BOISE, IDAHO

INDOOR AIR QUALITY MONITORING STUDY

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March 2013

EXECUTIVE SUMMARY

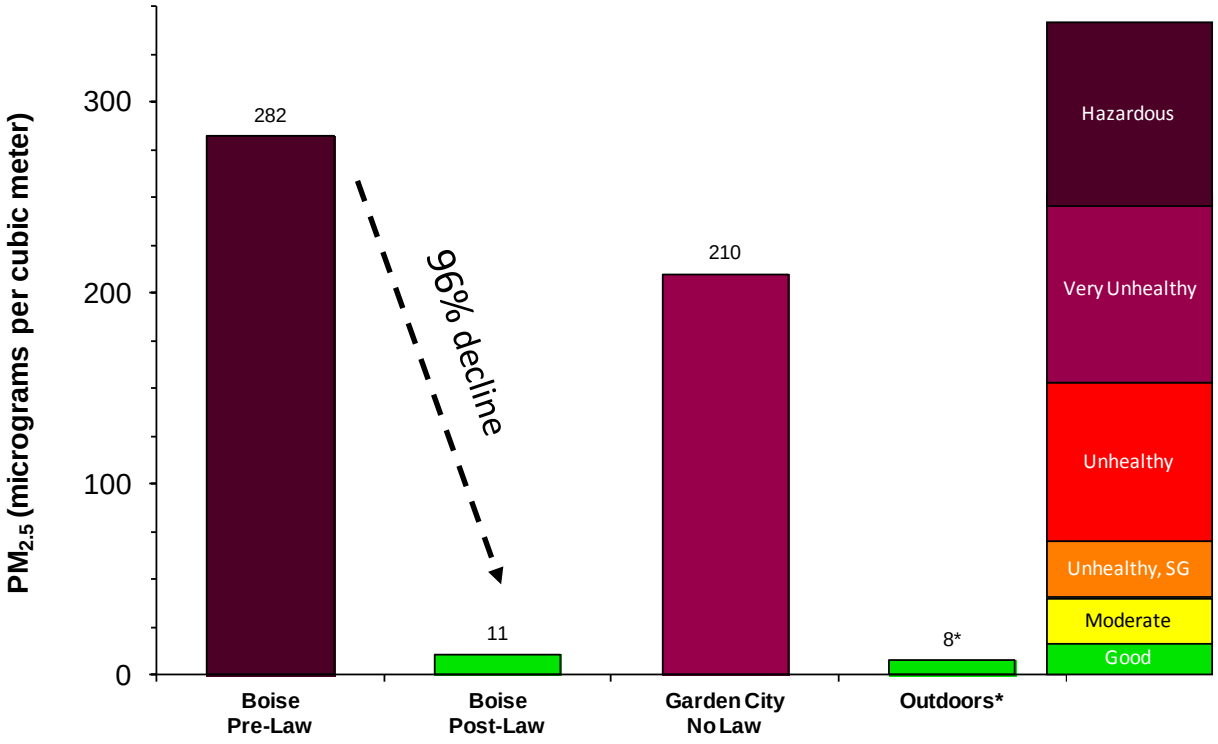
In May & June, 2009 and November & December, 2012, indoor air quality was assessed in 11 restaurants and bars in Boise and Garden City, Idaho. On July 1st, 2004, Idaho passed a State Wide Smoke-free Air Law that prohibits smoking in public places, publicly owned workplaces, bowling centers and restaurants, including those with attached bars. However, this state wide law does not preempt local municipalities from passing stronger laws. The Boise City Council unanimously approved a smoke-free ordinance, which includes a ban on smoking in bars, restaurants and private clubs effective January 2nd, 2012. Prior to the Boise smoke-free law, all bars were allowed by law to permit smoking indoors. After the smoke-free law took effect, Boise bars were reassessed to observe the effect the new smoke-free air law; no smoking was observed post-law. In addition, 7 Garden City bars and restaurants, where smoking is still permitted, were sampled post-law; smoking was observed in 5 locations, while there was no observed smoking in 2 locations.

The concentration of fine particle air pollution, $PM_{2.5}$, was measured with a TSI SidePak AM510 Personal Aerosol Monitor. $PM_{2.5}$ is particulate matter in the air smaller than 2.5 microns in diameter. Particles of this size are released in significant amounts from burning cigarettes, are easily inhaled deep into the lungs, and cause a variety of adverse health effects including cardiovascular and respiratory morbidity and death.

