Grand Forks Air Quality Monitoring Study Report Brief

On April 5, 2010, the Grand Forks City Council adopted a comprehensive smoke-free workplace ordinance. This ordinance, implemented on August 15, 2010, strengthened the existing local ordinance by removing the smoke-free exemptions for bars and truckstops.

The goal of the study was to determine the effect of Grand Forks' comprehensive smoke-free workplace ordinance on the level of fine particle air pollution in bars and truckstops in Grand Forks, ND.

Indoor air quality was assessed in 8 bars and truckstops in Grand Forks both before (August 2010) and after (January 2011) the comprehensive smoke-free workplace ordinance was implemented in Grand Forks

Venues were selected as part of a convenience sample based on the number of establishments in Grand Forks that allowed smoking prior to the implementation of the smoke-free ordinance.

Volunteers attended each venue for a minimum of 30 minutes to collect air samples using a TSI SidePak AM510 Personal Aerosol Monitor. Observations such as number of people, number of burning cigarettes, and room dimensions were also collected during the length of time in each venue.

Sampling was discrete in order not to disturb the occupants' normal behavior.

The SidePak was used to measure the concentration of fine particle air pollution of $PM_{2.5.}$ $PM_{2.5}$ is particulate matter that is smaller than 2.5 microns in diameter. Particles of this size are released in significant amounts from burning cigarettes and are easily inhaled deep into the lungs, causing a variety of adverse health effects including cardiovascular and respiratory morbidity and death.

The air sampling data was analyzed and reported by the Roswell Park Cancer Institute in Buffalo, NY.

Key Findings of the Study

- In the 8 locations permitting indoor smoking before the law, the level of fine particle air pollution was unhealthy ($PM_{2.5}$ = 85 μg/m^3). This level of particle air pollution was 11 times higher than outdoor air in North Dakota.
- Employees in the locations with indoor smoking were exposed to levels of air pollution 2 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 Grand Forks locations that permitted indoor smoking, indoor particle pollution levels declined 92% as a result of the local smoke-free air law to low levels, similar to outdoor levels found in 2010.

The study was sponsored by the Grand Forks Tobacco Free Coalition with support from the Grand Forks Public Health Department and funded by BreatheND ~ Saving Lives Saving Money with Measure 3.

For specific questions related to the study data and analysis please contact:

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ROSWELL PARK CANCER INSTITUTE

BreatheND Saving Lives, Saving Money with Measure 3.

Grand Forks Tobacco Free COALITION

GRAND FORKS, NORTH DAKOTA

AIR QUALITY MONITORING STUDY

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ROSWELL PARK CANCER INSTITUTE

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Executive Summary

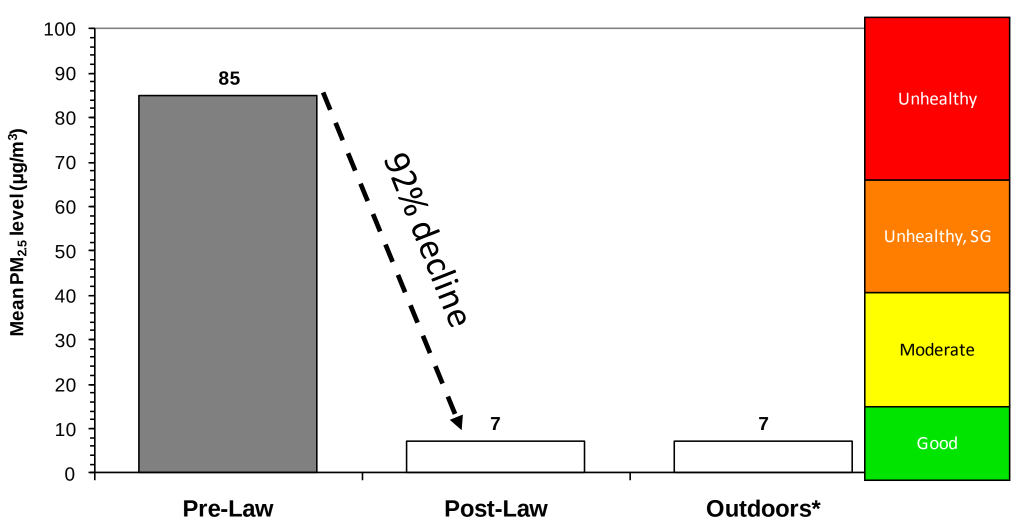
In August, 2010 (pre-implementation) and January, 2011 (post-implementation), indoor air quality was assessed in 11 restaurants and bars in Grand Forks, North Dakota. North Dakota's smokefree air law prohibits smoking in public places and places of employment as of August 1, 2005. However, smoking is allowed in bars and in separately enclosed areas in truckstops. Prior to the August 2010 implementation of Grand Forks' comprehensive smokefree air law covering workplaces, including bars and truckstops, 8 locations permitting indoor smoking were sampled. After the law took effect, 5 out of the 8 locations were reassessed along with 3 new locations to observe the effect of the comprehensive smoke-free air law.

