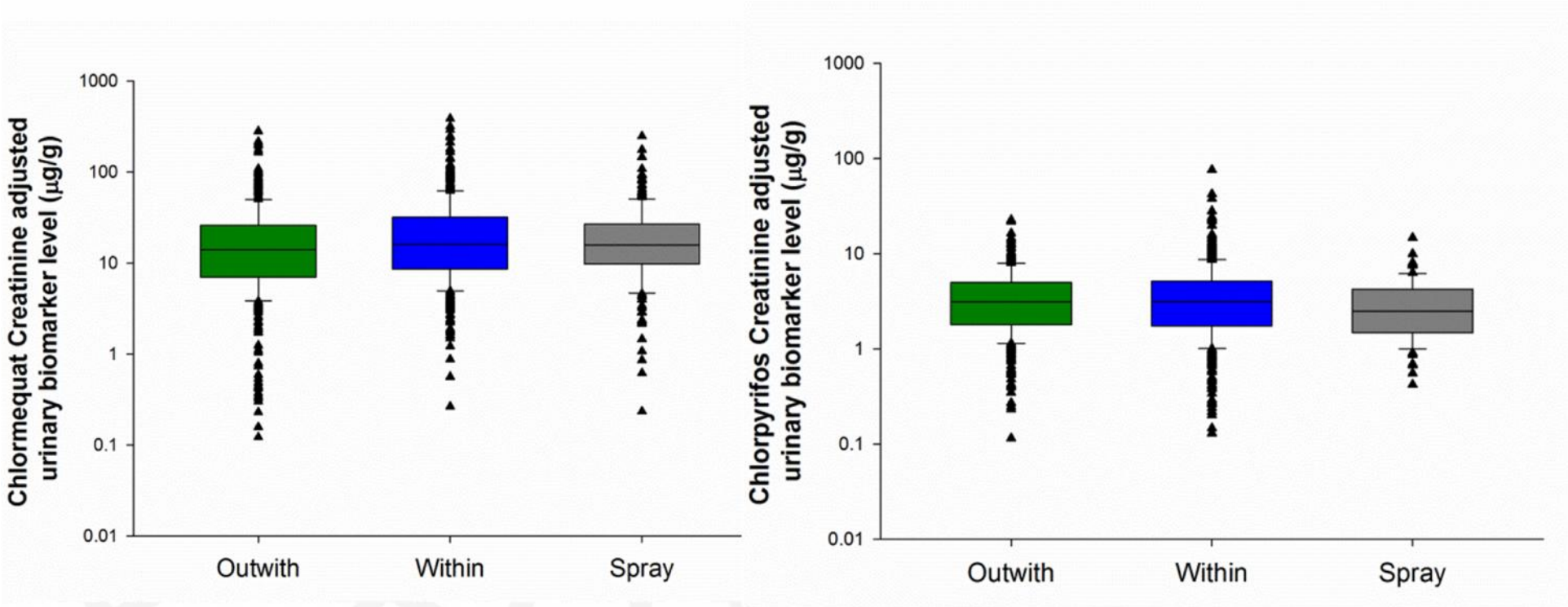
- Regulatory Exposure Assessment approach
  - Direct contact to spray drift (adults)
  - Inhalation of vapour (adults & children)
  - Direct contact with surfaces following application (adults & children)
- Used actual spray event info. rather than worst case directions for use
- Pathway providing highest predicted dose used
- Kinetic model estimates amount excreted in urine for this dose
- Predicted levels compared with actual urine results

# Population recruited & samples collected

- 21 farms and 156 households
- 296 residents providing >3000 first morning void samples
- 149 residents (125 adults; 24 children) provided relevant spray event urine samples:
  - 542 spray event samples
  - 484 outwith and 561 within spray season

# Urinary biomarker concs. (µg/g creatinine)

Captan, cypermethrin and penconazole - Proportion of values <LOD over 80%, regardless if samples were spray event related or backgrounds.



