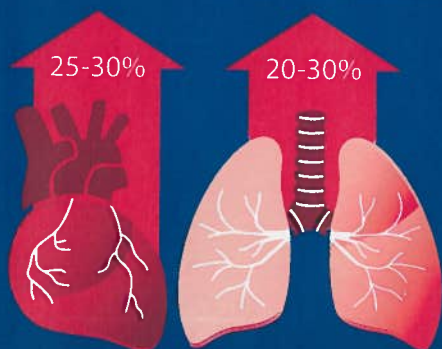


# Secondhand Smoke

Secondhand smoke (SHS) is the combination of smoke from the burning end of a cigarette, cigar or pipe tip and the smoke exhaled by the smoker. SHS is harmful to the health of everyone who comes in contact with it.<sup>1</sup>

## Health Effects: Adults and Workers



Nonsmokers who are exposed to SHS at work or home increase their risk of heart disease by 25-30% and risk of lung cancer by 20-30%.<sup>2</sup>

Smokefree workplace laws lead to less smoking, increases in quit attempts and an increase in cessation rates among protected workers.

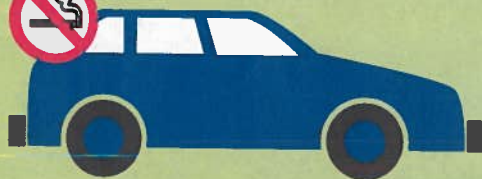
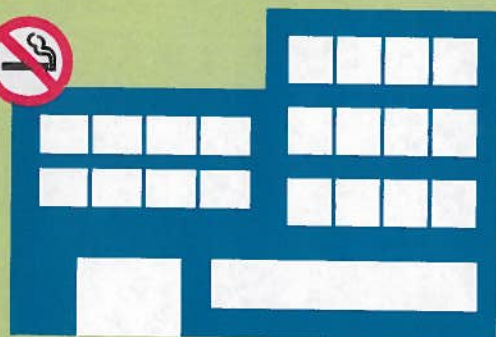


Nine out of 10 Alaska adults think smoking should be prohibited in Alaska workplaces.<sup>3</sup>



For every eight smokers who die from smoking, one nonsmoker dies from exposure to SHS.<sup>4</sup>

**BOTTOM LINE:** There is no risk-free level of secondhand smoke; even brief exposure can be harmful.<sup>2</sup> Eliminating smoking in indoor spaces is the only way to fully protect nonsmokers from SHS exposure. Separating smokers from nonsmokers, cleaning the air and ventilating rooms or buildings does not eliminate SHS exposure.<sup>2</sup>



## What Can You Do?

- Encourage businesses to go smokefree.
- Before signing a lease or purchase agreement, ensure the rental property or association has a smokefree housing policy.
- Maintain a 100% smokefree home and car, even if you smoke.
- Choose restaurants and bars that are smokefree.
- Support federal, statewide and local tobacco-prevention efforts like smokefree laws, higher tobacco taxes and funding for tobacco prevention programs.

## If You Smoke, Take Precautions

- Always smoke outdoors – never in the home or other enclosed environments.
- Do not smoke around others, especially pregnant women, infants, the elderly and children.
- Consider using a nicotine replacement therapy (NRT) such as patches or gum, which help to lessen nicotine withdrawal and cravings and make it easier to quit.
- If you smoke, quit. If you can't quit, keep trying.

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1. U.S. Department of Health and Human Services. A Report of the Surgeon General: How Tobacco Smoke Causes Disease: What It Means to You. Atlanta: 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, 2010 [accessed 2011 Mar 11].

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## Secondhand Smoke (SHS) Facts

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- [Overview](#)
- [Health Effects: Children](#)
- [Health Effects: Adults](#)
- [Estimates of Secondhand Smoke Exposure](#)
- [Disparities in Secondhand Smoke Exposure](#)
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### Overview

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Secondhand smoke is a mixture of gases and fine particles that includes:

- Smoke from a burning tobacco product such as a cigarette, cigar, or pipe<sup>1,2</sup>
- Smoke that has been exhaled or breathed out by the person or people smoking<sup>2</sup>
- More than 7,000 chemicals, including hundreds that are toxic and about 70 that can cause cancer<sup>1</sup>

Most exposure to secondhand smoke occurs in homes and workplaces. Secondhand smoke exposure also continues to occur in public places such as restaurants, bars, and casinos, as well as multiunit housing and vehicles.<sup>3</sup>

Eliminating smoking in indoor spaces is the only way to fully protect nonsmokers from secondhand smoke exposure.<sup>3</sup>

Separating smokers from nonsmokers within the same air space, cleaning the air, opening windows, and ventilating buildings does not eliminate secondhand smoke exposure.<sup>3</sup>

Since 1964, 2.5 million nonsmokers have died from exposure to secondhand smoke.<sup>1</sup>