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 8 locations permitting indoor smoking before the law, the level of fine particle air pollution was unhealthy ($PM_{2.5}$ = 85 μg/m^3). This level of particle air pollution was 11 times higher than outdoor air in North Dakota.
- Employees in the locations with indoor smoking were exposed to levels of air pollution 2 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 Grand Forks locations that permitted indoor smoking, indoor particle pollution levels declined 92% as a result of the local smoke-free air law to low levels, similar to outdoor levels found in 2010.

Figure 1. **Mean Level of Indoor Air Pollution in Grand Forks**



* Used for comparison purposes. Based on the 2010 average $PM_{2.5}$ level from the EPA monitoring sites in North Dakota (http://www.epa.gov/airexplorer/). The color-coded EPA Air Quality Index is also shown to demonstrate the magnitude of the measured particle levels

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., 29 states, Washington D.C., and Puerto Rico 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, Ohio, Oregon, Rhode Island, South Dakota, Utah, Vermont, Washington, and Wisconsin. Almost two-thirds of the U.S. population is now protected from secondhand smoke in all public places.[7] Almost all Canadian provinces and territories also have comprehensive smoke-free air laws in effect. Hundreds 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 Grand Forks local comprehensive smoke-free air law on the level of fine particle air pollution in bars and truckstops in Grand Forks, North Dakota. North Dakota's smokefree law prohibits smoking in public places and places of employment as of August 1, 2005. However, smoking was still allowed in bars and in separately enclosed areas in truckstops until the city of Grand Forks implemented its comprehensive smokefree air law covering workplaces, including bars and truckstops.

It is hypothesized that: 1) particle levels will decline significantly in a cohort of establishments permitting smoking at baseline that are sampled before and after the smoke-free air law; 2) the degree of indoor particle air pollution will be correlated with the amount smoking.

METHODS

Indoor air quality was assessed in 8 bars or truckstops in Grand Forks, North Dakota both before (August 2010) and after (January 2011) the Grand Forks smokefree air law. Five of the locations sampled were the same before and after the law while 3 of the locations were different.

$PM_{2.5}$ 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 mortality.

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 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.[8] The Sidepak was used with a calibration factor setting of 0.32, suitable for secondhand smoke.[9, 10] In addition, the SidePak was zero-calibrated prior to each use by attaching a HEPA filter according to the manufacturer's specifications.

TSI SIDEPAK AM510 PERSONAL AEROSOL MONITOR

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

The primary goal was to assess the difference in the average levels of $PM_{2.5}$ between establishments allowing smoking before Grand Forks' comprehensive smokefree law and those that are smoke-free after the local law. Statistical significance is assessed using the Mann-Whitney test on the $PM_{2.5}$ concentrations. The second hypothesis was tested by using all 16 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 100 m^3 are reported for each venue and averaged for all venues.

RESULTS

A summary of each location visited is shown in Table 1. Before the law, the average $PM_{2.5}$ level in the 8 locations permitting indoor smoking was 85 µg/m^3 (Figure 1). This $PM_{2.5}$ concentration was 92% lower after the law when the mean $PM_{2.5}$ concentration in all 8 locations was 7 µg/m^3. The difference is statistically significant (U=0.00, p=0.00, r=.847). The results are virtually the same if we restrict only to the 5 locations that were the same before and after the law. In this case, the pre-law $PM_{2.5}$ level was 70 µg/m^3 and the post-law level was 6 µg/m^3, a 91% reduction. Looking at all 16 sample visits, $PM_{2.5}$ level was significantly correlated with the active smoker density (r_s=0.89, p<0.01), indicating that the amount of indoor smoking is the primary driver of the indoor particle pollution levels.