Key findings of the study include:

- In the 4 Boise locations with observed indoor smoking before the law, the average level of fine particle air pollution was "hazardous" ($PM_{2.5}$ = 282 μg/m^3). This level of particle air pollution was 35 times higher than outdoor air in Idaho (8 μg/m^3).
- After the Boise smoke-free air law took effect January 2, 2012, indoor particle pollution levels declined 96%, to levels similar to those found in outdoor air.
- Employees in all 4 locations with indoor smoking before the smoke-free air law went into effect were exposed to levels of air pollution 4.3 times higher than safe annual levels established by the U.S. Environmental Protection Agency due to their occupational exposure to tobacco smoke pollution.
- In the 5 Garden City locations with observed smoking and where smoking is still permitted by law, particle pollution levels were "very unhealthy" ($PM_{2.5}$ = 210 μg/m^3). Employees in these locations remain exposed to levels of air pollution 3.2 times higher than safe annual levels established by the U.S. Environmental Protection Agency due to their occupational exposure to tobacco smoke pollution.
- The average particle pollution levels in the places with observed smoking in this study (total mean $PM_{2.5}$ = 218 μg/m^3) were 4.5 times higher than the worst 24-hour levels recorded outdoors in Idaho in 2012.

Figure 1. **Effect of Boise, Idaho Smoke-free Law on Indoor Air Pollution**



*Used for comparison purposes. Based on the 2011 average PM2.5 level at Meridian & Nampa, Idaho EPA monitoring sites. http://www.epa.gov/airdata/ad_rep_mon.html

INTRODUCTION

Secondhand smoke (SHS) contains at least 250 chemicals that are known to be toxic or carcinogenic, and is itself a known human carcinogen,[1] responsible for an estimated 3,000 lung cancer deaths annually in *never smokers* in the U.S., as well as more than 35,000 deaths annually from coronary heart disease in *never smokers,* and respiratory infections, asthma, Sudden Infant Death Syndrome, and other illnesses in children.[2] Although population-based data show declining SHS exposure in the U.S. overall, SHS exposure remains a major public health concern that is entirely preventable.[3, 4] Because establishing smoke-free environments is the most effective method for reducing SHS exposure in public places,[5] Healthy People 2020 Objective TU-13 encourages all States, Territories, Tribes and the District of Columbia to establish laws on smoke-free indoor air that prohibit smoking in public places and worksites.[6]

Currently in the U.S., 30 states, Washington D.C., Puerto Rico, and U.S. Virgin Islands have passed strong smoke-free air laws that include restaurants and bars. The states are Arizona, California, Colorado, Connecticut, Delaware, Hawaii, Illinois, Iowa, Kansas, Maine, Maryland, Massachusetts, Michigan, Minnesota, Montana, Nebraska, New Hampshire, New Jersey, New Mexico, New York, North Carolina, North Dakota, Ohio, Oregon, Rhode Island, South Dakota, Utah, Vermont, Washington, and Wisconsin. Well over 50% of the U.S. population is now protected from secondhand smoke in all public places.[7] Nine Canadian provinces and territories also have comprehensive smoke-free air laws in effect. Thousands of cities and counties across the U.S. have also taken action, as have whole countries including Ireland, Scotland, Uruguay, Norway, New Zealand, Sweden, Italy, Spain, England and France.

The goal of this study was to determine the effect of the Boise smoke-free air law on the level of fine particle air pollution in 4 bars and restaurants in Boise, Idaho. The new smoke-free law, unanimously approved by the Boise City Council, prohibits smoking in bars, restaurants and private clubs effective January 2nd, 2012. This Boise law is stronger than Idaho's state wide smoke-free air law (effective July 1st, 2004) that does not preempt local municipalities from passing stronger laws.

It was hypothesized that: 1) particle levels will decline significantly in a cohort of establishments permitting smoking at baseline that are sampled before and after the Boise smoke-free air law; 2) particle pollution levels will be significantly higher in establishments permitting smoking within Garden City, where no local smoke-free law exists, compared to post-law levels in Boise; and 3) the degree of indoor particle air pollution will be correlated with the amount smoking.

METHODS

In general, a good marker of SHS exposure should be easily and accurately measured at an affordable cost, providing a valid assessment of SHS exposure as a whole. However, SHS is a dynamic and complex mixture of thousands of compounds in vapor and particulate phases and it is not possible to directly measure SHS in its entirety. The two most commonly used and preferred methods of measuring SHS exposure are nicotine and fine particle ($PM_{2.5}$) sampling.[8] These methods are correlated with each other and with other SHS constituents. Nicotine sampling has the advantage of being specific to tobacco smoke, meaning there are no other competing sources of nicotine in the air. Active $PM_{2.5}$ sampling is not specific to tobacco smoke but was chosen for this study due to several advantages of this type of sampling: 1) data can be collected quickly, discreetly, and cost-effectively with a portable battery operated machine; 2) measurements are taken continuously and stored in memory so the changes in particle levels, including peak levels, can be readily observed; 3) the machine is highly sensitive to tobacco smoke, being able to instantly detect particle levels as low as 1 microgram per cubic meter; 4) $PM_{2.5}$ has known direct health effects in terms of morbidity and mortality and there are existing health standards for $PM_{2.5}$ in outdoor air (e.g. US EPA and WHO) that can be used to communicate the relative harm of $PM_{2.5}$ levels in places with smoking.

$PM_{2.5}$ is the concentration of particulate matter in the air smaller than 2.5 microns in diameter. Particles of this size are released in significant amounts from burning cigarettes, are easily inhaled deep into the lungs, and are associated with pulmonary and cardiovascular disease and death.

