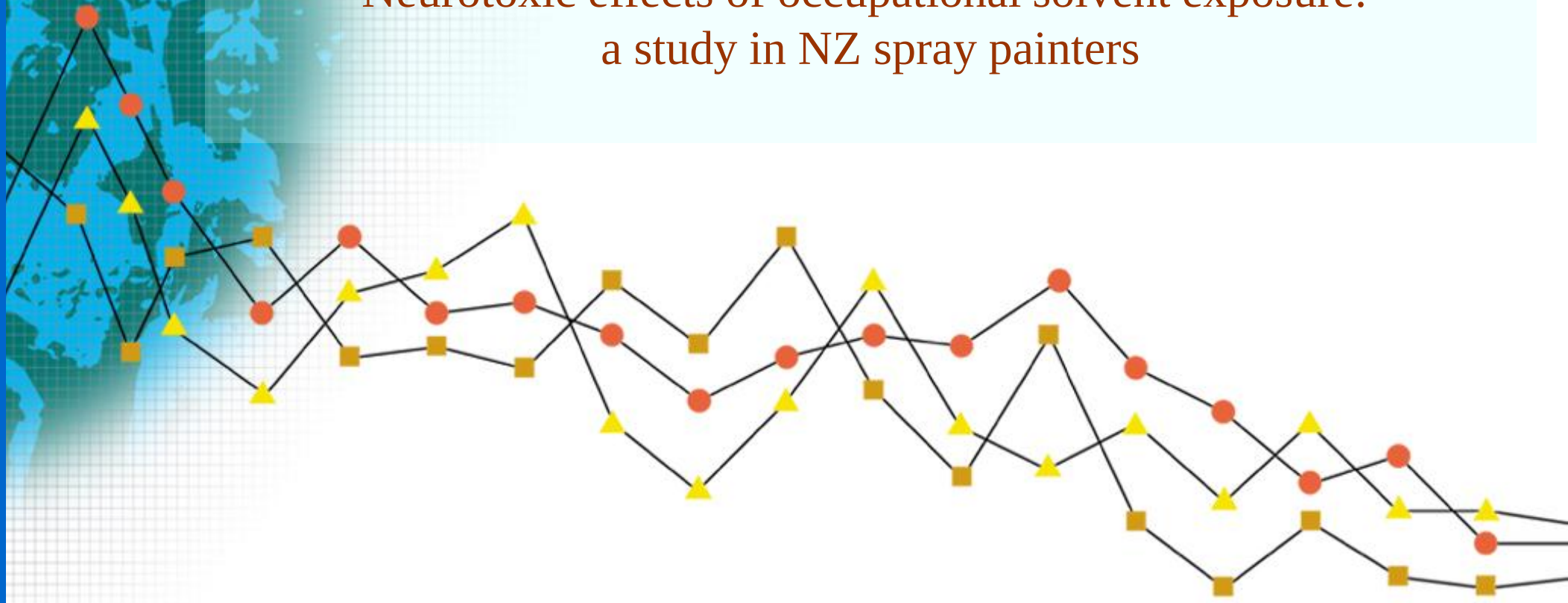
Neurotoxic effects of occupational solvent exposure: a study in NZ spray painters