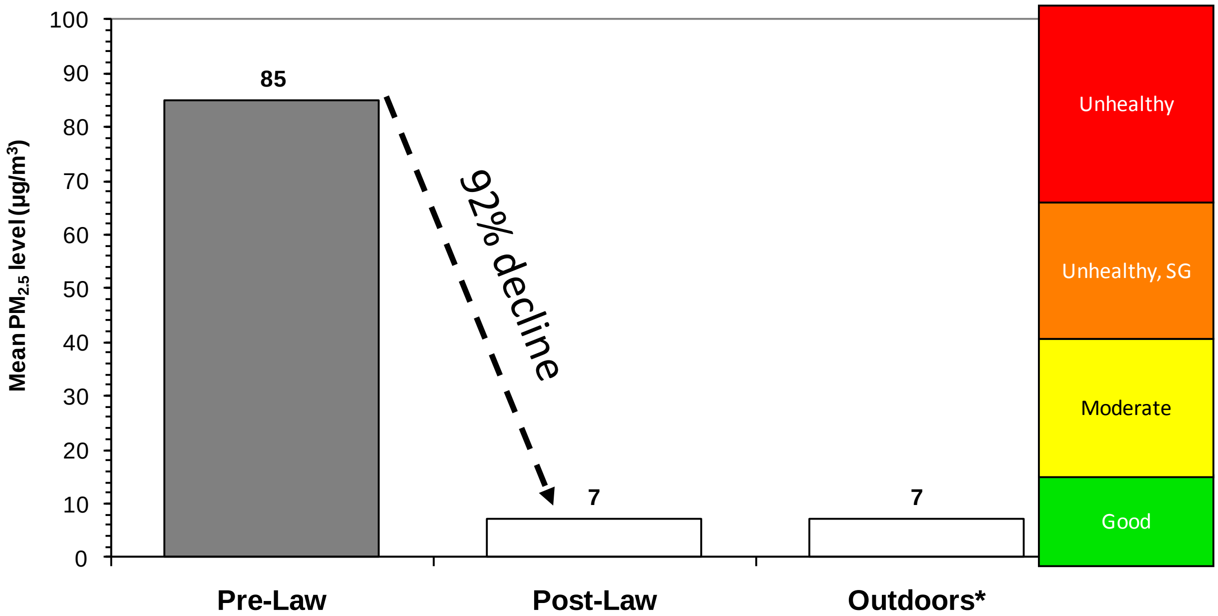
Table 1. Fine Particle Air Pollution in Grand Forks, North Dakota Bars and Restaurants

		Pre-Law					Post-Law				
Venue Number	Size (m^3)	Mean # people	Mean # burning cigs	Active smoker density*	Mean $PM_{2.5}$ level (µg/m^3)	Max $PM_{2.5}$ level (µg/m^3)	Mean # people	Mean # burning cigs	Active smoker density*	Mean $PM_{2.5}$ level (µg/m^3)	Max $PM_{2.5}$ level (µg/m^3)
1	3928	26	1.3	0.03	110	125	15	0.0	0.00	5	7
2	1448	11	0.7	0.05	30	48	21	0.0	0.00	5	12
3	4148	25	2.7	0.06	85	100	130	0.0	0.00	12	13
4	5774	11	0.3	0.01	11	14	202	0.0	0.00	4	6
5	731	21	1.0	0.14	112	151	51	0.0	0.00	5	8
Mean (venues 1-5)	**3206**	**19**	**1.2**	**0.06**	**70**	**88**	**84**	**0.0**	**0.00**	**6**	**9**
6	1562	22	5.8	0.37	190	216					
7	2744	22	3.0	0.11	84	99					
8	844	10	1.0	0.12	57	72					
9	1803						11	0.0	0.00	10	23
10	2464						9	0.0	0.00	5	15
11	946						67	0.0	0.00	6	10
Mean (all venues)	**2399**	**19**	**2.0**	**0.11**	**85**	**103**	**63**	**0.0**	**0.00**	**7**	**12**

*Average number of burning cigarettes per 100 cubic meters.

