

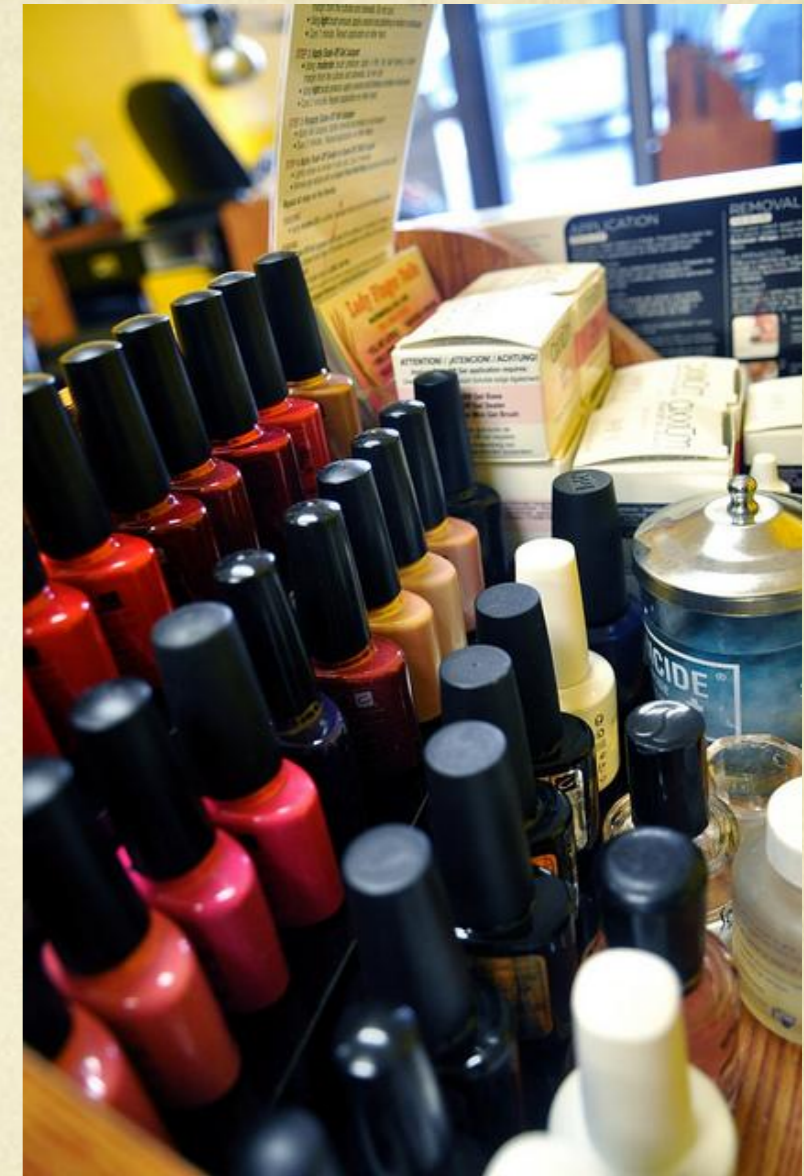
Indoor Air Quality Survey of Boston Nail Salons



**JBS Environmental Health
and Justice Program**

Introduction

- Number and popularity of nail salons in the U.S. has grown within the past two decades
 - In the U.S., nail salon revenue totaled over \$6.5 billion in 2003
 - Vietnamese-Americans make up 37% of licensed nail salon owners and workers
 - Nail salon employees are of reproductive age and are exposed to chemicals on a daily basis which have a potential of causing harm to them and their unborn children



Exposures and Health

- Xylene, toluene, acetone, and methyl ethyl ketone in nail polishes and hardeners are neurological toxicants (short-term effects may include headaches, nausea, dizziness, and irritability)
- Ng et al. (1992) suggest that spontaneous abortion in workers exposed to toluene may occur nearly 3 times more than a control group.
- Roelofs et al. (2008) showed an elevation of respiratory symptoms, skin problems, and headaches among nail salon workers as compared to the general population.
- Harris-Roberts et al. (2011) reported that chemicals found in nail salon products are associated with occupational asthma and contact dermatitis.

Study Team and Objective

- Researchers in the JBS Environmental Justice Program worked in collaboration with the Nail Salon Partners, including the Boston Public Health Commission and Viet-Aid
- Objectives
 - Assess indoor air quality in Boston nail salons
 - Assess factors that may influence exposure

Study Location Information

Table 1: Sampling Locations: Boston, MA, 2011		
Salons (n=21)		
Most Common Salon Architecture Type	Store Front	
<i>Storefront, Basement, Stand Alone Building</i>		
Neighborhood Distribution	Proportions	Percentages
Dorchester	16/21	76.2%
Roxbury	1/21	4.8%
Jamaica Plain	1/21	4.8%
Mattapan	3/21	14.2%

Study Methods

- A total of 21 salons participated in this study, which was conducted September through December, 2011
- All data, participants, and locations are confidential
- This study was reviewed by the Brandeis Institutional Review Board (IRB)
- Each salon visit had three components: air quality measurements, observations of salon activities, and a short questionnaire



