Human Health Risk Assessment of Toluene and Dibutyl Phthalate in Nail Lacquers

Angela L. Perez, Ph.D.
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About Angela L. Perez

- Ph.D. Toxicology
- Post-Doc Pharmaceutical Chemistry – UC, San Francisco
- Testifying and consulting expert – exposure and risk
- Mother, foster parent
This study was funded entirely by Cardno ChemRisk.
Toluene

- Used as a solvent in paint coatings
- Developmental toxicant, not carcinogenic
- Under Proposition 65, the Maximum Allowable Dose Level (MADL) for toluene is 7,000 μg/day
> Typically used in making flexible plastics
> Also used as a binder in nail polish to improve the longevity of the lacquer
> Developmental toxicant, not carcinogenic
> Under Proposition 65, the MADL is 8.7 μg/day
Cal EPA (2012) Study Objectives

> Verify legitimacy of “toxic-trio” [DBP, toluene and formaldehyde] related product claims
> Determine baseline concentrations of these chemicals
> Explore trends of possible ingredient substitution
25 Total products sampled representing 15 manufacturers
92% detection frequency toluene
40% detection frequency DBP
Toluene Concentrations

Median = 6,600
Maximum = 190,000

Mean = 39,000 ± 63,000
Two samples were ND
Results of “Three-Free” Labeling

<table>
<thead>
<tr>
<th>Toxic-Trio Declaration</th>
<th>Toluene</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Three-free</td>
<td>177,000</td>
<td>17.70</td>
</tr>
<tr>
<td>Three-free</td>
<td>73,000</td>
<td>7.30</td>
</tr>
<tr>
<td>Three-free</td>
<td>1,800</td>
<td>0.18</td>
</tr>
<tr>
<td>Two-free (toluene &amp; formaldehyde)</td>
<td>69,000</td>
<td>6.90</td>
</tr>
<tr>
<td>Three-free</td>
<td>680</td>
<td>0.00</td>
</tr>
<tr>
<td>Three-free</td>
<td>ND</td>
<td>0.00</td>
</tr>
<tr>
<td>Three-free</td>
<td>42</td>
<td>0.00</td>
</tr>
<tr>
<td>Three-free</td>
<td>ND</td>
<td>0.00</td>
</tr>
<tr>
<td>Two-free (toluene &amp; formaldehyde)</td>
<td>76</td>
<td>0.00</td>
</tr>
<tr>
<td>Two-free (toluene &amp; formaldehyde)</td>
<td>130,000</td>
<td>13.00</td>
</tr>
<tr>
<td>One-free (toluene)</td>
<td>10,000</td>
<td>1.00</td>
</tr>
<tr>
<td>Two-free (toluene &amp; formaldehyde)</td>
<td>360</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Of the 12 nail products listed as “toluene-free”:
- 2 non-detects
- 5 with trace concentrations (<1%)
- 5 contained toluene ≥1%
Our Study Objectives

> Utilize CalEPA 2012 data

> Quantify toluene and DBP exposures from normal use of nail products for:
  > Consumers (salon patron and home user)
  > Nail technicians

> Screening-level human health risk assessment
Inhalation Exposure

- AIHA Model, IH MOD
- Two-zone model
  - Near field
  - Far field
- Well-mixed room model
  - Consumer use
  - Small space
Dermal Exposure – SkinPerm

- Uses quantitative structural activity relationship (QSAR) methodology
- Estimates a skin permeability coefficient specific to each chemical
- Considers skin to be a lipophilic and hydrophilic pathway
Exposure Parameters

> Salon Patron:
  > 1 manicure/day
  > 30 minutes
  > 3 other patrons also in the salon

> Home user:
  > 1 manicure/day
  > 60 minutes
  > Less precise application
Exposure Parameters

> Nail Technician (worker):
  > 8 manicures/day
  > 30 minutes each
  > 3 other technicians working in the salon
Toluene Air Concentrations

Toluene Air Concentrations (ppm)

OSHA PEL 200 ppm
Cal OSHA PEL 10 ppm
U.S. EPA RfC 1.23 ppm

Max: 2.7
Median: 0.09

Max: 5.6
Median: 0.19

Two-Zone Model
Well-Mixed Model
Cumulative Toluene Exposure

<table>
<thead>
<tr>
<th></th>
<th>Technician</th>
<th>Patron</th>
<th>Home-user</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max</td>
<td>28,236</td>
<td>2,160</td>
<td>7,760</td>
</tr>
<tr>
<td>Median</td>
<td>2,410</td>
<td>268</td>
<td>387</td>
</tr>
</tbody>
</table>

Proposition 65 MADL 7000 µg/day
Cumulative Dibutyl Phthalate Exposure

- Technician
- Patron
- Home-user

Proposition 65 MADL
8.7 µg/day
Conclusions

> Product labels may not accurately represent true content

> Only the polish with the maximum toluene concentration resulted in exceedance of the MADL for technicians and home users

> Only polishes with toluene concentrations >13% exceeded the RfC in our scenarios
Conclusions

> The MADL for DBP was exceeded in every scenario (even those below detection).

> A disconnect exists between detection limits and the MADL of DBP.

> Exceedances of MADLs do not necessarily indicate risk.
Additional Research Questions

> Ventilation is variable!

> Dermal exposure may be overestimated – this should be measured.

> Cumulative dose including pedicures, other nail treatments?

> What about loss of toluene over time from the bottle?
QUESTIONS?

angela.perez@cardno.com