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### Health Effects: Children

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**In children, secondhand smoke causes the following:<sup>1,3</sup>**

- Ear infections
- More frequent and severe asthma attacks
- Respiratory symptoms (e.g., coughing, sneezing, shortness of breath)
- Respiratory infections (i.e., bronchitis, pneumonia)
- A greater risk for sudden infant death syndrome (SIDS)

**In U.S. children aged 18 months or younger, secondhand smoke exposure is responsible for:<sup>3</sup>**

- An estimated 150,000–300,000 new cases of bronchitis and pneumonia annually
- Approximately 7,500–15,000 hospitalizations annually

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## Health Effects: Adults

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**In adults who have never smoked, secondhand smoke can cause cardiovascular disease and lung cancer.<sup>1,5</sup>**

### Cardiovascular Disease

- For nonsmokers, breathing secondhand smoke has immediate harmful effects on the cardiovascular system that can increase the risk for heart attack. People who already have heart disease are at especially high risk.<sup>1,3</sup>
- Nonsmokers who are exposed to secondhand smoke increase their heart disease risk by 25–30%.<sup>3</sup>
- It is estimated that secondhand smoke exposure caused nearly 34,000 heart disease deaths annually (during 2005–2009) among adult nonsmokers in the United States.<sup>1</sup>
- Stroke is caused by exposure to secondhand smoke.<sup>1</sup>

### Lung Cancer

- Nonsmokers who are exposed to secondhand smoke at home or work increase their lung cancer risk by 20–30%.<sup>3</sup>
- Secondhand smoke exposure causes an estimated more than 7,300 lung cancer deaths annually (for 2005–2009) among adult nonsmokers in the United States.<sup>1</sup>

**There is no risk-free level of secondhand smoke exposure; even brief exposure can be harmful to health.<sup>1,3,4</sup>**

## Smoke-free laws can reduce the risk of heart disease and lung cancer among nonsmokers.<sup>1</sup>

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### Estimates of Secondhand Smoke Exposure

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When a nonsmoker breathes in secondhand smoke, the body begins to metabolize or break down the nicotine that was in the smoke. During this process, a nicotine byproduct called cotinine is created. Exposure to nicotine and secondhand smoke can be measured by testing saliva, urine, or blood for the presence of cotinine.<sup>3</sup>

#### Secondhand Smoke Exposure Has Decreased in Recent Years

- Measurements of cotinine have shown how exposure to secondhand smoke has steadily decreased in the United States over time.<sup>5\*</sup>
  - During 1988–1991, approximately 87.9% of nonsmokers had measurable levels of cotinine.
  - During 1999–2000, approximately 52.5% of nonsmokers had measurable levels of cotinine.
  - During 2007–2008, approximately 40.1% of nonsmokers had measurable levels of cotinine.
- The decrease in exposure to secondhand smoke is due to the growing number of laws that prohibit smoking in workplaces and public places, including restaurants and bars, the increase in the number of households with voluntary smoke-free home rules, and the decreases in adult and youth smoking rates.<sup>1,5,6,7,8</sup>

\*This information will be updated in 2014.

#### Many in the United States Continue to be Exposed to Secondhand Smoke\*

- An estimated 88 million nonsmokers in the United States were exposed to secondhand smoke in 2007–2008.<sup>5</sup>
- Children are at particular risk for exposure to secondhand smoke: 53.6% of young children (aged 3–11 years) were exposed to secondhand smoke in 2007–2008.<sup>5</sup>
- While only 5.4% of adult nonsmokers in the United States lived with someone who smoked inside their home, 18.2% of children (aged 3–11 years) lived with someone who smoked inside their home in 2007–2008.<sup>5</sup>
- Among children who live in homes in which no one smokes inside, those who live in multiunit housing have 45% higher cotinine levels compared to those who live in detached homes.<sup>9</sup>
- Today about half of the children between ages 3 and 18 in the U.S. are exposed to cigarette smoke regularly, either at home or in places such as restaurants that still allow smoking.<sup>10</sup>

\*This information will be updated in 2014.

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## Disparities in Secondhand Smoke Exposure

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### Racial and Ethnic Groups<sup>5</sup>

- Although declines in cotinine levels have occurred in all racial and ethnic groups, cotinine levels have consistently been found to be higher in non-Hispanic black Americans than in non-Hispanic white Americans and Mexican Americans. In 2007–2008:
  - 55.9% of non-Hispanic blacks were exposed to secondhand smoke.
  - 40.1% of non-Hispanic whites were exposed to secondhand smoke.
  - 28.5% of Mexican Americans were exposed to secondhand smoke.

### Low Income<sup>5</sup>

- Secondhand smoke exposure tends to be high for persons with low incomes: 60.5% of persons living below the poverty level in the United States were exposed to secondhand smoke in 2007–2008.