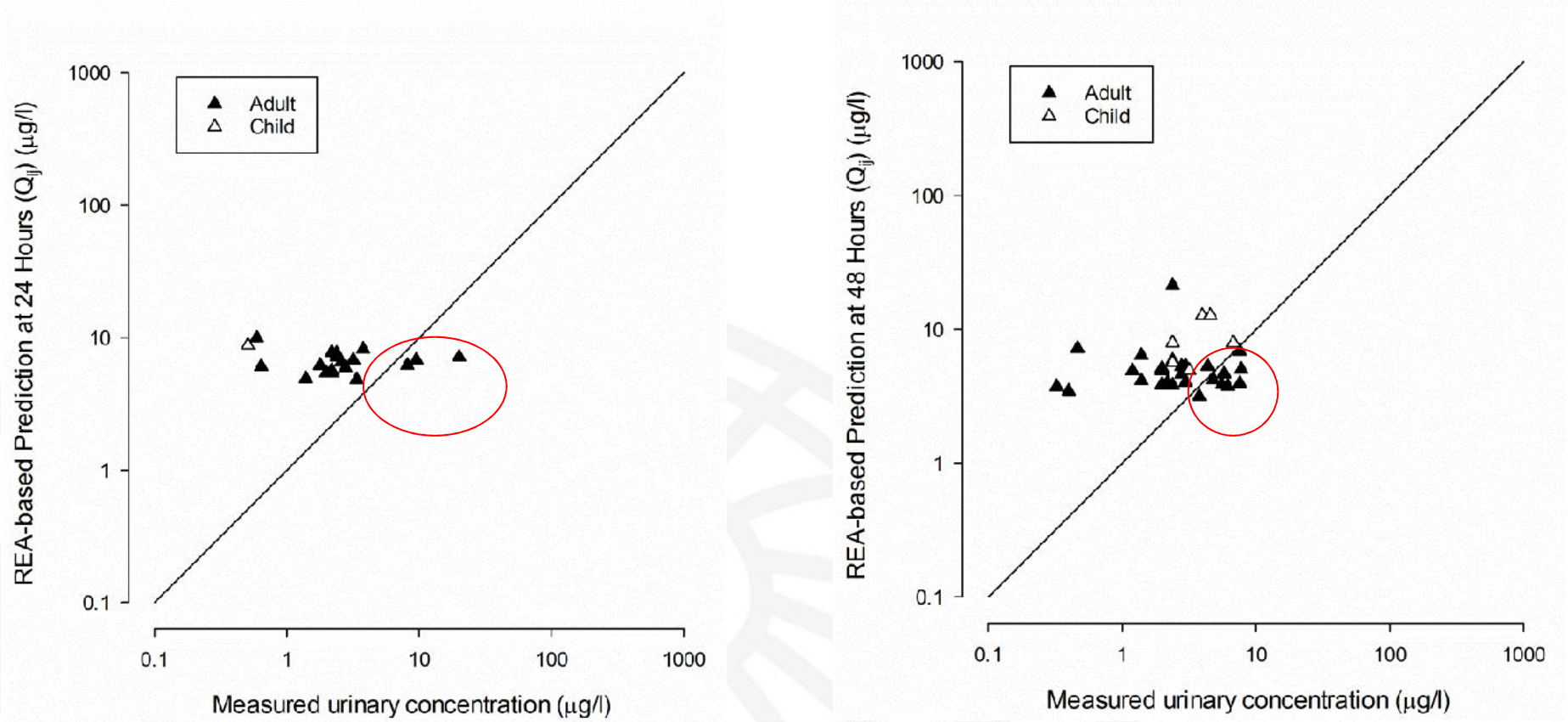
# REA pathways used in analysis

| Pesticide | AOEL (µg/kg BW) | Adult | | Child | |
|---|---|---|---|---|---|
| | | Pathway | Predicted exposure (µg/kg BW) | Pathway | Predicted exposure (µg/kg BW) |
| Captan | 100 | 3 | 8.0-24.0 | ‘Inhalation following volatilisation of pesticide’ | 8.30 |
| Chlormequat | 40 | 3 | 5.0-21.6 | | 0.53 |
| Chlorpyrifos | 10 | 3 | 4.8 | | 8.30 |
| | | 2 | 3.8 | | |
| Cypermethrin | 20 | 3 | 0.5-1.3 | | 0.53 |
| Penconazole | 30 | 2 | 3.8 | | 8.30 |

Pathway 2- inhalation following volatilisation of the pesticide after spray event;
Pathway 3 – direct contact with surfaces and plants;