In May & June, 2009 and November & December, 2012, indoor air quality was assessed in 11 restaurants and bars in Boise and Garden City, Idaho. After the smoke-free law took effect on January 2, 2012, Boise bars and restaurants were reassessed to observe the effect the new smoke-free air law. In addition, 7 Garden City bars and restaurants, where smoking is still permitted, were sampled post-law.

Measurement Protocol

A minimum of 30 minutes was spent in each venue. The number of people inside the venue and the number of burning cigarettes were recorded every 15 minutes during sampling. These observations were averaged over the time inside the venue to determine the average number of people on the premises and the average number of burning cigarettes. Room dimensions were also determined using a combination of any or all of the following techniques; a sonic measuring device, counting of construction materials of a known size such as floor tiles, or estimation. Room volumes were calculated from these dimensions. The active smoker density was calculated by

TSI SIDEPAK AM510 PERSONAL AEROSOL MONITOR

dividing the average number of burning cigarettes by the volume of the room in meters.

A TSI SidePak AM510 Personal Aerosol Monitor (TSI, Inc., St. Paul, MN) was used to sample and record the levels of respirable suspended particles in the air. The SidePak uses a built-in sampling pump to draw air through the device where the particulate matter in the air scatters the light from a laser. This portable light-scattering aerosol monitor was fitted with a 2.5 µm impactor in order to measure the concentration of particulate matter with a mass-median aerodynamic diameter less than or equal to 2.5 µm, or $PM_{2.5}$. Tobacco smoke particles are almost exclusively less than 2.5 µm with a mass-median diameter of 0.2 µm.[9] The Sidepak was used with a calibration factor setting of 0.32, suitable for secondhand smoke.[10, 11] In addition, the SidePak was zero-calibrated prior to each use by attaching a HEPA filter according to the manufacturer's specifications.

The equipment was set to a one-minute log interval, which averages the previous 60 one-second measurements. Sampling was discreet in order not to disturb the occupants' normal behavior. For each venue, the first and last minute of logged data were removed because they are averaged with outdoors and entryway air. The remaining data points were averaged to provide an average $PM_{2.5}$ concentration within the venue.

Statistical Analyses

To evaluate the first hypothesis, the Wilcoxon signed-rank test was used to compare the difference in the mean levels of $PM_{2.5}$ from before the Boise smoke-free air law to after the law, separately in both places permitting smoking at baseline and those that were smoke-free. The second hypothesis was tested by using the Mann-Whitney U test to compare post-law Boise $PM_{2.5}$ levels to those in Garden City. The third hypothesis is tested by using all 15 sample visits and correlating the average smoker densities to the $PM_{2.5}$ levels using the Spearman rank correlation coefficient (r_s). Descriptive statistics including the venue volume, number of patrons, and average smoker density (i.e., number of burning cigarettes) per $100m^3$ are reported for each venue and averaged for all venues.

