Evaluating Ingredients and Product Labels of Nail Polishes to Inform Safer Alternatives

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Public Workshop on Potential Health and Safety Impacts of Chemicals in Nail Products
Webinar, March 2, 2017
OUTLINE

• Nail Salon Industry
• Chemical Hazards
• Current Studies
• Preliminary Results
  • Nail Polish Ingredients & Labeling
• Future Studies
U.S. Nail Salon Industry

- $9 billion industry
- 130,000 nail salons
- 400,000 licensed nail salon technicians

(US Nails 2015)
Revolution of nail procedures, nail polish finishes, nail art, and brands
Revolution of nail procedures, nail polish finishes, nail art, and brands
Vulnerable Workers

• Small businesses
• Mostly female (97%)
• Young workers (43% aged 40 or below)
• Majority immigrant (63%)
• Low education
• Limited training
• Complex chemical mixtures

(US Nails 2015, NIOSH 2017)
Little Controls in Many Nail Salons

- Surgical masks
- No gloves
- Little ventilation

(Roelofs and Do 2012; Basch et al. 2016)

“The Price of Nice Nails”
- Underpaid and exploited
- Ethnic bias and other abuse

“Perfect Nails, Poisoned Workers”
- Reproductive problems
- Cancer
- Lung disease
- Nose bleeds
- Skin conditions
Limited Research has Associated Nail Salon Work with:

• Skin irritation
• Respiratory conditions
• Headaches
• Neurological problems
• Maternal complications

(Roelofs et al. 2008; Harris-Roberts et al. 2011; Sasseville 2012; Quach et al. 2015)
Volatile Organic Compounds (VOCs)
Nail polish, removers, glues

- Toluene
- Acetonitrile
- Acetone
- Isopropyl acetate
- Ethyl acetate
- Butyl acetate
- Formaldehyde
Studies Have Assessed Exposures to VOCs

• Levels often well below occupational exposure limits despite strong odors
  (NIOSH 1992a,b, 1998; Tsigonia et al. 2010; Quach et al. 2011; Alaves et al. 2013)

• Toluene mean air concentrations of 84ppb
  (GSD=1.2, n=6)
  (Garcia et al. 2015)
Exposures to VOCs and Ventilation

- Exposure to total VOCs (TVOC) was associated with lower ventilation in Boston area nail salons (Goldin et al. 2014)
Exposures to VOCs and Ventilation

- Most Boston area nail salons did not meet ASHRAE minimum ventilation requirements

(Goldin et al. 2014)
Semi Volatile Organic Compounds (SVOCs)

Plasticizers in nail polish

- Phthalates
  - DBP: dibutyl phthalate*
  - DMP: dimethyl phthalate*
  - DEP: diethyl phthalate*
- Other plasticizers
  - TPHP: triphenyl phosphate
  - ?

*Not commonly disclosed in new products
Few Studies Have Assessed Exposures to SVOCs

- Much higher air concentrations of DEP and DBP occur in nail salons compared to other indoor environments (Tran and Kannan 2015)
- DBP exposure was higher in salon workers compared with: (Hines et al. 2009)
  - Other workers
  - General US population
- DBP metabolites in urine increased from pre- to post-shift in nail salons (Kwapniewski et al. 2008)
Dermal Contact to Plasticizers Matters

• Metabolite levels in urine to DBP in nail salon workers have been shown to decrease with the use of gloves (Kwapniewski et al. 2008)

• Self-application and wearing of nail polish containing TPHP leads to dermal exposure (Mendelsohn et al. 2016)
Metal Contaminants in Nail Polish

- Metal traces from pigments and colorants
  - Lead, cadmium, nickel, manganese, chromium, arsenic, cobalt, mercury in parts per million levels
    (Ouremi & Ayodele, 2014; Borowska & Brz.ska, 2015; Sipahi et al., 2015; Iwegbue, 2016; Bocca et al., 2014; Perkin Elmer, 2012)

- Any effect from the increase in metallic and shimmer finishes?
Research Objectives

• Understand exposures to chemicals that may affect reproductive health
  • VOCs
  • SVOCs
  • Metal contaminants
• Understand how chemicals get into the body: inhalation? dermal absorption?
• Understand sources of the chemicals
PRELIMINARY FINDINGS

