

# Chemical Exposure Assessment in a Nail Salon

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# Objectives

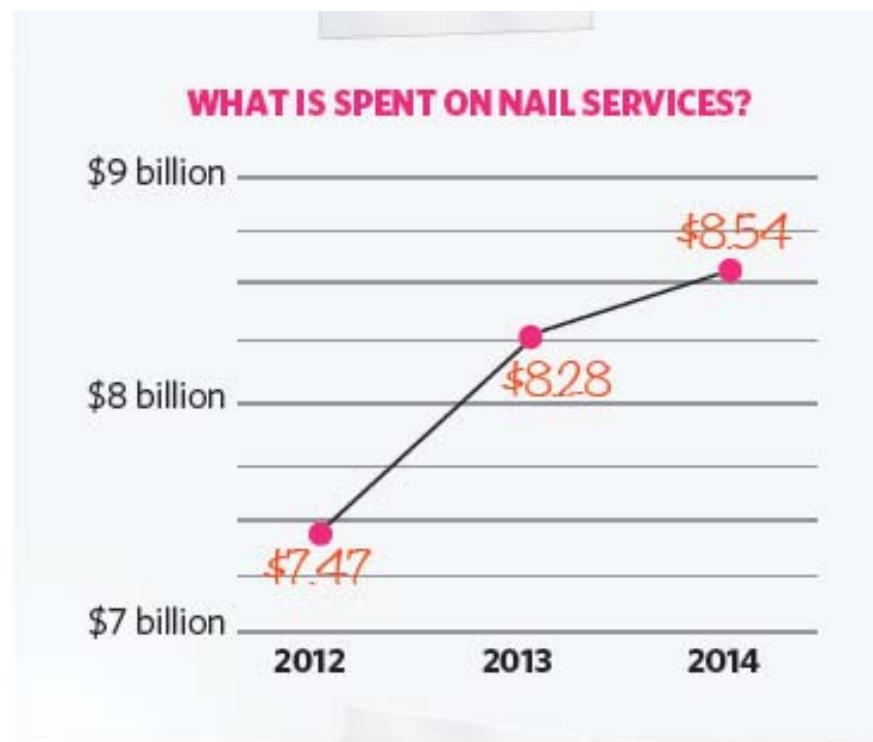
- Prioritize exposure risk of volatile organic compounds (VOCs) in nail products using a risk ranking system
- Determine if chemical exposures exceed exposure limit in an illustrative salon using a comprehensive exposure assessment strategy



Top coat, base coat, gel polish, regular nail polish

# Nail Salon Industry

- Products are driving sales growth
  - **Polish = Polymer + Volatile Organic Compound**
- The “Trio” eliminated in products
  - **Toluene, xylene, dibutyl phthalate**
  - Substituted with less hazardous chemicals
    - Potential for overexposure and health risk