Study Methods

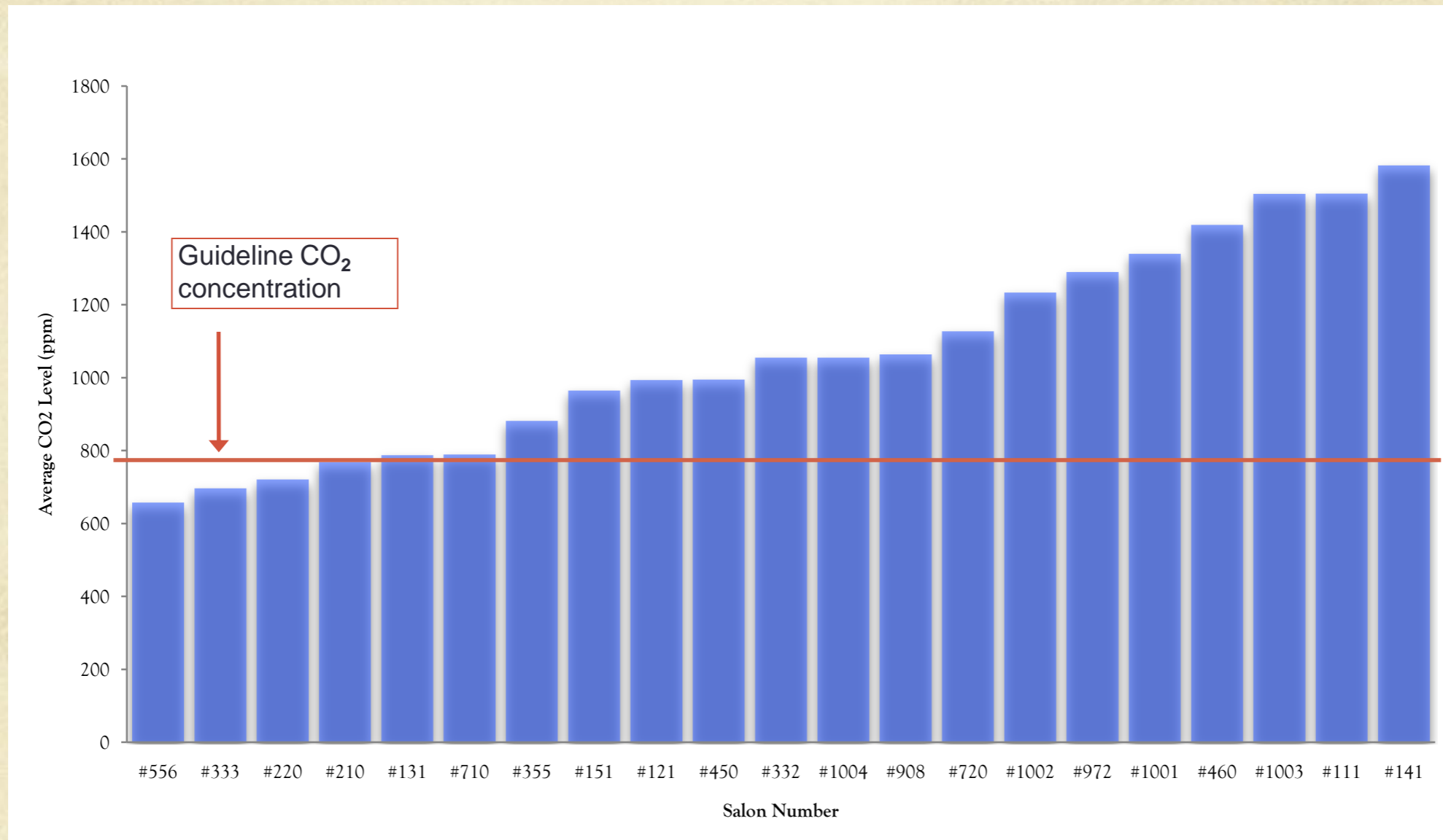
- **Carbon Dioxide (CO₂)** can be used as an indicator of ventilation
- **Total volatile organic compounds (TVOCs)** are potential toxins
- **Particulate matter 2.5 (PM_{2.5})** are linked with respiratory problems