Centre for Public Health Research
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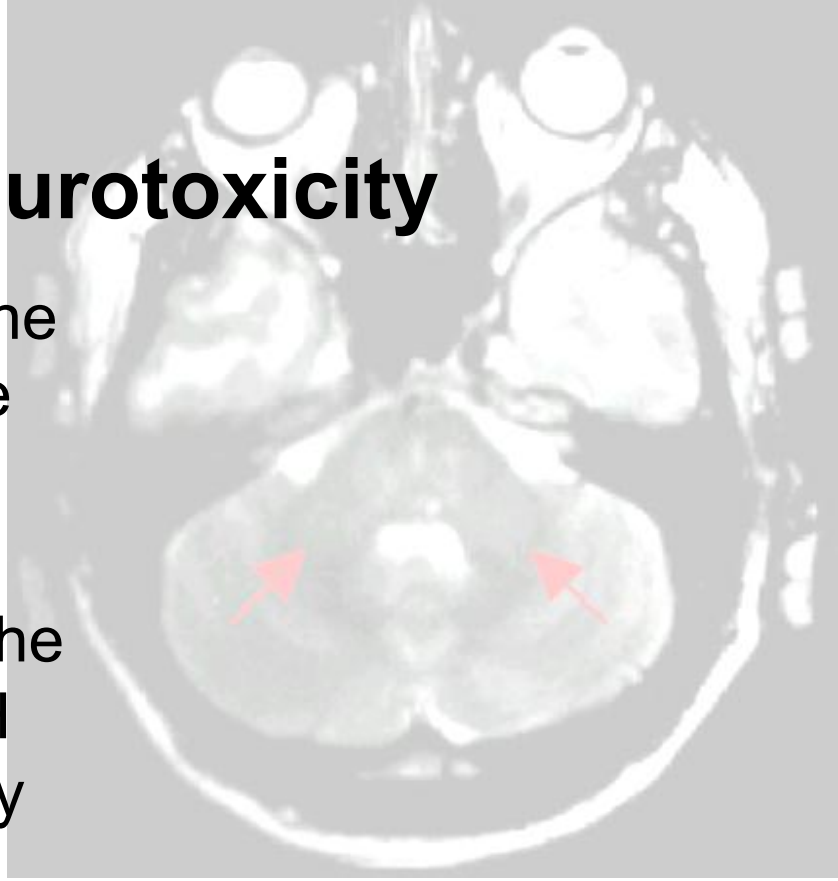
Department of Labour
TE TARI MAHI

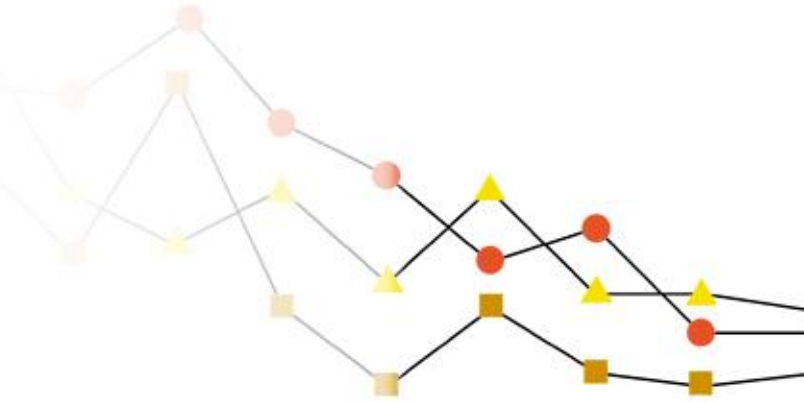
BRONZ Building Research in Occupational Health in New Zealand