### Occupational Disparities<sup>8</sup>

- Occupational disparities in secondhand smoke exposure decreased over the past two decades, but substantial differences in exposure among workers remain.
- African-American male workers, construction workers, and blue collar workers and service workers are some of the groups who continue to experience particularly high levels of secondhand smoke exposure relative to other workers.

**Eliminating smoking in indoor spaces is the only way to fully protect nonsmokers from secondhand smoke exposure. Separating smokers from nonsmokers within the same air space, cleaning the air, opening windows, and ventilating buildings does not eliminate secondhand smoke exposure.<sup>3</sup>**

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## For Further Information

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Centers for Disease Control and Prevention  
 National Center for Chronic Disease Prevention and Health Promotion  
 Office on Smoking and Health  
 E-mail: [tobaccoinfo@cdc.gov](mailto:tobaccoinfo@cdc.gov) (<mailto:tobaccoinfo@cdc.gov>)  
 Phone: 1-800-CDC-INFO

Media Inquiries: Contact CDC's Office on Smoking and Health press line at 770-488-5493.

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*Lancet*. 2014 May 3;383(9928):1549-60. doi: 10.1016/S0140-6736(14)60082-9. Epub 2014 Mar 28.

## Effect of smoke-free legislation on perinatal and child health: a systematic review and meta-analysis.

Been JV<sup>1</sup>, Nurmatov UB<sup>2</sup>, Cox B<sup>3</sup>, Nawrot TS<sup>4</sup>, van Schayck CP<sup>5</sup>, Sheikh A<sup>6</sup>.

### Author information

#### Abstract

**BACKGROUND:** Smoke-free legislation has the potential to reduce the substantive disease burden associated with second-hand smoke exposure, particularly in children. We investigated the effect of smoke-free legislation on perinatal and child health.

**METHODS:** We searched 14 online databases from January, 1975 to May, 2013, with no language restrictions, for published studies, and the WHO International Clinical Trials Registry Platform for unpublished studies. Citations and reference lists of articles of interest were screened and an international expert panel was contacted to identify additional studies. We included studies undertaken with designs approved by the Cochrane Effective Practice and Organisation of Care that reported associations between smoking bans in workplaces, public places, or both, and one or more predefined early-life health indicator. The primary outcomes were preterm birth, low birthweight, and hospital attendances for asthma. Effect estimates were pooled with random-effects meta-analysis. This study is registered with PROSPERO, number CRD42013003522.

**FINDINGS:** We identified 11 eligible studies (published 2008-13), involving more than 2.5 million births and 247,168 asthma exacerbations. All studies used interrupted time-series designs. Five North American studies described local bans and six European studies described national bans. Risk of bias was high for one study, moderate for six studies, and low for four studies. Smoke-free legislation was associated with reductions in preterm birth (four studies, 1,366,862 individuals; -10.4% [95% CI -18.8 to -2.0];  $p=0.016$ ) and hospital attendances for asthma (three studies, 225,753 events: -10.1% [95% CI -15.2 to -5.0];  $p=0.0001$ ). No significant effect on low birthweight was identified (six studies, >1.9 million individuals: -1.7% [95% CI -5.1 to 1.6];  $p=0.31$ ).

**INTERPRETATION:** Smoke-free legislation is associated with substantial reductions in preterm births and hospital attendance for asthma. Together with the health benefits in adults, this study provides strong support for WHO recommendations to create smoke-free environments.

**FUNDING:** Thrasher Fund, Lung Foundation Netherlands, International Paediatric Research Foundation, Maastricht University, Commonwealth Fund.

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## *A Cancer Journal for Clinicians*

### **The Economic Impact of Clean Indoor Air Laws**

Michael Eriksen and Frank Chaloupka

*CA Cancer J Clin* 2007;57:367-378

DOI: 10.3322/CA.57.6.367

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# The Economic Impact of Clean Indoor Air Laws

Michael Eriksen, ScD; Frank Chaloupka, PhD

**ABSTRACT** Clean indoor air laws are easily implemented, are well accepted by the public, reduce nonsmoker exposure to secondhand smoke, and contribute to a reduction in overall cigarette consumption. There are currently thousands of clean indoor air laws throughout the United States, and the majority of Americans live in areas where smoking is completely prohibited in workplaces, restaurants, or bars. The vast majority of scientific evidence indicates that there is no negative economic impact of clean indoor air policies, with many studies finding that there may be some positive effects on local businesses. This is despite the fact that tobacco industry-sponsored research has attempted to create fears to the contrary. Further progress in the diffusion of clean indoor air laws will depend on the continued documentation of the economic impact of clean indoor air laws, particularly within the hospitality industry. This article reviews the spread of clean indoor air laws, the effect on public health, and the scientific evidence of the economic impact of implementation of clean indoor air laws. (*CA Cancer J Clin* 2007;57:367-378.) © American Cancer Society, Inc., 2007.

