Assessing Occupational Exposure in Nail Salons

Environmental Health and Justice
Justice Brandeis Semester

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Introduction

Why nail salons?
Nail Salons

- Currently about **350,000 nail technicians** in 58,000 beauty salons in the U.S. (Quach et al. 2011; OSHA 2013)

- **40%** of nail salon licenses across the country are **Vietnamese owned** (NAILS 2013)

  - Massachusetts: 1,377 salons, employing 13,077 nail technicians (NAILS 2013)
Harmful Chemicals & Known Hazards

- **Volatile organic compounds (VOCs)**
  - Nail polishes, nail polish removers, gels and acrylic nails

  - Potential short term effects:
    - Headaches
    - Eye irritation
    - Skin irritation
    - Respiratory Irritation

  - Potential long term effects:
    - CNS syndrome
    - Liver damage
    - Kidney damage
    - Cough
    - Spontaneous abortion
    - Convulsions

(Roelofs 2007)
Methods

How did we complete our study?
Questions we wanted answered:

- What are the daily workplace exposures to VOC’s for individual nail technicians?
- What methods of ventilation can best improve VOC levels in salons?
- Is “Green & Clean” certification effective in reducing the chemical exposure of workers?
Design Focus

- Chemicals chosen
  - Acetone
  - Toluene
  - Formaldehyde
  - Ethyl Methacrylate
Fundraising
Recruitment

- Students contacted and visited 95 salons in the Boston area

- 15 salons agreed to participate

- Difficulties:
  - Recent regulations
  - Language barrier
  - Potentially bad for business
Salon Locations

All salon locations are mapped by city, not exact location; information concerning the salons who participated in our study is confidential.
Equipment

- Colorimetric tubes (Gastec passive dosi-tubes)
  - Acetone
  - Formaldehyde
  - Toluene

- Passive diffusion badges
  - Ethyl
  - Methacrylate
  - Toluene

- Dust Trak
  - PM$_{2.5}$

- Q- Trak
  - CO$_2$

- Sampling Tripod
Ben wearing an EMA badge

Molly, Morgan, Maia, and Ben out in the field with equipment!
Sampling

- Sampling duration: 8-hour work day
- Colorimetric tubes and passive diffusion badge
  - technician
  - tripod
- Q-Trak and DustTrak in an agreed upon location with salon owner
Quality Assurance/Quality Control

- Two blank passive diffusion badges
- Duplicate sets of colorimetric tube samples in two salons
- Equipment calibrated before sampling
# Field Observation Log

**FOR DATA COORDINATORS ONLY**

- **Salon Code:**
- **Data Coordinator:**
- **Date/Time of Analysis:**

## Field Observation Log

**Date/Time of Testing:**

**Day of the week:**

**Salon Code:**

**On-site operators:**

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Room occupancy</td>
<td></td>
</tr>
<tr>
<td>2. Number of workers in salon</td>
<td></td>
</tr>
<tr>
<td>3. Age of business</td>
<td></td>
</tr>
<tr>
<td>4. Peak hours</td>
<td></td>
</tr>
<tr>
<td>5. Geographic location</td>
<td></td>
</tr>
<tr>
<td>6. Salon in enclosed building structure</td>
<td></td>
</tr>
<tr>
<td>7. Gas station near salon</td>
<td></td>
</tr>
<tr>
<td>8. Other sources of VOCs</td>
<td></td>
</tr>
<tr>
<td>9. Number and location of pedicure tables</td>
<td></td>
</tr>
<tr>
<td>10. Number and location of manicure tables</td>
<td></td>
</tr>
<tr>
<td>11. Acrylic nails performed</td>
<td></td>
</tr>
<tr>
<td>12. Acrylic nails performed TODAY</td>
<td></td>
</tr>
<tr>
<td>13. Laquer nails performed TODAY</td>
<td></td>
</tr>
<tr>
<td>14. Number of pedicures performed TODAY</td>
<td></td>
</tr>
<tr>
<td>15. Average # of pedicures performed/day</td>
<td></td>
</tr>
<tr>
<td>16. Average # of manicures performed/day</td>
<td></td>
</tr>
<tr>
<td>17. Table vents used (if yes, how many?)</td>
<td></td>
</tr>
<tr>
<td>18. Is it used all day? Or only during a service?</td>
<td></td>
</tr>
<tr>
<td>19. Roof fan used (enclosed vent; NOT ceiling fan)</td>
<td></td>
</tr>
<tr>
<td>20. Is it used all day? Or only during a service?</td>
<td></td>
</tr>
<tr>
<td>21. Doors open</td>
<td></td>
</tr>
<tr>
<td>22. Windows open</td>
<td></td>
</tr>
<tr>
<td>23. Do workers wear masks (if so, what kind?)</td>
<td></td>
</tr>
<tr>
<td>24. Is anyone eating?</td>
<td></td>
</tr>
<tr>
<td>25. Is there a refrigerator in the salon? Where?</td>
<td></td>
</tr>
</tbody>
</table>
Follow-Up Sampling
Investigating Initial Formaldehyde Results