Background

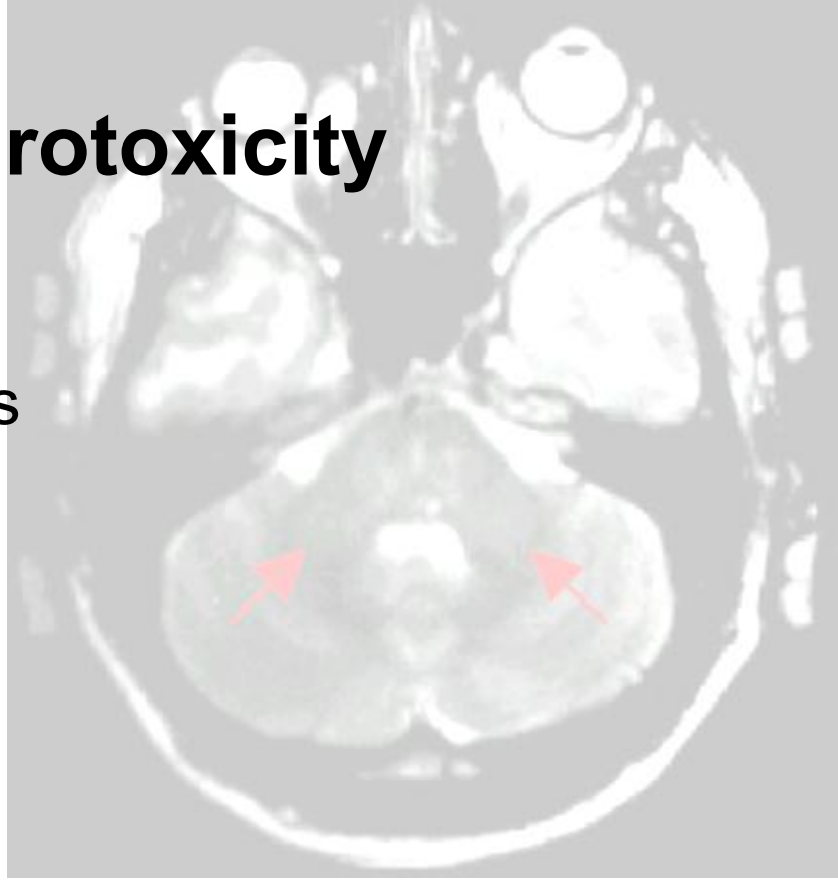
Occupational solvents and neurotoxicity



- Neurotoxic conditions comprise one of the ten leading occupational disorders in the United States
- Neurotoxic effects are the basis for exposure limit criteria for about 40% of the agents considered hazardous by NIOSH (National Institute of Occupational Safety and Health, US)
- Of those chemicals with established neurotoxic effects, solvents represent the greatest potential hazard in New Zealand with an estimated 100,000 workers exposed



Occupational solvents and neurotoxicity



- There has been little research into these occupational hazards in New Zealand to date, and no studies of neurotoxic effects

- Exposures mainly occur in small and medium enterprises and are therefore likely to be higher in New Zealand enterprises than those in the larger factories that have been studied overseas

- With little research or publicity about these issues in New Zealand, work practices have not been upgraded as extensively as in other countries.

Solvent neurotoxicity

F Dick, Occupational and Environmental Medicine, 2006

Neurobehavioural effects

- Type 1 – Acute reversible effects , Type 2a, 2b & 3 – Chronic, long term effects

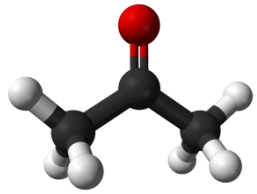
- Industrial painting Industry with high intensity of solvent exposure – main exposure routes Airway and Dermal

A relative cocktail of solvents

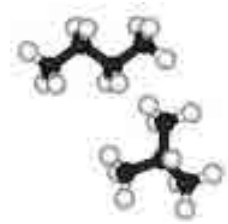
- Toluene, Acetone, N-Butyl acetate, Styrene, Xylene, Methyl Ethyl Ketone, Solvent naptha, Ethylbenzene, 1,2,4, trimethylbenzene, Butan-1-ol, Cumene, Propanols, acetates

- Isocyanates

Previous studies

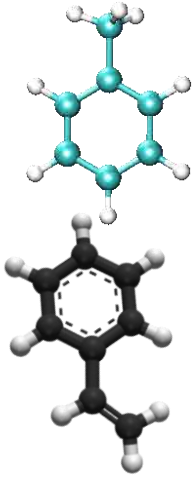


Occupational chronic solvent encephalopathy in Finland 1995 – 2007: incidence and exposure **Keski Saanti et al, 2010**



- **All cases of CSE** in Finland between 1995 and 2007 (**128** total)
- **Nature & duration** of previous solvent exposure + patient **employment history**

- Main exposure-work of highest proportion of cases was **indust., metal & car painting (38%)**, Main solvent groups patients exposed to were **Aromatics, Alcohols & Ketones**



- Concluded that the probability CSE **increased with age and duration of occ. Exposure**, & highest risks for CSE is in tasks with exp. **Aromatic hydrocarbons** and with predominantly **Spray painting**

- Number of studies overseas looking at solvent exposure and health effects **in spray painters**
- Dockyard & industrial painters, few auto-body
- Although not always consistent, most indicate s. painters have an increased risk of neurological symptoms

