

## Indoor Air Quality in Bars and Restaurants Before and After Implementation of Smoke-free Ordinances in Hennepin and Ramsey Counties

Technical Summary  
September 15, 2005

### Overview

Exposure to secondhand smoke is known to be a serious health hazard. Secondhand smoke contains human carcinogens and respirable particulate matter that makes tobacco smoke a dangerous air pollutant. Health problems that are associated with secondhand smoke include lung cancer, heart disease, chronic lung ailments such as bronchitis and asthma, and low birth-weights. Each year, secondhand smoke causes 35,000 people in the United States to die from heart disease.<sup>1</sup> Short periods of exposure to secondhand smoke have also shown to lead to adverse health effects. In healthy volunteers, only 30 minutes of exposure to secondhand smoke compromised function of the coronary arteries of non-smokers in a way that was indistinguishable from smokers<sup>2</sup>.

It is possible to quantify levels of particulate matter from tobacco smoke in the air. PM<sub>2.5</sub> is air pollutant particulates that have a diameter smaller than 2.5 microns. Particulates of this size are easily inhaled deeply into the lungs, and the more particulate matter in the air, the greater the health danger. The U.S. Environmental Protection Agency (EPA) has found that fine particulate air pollutants can penetrate deeply into the lungs and have serious health effects, including increased respiratory symptoms and disease, decreased lung function, and alterations in lung tissue and structure. These particles also carry other dangerous chemicals, including carcinogens, into the lungs. In addition, recent studies suggest adverse respiratory and cardiovascular health impacts from elevated levels of ultrafine (0.1 micron and smaller) particulates.<sup>3</sup>

In order to protect the public's health, occupational, environmental and public health agencies have all recommended limiting exposure to secondhand smoke through policies prohibiting smoking in indoor environments.<sup>4,5,6,7,8,9</sup> In addition, the EPA has set limits of 15 µg/m<sup>3</sup> (micrograms per cubic meter) as the average annual level of PM<sub>2.5</sub> exposure and 65 µg/m<sup>3</sup> as the 24-hour exposure. Smoking in bars and restaurants will often produce particulate levels that exceed these standards.<sup>10,11, 12</sup>

Policies requiring smoke-free environments are the most effective method for reducing secondhand smoke exposure in public places.<sup>13</sup> In 2005, the Minnesota Partnership for Action Against Tobacco (MPAAT) commissioned a study to assess the impact of smoke-free ordinances on indoor air quality of selected Twin City Metropolitan Area bars and restaurants. Indoor air quality monitoring took place before and after the implementation of smoke-free ordinances that went into effect for Ramsey and Hennepin counties on March 31, 2005. The study was conducted by the Minnesota Institute of Public Health (MIPH) in collaboration with the Center for Energy and the Environment (CEE) with funding from the Minnesota Partnership for Action Against Tobacco.

## Methodology

The purpose of this study was to examine indoor air quality in a sample of bars and restaurants to assess the relationship between indoor air pollution and the presence of smoke-free ordinances.

Air quality monitoring was conducted before and after the implementation of smoke-free ordinances in 25 venues in Hennepin, Ramsey and Dakota counties during the period of March 2005 (pre-ordinance monitoring) through June 2005 (post-ordinance monitoring). The Hennepin County ordinance covers both bars and restaurants while the Ramsey County ordinance exempts bars where liquor sales are greater than 50 percent of total food and beverage sales. Dakota County does not have a smoke-free ordinance and was used as a control county for this study.

The venues included in the study were selected to include small, mid-size and large bars and restaurants and venues from different geographical locations throughout the Metro Area. In order to maximize efficiency of data collection, clusters of venues within short driving time of each other were selected in the St. Paul, Minneapolis, Bloomington, and Golden Valley regions of the Metro area.

Two different types of particulate monitors were used to evaluate the effect of secondhand smoke on bar and restaurant air quality. The concentration of ultrafine and larger particulates was measured using a TSI P-Trak Model 8525 condensation particle counter. This monitor counts particulates with aerodynamic diameters from 0.02 to 1 microns and greater from all source types. A Magee Scientific Model AE42 Aethalometer was used to measure the mass concentration of respirable particles specifically due to secondhand smoke. This system measures the response to ultraviolet particulate matter (UVPM). A correlation of UVPM response to total secondhand smoke respirable particulates was used to convert the measurements to the concentration of secondhand smoke particulates. A carbon dioxide monitor was also used to evaluate the outdoor air ventilation rate. The air exchange rate, average concentration of pollutants, and the estimated numbers of customers who were smokers, were calculated.