Nail Magazine Big Book 2014-2015

# Nail Magazine 2014-2015 Statistic: USA

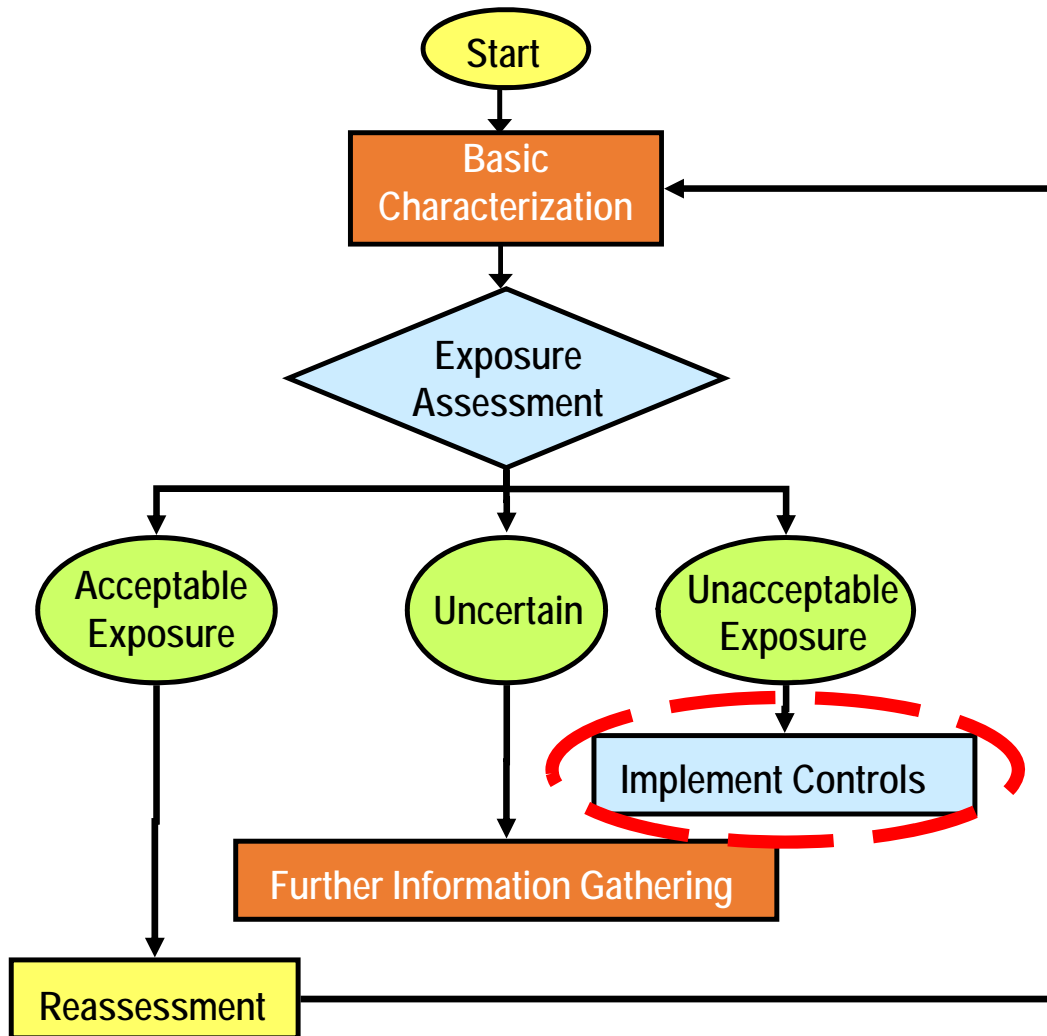
- +350,000 nail technicians (~2000 in Minnesota)

National Survey	My Project Survey
94% Female	100% Female
51% Vietnamese	100% Vietnamese
24% Independent Contractors i.e. booth renters	100% Hire by commission
Few take adequate measures for health and safety	Sometimes wear protective gear e.g. gloves, masks

“A Strategy for Assessing and Managing Occupational Exposures”, 4<sup>th</sup> Edition

# Exposure Assessment Strategy

American Industrial Hygiene Association (AIHA)  
building blocks for hazard communication



## Hierarchy of Controls

1. Elimination
2. Substitution
3. Engineering Control
4. Administrative Control
5. Personal Protective Equipment

## START: Exposure Assessment Goal

- Use **statistics** to differentiate “acceptable” exposures from “unacceptable” exposures
  - 95<sup>th</sup> percentile: worst-case exposure point estimate
  - *Upper Tolerance Limit (UTL): upper confidence limit of 95<sup>th</sup> percentile*

For an exposure to be acceptable:

**The 95<sup>th</sup> percentile estimate should be less than the Occupational Exposure Limit (OEL)**

# Basic Characterization: Workplace Survey

- Received health and safety training in beauty school
- **No Safety Data Sheets (SDS)**
- Protective gear available
  - **Surgical masks, vinyl gloves**
- General Exhaust Ventilation (GEV)
- No Local Exhaust Ventilation (LEV)