Nail Polish Ingredients and Labels

Young et al. 2016, EHS Fest Poster
Young A, science blog: https://sites.sph.harvard.edu/hoffman-program/2017/02/22/the-continual-regrettable-substitution-of-nail-polish-ingredients/
PRELIMINARY FINDINGS

Review of Ingredient Information from 20 Brands

Safety Data Sheets (SDS):
• Inadequate ingredient information
• Trade secrets or “proprietary formula”
• Not always accessible online

Consumer product ingredient lists:
• Often more helpful than SDS
• “Colorants” and “fragrance”
• >200 unique ingredients
Review of Ingredient Information from 20 Brands

Product Labels:
• Companies are removing certain ingredients of concern
• “3-Free” to “10-Free”: exclusion of 3 to 10 ingredients
  • “3-Free” = free of the Toxic Trio: DBP, Toluene, and Formaldehyde
## Current Product Labels

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>3-Free</th>
<th>4-Free</th>
<th>5-Free</th>
<th>6-Free</th>
<th>7-Free</th>
<th>8-Free</th>
<th>9-Free</th>
<th>10-Free</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toluene</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X or</td>
<td>X</td>
<td>X or</td>
</tr>
<tr>
<td>Dibutyl phthalate</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>(X)</td>
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<tr>
<td>Formaldehyde</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Camphor</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Tosylamide/formaldehyde resin</td>
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<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<td>Nitrocellulose</td>
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<td>Xylene</td>
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<td>Methyl ethyl ketone</td>
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<td>Parabens</td>
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<tr>
<td>Phthalates</td>
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<td></td>
<td>X</td>
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<td>Ethyl tosylamide</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<td>Triphenyl phosphate</td>
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<td>Lead</td>
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<td>Acetone</td>
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<td>Fragrance</td>
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<td>Animal ingredients</td>
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</tbody>
</table>

*“X” = reported to not contain*

*Ingredients reported to exclude*
Challenges with Product Labels

Evolving labels:
- Labels are not consistently defined
- Implications for health are not well understood
- “Safe,” “Non-Toxic,” “Natural,” “Vegan” could be misinterpreted as safe
Challenges with Product Labels

Regrettable substitution of nail polish ingredients:
- 13 of the 20 nail polishes we studied disclose triphenyl phosphate (TPHP), an alternative plasticizer
  - None list DBP
- TPHP associated with:
  - Endocrine disruption
  - Reproductive and developmental concerns
  - Possible skin sensitization

(EPA 2017; Preston et al. 2017; Mendelsohn et al. 2016)
Challenges with Product Labels

Quality of products is not consistent:
- 5 of 6 tested “3-Free” nail polishes did contain one of Toxic Trio
- 10 of 12 toluene-free nail polishes did contain toluene, and often in higher concentrations

(Cal EPA DTSC, 2012)

<table>
<thead>
<tr>
<th>Products</th>
<th>No. of Products</th>
<th>Dibutyl Phthalate</th>
<th></th>
<th></th>
<th></th>
<th>Toluene</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>% positive</td>
<td>Median</td>
<td>Average</td>
<td>Range</td>
<td>% positive</td>
</tr>
<tr>
<td>With Toxic-trio related claims</td>
<td>12</td>
<td>33</td>
<td>76,000</td>
<td>75,500</td>
<td>62,000-88,000</td>
<td>83</td>
</tr>
<tr>
<td>Without Toxic-trio related claims&quot;</td>
<td>13</td>
<td>38</td>
<td>24,000</td>
<td>29,000</td>
<td>14,000-42,000</td>
<td>62</td>
</tr>
</tbody>
</table>
Next Steps for Pilot Projects

• Analyze nail polish samples for plasticizers and metals
• Compare analysis results with information from SDSs and labels
• Compare results with exposure assessment on workers:
  • Solvents: blood, breath, air
  • Plasticizers: urine, skin wipes, air
  • Metals: toenails
FUTURE STUDIES

- Assess effectiveness of interventions
  - Safer alternatives
  - Better controls
- Assess health effects of exposures
- Training and outreach
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