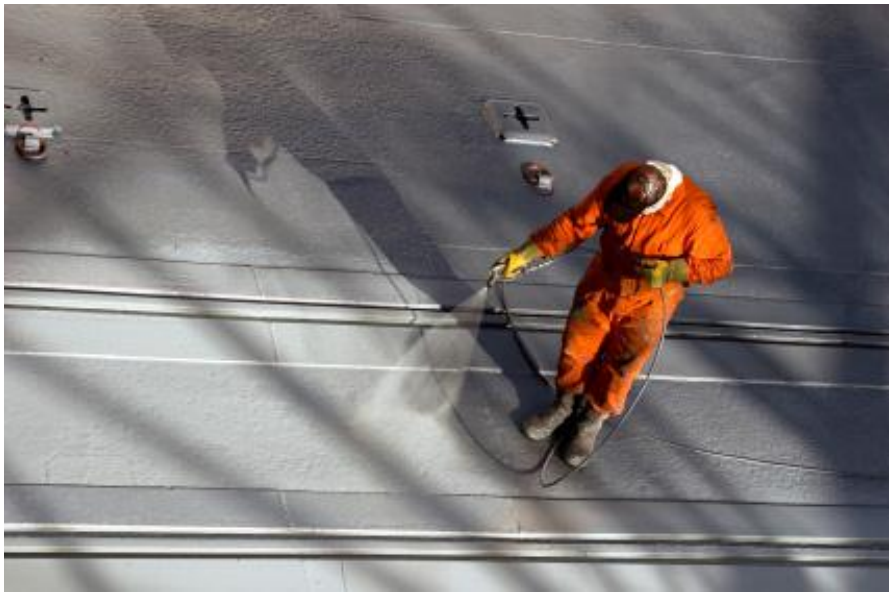
N Z Med J. 1998 Nov 13;111(1077):425-7.

Chronic solvent neurotoxicity in New Zealand: notified cases between 1993 and 1997.

Dryson EW, Ogden JA.

Department of Labour, Auckland.

- Report on cases of **chronic solvent neurotoxicity** between 1993 & 1997
- 193 notified cases – **76** classified as **"verified"**
- Cases classified as **type 1 or 2**
- Analysed according to **occupation, solvent type & exp. Duration**
- "Most frequent occupation was **spray painting (39%)"**
- "**no correlation** between **severity of symptoms and type of solvent"**
- "**non-significant trend** of increasing **severity of symptoms** with **length of exposure**"



Neurotoxic effects of occupational solvent exposure in NZ spray painters

- The only study so far conducted in NZ spray painters
- One of relatively few studies conducted internationally
- One of few to include detailed exposure assessment
- One of few to include objective, valid neurobehavioural testing

Study Design

Cross-sectional survey

400 spray painters

Questionnaires
exposure
measures

200 carpenters

Questionnaires

Nested Case-Control study

75 with symptoms

75 without symptoms

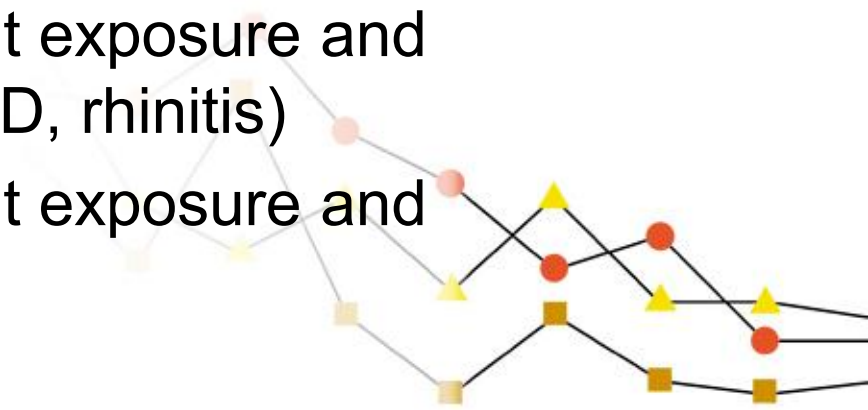
More Detailed exposure measurements & neurobehav. testing