Table 1: Information on Layout, Ventilation, and Measurements in Salons

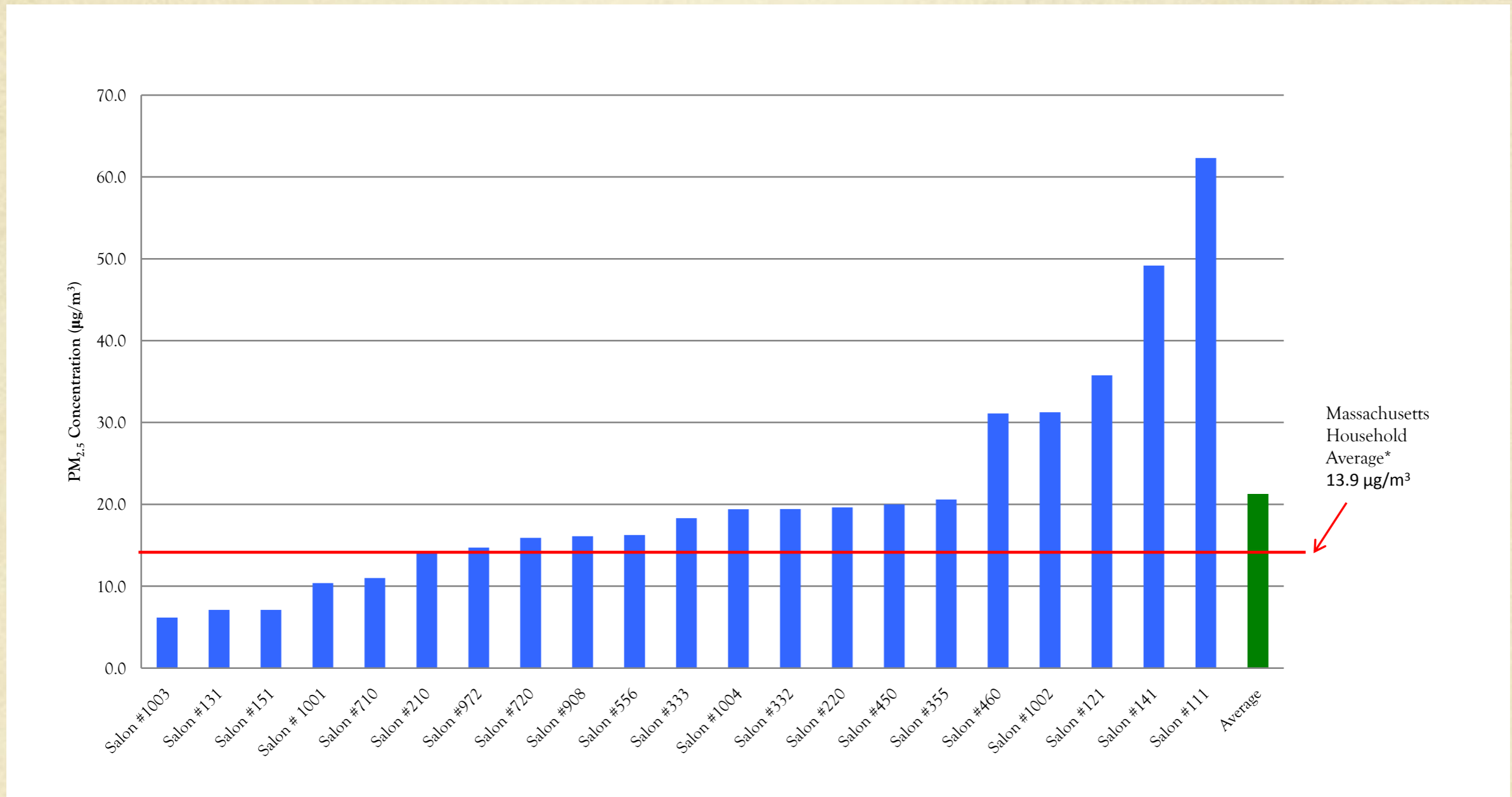
Table 1: Descriptive Characteristics of Nail Salons: Boston, MA, 2011							
		Percentiles					
	Mean	Min	25 th	50 th	75 th	95 th	Max
Salon Layout (n=21)							
Volume (m ³)	218	89	117	157	295	491	613
Number of Measurement Locations in Salon	7	4	6	7	7	9	9
Number of Manicure Stations	6	3	5	6	8	14	18
Number of Pedicure Stations	5	2	4	5	6	11	12
Ventilation¹							
Number of Ventilation Systems	2	1	2	3	3	5	5
Measurement Data							
TVOC's (ppb)	9,519	45	1,409	5,475	16,225	35,711	37,767
CO ₂ (ppm)	1,085	641	809	1,055	1,257	1,544	2,057
PM _{2.5} (µg/m ³)	21	6	14	16	20	49	62

Average Measured CO₂ (ppm) Concentrations



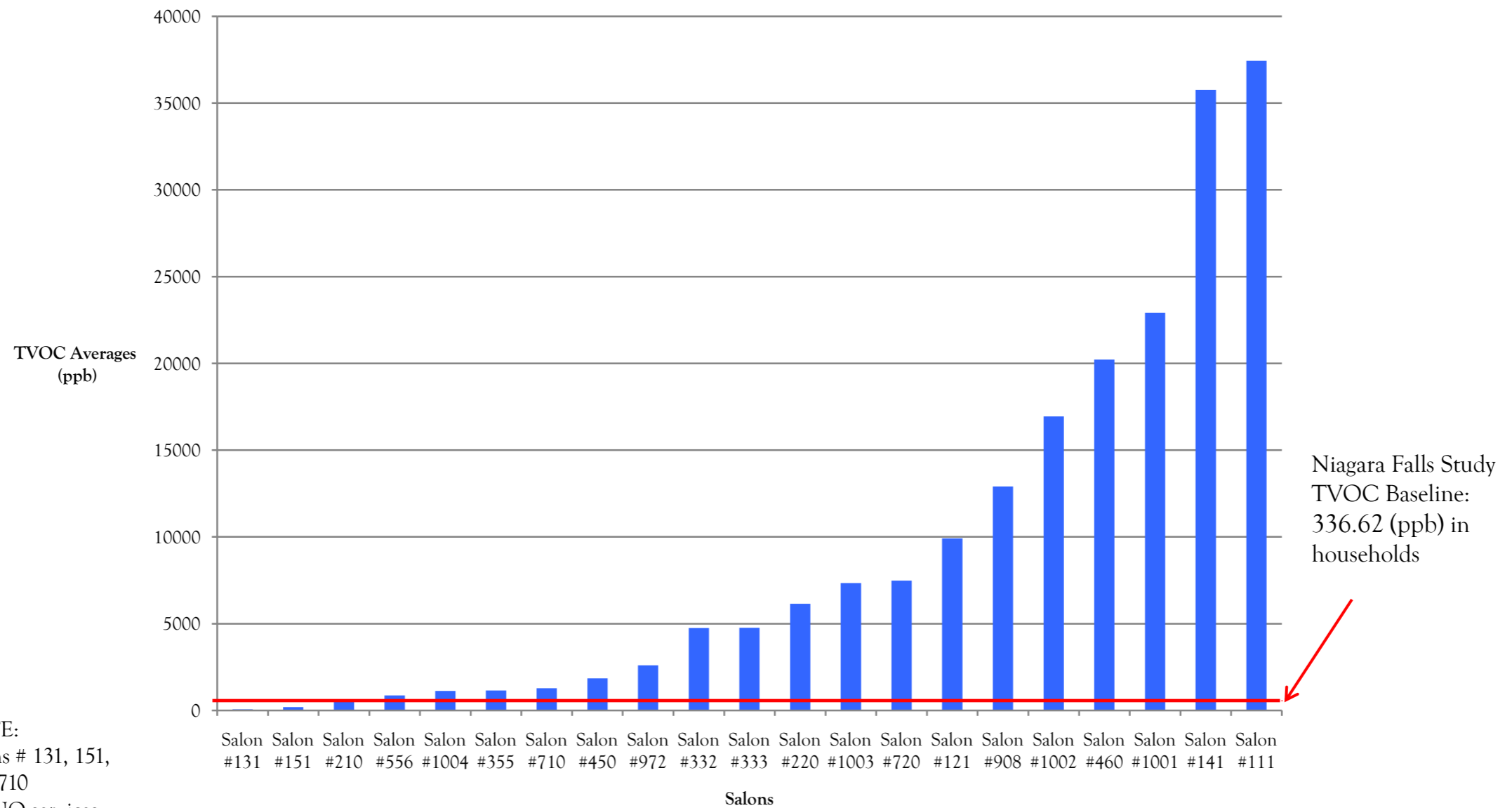
- CO₂ levels in 15 of 21 salons exceeded 800 ppm indicating these salons may have insufficient ventilation