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## THE SPREAD OF CLEAN INDOOR AIR LAWS

States and localities have restricted smoking in a variety of places for many years. The earliest policies usually restricted smoking in a few venues (eg, theaters or food preparation areas) and were intended to prevent fires or food contamination rather than to protect the health of nonsmokers. As evidence emerged about the health consequences of smoking, including limited evidence on the consequences of exposure of nonsmokers to tobacco smoke, the public health community and advocates called for protection from exposure to secondhand smoke. In 1971, Surgeon General Jesse Steinfeld called for a complete ban on smoking in confined public places and went on to tell the Interagency Committee on Smoking and Health, "Nonsmokers have as much right to clean air and wholesome air as smokers have to their so-called right to smoke, which I would define as a 'right to pollute.' It is high time to ban smoking from all confined public places such as restaurants, theaters, airplanes, trains and buses."<sup>1</sup>

The next year, Surgeon General Steinfeld released the 1972 Surgeon General's Report<sup>2</sup> and sparked national awareness of the possible adverse health effects due to "public exposure to air pollution from tobacco smoke."

Policy makers ultimately listened and adopted new policies limiting smoking, with the specific intent of protecting nonsmokers. The earliest of these state policies was the 1973 law in Arizona that limited smoking in a number of public places. This was soon followed by the 1974 Connecticut law restricting smoking in restaurants and the 1975 Minnesota law that was the first comprehensive clean indoor air law that included restrictions on smoking in private workplaces.<sup>3</sup>

Perhaps surprisingly given that California has been at the leading edge of state tobacco-control efforts, statewide clean indoor air referenda were defeated in California in 1978 and 1980. These defeats resulted in a shift from statewide to local efforts to restrict public smoking in the state. In the early 1980s, local clean indoor air ordinances were passed in San Francisco, Los Angeles, Sacramento, and San Diego. This focus on local municipalities started in California and spread throughout the nation.

**Disclosures:** The authors would like to acknowledge the support of the Georgia Cancer Coalition (M.P.E.) and the Robert Wood Johnson Foundation's ImpacTeen project (F.J.C.) for conducting the research to prepare this manuscript.

As public advocacy and scientific discovery advanced, the tobacco industry took note. In 1978, the Tobacco Institute commissioned the Roper Organization to conduct a national public-opinion survey on smoking.<sup>4</sup> The Roper Organization warned the Tobacco Institute that the tobacco industry should give serious consideration to public concerns about secondhand smoke, stating, "... what the smoker does to himself may be his business, but what the smoker does to the nonsmoker is quite a different matter." The Roper Report went on to conclude the following:

"Nearly six out of ten believe that smoking is hazardous to the nonsmoker's health, up sharply over the last four years. More than two-thirds of nonsmokers believe it and nearly one half of all smokers believe it. This we see as the most dangerous development to the viability of the tobacco industry that has yet occurred."<sup>4</sup>

Momentum for clean indoor air policies grew following the release of the 1986 Surgeon General's report, *The Health Consequences of Involuntary Smoking*, which concluded that exposure to tobacco smoke caused diseases, including lung cancer, and that children of smoking parents were at increased risk of respiratory diseases.<sup>3</sup> Importantly, the report concluded that the simple separation of smokers and nonsmokers might reduce but did not eliminate the health risks from nonsmokers' exposure to tobacco smoke. In the years following the report, new federal regulations were adopted banning smoking on domestic flights of 2 hours or fewer and, eventually, virtually all domestic flights (in 1990) and all international flights departing from or arriving in the United States (in 2000). The report spurred more action at the state and local level as governments strengthened existing policies and adopted new policies, including complete bans on smoking in some venues (eg, health care facilities). At the same time, it led numerous private companies to adopt policies governing smoking in their workplaces. Much of the push for strong state and local policies was the result of effective grassroots advocacy efforts of groups like the Americans for Nonsmokers' Rights Foundation and the coalitions supported by the American Stop Smoking Intervention Study and SmokeLess States programs.<sup>3</sup>

As evidence grew about the health consequences of exposure to tobacco smoke, state and local policies became stronger and stronger. The 1997 release of the California Environmental Protection Agency's report on the health consequences of exposure<sup>5</sup> was followed in 1998 by California's law banning smoking in bars without separately ventilated smoking areas. In 2002, New York City made history by banning smoking in bars, restaurants, and virtually all other workplaces beginning in July 2003, while Florida voters overwhelmingly supported a ballot initiative that with some exceptions (most notably bars) did the same. By 2003, every state and thousands of localities had adopted policies limiting or banning smoking in a variety of locales. The growth and strengthening of these state policies is illustrated in Figure 1.