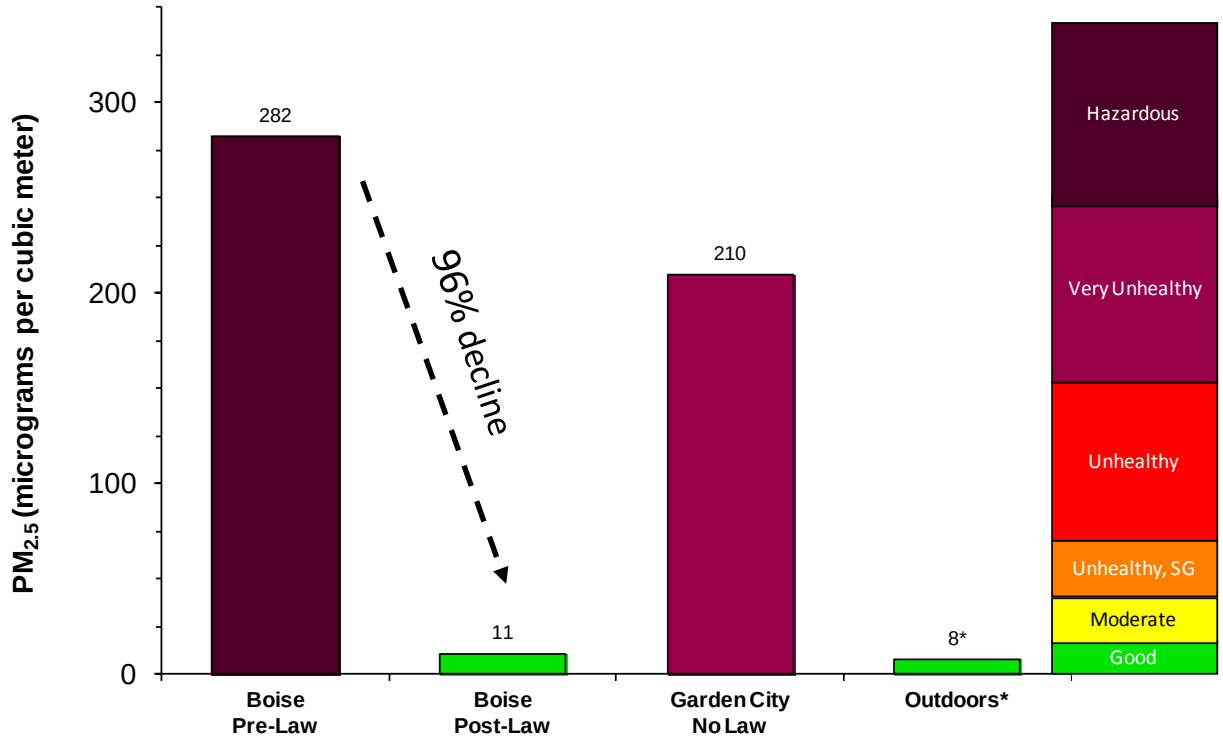
RESULTS

A summary of each location visited and tested in Boise is shown in Table 1. Locations tested in Garden City are shown in Table 2. Before the local Boise smoke-free law, the average $PM_{2.5}$ level in the 4 locations, that allowed smoking before the law, was 282 µg/m^3 (Figure 1). After Boise's smoke-free air law, the mean $PM_{2.5}$ level in these 4 locations where smoking was previously observed was 11 µg/m^3. This is a 96% reduction in $PM_{2.5}$ levels compared to the pre-law levels (T=0, p<0.1).

In the 5 Garden City locations where there is no local smoke-free air law and where smoking was observed, the average $PM_{2.5}$ level was "very unhealthy" (210 µg/m^3). This level is 19 times higher than the post-law level in Boise (U=0.00, p<0.05) and 30 times higher than the level (7 µg/m^3) seen in 2 smoke-free locations in Garden City (U=0.00, p<0.01).

In all 4 Boise locations with observed smoking, before the smoke-free law was passed, the average number of burning cigarettes was 7.3 which correspond to an average smoker density (ASD) of 2.36 burning cigarette per 100 m^3. After the law, the observed smoking was reduced to 0.0 average cigarettes and an ASD of 0.00. Looking at all 15 sample visits, pre-law and post-law, in Boise and Garden City, $PM_{2.5}$ levels are positively associated with the active smoker density indicating that the amount of indoor smoking is the primary driver of the indoor particle pollution levels. This association was statistically significant (r_s=0.78, p<0.01).

Figure 1. **Effect of Boise, Idaho Smoke-free Law on Indoor Air Pollution**



*Used for comparison purposes. Based on the 2011 average PM2.5 level at Meridian & Nampa, Idaho EPA monitoring sites. http://www.epa.gov/airdata/ad_rep_mon.html

The real-time plots showing the level of indoor air pollution in each venue sampled is presented in Figures 2 & 3, starting on page 13. The real-time $PM_{2.5}$ plots reveal the following results: 1) low background levels are observed outdoors; 2) high levels of indoor air pollution are observed in the venues where smoking was observed; and 3) peak exposure levels in some venues where smoking was observed reached levels far in excess of the average recorded level.

Table 1. Change in Fine Particle Air Pollution in Boise, Idaho Hospitality Venues

	Pre-Law					Post-Law			
Venue Number	Size (m^3)	Average # people	Average # burning cigs	Active smoker density*	Average $PM_{2.5}$ level ($\mu g/m^3$)	Average # people	Average # burning cigs	Active smoker density*	Average $PM_{2.5}$ level ($\mu g/m^3$)
1	487	45	8.0	1.64	119	26	0.0	0.00	6
2	214	26	8.0	3.74	647	24	0.0	0.00	9
3	275	86	8.0	2.91	311	66	0.0	0.00	24
4	447	24	5.2	1.16	50	37	0.0	0.00	6
Average	**356**	**45**	**7.3**	**2.36**	**282**	**38**	**0.0**	**0.00**	**11**

*Average number of burning cigarettes per 100 cubic meters.

Table 2. Fine Particle Air Pollution in Garden City, Idaho Bars and Restaurants

Venue Number	Size (m^3)	Average # people	Average # burning cigs	Active smoker density*	Average $PM_{2.5}$ level ($\mu g/m^3$)
Smoking Observed					
5	153	18	6.0	3.92	199
6	1306	19	3.0	0.20	129
7	589	21	5.0	0.76	246
8	984	9	1.0	0.08	41
9	141	28	6.0	4.03	436
Average	**635**	**19**	**4.2**	**1.80**	**210**
No Observed Smoking					
10	277	4	0.0	0.00	12
11	349	30	0.0	0.00	2
Average	**313**	**17**	**0.0**	**0.00**	**7**

*Average number of burning cigarettes per 100 cubic meters.