- Duration: 8-hour work day
- 3 participating salons
- Personal sampling
- Quality control applied

Passive diffusion badges
- Formaldehyde
Results

What were our findings?
# Data Summary

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Measured in # of salons</th>
<th>Average</th>
<th>Minimum</th>
<th>Median</th>
<th>Maximum</th>
<th>Guideline</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO₂</td>
<td>13</td>
<td>816.76</td>
<td>467</td>
<td>734</td>
<td>1781.2</td>
<td>800 ppm</td>
<td>ASHRAE</td>
</tr>
<tr>
<td>PM₂.₅</td>
<td>14</td>
<td>7.71</td>
<td>2</td>
<td>8</td>
<td>13</td>
<td>35 µg/m³</td>
<td>EPA</td>
</tr>
<tr>
<td>Acetone (personal)¹</td>
<td>15</td>
<td>15.97</td>
<td>0</td>
<td>12.5</td>
<td>66.67</td>
<td>1000 ppm, 250 ppm</td>
<td>OSHA PEL NIOSH REL</td>
</tr>
<tr>
<td>Acetone (area)¹</td>
<td>14</td>
<td>13.02</td>
<td>0</td>
<td>6.7</td>
<td>46.67</td>
<td>1000 ppm, 250 ppm</td>
<td>OSHA PEL NIOSH REL</td>
</tr>
<tr>
<td>Formaldehyde (personal)¹</td>
<td>15</td>
<td>1.93</td>
<td>0</td>
<td>2.38</td>
<td>3.27</td>
<td>0.75 ppm, 0.016 ppm</td>
<td>OSHA PEL NIOSH REL</td>
</tr>
<tr>
<td>Formaldehyde (area)¹</td>
<td>14</td>
<td>1.92</td>
<td>0</td>
<td>2.36</td>
<td>2.96</td>
<td>0.75 ppm, 0.016 ppm</td>
<td>OSHA PEL NIOSH REL</td>
</tr>
<tr>
<td>Toluene (area)¹</td>
<td>14</td>
<td>&lt;1.25</td>
<td>&lt;1.25</td>
<td>&lt;1.25</td>
<td>&lt;1.25</td>
<td>200 ppm, 100 ppm</td>
<td>OSHA PEL NIOSH REL</td>
</tr>
<tr>
<td>Toluene (personal)¹</td>
<td>15</td>
<td>&lt;1.25</td>
<td>&lt;1.25</td>
<td>&lt;1.25</td>
<td>1.26</td>
<td>200 ppm, 100 ppm</td>
<td>OSHA PEL NIOSH REL</td>
</tr>
<tr>
<td>Toluene (personal)²</td>
<td>14</td>
<td>0.07</td>
<td>0.01</td>
<td>0.08</td>
<td>0.09</td>
<td>200 ppm, 100 ppm</td>
<td>OSHA PEL NIOSH REL</td>
</tr>
<tr>
<td>EMA (personal)²</td>
<td>14</td>
<td>0.08</td>
<td>&lt;0.04</td>
<td>&lt;0.05</td>
<td>0.49</td>
<td>0.3 ppm</td>
<td>EPA</td>
</tr>
<tr>
<td>Formaldehyde (personal)²</td>
<td>3</td>
<td>0.028</td>
<td>0.0036</td>
<td>0.0054</td>
<td>0.16</td>
<td>0.75 ppm, 0.016 ppm</td>
<td>OSHA PEL NIOSH REL</td>
</tr>
</tbody>
</table>

**Key:** colorimetric tube¹ passive diffusion badge²
CO$_2$ Concentrations

The red line represents the 800 ppm ASHRAE limit for CO$_2$.
# Acetone Concentrations