# Basic Characterization: Workforce and Services Survey

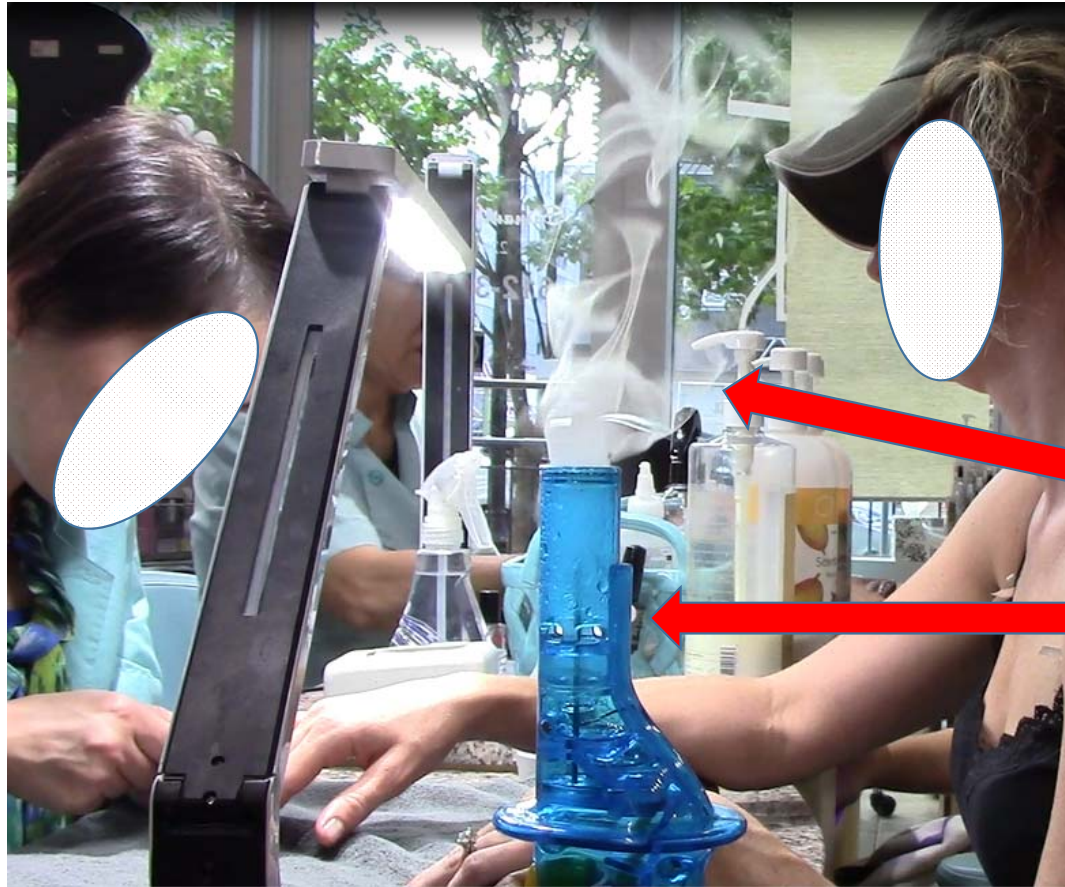
- 4 full-time, 2 part-time technicians
  - Salon open 6 days a week
- Summer months to year round employment
- Mostly regular polish and gel polish services
- 30-40 manicures and 30-40 pedicures per week
- 4 manicure, 4 pedicure stations
- 1 hair dressing station





# Basic Characterization: Airflow Visualization

- Contaminant source/release
- Mechanism of transport
- Exposure point or area
- Exposure route