DISCUSSION

The EPA cited over 80 epidemiologic studies in creating a particulate air pollution standard in 1997.[12] The EPA has recently updated this standard and, in order to protect the public health, the EPA has set limits of 15 $\mu g/m^3$ as the average annual level of $PM_{2.5}$ exposure and 35 $\mu g/m^3$ for 24-hour exposure.[12] In order to compare the findings in this study with the annual EPA $PM_{2.5}$ exposure standard, it was assumed that a full-time employee in the locations sampled that allow smoking works 8 hours, 250 days a year, is exposed to 282 $\mu g/m^3$ (the average level in all 4 Boise sites with smoking Pre-Law) on the job, and is exposed only to background particle levels of 8 $\mu g/m^3$ during non-work times. For a full-time employee their average annual $PM_{2.5}$ exposure is 64 $\mu g/m^3$. The EPA average annual $PM_{2.5}$ limit is exceeded by 4.3 times due to their occupational exposure. A full-time employee in the Garden City locations sampled with observed smoking is exposed to particle levels of 210 $\mu g/m^3$ on the job. The average annual $PM_{2.5}$ exposure is 50 $\mu g/m^3$ and the EPA average annual $PM_{2.5}$ limit is exceeded by 3.2 times due to their occupational exposure. Based on the latest scientific evidence, the EPA staff currently proposes even lower $PM_{2.5}$ standards to adequately protect the public health,[13] making the high $PM_{2.5}$ exposures of people in smoking environments even more alarming.

To further put the $PM_{2.5}$ levels in places with smoking into perspective, we compared the average level seen in places with observed smoking in this study to the worst $PM_{2.5}$ levels seen in outdoor air in Idaho in 2012. The average of the highest 24-hour reading from each of the 6 outdoor EPA reference monitors in Idaho was 48 $\mu g/m^3$ (SD=22) and the average particle pollution levels in the places with observed smoking in this study was 218 $\mu g/m^3$ (SD=198), 4.5 times higher than the worst levels recorded outdoors in Idaho in 2012.

Previous studies have evaluated air quality by measuring the change in levels of respirable suspended particles (RSP) between smokefree venues and those that permit smoking. Ott et al. did a study of a single tavern in California and showed an 82% average decrease in RSP levels after smoking was prohibited by a city ordinance.[14] Repace studied 8 hospitality venues, including one casino, in Delaware before and after a statewide prohibition of smoking in these types of venues and found that about 90% of the fine particle pollution could be attributed to tobacco smoke.[15] Similarly, in a study of 22 hospitality venues in Western New York, Travers et al. found a 90% reduction in RSP levels in bars and restaurants, an 84% reduction in large recreation venues such as bingo halls and bowling alleys, and a 58% reduction even in locations where only SHS from an adjacent room was observed at baseline.[16] A cross-sectional study of 53 hospitality venues in 7 major cities across the U.S. showed 82% less indoor air pollution in the locations subject to smokefree air laws, even though compliance with the laws was less than 100%.[17]

Other studies have directly assessed the effects SHS exposure has on human health. Rapid improvements in the respiratory health of bartenders were seen after a state smokefree workplace law was implemented in California[18]. Smokefree legislation in Scotland was associated with significant early improvements in symptoms, lung function, and systemic inflammation of all bar workers, while asthmatic bar workers also showed reduced airway inflammation and improved quality of life.[19] Farrelly et al. also showed a significant decrease in both salivary cotinine concentrations and sensory

symptoms in hospitality workers after New York State's smokefree law prohibited smoking in their worksites.[20] A meta-analysis of the 8 published studies looking at the effects of smokefree air policies on heart attack admissions yielded an estimate of an immediate 19% reduction in heart attack admissions associated with these laws.[21]

The effects of passive smoking on the cardiovascular system in terms of increased platelet aggregation, endothelial dysfunction, increased arterial stiffness, increased atherosclerosis, increased oxidative stress and decreased antioxidant defense, inflammation, decreased energy production in the heart muscle, and a decrease in the parasympathetic output to the heart, are often nearly as large (averaging 80% to 90%) as chronic active smoking. Even brief exposures to SHS, of minutes to hours, are associated with many of these cardiovascular effects. The effects of secondhand smoke are substantial and rapid, explaining the relatively large health risks associated with secondhand smoke exposure that have been reported in epidemiological studies.[22]

The hazardous health effects of exposure to second-hand smoke are now well-documented and established in various independent research studies and numerous international reports. The body of scientific evidence is overwhelming: there is no doubt within the international scientific community that second-hand smoke causes heart disease, lung cancer, nasal sinus cancer, sudden infant death syndrome (SIDS), asthma and middle ear infections in children and various other respiratory illnesses. There is also evidence suggesting second-hand smoke exposure is also causally associated with stroke, low birth weight, spontaneous abortion, negative effects on the development of cognition and behavior, exacerbation of cystic fibrosis, cervical cancer and breast cancer. The health effects of secondhand smoke exposure are detailed in recent reports by the California Environmental Protection Agency[23] and the U.S. Surgeon General[24].