Air quality monitoring was conducted on Friday and Saturday nights between the hours of 6:00 p.m. and midnight. Measurements were also taken on Fridays over the noon hour. For each establishment the post-monitoring was conducted on the same day of week and approximately the same time of day as the pre-monitoring for that establishment. No monitoring was conducted over holiday weekends. Venues were monitored for approximately 60 minutes during each testing period.

## Study Findings

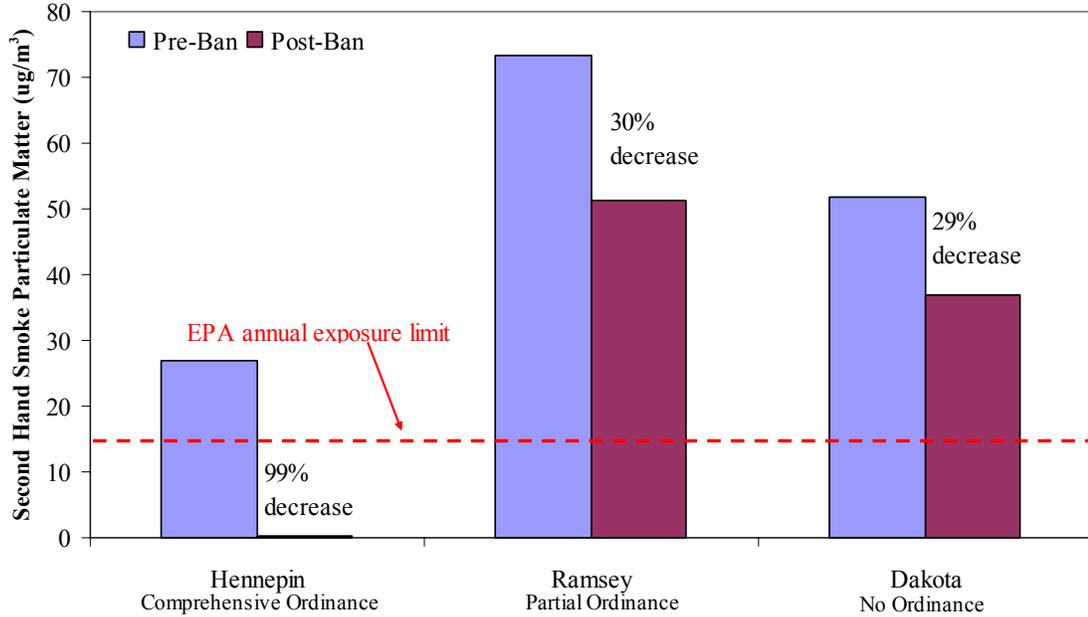
Prior to March 31, 2005, employees and patrons of restaurants and bars in Hennepin, Ramsey and Dakota Counties were exposed to high levels of fine particulate air pollution and cancer-causing chemicals.

- Before smoke-free ordinances went into effect the median level of respirable second hand smoke particulates in the venues samples was  $70 \mu\text{g}/\text{m}^3$ .
- In 55% of the bars and restaurants the respirable particulate levels were greater than the EPA 24-hour exposure limit of  $65 \mu\text{g}/\text{m}^3$  for PM2.5.
- In 85% of the bars and restaurants the measured level of respirable particulate levels was greater than the EPA's annual exposure limit of  $15 \mu\text{g}/\text{m}^3$  for PM2.5.
- Before smoke-free ordinances went into effect the median level of ultrafine particulates was 87,700 particles per cubic centimeters (pt/cc). That is over 6 times greater than typical outdoor concentrations of ultrafine particulates measured in the Metro area. The median level is also over 3 times greater than the typical level monitored in a Minneapolis bus transit station during the afternoon rush hour.