Fog plume in breathing zone

Wizard Stick Fog Generator

# Basic Characterization: Exposure Source

## Regular Nail Polish Application Process



1. Soak fingers in acetone; scrape off old polish (5-10 minutes)



2. Cutting and filing nails; cuticle removal (15-20 minutes)



3. Bond aid, base coat, color, top coat application (10-20 minutes)



4. UV curing of nails (2-5 minutes)

# Basic Characterization: Exposure Source

## Gel Polish Application Process



1. Soak fingers in acetone; scrape off old polish (5-10 minutes)



2. Cutting and filing nails; cuticle removal (15-20 minutes)

3. Bond aid, base coat, gel color, top coat application; UV curing (20-35 minutes)



4. Massage hands (2-5 minutes)



# Basic Characterization: Chemical Hazard Identification

Common Chemicals	Weight Content	Usage	GHS Hazard Class/Hazard Category	ACGIH TLV (TWA/STEL)
n-Butyl acetate	10-50%	Gel, polish, base coat	H225: Flammable liquid (cat 2) - Harmful H335, H336:Respiratory irritation (cat 2) – Harmful H319: Serious eye damage (cat 1) - Harmful <b>H302: Acute toxicity, oral (cat 4) - Harmful</b> <b>H315: Skin Irritation (cat 2) – Harmful</b>	150ppm /200ppm
Ethyl acetate	10-100%	Gel, polish, Base coat	H225 H319 H336	400ppm
Isopropyl alcohol	1-15%	Gel, polish	H225 H319 H336	200ppm /400ppm

**ACGIH:** American Conference of Governmental Industrial Hygienists  
**TWA:** Time Weighted Average

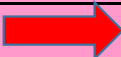
**GHS:** Globally Harmonized System  
**STEL:** Short Term Exposure Limit

**TLV:** Threshold Limit Value



# Risk Ranking Scheme - Raoult's Law

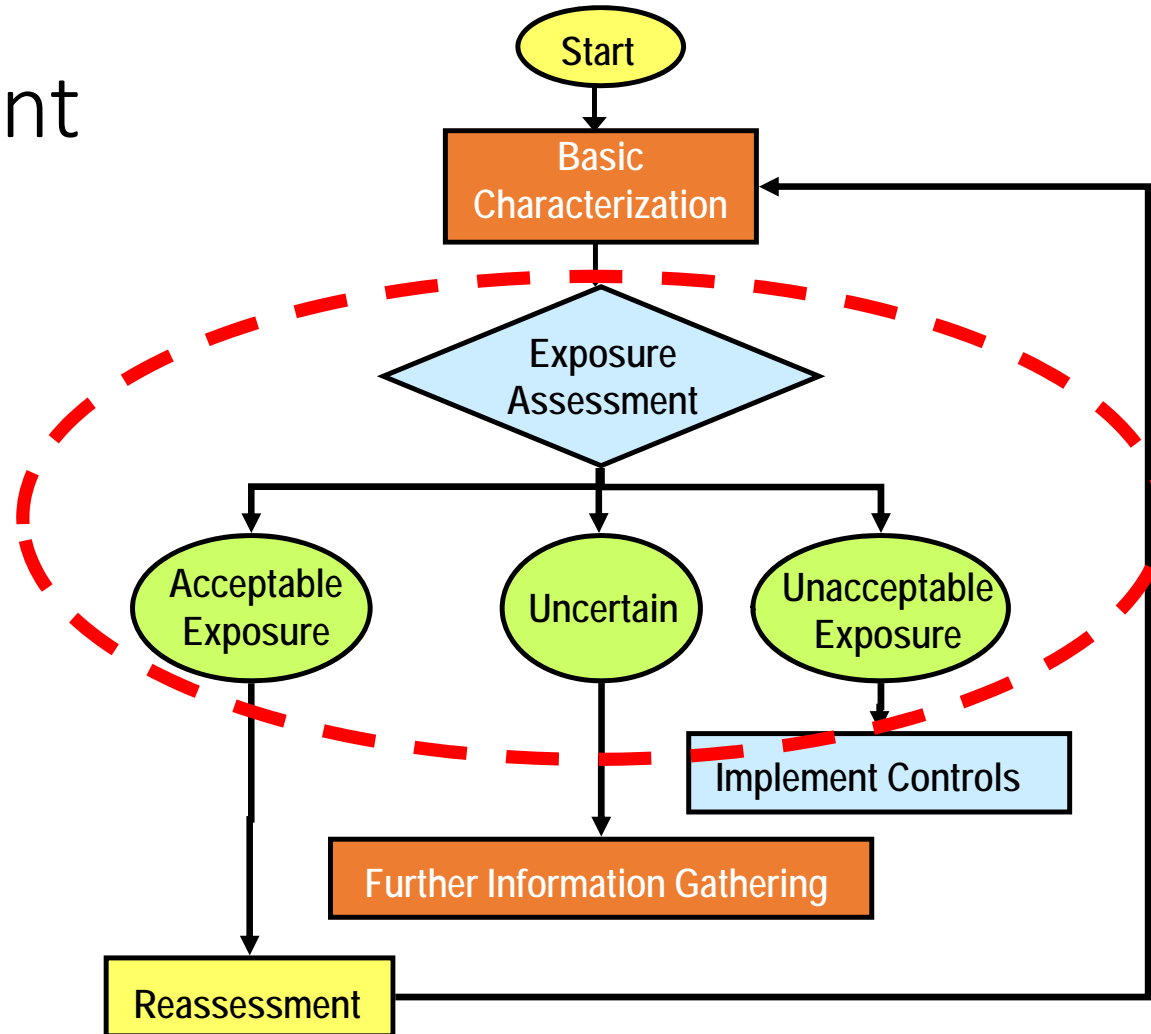
- Component with the greatest likelihood to exceed its Occupational Exposure Limit (OEL)