Most recently, the 2006 Surgeon General's Report, *The Health Consequences of Involuntary Exposure to Tobacco Smoke*,<sup>3</sup> stimulated further action, leading a growing number of states and communities to adopt comprehensive bans on cigarette smoking in virtually all public places and private worksites. In some places, these policies have included some outdoor spaces (eg, sports stadiums, beaches, and public parks). As of July 2007, 23 states, Puerto Rico, and Washington, DC, have laws in effect that require 100% smoke-free workplaces, restaurants, or bars (or some combination thereof), with another 6 states having enacted similar laws that are not yet in effect. There are also over 2,500 municipalities with clean indoor air laws.<sup>6</sup> The growth in these comprehensive policies since 1985 is illustrated in Figure 2.

These comprehensive state policies (including those scheduled to take effect in the future), along with comparable local policies, currently apply to well over half of the US population.<sup>6</sup> Further limits on smoking are being considered, including extending the policies to a greater variety of outdoor spaces and prohibiting smoking in private cars when children are present. In addition, as awareness of the health consequences of exposure to tobacco smoke grew and as public and private policies were implemented and strengthened, a growing number of households, including those of smokers, have adopted rules governing smoking in the home. By 2003, nearly

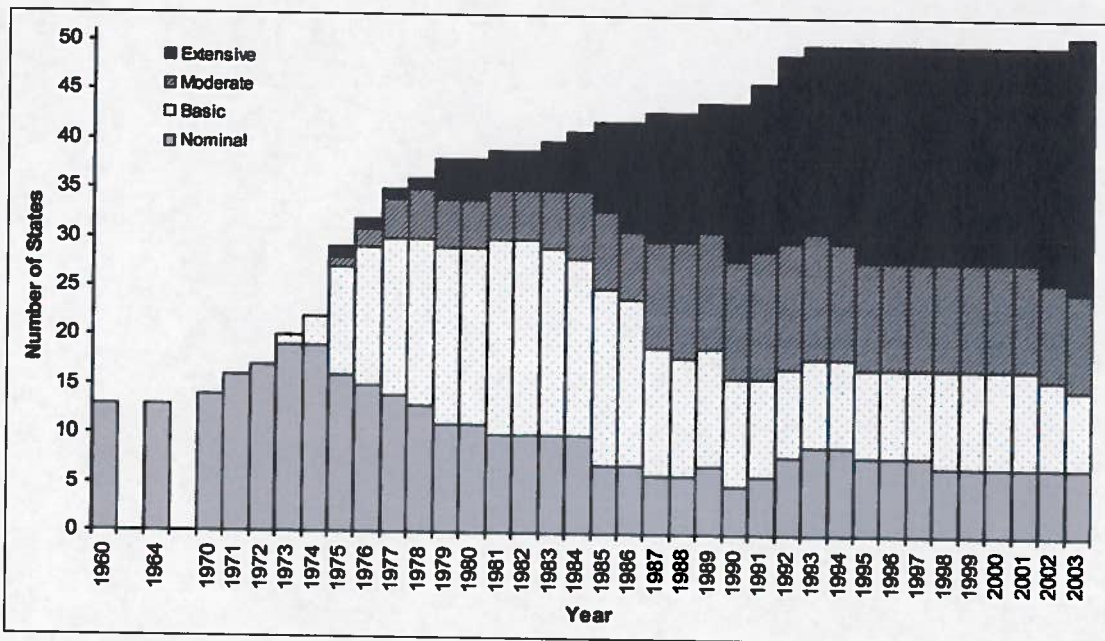


FIGURE 1 Restrictiveness of State Laws Regulating Smoking in Public Places, 1960 to 2003. Note: classification scheme from 1989 Surgeon General's Report (US Department of Health and Human Services, 1989) used to define restrictiveness as follows: nominal indicates 1 to 3 public places, not including restaurants or worksites; basic, 4 or more public places, not including restaurants or worksites; moderate, regulates smoking in restaurants, but not worksites; extensive, regulates smoking in private worksites. Figure courtesy of Roswell Park Cancer Institute and the ImpacTeen Project.

three fourths of US households had smoke-free home rules in place.<sup>7</sup>

#### GLOBAL CLEAN INDOOR AIR LAWS

In March 2004, Ireland became the first country to implement laws prohibiting smoking in enclosed workplaces, including bars and restaurants. Although some feared that the policy would be harmful to the economy and that people would not adhere to the law, the majority of the public supported the ban, and over 26,000 inspections reported a 94% compliance level.<sup>8</sup> In addition, there was an 11% increase in the number of customers who visited Dublin pubs after the ban.<sup>9</sup> Other studies have supported positive findings from Ireland's ban, including the following: (1) increase of public support of smoke-free laws from 67% to 89%, (2) increase of support from smokers from 40% to 70%, (3) high compliance to the smoke-free laws, (4) decreases of particulate concentrations and benzene levels in indoor air, and (5) improvements in nonsmokers' pulmonary functions.<sup>10</sup> Since the enactment of Ireland's smoke-free laws, other countries have followed

suit or are planning to do so, such as New Zealand, Bermuda, Iran, Italy, South Africa, Finland, and others.<sup>11</sup>