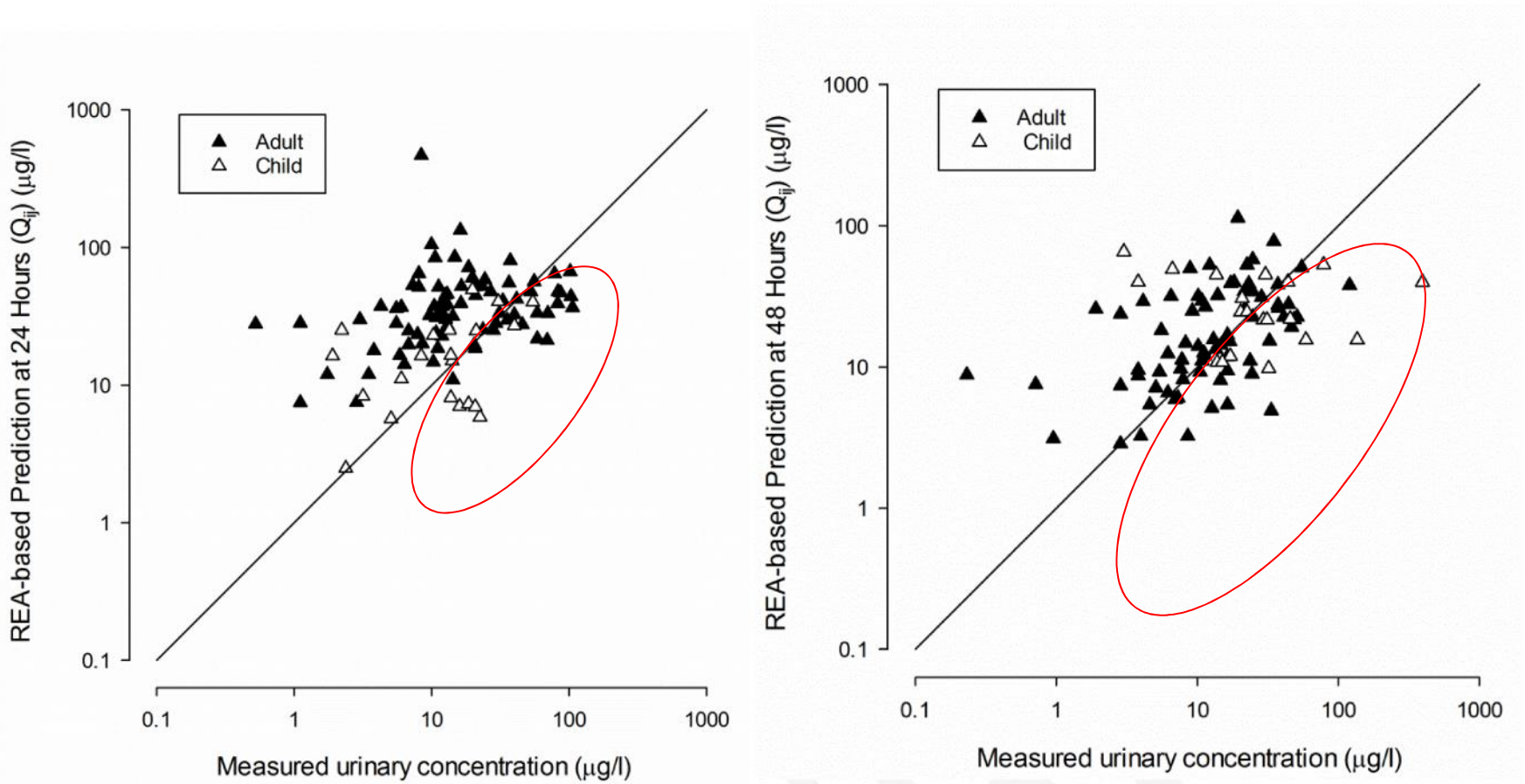
**Highest estimated exposure pathway for the spray events for each pesticide was found to be well below their respective AOEL**

# REA Comparisons - chlorpyrifos




Scatterplot of measured urinary biomarker chlorpyrifos concentrations against the background corrected REA-based urinary predictions - 24 hours (left) and 48 hours (right)