CONCLUSIONS

This study demonstrates that employees and patrons in Boise bars and restaurants with observed indoor smoking, prior to the smoke-free air law, were exposed to harmful levels of indoor air pollution resulting from indoor smoking. The Boise smoke-free air law, implemented on January 2nd, 2012, has been shown to decrease exposure to toxic tobacco smoke pollution by 96%. However, in other Idaho cities, such as Garden City that lack a strong municipal smoke-free air law, secondhand smoke continues to pose a health risk as demonstrated by the harmful levels of fine particle air in locations with observed smoking. A comprehensive smoke-free air law, similar to the one in Boise, would guarantee a reduction in exposure to toxic tobacco smoke in all public places and places of employment. A stronger state smoke-free air law would result in improved quality of life and health outcomes for all Idaho workers and residents.

ACKNOWLEDGMENTS

The study was funded by the American Nonsmokers' Rights Foundation.

Support for Roswell Park Cancer Institute researchers was also provided by the Flight Attendant Medical Research Institute.

Roswell Park Cancer Institute (RPCI) is America's first cancer center founded in 1898 by Dr. Roswell Park. RPCI is the only upstate New York facility to hold the National Cancer Center designation of "comprehensive cancer center" and to serve as a member of the prestigious National Comprehensive Cancer Network.

Over its long history, Roswell Park Cancer Institute has made fundamental contributions to reducing the cancer burden and has successfully maintained an exemplary leadership role in setting the national standards for cancer care, research and education.

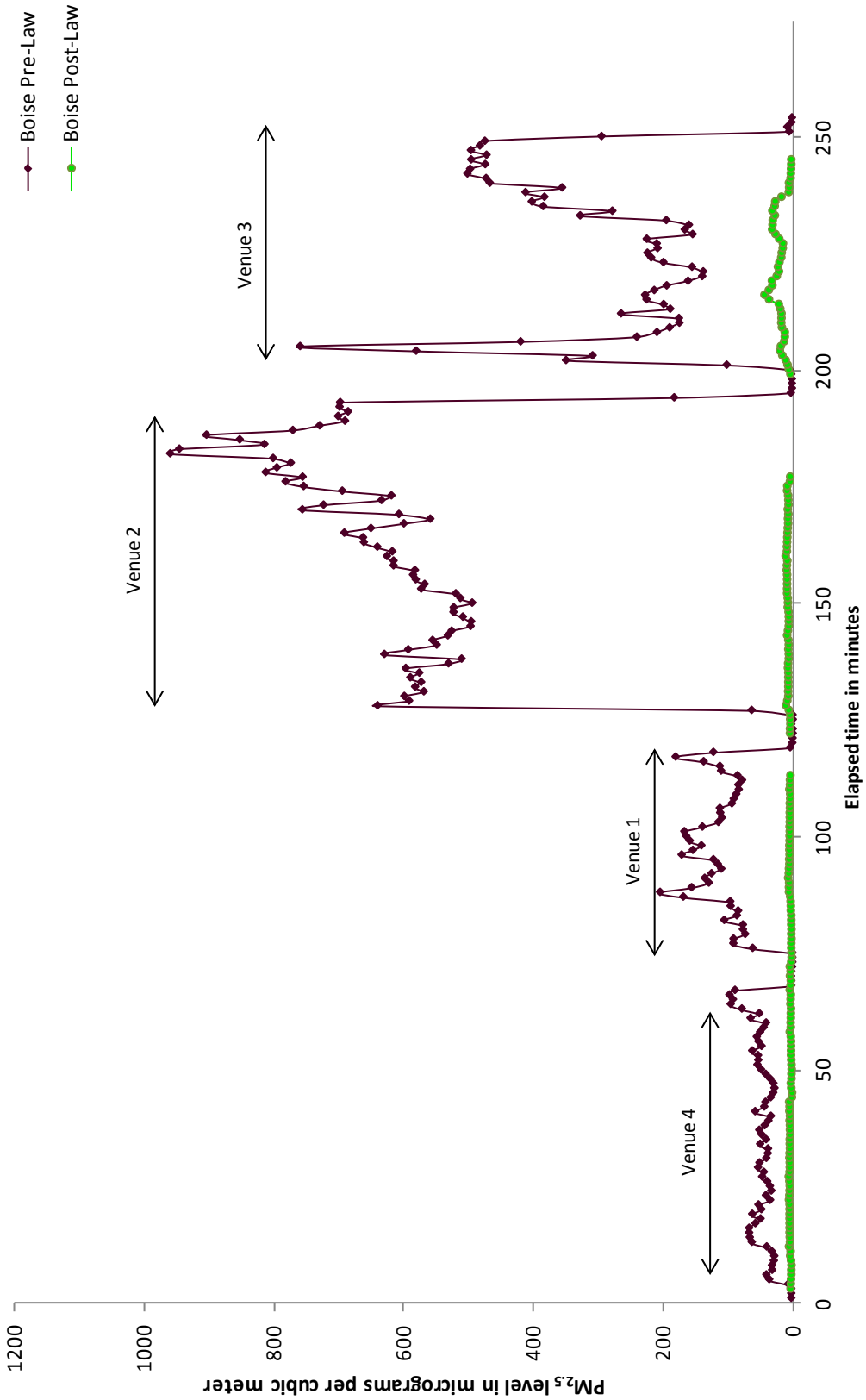
The campus spans 25 acres in downtown Buffalo and consists of 15 buildings with about one million square feet of space. A new hospital building, completed in 1998, houses a comprehensive diagnostic and treatment center. In addition, the Institute built a new medical research complex and renovated existing education and research space to support its future growth and expansion.