Average Measured PM_{2.5} Concentrations



- 86% of the salons studied were above the household average
- Background: PM_{2.5} concentration in households in Boston is 13.9 µg/m³

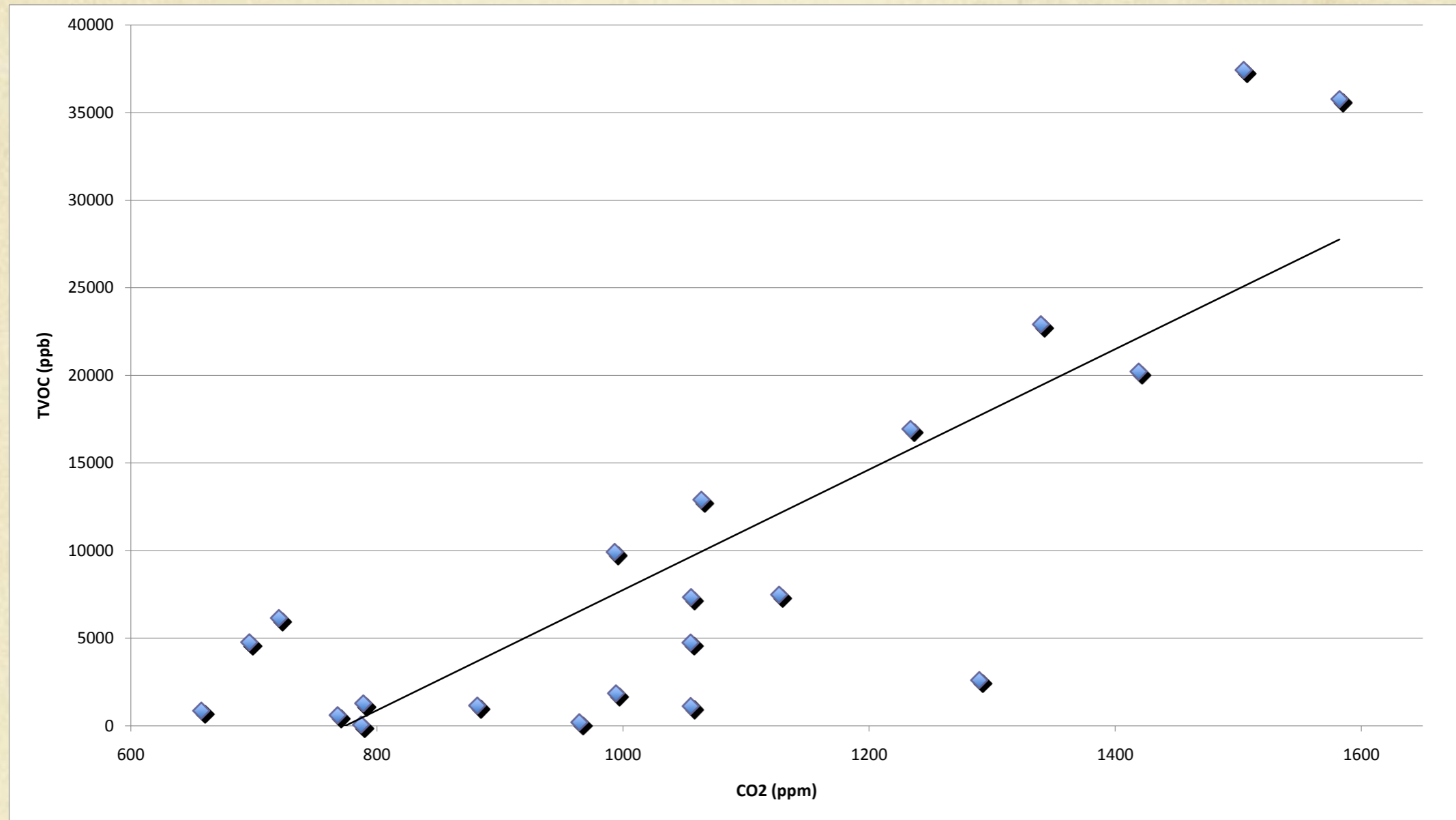
Average Measured TVOC (ppb) Concentrations