The real-time plots showing the level of indoor air pollution in each venue sampled is presented in Figures 2 and 3 on pages 11 & 12. The real-time $PM_{2.5}$ plots reveal the following results: 1) low outdoor $PM_{2.5}$ levels are observed while outside between locations; 2) high levels of indoor air pollution are observed in the venues where smoking was observed before the law went into effect; and 3) peak exposure levels in some venues where smoking was observed reached levels far in excess of the average recorded level.

Figure 1. **Mean Level of Indoor Air Pollution in Grand Forks**



* Used for comparison purposes. Based on the 2010 average $PM_{2.5}$ level from the EPA monitoring sites in North Dakota (http://www.epa.gov/airexplorer/). The color-coded EPA Air Quality Index is also shown to demonstrate the magnitude of the measured particle levels

DISCUSSION

The EPA cited over 80 epidemiologic studies in creating a particulate air pollution standard in 1997.[11] The EPA has recently updated this standard and, in order to protect the public health, the EPA has set limits of 15 µg/m^3 as the average annual level of $PM_{2.5}$ exposure and 35 µg/m^3 for 24-hour exposure.[11] 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 85 µg/m^3 (the average level in the sites with smoking) on the job, and is exposed only to background particle levels of 8 µg/m^3 during non-work times. For a full-time employee their average annual $PM_{2.5}$ exposure is 27 µg/m^3. The EPA average annual $PM_{2.5}$ limit is exceeded by 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,[12] making the high $PM_{2.5}$ exposures of people in smoking environments even more alarming.

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.[13] 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.[14] 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 secondhand smoke from an adjacent room was observed at baseline.[15] 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%.[16]

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[17]. 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.[18] 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.[19] 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.[20] In its 2009 report, *Secondhand Smoke Exposure and Cardiovascular Effects: Making Sense of the Evidence*, the Institute of Medicine also concludes that secondhand-smoke exposure increases the risk of coronary heart disease and heart attacks and that clean indoor air laws reduce this risk. Given the prevalence of heart attacks, and the resultant deaths, clean indoor air laws can have a substantial impact on public health.[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, 25].

CONCLUSIONS

This study demonstrates that employees and patrons in Grand Forks bars and truckstops with observed indoor smoking, prior to the local smoke-free air law, were exposed to harmful levels of indoor air pollution resulting from indoor smoking. The Grand Forks implementation of a comprehensive smoke-free law covering workplaces, including bars and truckstops has been shown to decrease exposure to toxic tobacco smoke pollution by 92%. This reduction in exposure to toxic tobacco smoke will result in improved quality of life and health outcomes for Grand Forks workers and residents.

ACKNOWLEDGMENTS

The study was sponsored by the Grand Forks Tobacco Free Coalition with support from the Grand Forks Public Health Department, and funded by BreatheND ~ Saving Lives Saving Money with Measure 3.