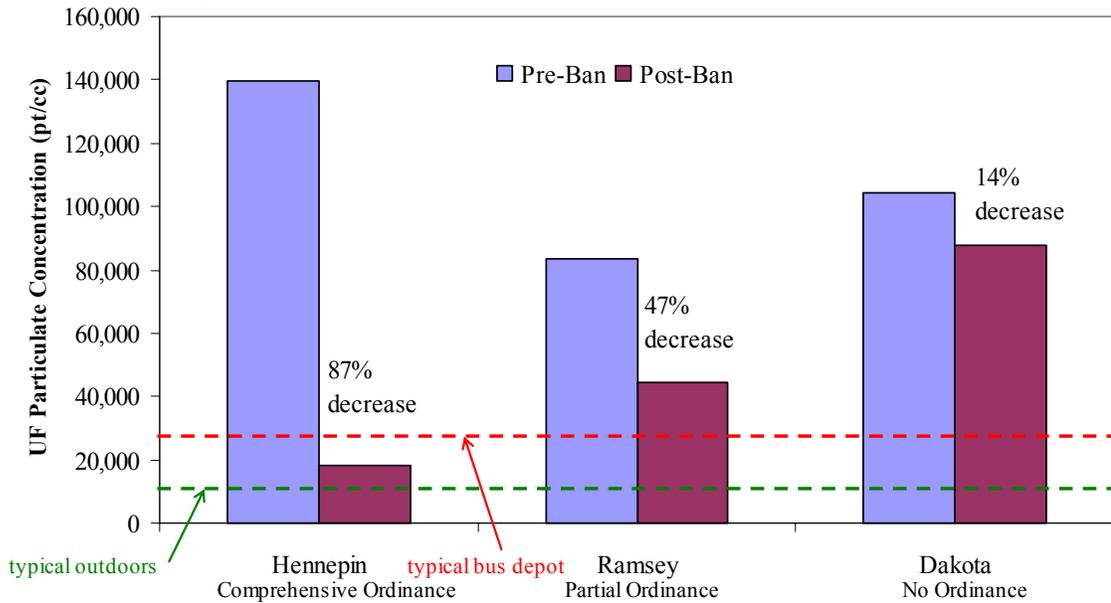
Comprehensive ordinances that protect workers and patrons with smoke-free workplaces dramatically lower levels of indoor air pollution.

- The concentration of respirable particulates due to secondhand smoke showed a 99% decrease in communities that implemented a complete ban on smoking in bars and restaurants (See Figure 1).
- After smoke-free ordinances were implemented, levels of ultrafine particulate pollution decreased by 87% in communities implementing a complete ban on smoking in bars and restaurants (See Figure 2).
- In communities with a complete ban on smoking in bars and restaurants, air quality improved in all types of venues, with bars showing the most dramatic decrease in ultrafine particulate matter.
- Full-time bar and restaurant employees in communities with either a partial ordinance (Ramsey County) or no ordinance (Dakota County) continue to be exposed to levels of fine particulate air pollution that exceeds EPA limits. Exposure levels during the post-monitoring period were still 2.5- 3.5 times the annual limit of fine particulate air pollution recommended by the EPA.
- Decreases in particulate levels were seen in all communities due to seasonal effects (e.g., increased ventilation and outdoor seating during the post-ordinance monitoring period). Only employees and patrons in communities with a comprehensive ordinance, however, were fully protected from harmful exposure to fine particulates.
- After smoke-free ordinances went into effect, no smoking was observed in any of the 15 venues which implemented a smoke-free ban.

**Figure 1.**  
**Typical Secondhand Smoke Particulate Level Before & After Ban**



**Figure 2.**  
**Typical Ultra Fine Particulate Level Before & After Ban**



The **Minnesota Institute for Public Health (MIPH)** is a non-profit organization committed to improving policies and programs that safeguard and protect the health of the public. For over 30 years, MIPH has provided prevention and health promotion leadership in Minnesota and throughout the country.

The **Center for Energy and the Environment (CEE)** is an independent, nonprofit organization that works to promote public interest through the responsible and efficient use of natural and economic resources. CEE accomplishes this mission through program development and delivery, research and education, evaluation and public policy initiatives. CEE has provided energy, environmental and housing rehabilitation services to utilities, private corporations, neighborhood organizations, municipalities and public agencies for over twenty years. These services include financing, building audits, technical research and training, program design and delivery and evaluations.

Funding for this study was provided by the **Minnesota Partnership for Action Against Tobacco**. MPAAT is an independent, non-profit organization that improves the health of Minnesota by reducing the harm caused by tobacco. MPAAT serves Minnesota through its grant-making program, QUITPLAN<sup>sm</sup> services to help people stop smoking and statewide outreach activities. It is funded with three percent of the state's tobacco settlement.

Thomas Griffin, Ph.D., M.S.W., Associate Director at MIPH, Dave Bohac, P.E., Director of Indoor Air Quality at CEE, and Barbara A. Schillo, Ph.D., Director of Research Programs for MPAAT directed the study.

Dr. Griffin has more than 30 years of professional experience in the field of alcohol, tobacco, and other drug use problem prevention. He currently directs evaluation services for the MIPH. He also serves on the faculty of the Rutgers University Center for Alcohol Studies.

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Dr. Schillo has served as the Director of Research Programs for MPAAT since 2001, where she oversees the grant-making process for tobacco use research funds and coordinates surveillance, evaluation and other MPAAT research activities.

***This report is available at <http://www.mpaat.org>***

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