NOTE:
Salons # 131, 151,
556, 710
had NO services
being done while
we sampled

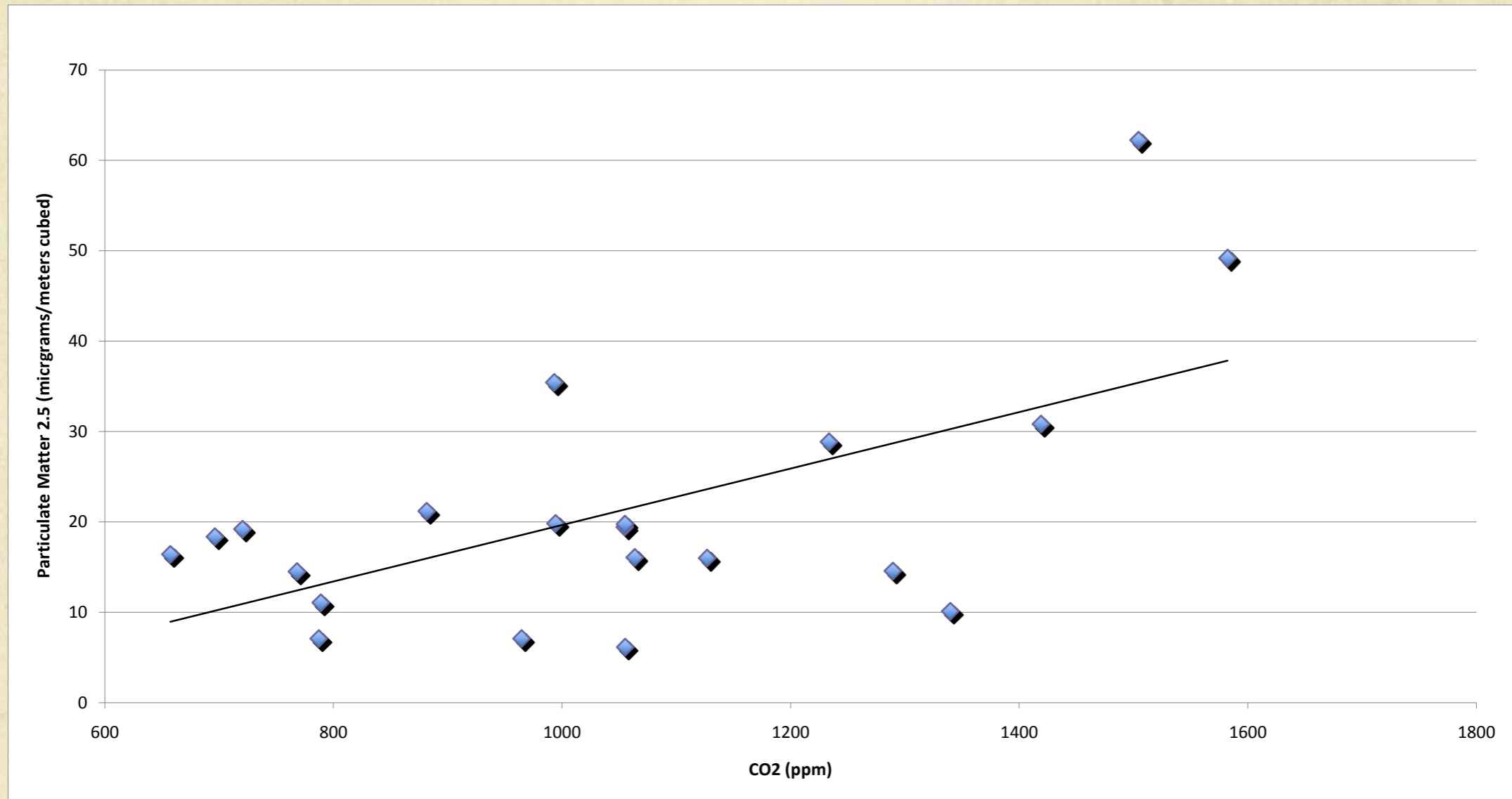
- Background: TVOC concentration in households in New York is 336.62 ppb

CO₂ (ppm) vs. TVOC (ppb) Levels



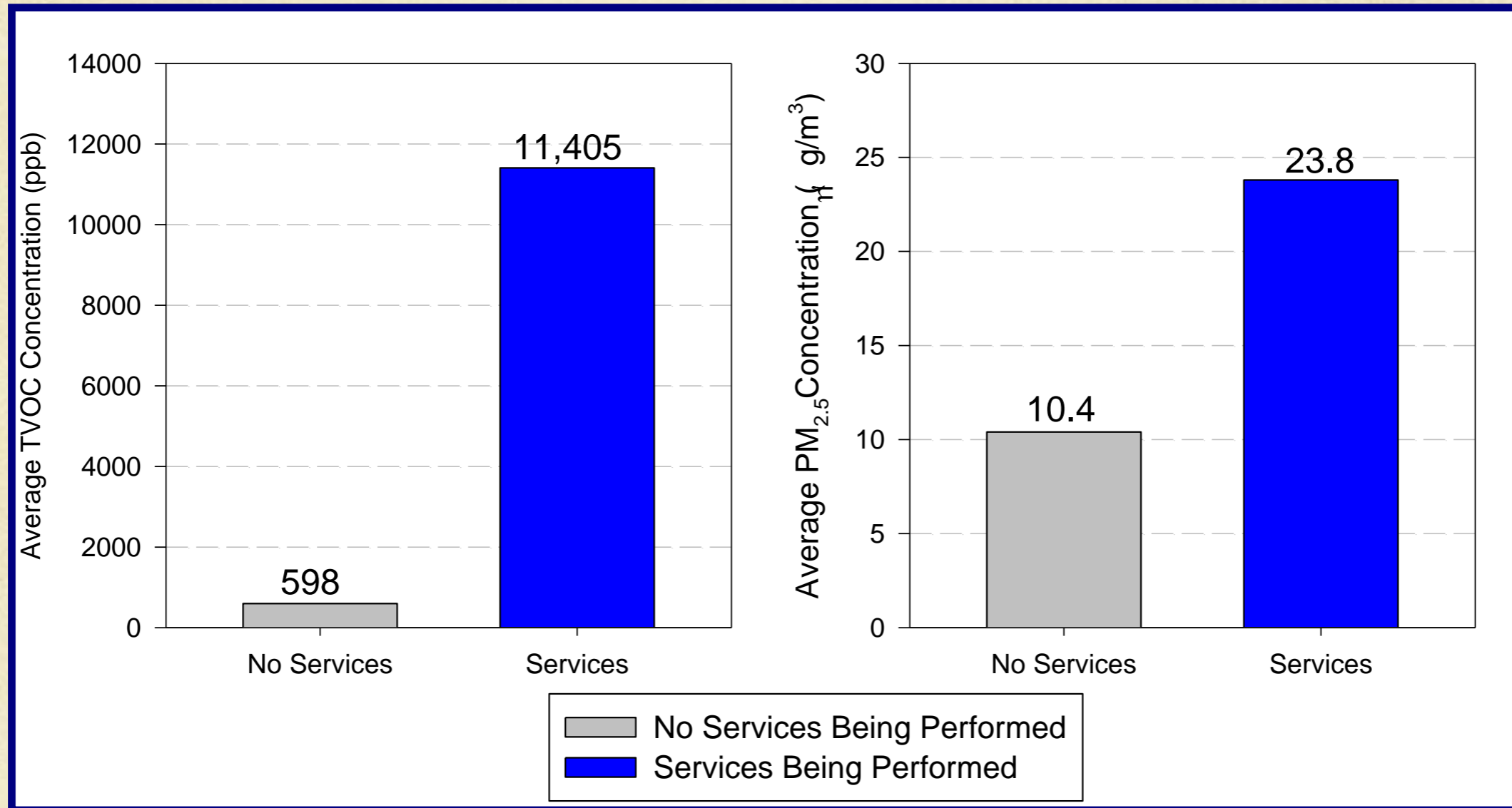
- Higher CO₂ levels were found in salons with higher TVOC levels
- This suggests that higher ventilation rates may decrease TVOC concentrations