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

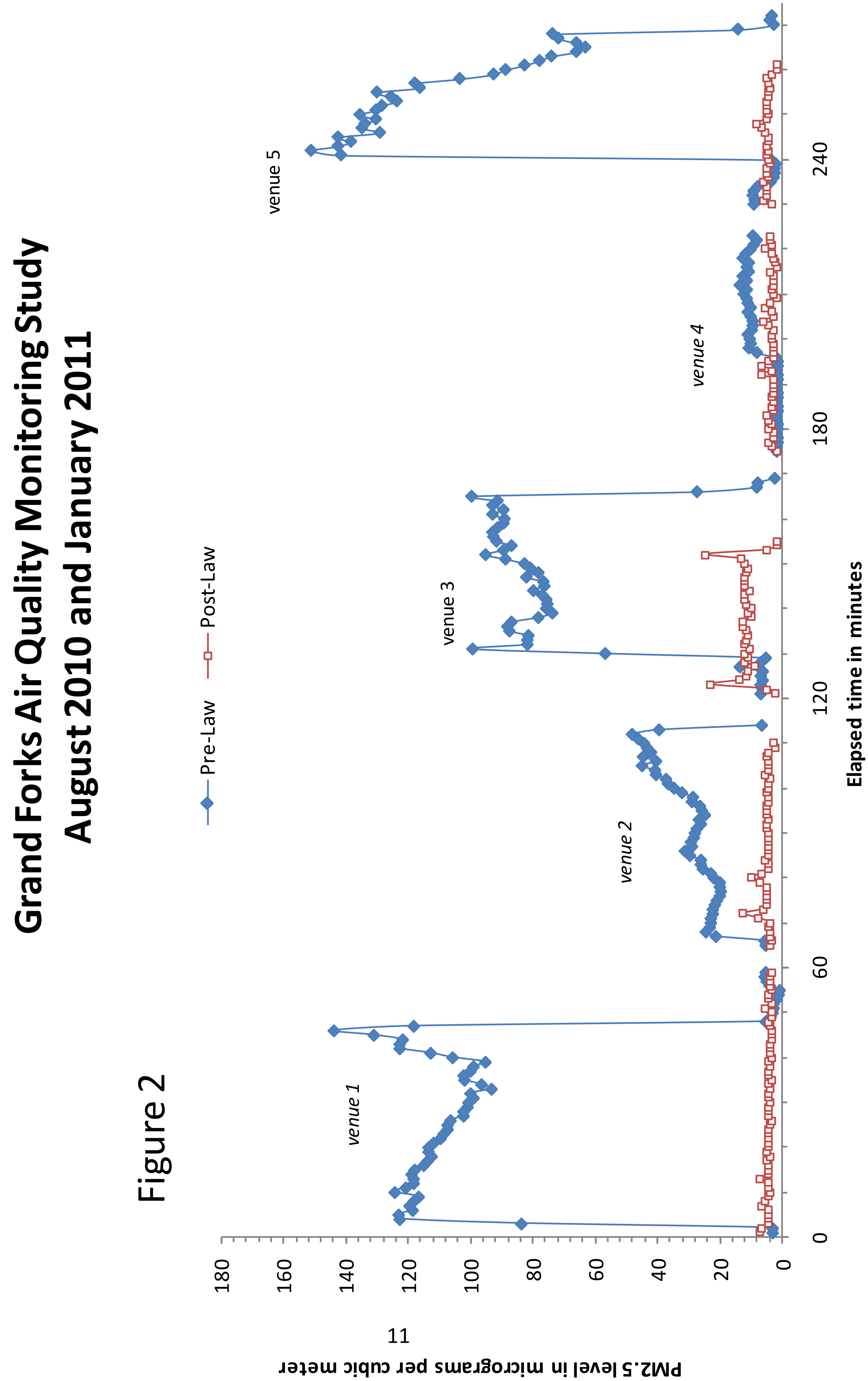
Roswell Park Cancer Institute (RPCI) is America's first cancer center founded in 1898 by Dr. Roswell Park. RPCI is the only upstate New York facility to hold the National Cancer Center designation of "comprehensive cancer center" and to serve as a member of the prestigious National Comprehensive Cancer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