For more information about Roswell Park and cancer in general, please contact the Cancer Call Center at 1-877-ASK-RPCI (1-877-275-7724).

REFERENCES

1. National Toxicology Program, *9th Report on Carcinogens 2000*. 2000, U.S. Department of Health and Human Services, National Institute of Environmental Health Sciences: Research Triangle Park, NC.
2. CDC, *Annual smoking-attributable mortality, years of potential life lost, and economic costs - United States, 1995-1999.* MMWR, 2002. **51**(14): p. 300-320.
3. U.S. Department of Health and Human Services, *Second national report on human exposure to environmental chemicals*. 2003, US Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Environmental Health: Atlanta, GA.
4. U.S. Department of Health and Human Services, *Reducing tobacco use: a report of the Surgeon General*. 2000, US Government Printing Office: Washington, DC.
5. Hopkins, D.P., et al., *Reviews of evidence regarding interventions to reduce tobacco use and exposure to environmental tobacco smoke.* Am J Prev Med, 2001. **20**(2 Suppl): p. 16-66.
6. U.S. Department of Health and Human Services, *Healthy People 2010: Objectives for Improving Health (Volume 2)*. 2000, U.S. Government Printing Office: Washington, DC.
7. American Nonsmokers' Rights Foundation. *Summary of 100% Smokefree State Laws and Population Protected by 100% U.S. Smokefree Laws*. 2013 1/2/2013 [cited 2013 Feb 8]; Available from: http://www.no-smoke.org/pdf/SummaryUSPopList.pdf
8. *The Arkansas Clean Indoor Air Act of 2006*, in *Arkansas Code Title 20*. 2006.
9. Klepeis, N.E., et al., *Determining Size-Specific Emission Factors for Environmental Tobacco Smoke Particles.* Aerosol Science and Technology, 2003. **37**: p. 780-790.
10. Klepeis, N.E., W.R. Ott, and P. Switzer, *Real-Time Measurement of Outdoor Tobacco Smoke Particles.* Journal of the Air & Waste Management Association, 2007. **57**: p. 522-534.
11. Travers, M.J., *Smoke-free air policy: changing what's in the air and in the body*, in *Social and Preventive Medicine [Dissertation]*. 2008, State University of New York at Buffalo: Buffalo.
12. U.S. Environmental Protection Agency, *National ambient air quality standards for particulate matter; final rule.* Federal Register, 1997. **62**(138): p. 38651-38701.
13. U.S. Environmental Protection Agency. *Draft Staff Paper for Particulate Matter Fact Sheet*. 2005 [cited 2006 October 4]; Available from: http://www.epa.gov/airlinks/pdfs/pmstaff2_fact.pdf.
14. Ott, W., P. Switzer, and J. Robinson, *Particle concentrations inside a tavern before and after prohibition of smoking: evaluating the performance of an indoor air quality model.* J Air Waste Manag Assoc, 1996. **46**(12): p. 1120-1134.
15. Repace, J.L., *Respirable particles and carcinogens in the air of Delaware hospitality venues before and after a smoking ban.* J Occup Environ Med, 2004. **46**(9): p. 887-905.
16. Travers, M.J., et al., *Indoor Air Quality in Hospitality Venues Before and After the Implementation of a Clean Indoor Air Law-Western New York, 2003.* Morbidity and Mortality Weekly Report (MMWR), 2004. **53**(44): p. 1038-1041.
17. Travers, M.J., A. Hyland, and J.L. Repace, *7-City Air Monitoring Study (7-CAMS), March-April 2004*. 2004, Roswell Park Cancer Institute: Buffalo.
18. Eisner, M.D., A.K. Smith, and P.D. Blanc, *Bartenders' respiratory health after establishment of smoke-free bars and taverns.* JAMA, 1998. **280**(22): p. 1909-14.
19. Menzies, D., et al., *Respiratory symptoms, pulmonary function, and markers of inflammation among bar workers before and after a legislative ban on smoking in public places.* JAMA, 2006. **296**(14): p. 1742-8.
20. Farrelly, M.C., et al., *Changes in hospitality workers' exposure to secondhand smoke following the implementation of New York's smoke-free law.* Tob Control, 2005. **14**(4): p. 236-41.
21. Glantz, S.A., *Meta-analysis of the effects of smokefree laws on acute myocardial infarction: An update.* Preventive Medicine, 2008. **47**(4): p. 452-453.
22. Barnoya, J. and S.A. Glantz, *Cardiovascular effects of secondhand smoke: nearly as large as smoking.* Circulation, 2005. **111**(20): p. 2684-98.
23. California Environmental Protection Agency, *Proposed Identification of Environmental Tobacco Smoke as a Toxic Air Contaminant.* 2005, California Environmental Protection Agency, Air Resources Board, Office of Environmental Health Hazard Assessment.
24. U.S. Department of Health and Human Services, *The Health Consequences of Involuntary Exposure to Tobacco Smoke: A Report of the Surgeon General*. 2006, U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health: Atlanta, GA.