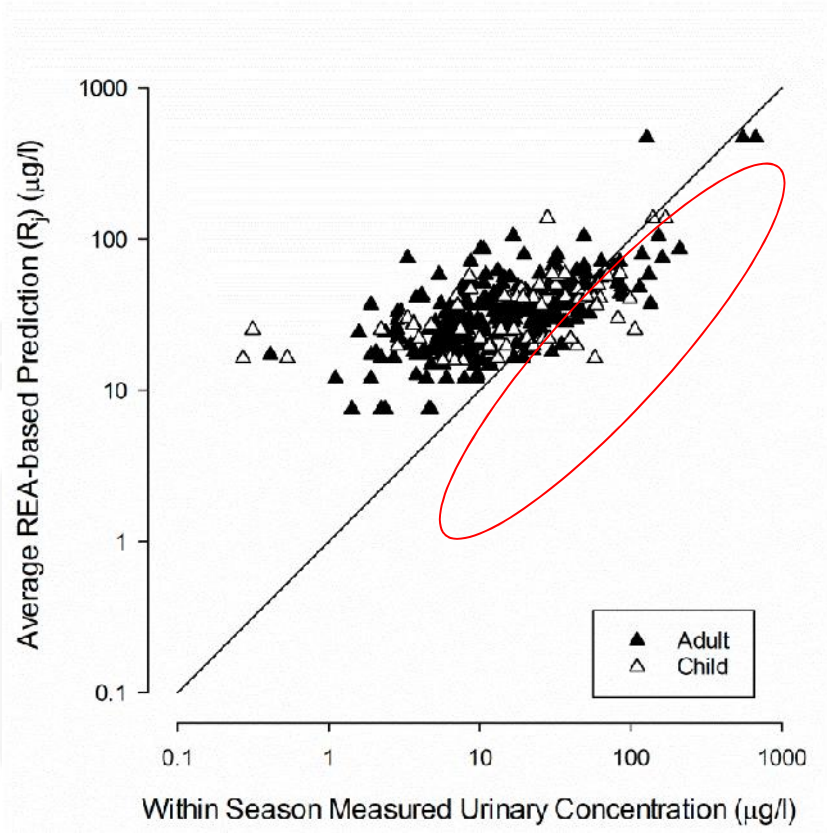
# REA Comparisons - chlormequat



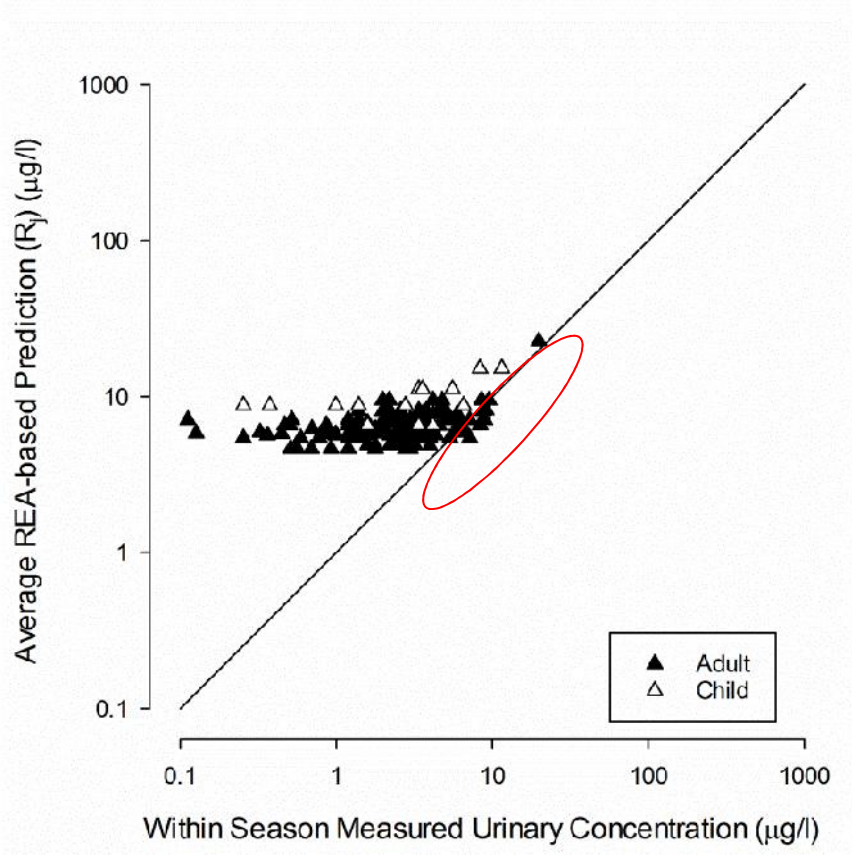

Scatterplot of measured urinary chlormequat concentrations against the background corrected REA-based urinary predictions - 24 hours (left) and 48 hours (right)

# Considering background levels

Chlormequat




Chlorpyrifos



# Discussion

- REA comparisons based on actual spray event info. rather than worst case direction of use
  - Considers only predominant exposure pathway

- Although appeared to be a number of measurements higher than predictions, these were not significantly different to what would be expected had no spray event occurred

- Consideration should be given to whether
  - All pathways should be included in REA
  - Background levels of pesticide exposures

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- HSL: C Sams, L Kenny, S Iqbal and F Garner
- Advisory Committee: Prof. D Coggon, P Hamey, Prof. L Levy and Dr. S Semple

# Open access publications

- Galea KS, et al (2011) Biological monitoring of pesticide exposures in residents living near agricultural land. BMC Public Health; 11:856.
- Teedon P, et al (2015) Engaging with community researchers for exposure science: lessons learned from a pesticide biomonitoring study. PLOS One.
- Galea KS, et al (2015) Urinary biomarker concentrations of captan, chlormequat, chlorpyrifos and cypermethrin in UK adults and children living near agricultural land. JESEE.
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- Sams C, et al (2016) Development of a biomarker for penconazole: A human oral dosing study and a survey of UK residents' exposure. Toxics.