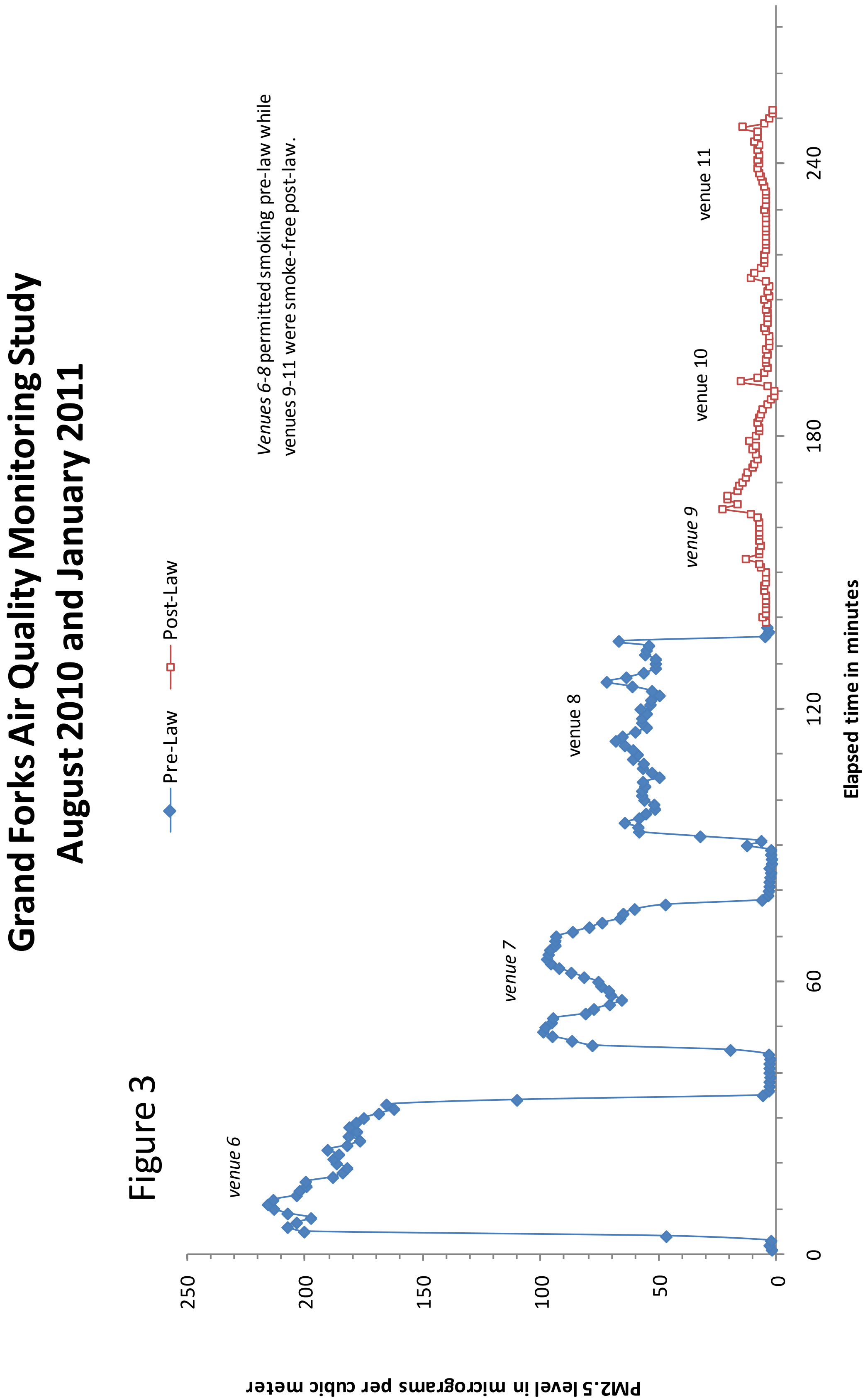
Over its long history, Roswell Park Cancer Institute has made fundamental contributions to reducing the cancer burden and has successfully maintained an exemplary leadership role in setting the national standards for cancer care, research and education.

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).

Figure 2


Grand Forks Air Quality Monitoring Study
August 2010 and January 2011
Pre-Law
Post-Law
venue 1
venue 2
venue 3
venue 4
venue 5
PM2.5 level in micrograms per cubic meter
Elapsed time in minutes
0
20
40
60
80
100
120
140
160
180
0
60
120
180
240



Grand Forks Air Quality Monitoring Study
August 2010 and January 2011
Pre-Law
Post-Law
Venues 6-8 permitted smoking pre-law while
venues 9-11 were smoke-free post-law.
venue 6
venue 7
venue 8
venue 9
venue 10
venue 11
PM2.5 level in micrograms per cubic meter
Elapsed time in minutes
0
50
100
150
200
250
0
60
120
180
240