On May 21, 2003, the world's first international public health treaty, the Framework Convention on Tobacco Control (FCTC), was adopted unanimously by the World Health Assembly. Article 8 of the FCTC addresses secondhand-smoke exposure as a health risk and identifies interventions to reduce the exposure. The FCTC calls for ratifying parties to implement clean indoor air laws that will protect citizens from secondhand-smoke exposure in indoor workplaces and public places.<sup>12</sup> On August 14, 2007, Grenada became the 149th country to ratify the FCTC.<sup>13</sup> Unfortunately, while the United States signed the treaty in May 2004, it has not yet been sent to the Senate for ratification. At the second meeting of the Conference of Parties in July 2007 in Bangkok, the countries that ratified the FCTC adopted standards for implementation of the smoke-free provisions as outlined in Article 8 of the FCTC. The standards acknowledge that only 100% smoke-free environments provide effective protection from secondhand

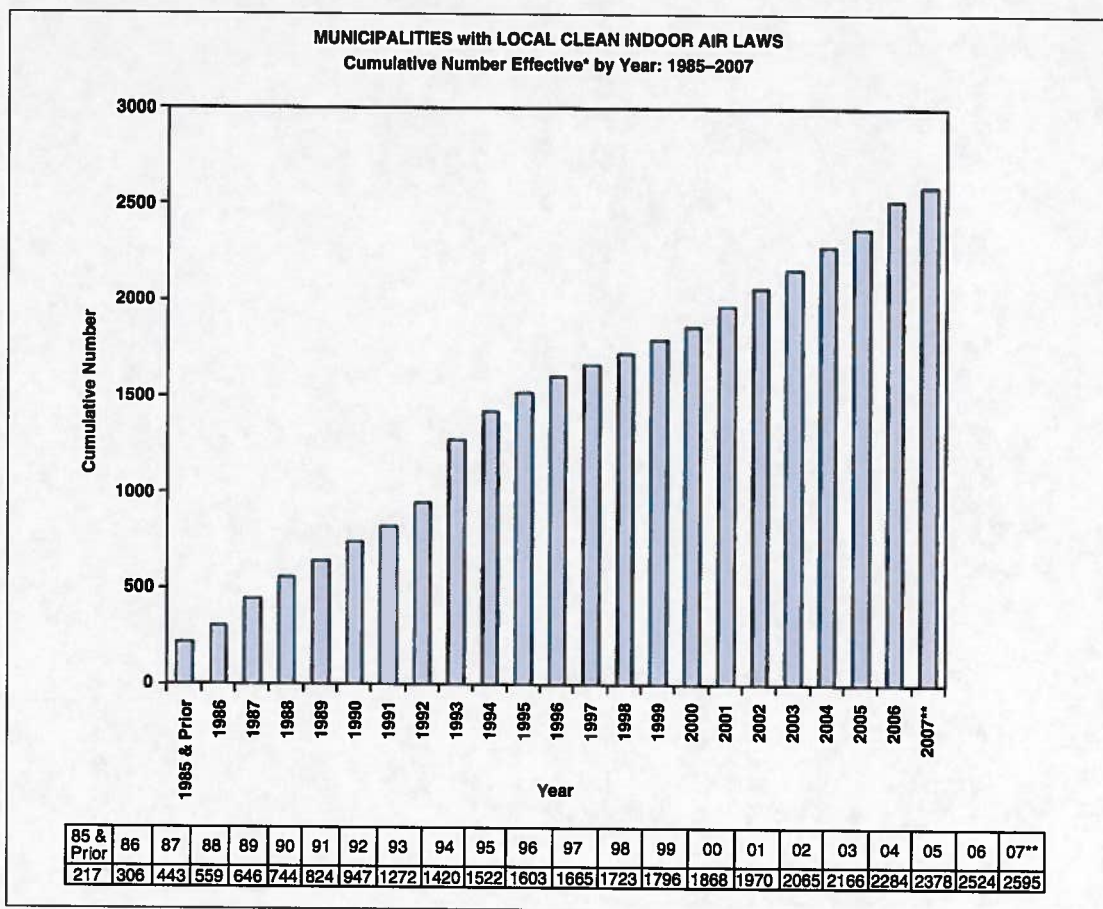


FIGURE 2 Municipalities with Local Clean Indoor Air Laws, Cumulative Number Effective\* by Year: 1985–2007. \*Includes ordinances effective for any part of the year (ie, if an ordinance was effective for the first half of 2001, but then repealed halfway through the year, that ordinance still gets counted in 2001 since it was in effect for part of the year).<sup>6</sup> \*\*Year to date.