Dose-response relationship

LOW EXPOSURE	MED EXPOSURE	HIGH EXPOSURE

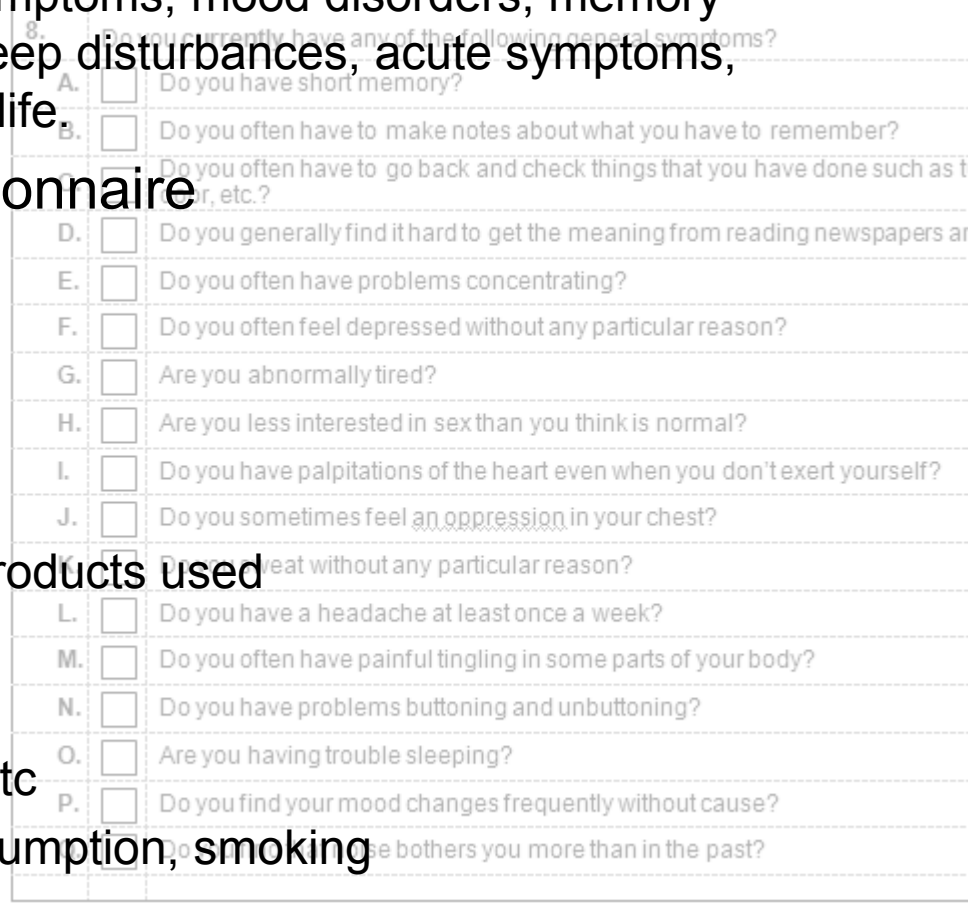
Study aims

- For this nested subset, Assess whether the observed symptoms are consistent with acute effects and/or chronic effects of solvent exposure
- Assess whether acute and/or chronic effects are associated with peak or average exposure levels
- Compare the results from the questionnaire and the neurobehavioural test battery to determine if they give consistent findings for the same neurologic function
- Assess associations between solvent exposure and respiratory symptoms (asthma; COPD, rhinitis)
- Assess associations between solvent exposure and dermatitis



Methods – Questionnaire (face-to-face)