CAS Number	Chemical	WT (%) SDS	VP mm of Hg look up	VHR Ratio % (H/Max H)* 100
141-78-6	Ethyl Acetate	35.00	11.06	6.34%
123-86-4	 n-Butyl Acetate	35.00	86.2	100.00%
67-63-0	Isopropyl Alcohol	10.00	33	15.85%
9004-70-0	Nitrocellulose	12.00	0.001	0.00%
1338-51-8	Tosylamide	6.00	0.001	0.00%
9004-36-8	Cellulose Acetate Butyrate	1.00	0.001	0.00%
25035-69-2	Acrylates Copolymer	1.00	0.001	0.00%
		0.00	0.001	0.00%

**n-Butyl Acetate is the controlling component**

# Exposure Assessment

- Define Similar Exposure Group (SEG)
  - Nail technicians
- Define Exposure Profile of SEG
  - Monitoring data
  - Exposure rating
  - Exposure judgement



# Exposure Assessment: Exposure Rating

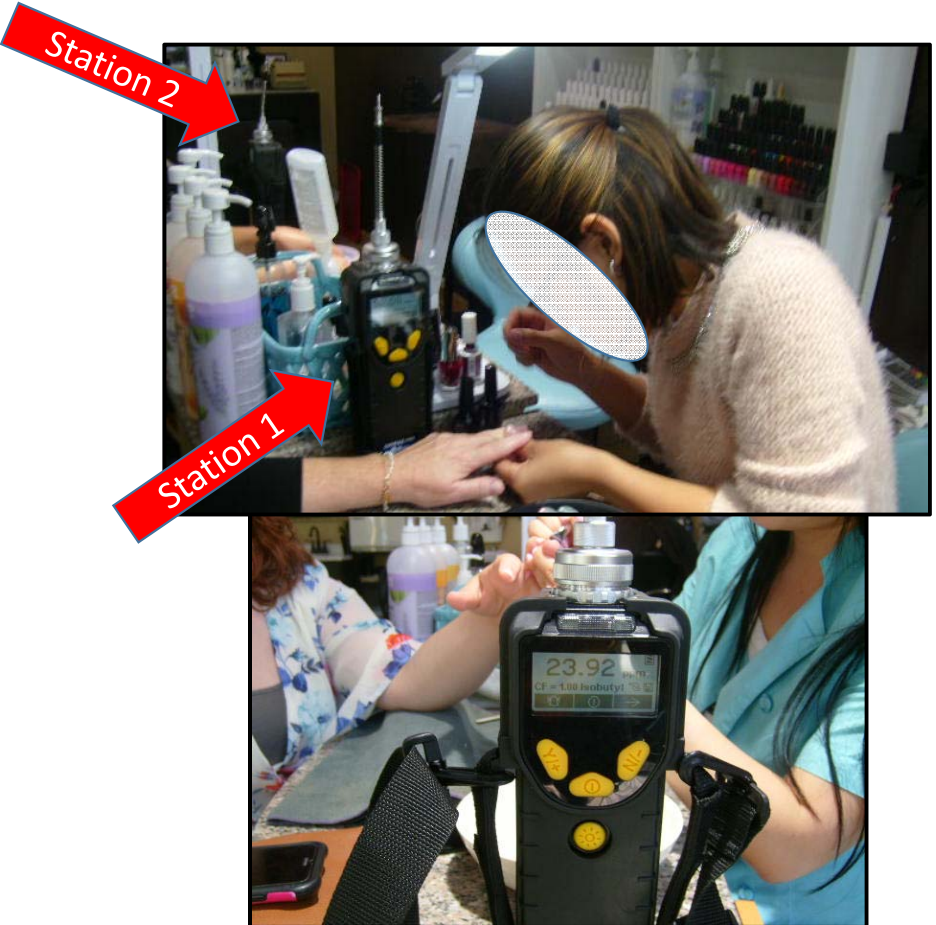
	<b>SEG Exposure Risk</b>	<b>Description</b>
	0 (<1% of OEL)	Exposures are negligible
	1 (<10% of OEL)	Exposures are controlled
	2 (10-50% of OEL)	Exposures are controlled but not assured
	3 (50-100% of OEL)	Exposures are not adequately controlled
	4 (>100% of OEL)	Exposures are excessive

**\*Compare 95<sup>th</sup> percentile to OEL**

**Hierarchy of Controls**

# Exposure Assessment: Air Measurement

- 2 PPBRAE 3000 (Rae Systems Inc.)
  - Direct-reading instrument
  - Measures Volatile Organic Compounds e.g. n-Butyl acetate
  - Placed on 2 manicure stations
- Task specific measurements





# Monitoring Data: N-Butyl Acetate Exposures

Day	Nail tech	Nail Process	Time (mins)	Avg. conc. (ppm)
1	A	Polish	31	<b>11.9</b>
1	B	Gel	78	<b>79.8</b>
1	C	Gel	48	<b>48.1</b>
2	A	Gel	77	<b>83.7</b>
2	B	Gel	73	<b>73.9</b>
2	B	No G/P	43	<b>67.4</b>