CO₂ (ppm) vs. PM_{2.5} Levels



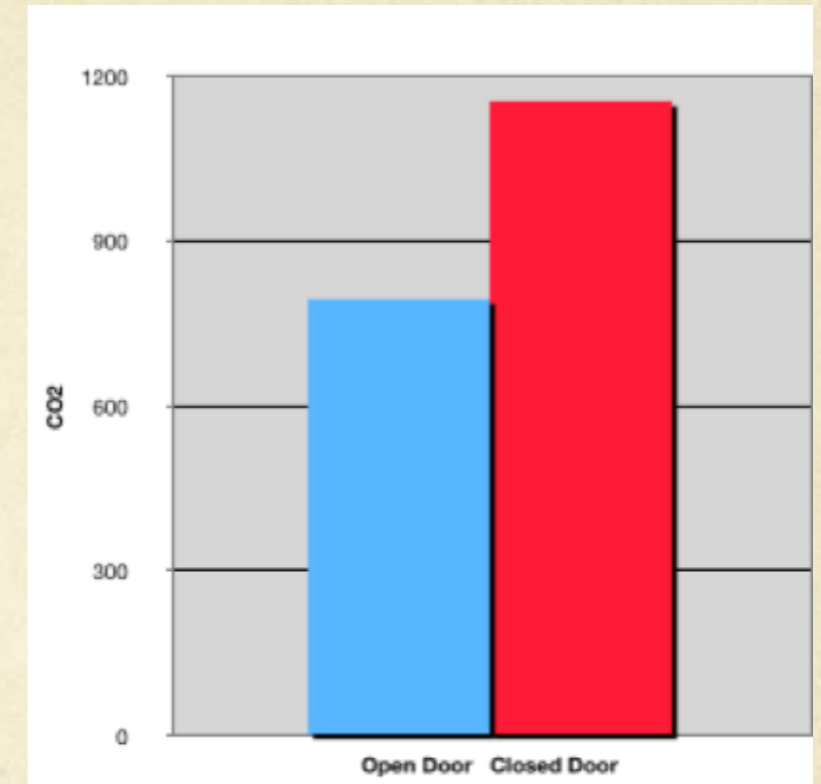
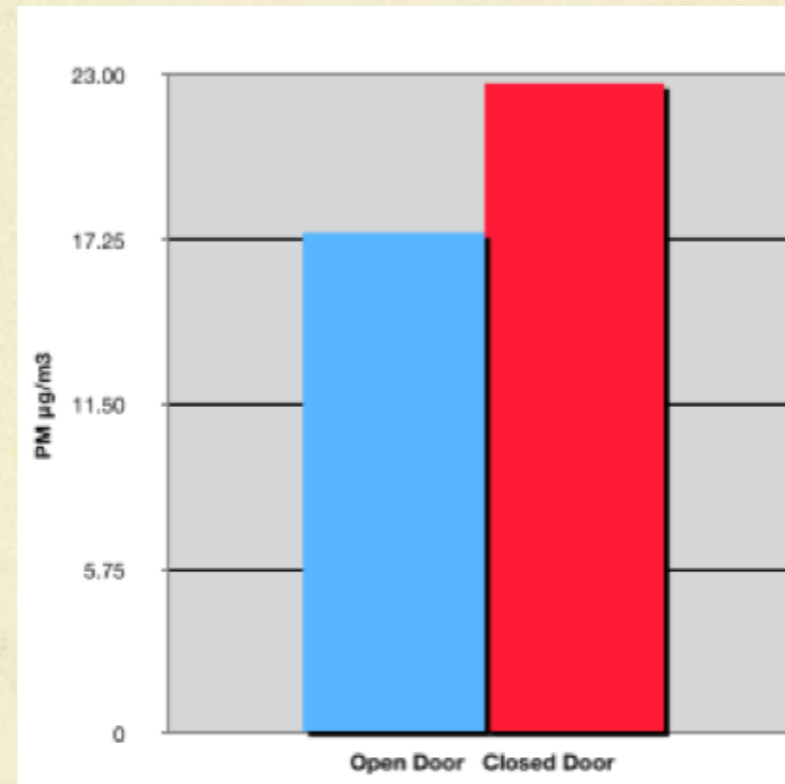
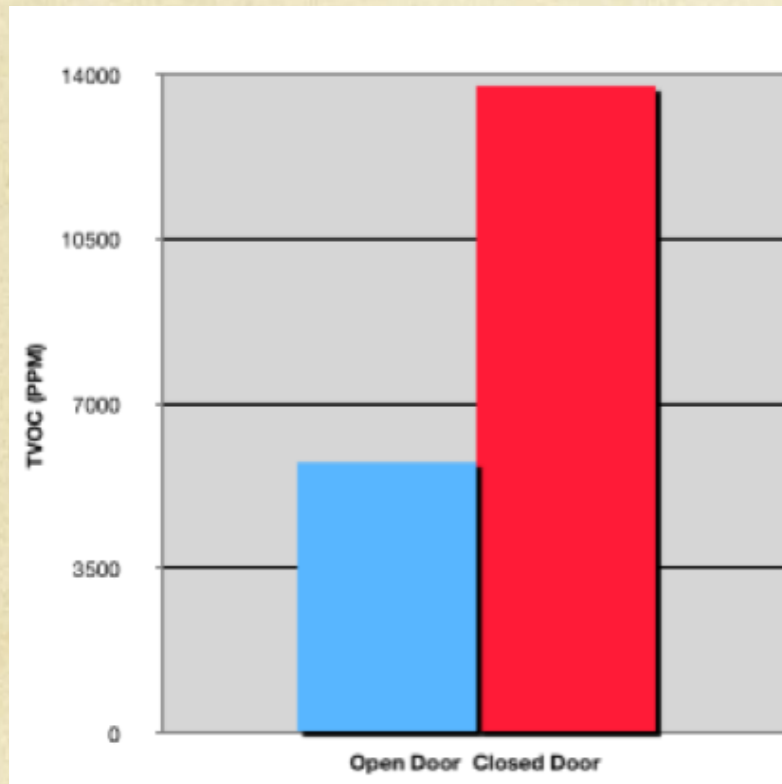
- Particulate Matter is an indicator of nail salon services being performed
- This suggests that higher ventilation rates may decrease PM_{2.5} concentrations