Figure2.


Boise, Idaho Air Monitoring Study
Boise Pre-Law
Boise Post-Law
Venue 1
Venue 2
Venue 3
Venue 4
PM2.5 level in micrograms per cubic meter
Elapsed time in minutes
0
200
400
600
800
1000
1200
0
50
100
150
200
250

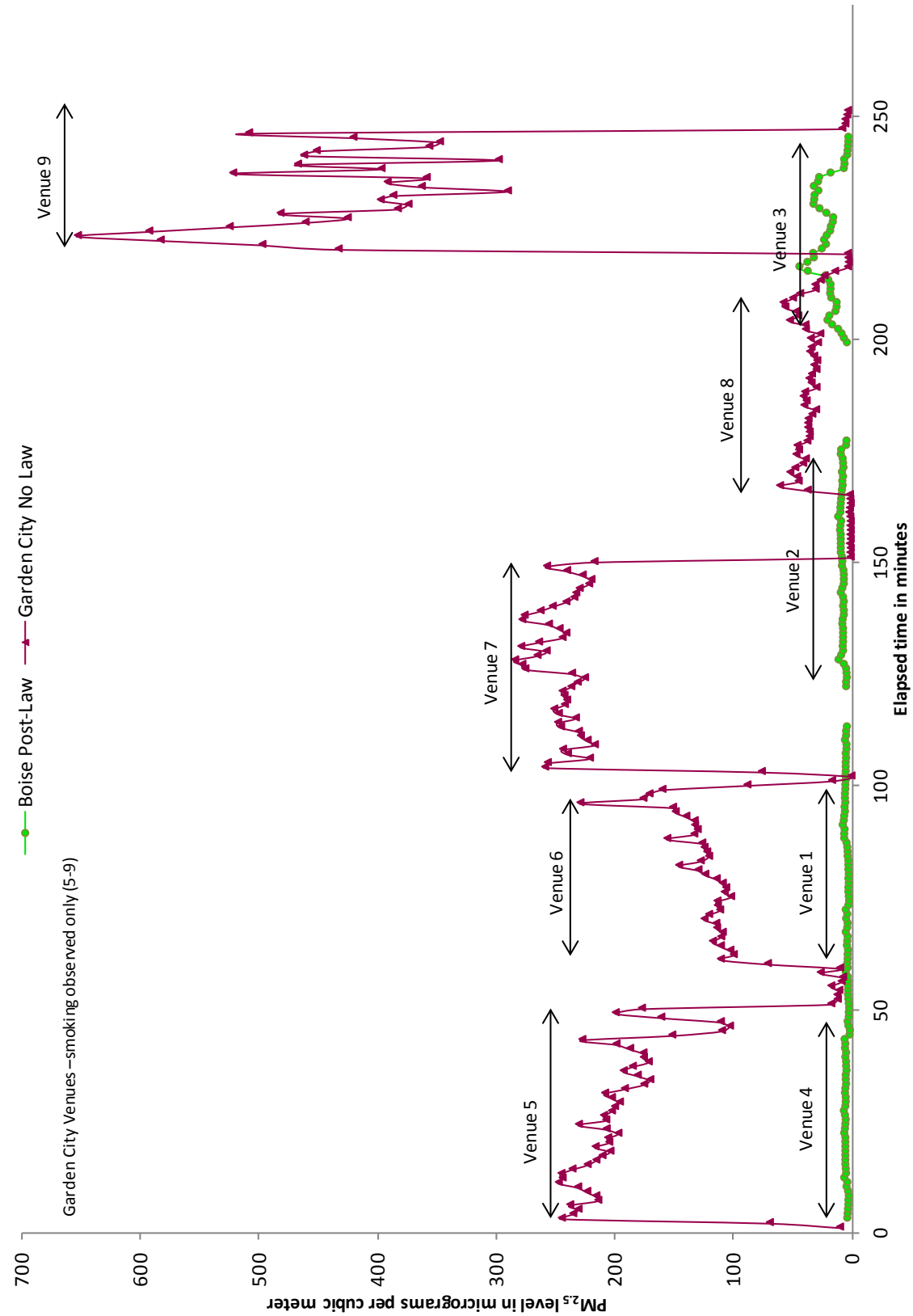

Boise & Garden City Venues (Post-law data only)
Boise Post-Law
Garden City No Law
Garden City Venues –smoking observed only (5-9)
PM2.5 level in micrograms per cubic meter
Elapsed time in minutes
0
100
200
300
400
500
600
700
0
50
100
150
200
250
Venue 1
Venue 2
Venue 3
Venue 4
Venue 5
Venue 6
Venue 7
Venue 8
Venue 9

Figure 3.