Figure 3

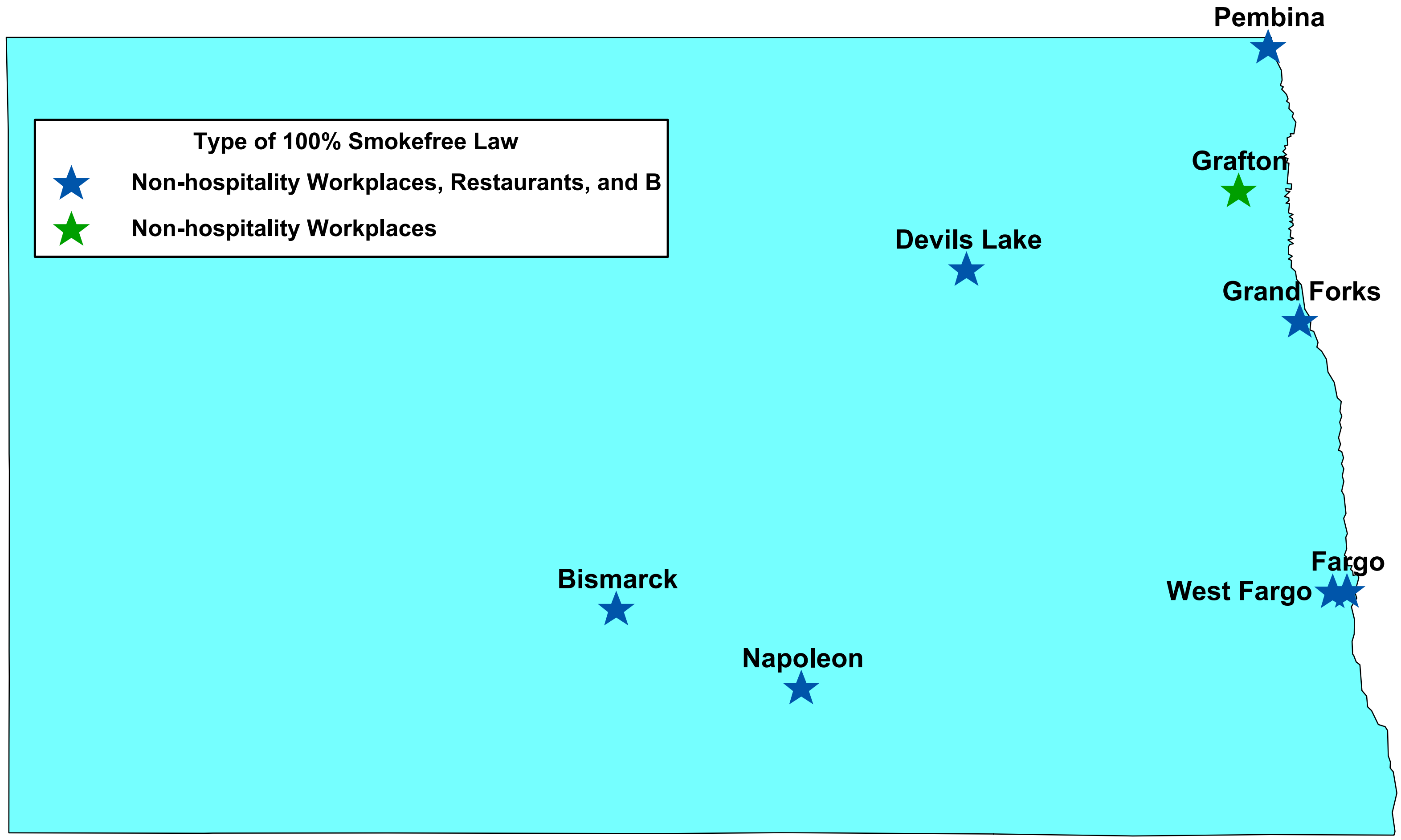
References

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 2020: Objectives for Improving Health*. 2010 1/14/2011]; v5:[Available from: http://www.healthypeople.gov/2020/topicsobjectives2020/pdfs/HP2020objectives.pdf.
7. American Nonsmokers' Rights Foundation. *Summary of 100% Smokefree State Laws and Population Protected by 100% U.S. Smokefree Laws*. 2011 4/1/2011 [cited 2011 Apr 25]; Available from: http://www.no-smoke.org/pdf/SummaryUSPopList.pdf.
8. Klepeis, N.E., et al., *Determining Size-Specific Emission Factors for Environmental Tobacco Smoke Particles.* Aerosol Science and Technology, 2003. **37**: p. 780-790.
9. 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.
10. 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.
11. U.S. Environmental Protection Agency, *National ambient air quality standards for particulate matter; final rule.* Federal Register, 1997. **62**(138): p. 38651-38701.
12. 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.
13. 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.
14. 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.
15. 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.
16. 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.
17. 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.
18. 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.
19. 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.
20. 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.
21. Institute of Medicine (U.S.). Committee on Secondhand Smoke Exposure and Acute Coronary Events., *Secondhand smoke exposure and cardiovascular effects : making sense of the evidence*. 2009, Washington, DC: National Academies Press. p.
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.
25. U.S. Department of Health and Human Services, *How tobacco smoke causes disease: the biology and behavioral basis for smoking-attributable disease: a report of the Surgeon General*. 2010, U.S. Department of Health and Human Services, Public Health Service, Office of the Surgeon General: Rockville, MD.

North Dakota 100% Smokefree Laws

American Nonsmokers' Rights Foundation

As of June 8, 2011



Note: American Indian sovereign tribal laws are not reflected on this map.