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smoke and that there is no safe level of exposure, which is consistent with the conclusions of the 2006 Surgeon General's Report.<sup>14</sup>

PROGRESS IN REDUCING EXPOSURE TO SECONDHAND SMOKE

Not only have clean indoor air laws become prevalent, their implementation has had a positive effect on public health. For example, Healthy People 2010 has established objectives to help achieve the goal of reducing illness, disability, and death related to tobacco use and exposure to secondhand smoke.<sup>15</sup> There are 17 specific objectives, with 5 pertaining to reducing exposure to secondhand smoke in the United States. During the Healthy People 2010 Midcourse Review,<sup>16</sup> progress toward all the tobacco objectives was

assessed, and the *only* objective that was actually met was reducing the proportion of nonsmokers exposed to secondhand smoke from 88% to 54% (Objective 27–10), exceeding its target by 36%.

The Centers for Disease Control and Prevention's *Third National Report on Human Exposure to Environmental Chemicals*<sup>17</sup> shows that the presence of serum cotinine in nonsmokers has decreased dramatically over the past decade. Cotinine is a metabolite of nicotine and is primarily present in nonsmokers as a result of inhaling secondhand tobacco smoke. Compared with 1988 to 1991, the 1999 to 2002 data illustrate that cotinine levels in nonsmokers have decreased by approximately 70% (see Figure 3).<sup>18</sup> These investigators reported that nearly all (88%) of nonsmokers had measurable levels of cotinine in their blood in 1988 to 1991, but

only 43% had measurable cotinine levels in 1999 to 2002.

To better understand the reason for this precipitous drop in serum cotinine levels since 1988, Pickett and her colleagues<sup>20</sup> analyzed the National Health and Nutrition Examination Survey data in the 57 locations in which the survey was conducted and compared serum cotinine levels in relation to the presence of clean indoor air laws. These investigators found a dose-response relationship between exposure to secondhand smoke (as measured by serum cotinine) and the extensiveness of the clean indoor air law in the subject's county of residence. In counties with extensive laws, 12.5% of the residents had serum cotinine levels consistent with secondhand smoke exposure compared with 35.1% in counties with limited coverage and 45.9% in counties with no clean indoor air law at all. Recent data from New York State indicate a reduction of nearly 50% in serum cotinine levels following the implementation of a comprehensive statewide smoking ban and an increase from under one third to over one half of the study population with undetectable levels of cotinine.<sup>21</sup>

In general, research suggests that these policies are self-enforcing and that compliance is high within a short time after their implementation.<sup>22,23</sup> As a result, these policies are highly effective in reducing nonsmokers' exposure to tobacco smoke.<sup>3,24</sup> Somewhat surprisingly perhaps, even many smokers residing in communities with comprehensive smoke-free policies indicate that they support such bans.<sup>23</sup> For example, in one recent survey, 83% of Irish smokers indicated that the comprehensive smoking ban implemented in Ireland in March 2004 was a good or very good policy.<sup>25</sup>

In addition to protecting nonsmokers from exposure to tobacco smoke, these policies are effective in reducing cigarette smoking both by encouraging adult smokers to quit smoking and preventing youth from initiating smoking. These reductions result, in part, from the strengthening of social norms against smoking that follows the adoption of these policies, as well as from limiting opportunities for smoking and raising the "costs" of smoking (eg, the inconvenience or discomfort associated with smoking outdoors). Comprehensive reviews of the research evidence

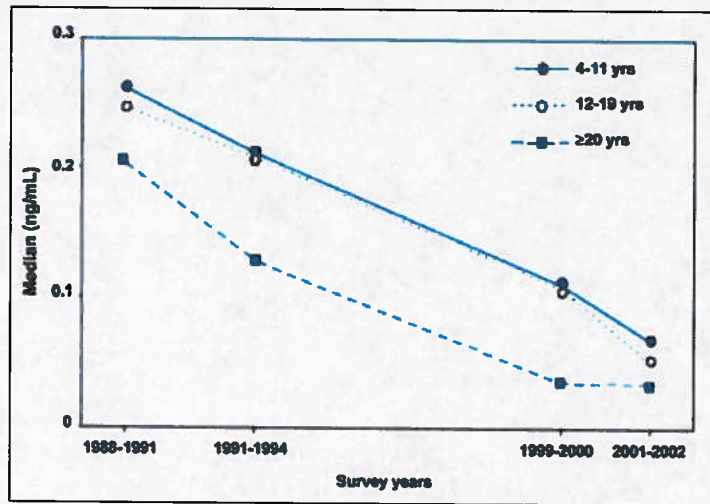


FIGURE 3 Median Serum Cotinine Levels in Nonsmokers, by Age Group—National Health and Nutrition Examination Survey (NHANES), United States, 1988–1991 through 2001–2002.<sup>18</sup> Reprinted with permission from the Centers for Disease Control and Prevention, Department of Health and Human Services.<sup>19</sup>

on the impact of smoke-free workplace policies by the National Cancer Institute,<sup>26</sup> the Task Force on Community Preventive Services,<sup>24,27</sup> and the Surgeon General<sup>3</sup> find that these policies are effective in inducing some smokers to quit smoking and in reducing the number of cigarettes consumed by some smokers who continue to smoke.