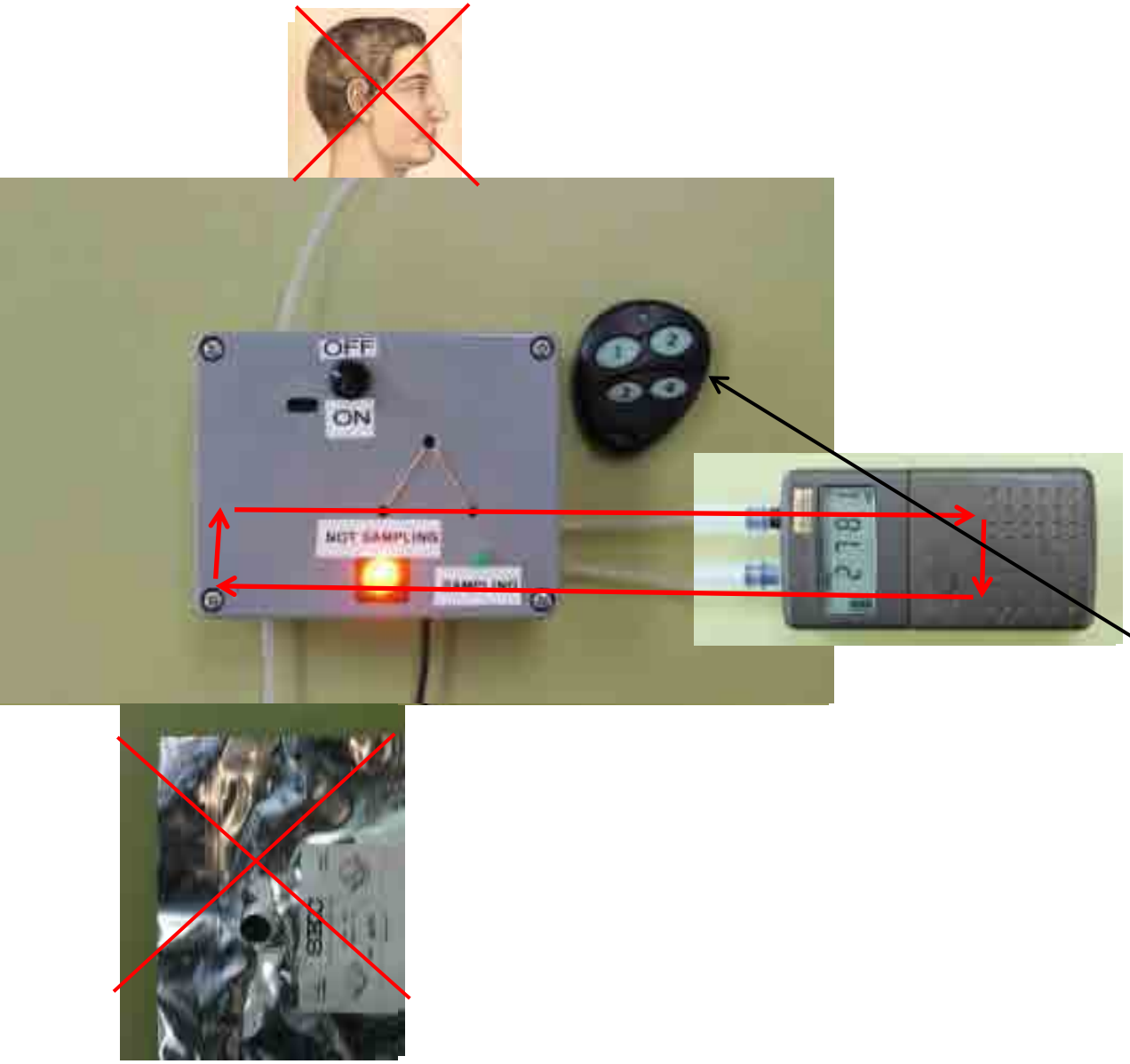
- Euroquest questionnaire (83 items)
  - neurologic symptoms, psychosomatic symptoms, mood disorders, memory troubles, attention troubles, tiredness, sleep disturbances, acute symptoms, anxiety, subjective health, and quality of life.
- Validated respiratory symptom questionnaire
  - Asthma, wheeze, cough, rhinitis, etc
- Skin symptom questions
- Questions on exposures
  - Questions pertaining to work history
  - Frequency and intensity of exposure + products used
  - Isocyanate-based product use
  - use of personal protective equipment
  - Non-work related exposures - hobbies etc
  - Other risk factors, including alcohol consumption, smoking
  - Educational level



Exposure assessment – Cross-sectional study

- Active personal sampling (whole air) for 400 spray painters – 8-hour TWA
  - Gas Chromatography Mass Spectrometry (GCMS)
- Issues
  - Respirator use including Variability of use, including tasks and frequency

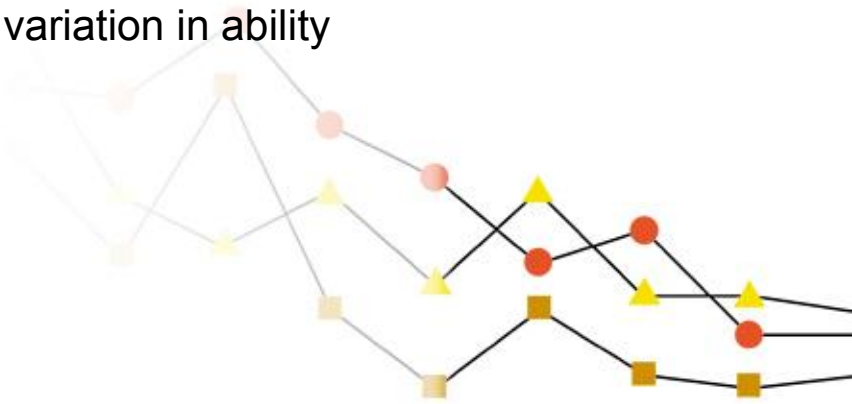
Controlled sampling – Real exposure



- Control for respirator use
- Control for variability in respirator use
- accumulative task-specific exposures
- Low-flow pump = long duration sampling
- Hands-off