Services Being Performed vs. Not



- Nail salons performing services had significantly higher TVOC and PM_{2.5} concentrations
- Not dependent on number of services

Door Open vs. Door Closed Comparisons



- Salons with open doors and/or windows had significantly reduced TVOC concentrations
- Opening doors and windows may be a simple approach to reducing exposures

Conclusions

- CO₂ levels in 15 of 21 salons exceeded 800 ppm indicating that these salons may have insufficient ventilation
- Higher TVOC and PM_{2.5} levels were found in salons with poorer ventilation (as determined by elevated CO₂ concentrations)
- Contrary to our *a priori* hypothesis, average levels of TVOCs, CO₂ and PM_{2.5} were consistent throughout salons, indicating that elevated exposures may not be restricted to areas in the salon where work is being performed (eg., at the manicure table)
- Higher TVOC concentrations were observed when tasks were being performed, and were not dependent upon the number of tasks being performed.
- Salons with open doors and/or windows had significantly reduced TVOC concentrations.

Recommendations

- Improving ventilation conditions in salons to meet minimum outdoor air delivery requirements can reduce exposures to TVOCs and PM_{2.5}
- Weather permitting, increasing outdoor-indoor air exchange by opening doors and windows may be a simple approach to reducing exposures.
- Conduct additional studies of personal exposures to individual VOCs to characterize occupational exposure
- Evaluate options to increase ventilation on TVOC exposures and filtration on reducing PM_{2.5} exposures

Thank you!

Thank you to all of the salon owners and workers that allowed us to conduct our study in their salons, our research and study partners, Tiffany Skogstrom and Nancy Nguyen at BPHC and Professor Goldin!



the *safe nail salon* project





Indoor Air Quality Survey of Boston Nail Salons

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Introduction

The number and popularity of nail salons in the U.S. has grown tremendously within the past two decades, resulting in a 67% increase in revenue and over \$6.5 billion for 2003 (Protecting the Health of Nail Salon, 2004). An overwhelming majority of nail salon workers are of Asian descent; Vietnamese-Americans make up 37% of licensed nail salon owners and workers nationwide (Design for the Environment, 2011). Nail salon employees typically are of reproductive age and are exposed to chemicals on a daily basis, which have the potential for causing harm to them and to their unborn children. According to the EPA, xylene, toluene, acetone, and methyl ethyl ketone in nail polishes and hardeners are neurological toxicants. Short-term effects are headaches, nausea, dizziness, and irritability. These solvents may cause neuropsychological and neurobehavioral effects, such as difficulty learning numbers and concentrating. For example, toluene in nail polish remover can be a reproductive and developmental toxicant, and may retard the development of fetuses exposed in the uterus. A 1992 epidemiological study by Ng et al. suggests that spontaneous abortion in workers exposed to toluene may occur nearly 3 times more than a control group. In addition, a 2008 occupational health survey by Roelofs et al. showed an elevation of respiratory symptoms, skin problems, and headaches among nail salon workers as compared to the general population. According to a 2011 study by Harris-Roberts et al. chemicals found in nail salon products are associated with occupational asthma and contact dermatitis. Researchers in the JBS Environmental Health and Justice program at Brandeis worked in collaboration with the Nail Salon Partners, including Boston Public Health Commission and Viet-Aid, to further understand potential chemical exposure in nail salons.