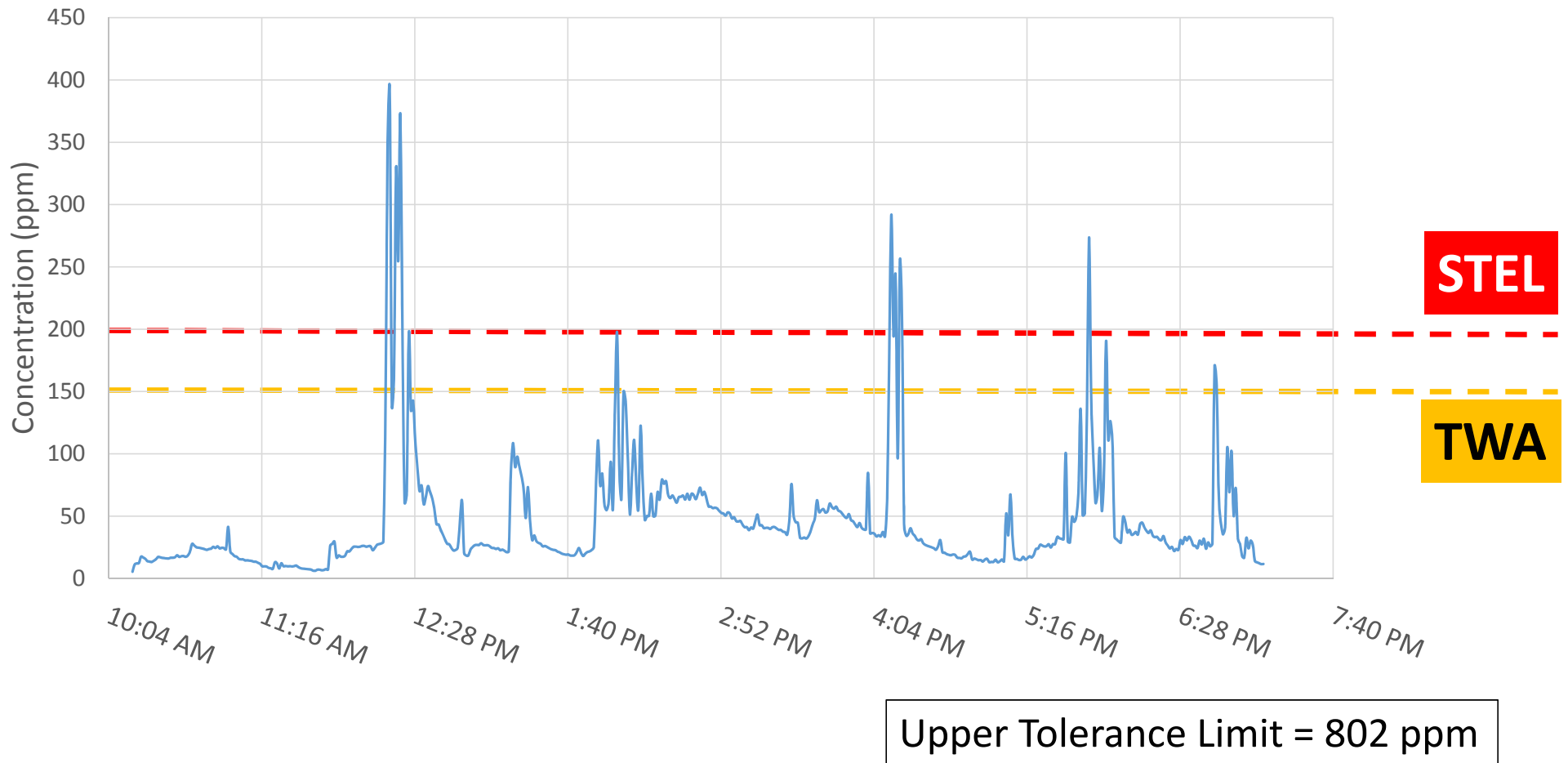
Decision Statistics  
95<sup>th</sup> percentile, 95% = 176.250 ppm  
STEL OEL = 200 ppm

**Exposure Rating 3**

PPE: None worn

Engineering Control: General Exhaust Ventilation

# N-Butyl concentration changes over a 10-hr shift



# Conclusion

- Hazard Communication findings
  - Risk of overexposure
  - Limited awareness of SDS
  - Unsuitable PPE
  - Minimal Health and Safety training or courses
- Next Steps
  - Communicate proper PPE selection and use to salon owner
  - Lab experiment to validate concentrations observed in the salon and develop control options



Observation of airflow patterns in the nail salon