## Acetone: Personal vs. Area

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
<th>J</th>
<th>K</th>
<th>L</th>
<th>M</th>
<th>N</th>
<th>O</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACETONE Area ppm</td>
<td>7.14</td>
<td>0</td>
<td>2.5</td>
<td>6.25</td>
<td>27.4</td>
<td>14.9</td>
<td>5.61</td>
<td>11.72</td>
<td>30.6</td>
<td>46.67</td>
<td>2.53</td>
<td>0</td>
<td>3.27</td>
<td>23.75</td>
<td>6.39</td>
</tr>
<tr>
<td>ACETONE Personal ppm</td>
<td>21.43</td>
<td>20.22</td>
<td>2.5</td>
<td>12.5</td>
<td>6.85</td>
<td>22.4</td>
<td>8.33</td>
<td>14.57</td>
<td>30.6</td>
<td>66.67</td>
<td>0</td>
<td>0</td>
<td>3.27</td>
<td>23.75</td>
<td>0</td>
</tr>
</tbody>
</table>
Formaldehyde Personal vs. Area

Formaldehyde ppm

Salon

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
<th>J</th>
<th>K</th>
<th>L</th>
<th>M</th>
<th>N</th>
<th>O</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.86</td>
<td>0.25</td>
<td>2.5</td>
<td>2.74</td>
<td>2.96</td>
<td>2.24</td>
<td>2.34</td>
<td>2.45</td>
<td>2.67</td>
<td>0.63</td>
<td>0</td>
<td>0.98</td>
<td>2.38</td>
<td>1.92</td>
<td></td>
</tr>
<tr>
<td>2.86</td>
<td>2.7</td>
<td>0.5</td>
<td>2.5</td>
<td>2.74</td>
<td>2.96</td>
<td>2.22</td>
<td>2.33</td>
<td>2.45</td>
<td>0.4</td>
<td>0</td>
<td>0</td>
<td>3.27</td>
<td>2.38</td>
<td>1.6</td>
</tr>
</tbody>
</table>

- FORMALDEHYDE Area ppm (02)
- FORMALDEHYDE Personal ppm (06)

OSHA Permissible Exposure Limit Time Weighted Average over 8 hour work day ppm
Based on our Observation Log and chemical findings, acetone concentrations were significantly lower when ventilation systems were noted.
Regardless of socioeconomic status or location, salons produced similar results.

All salon locations are mapped by city, not exact location; information concerning the salons who participated in our study is confidential.
Measuring Total Volatile Organic Compounds (TVOCs):
Acrylic Nail Procedure

Brandeis University, Fall 2013
Environmental Health and Justice
Justice Brandeis Semester (JBS)

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Video Production: Katherine Chin, Sara Shahanaghi, and Maia Rodriguez-Semp
Study Limitations

- Budget maximization
  - others chemicals of concern
    (e.g. MMA, etc.)

- No ability to observe salons during day

- Limitations with colorimetric tubes

- Slow season: winter
  - Poorer ventilation

- Selection bias
  - Self-selection (salons)
  - Worker selection
Conclusions

- Some salons had levels of CO₂ that indicated they did not meet the ASHRAE ventilation standard CO₂ of 800ppm.
- Our findings showed high levels of formaldehyde in the air of some salons.
- Our data show high acetone concentrations in the personal breathing zones of the workers.
- Our data show a strong correlation between low acetone concentrations and mechanical ventilation.
- Toluene was detected at minimal levels.
- EMA was detected in only one salon. In that salon, the EMA concentration exceeded EPA’s health-based guideline for EMA.
Recommendations

- Promote safer practices for nail salon workers, clients, and owners
- Use safer products (where possible) rather than substituting personal protective equipment
- Install proper mechanical ventilation, if not already installed
- Install table vents
- Adopt “greener” products
- Expand checklist for Green & Clean Salons to specifically require chemical exposure limits

- Research nail products to provide accurate knowledge to users and regulators
- Further evaluate occupational exposure to formaldehyde (short-term exposure, task monitoring, product analysis)
Acknowledgements

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Theodore A. Myatt
James H. Stewart
Vlad Albin
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Talena Thu Ngo (Vietnamese Business Directory)
Viet-AID
Boston Public Health Commission
All the participating salon owners and workers


Roelofs, Cora; et. al. 2007. Results from a Community-based Occupational Health Survey of Vietnamese-American Nail Salon Workers. *Journal of Immigrant Minority Health.*