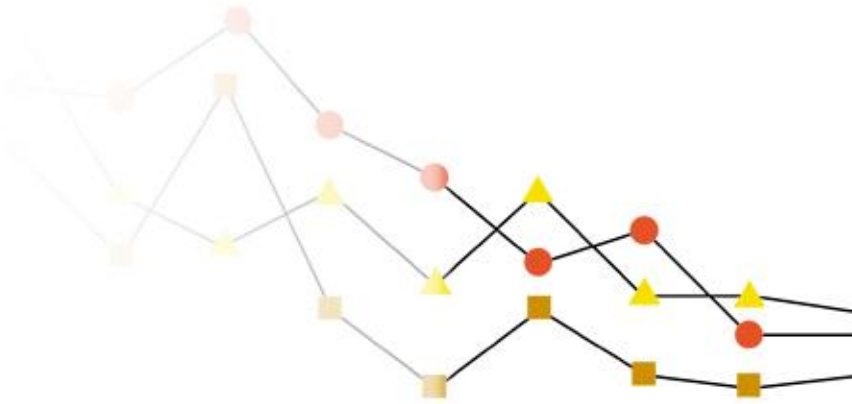
Methods – Nested case-control study

- Neurobehavioural tests
  - Behavioural Evaluation for Epidemiologic Studies (BEES) test battery,
  - memory, attention, cognitive fluency, perceptual motor, and reaction time tests
  - “touch-screen” self-administered format that can be efficiently administered in less than an hour
- Tests will take place on Monday pre and post shift and Friday pre and post shift
  - This will allow testing for both acute (reversible) and chronic (non-reversible) effects
- Pre-morbid intelligence tests
  - WRAT3 reading test
  - Vocabulary test (NART, Toni-3)
  - resistant to neurotoxic exposures → controlling for variation in ability
- Repeat exposure measurements
  - Improve exposure assessment
- Video exposure monitoring
  - Identify peak exposures
  - Develop specific control strategies



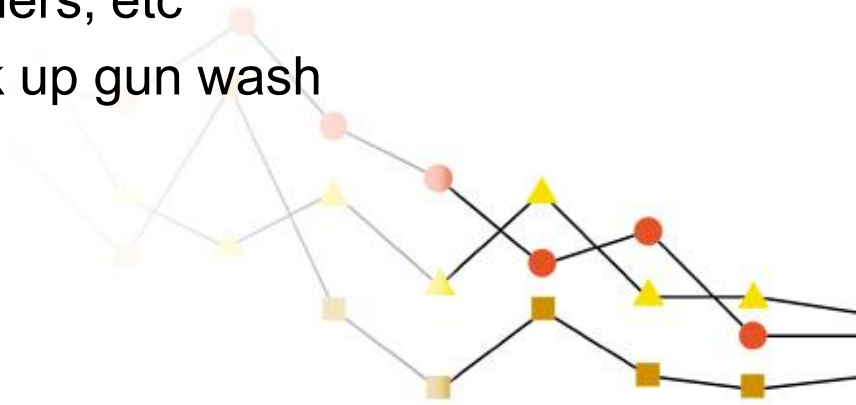
Health relevance

- Assess the risk of neurological (and respiratory and skin) symptoms in New Zealand spray painters
- Assess causal factors and mechanisms
- Develop effective preventive strategies
- Develop expertise in evaluating neurotoxic exposures permitting other studies on neurotoxic agents to be conducted in NZ in the future.



The story so far.....

- 90 painters recruited since Late November 2011 – questionnaires done
- Vast majority using primarily solvent based system
- Movement to water-based system afoot - expensive – few places so far (only large enterprises – solvents still used In process
- All using relatively large quantities of Isocyanate based products – occ asthma / respiratory problems
- Spraying going on outside booth, including some isocyanates
- PPE use extremely variable – examples lack of awareness? Laziness.
- Washing hands in solvents
- Panelbeaters and styrene based fillers, cleaners, etc
- Paint mixing rooms/gun cleaners – MEK bulk up gun wash



Thank you!

- Everyone at CPHR involved,
  - Nurses
  - Jeroen PI and all collaborators

- Neil Pritchard @ CRA

- All the panel & paint enterprises who agreed to take part

- All the study participants