Assessing isocyanate skin and surface contamination in car painters using SWYPE-RGB analysis

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BACKGROUND:
Isocyanate Occupational Asthma

- Isocyanate; the most frequently reported causative agents of allergic occupational asthma
- Affect 1 to 25% of the isocyanate-exposed population
- Asthma cases reported among car body painters
- Isocyanate can cause sensitization leading to asthma.
Respiratory sensitisation may be induced via skin exposure (Redlich 2010) as well as inhalation route.

- Toxicological and epidemiological evidence (Bello et al. 2007)

- Dermal exposure to TDI can result in sensitisation of the respiratory tract in guinea pigs (Karol et al. 1981)

- Increase in urinary isocyanates in workers with skin contamination where airborne isocyanate levels were low. (Creely et al. 2006)
TAKE HOME PATHWAY

Workers may take home the sensitising agent from the workplace via contaminated skin and clothes, so exposing their family members to occupational sensitisers and the risk of developing asthma.
AIMS AND OBJECTIVES

- Identify suitable methods for dermal sampling and analysis of isocyanate
- Validate the selected method in characterizing isocyanate exposure
METHODS
(Based on Ceballos et al. 2009 with modification)

**Sampling method:**
Skin and surface wiping using SWYPETM pad (CLI Colormetric Laboratory Inc.)

Scan SWYPETM using a photo scanner attached to a laptop computer

Scanned images were saved as raw TIFF files and analyzed using Image J (National Institute of Health, US) for Red-Green-Blue histogram
METHODS

- The study involves three components:

  - Method development (laboratory testing)
  - Validation of method (characterizing exposure)
  - Take home exposure determination
RESULTS FOR LABORATORY TESTING AND ISOCYANATE EXPOSURE CHARACTERIZATION IN THE WORKPLACE
EXPOSURE (ug/cm²)

COLOUR SCALE

YELLOW
0.07

LIGHT ORANGE
0.3

DEEP ORANGE
0.7

RED
1.4

DEEP RED
2.8
Percentage reduction of summed mean green and blue against hardener loading (ug in 200 ul spiked surface)
## Percentage Recovery

<table>
<thead>
<tr>
<th></th>
<th>Summed Green and Blue</th>
<th>Percentage Recovery (%)</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Spiked NCO</td>
<td></td>
<td>75.8</td>
<td></td>
</tr>
<tr>
<td>(6.88 ug)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medium Spiked NCO</td>
<td></td>
<td>79.4</td>
<td>70.6</td>
</tr>
<tr>
<td>(34.4 ug)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Spiked NCO</td>
<td></td>
<td>56.7</td>
<td></td>
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<tr>
<td>(275 ug)</td>
<td></td>
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</tbody>
</table>
Example results of characterization of isocyanate exposure at car body workshop

Sampling sites

- Skin
- Spray gun handle
- Mixing bench
- Hardener cap

*Liu et al (2007) SWYPE colour intensity scale from 0-5 where 0 = no colour change, 1 = light orange, 2 = orange, 3 = deep orange, 4 = red orange and 5 = deep red
RESULTS: TAKE HOME EXPOSURE

- Four car body workshops agreed to participate (40 approached within Aberdeenshire; <40 miles)
- N=12 (7 car sprayers, 2 panel beaters, 1 paint mixer, 1 manager and 1 finishing/untaping worker)

<table>
<thead>
<tr>
<th>SWYPE skin and surface sampled</th>
<th>Positive results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skin (n=12)</td>
<td>n=1 (finishing worker’s)</td>
</tr>
<tr>
<td>Footwear (n=12)</td>
<td>n=2 (car sprayers’)</td>
</tr>
<tr>
<td>Car body workshop exit door handle (n=4)</td>
<td>none</td>
</tr>
<tr>
<td>Car steering wheel (n=4)</td>
<td>none</td>
</tr>
<tr>
<td>House door handle (n=1)</td>
<td>none</td>
</tr>
</tbody>
</table>
DISCUSSION/CONCLUSION

- SWYPE technique was able to recover 70% of isocyanate loaded from hard surfaces.

- The methods (SWYPE) could be utilized in measuring the take home dermal contamination for the actual fieldwork.

- Interferences of RGB analysis: eg dirt and wet paint.
FURTHER WORKS

- To validate the SWYPE-RGB analysis with quantitative assay MDHS 25/3 (HSE 1999).

- To determine the take home contamination of isocyanate among car painters utilizing the technique.

- To make a conceptual model of transfer of take home contamination; eg
  - from sources of exposure to skin, surface to skin, skin to surface, skin to skin, surface to surface
ACKNOWLEDGEMENTS

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Thank you,
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REFERENCES


Redlich CA 2010. Skin exposure and asthma, is there a connection? *Proceeding of the American Thoracic Society* 7:134-137