Methods

Brandeis Environmental Health & Justice students conducted sampling in 21 salons in Roxbury, Dorchester, Mattapan and Jamaica Plain between September and December, 2011. All information gathered was kept confidential and individuals and salons were not identified. The study protocol was reviewed by the Institutional Review Board (IRB) at Brandeis University. Study visits consisted of three parts: indoor environmental quality measurements, site observations, and a short interview with each salon owner. Field sampling teams created a diagram including general dimensions and ventilation characteristics such as locations of doors, windows, fans and vents. Observational data included what services were being provided at the time: acrylic, silk, gel, airbrushing, manicure, or pedicure, as well as the number of employees and customers present. Six to eight sampling locations were selected in each salon. A Q-Trak was used to measure carbon dioxide (CO₂), temperature and relative humidity. A DustTrak was used to measure airborne particles, and a ppbRae was used to measure total volatile organic compounds (TVOCs). Outdoor measurements were taken at each salon before entering as quality control indicators.

Results

Figure 1. Impact of services being performed on TVOC and PM_{2.5} concentrations

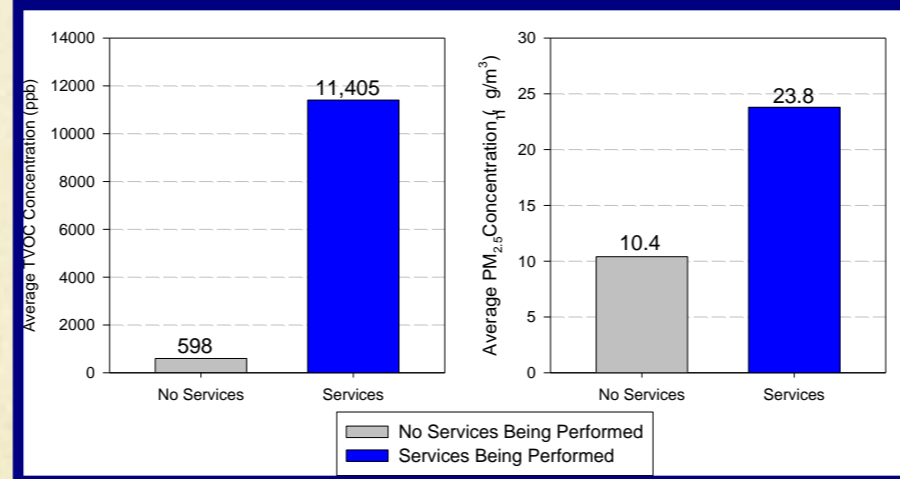


Figure 2. Average measured CO₂ (ppm) concentrations as an indicator of ventilation



Figure 3. CO₂ (ppm) vs. PM_{2.5} (µg/m³)

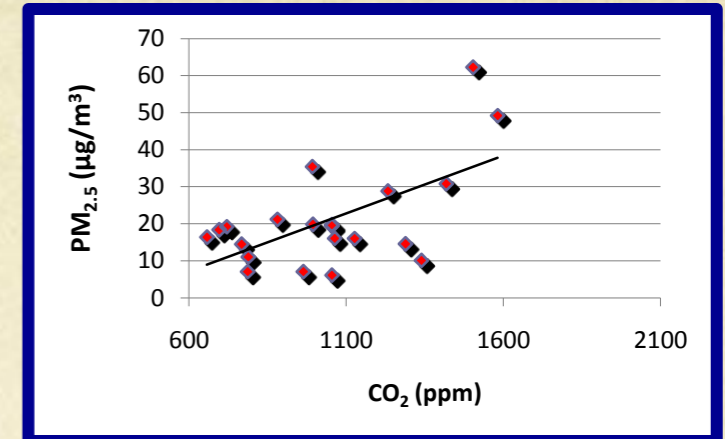
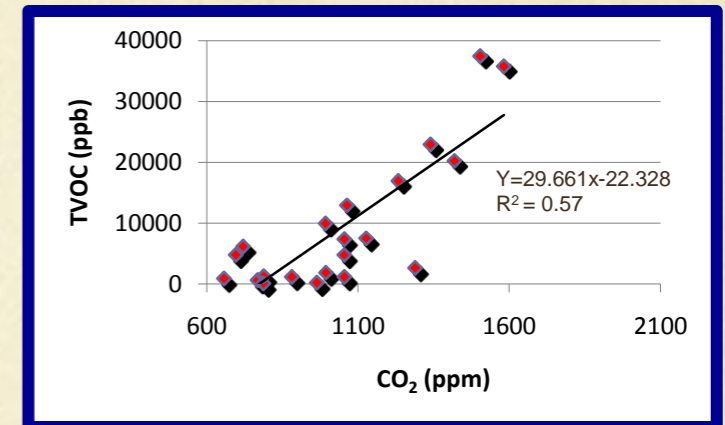


Figure 4. CO₂ (ppm) vs. TVOC (ppb)



Conclusions and Recommendations

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- Higher TVOC and PM_{2.5} levels were found in salons with poorer ventilation (as determined by elevated CO₂ concentrations)
- Contrary to our *a priori* hypothesis, average levels of TVOCs, CO₂ and PM_{2.5} were consistent throughout salons, indicating that elevated exposures may not be restricted to areas in the salon where work is being performed (e.g., at the manicure table)
- Higher TVOC concentrations were observed when tasks were being performed, and were not dependent upon the number of tasks being performed.
- Salons with open doors and/or windows had significantly reduced TVOC concentrations.
- Improving ventilation conditions in salons to meet minimum outdoor air delivery requirements can reduce exposures to TVOCs
- Weather permitting, increasing outdoor-indoor air exchange by opening doors and windows may be a simple approach to reducing exposures.
- Conduct additional studies of personal exposures to individual VOCs to characterize occupational exposure
- Evaluate the effectiveness of options to increase ventilation on TVOC exposures and filtration on reducing PM_{2.5} exposures

	Percentiles						
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CO ₂ (ppm)	1,085	641	809	1,055	1,257	1,544	2,057
PM _{2.5} (µg/m ³)	20	6	11	16	23	49	68

¹Five most common ventilation systems: central ventilation system, ceiling fan, open door/window, table fan, local exhaust

Thank you to our collaborators :