Likewise, among youth and young adults, these policies are associated with stronger perceptions of the risks from smoking and lower perceived smoking prevalence among adults. These factors and the increased "costs" of smoking associated with the policies help explain the consistent findings from a growing number of studies showing that comprehensive smoke-free air policies are effective in reducing youth smoking prevalence, initiation, and uptake.<sup>3</sup>

The association between state smoke-free air policies and adult smoking prevalence is illustrated in Figure 4. While this simple graph does not control for the other factors that affect smoking prevalence or for the potential reverse causality between prevalence and state policies, it is consistent with the extensive and growing body of research that does take these into account. The figure uses an index developed by the ImpacTeen project that reflects both the number of places covered by state smoke-free air policies and the extent of the restrictions in each of these places (ranging from no restrictions to a complete ban).



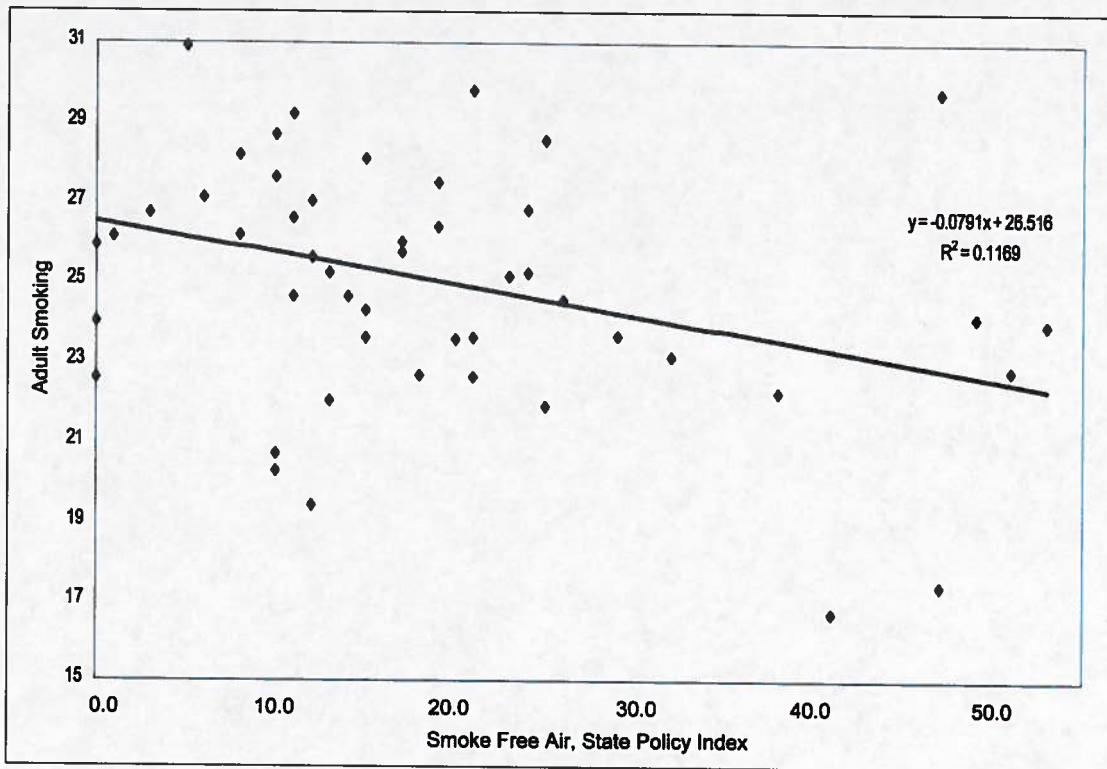


FIGURE 4 Strength of Smoke-free Air Policies and Adult Smoking Prevalence, 2003 to 2004. Figure courtesy of Substance Abuse and Mental Health Services Administration, Roswell Park Cancer Institute, and the ImpactTeen Project.

The actual experience in implementing clean indoor air laws has confirmed the anticipated public health benefit. Levy and colleagues<sup>28</sup> estimate that state clean indoor air laws adopted between 1993 and 2003 accounted for about 9% of the decline in adult smoking prevalence during this period. Levy<sup>29</sup> further predicts that prevalence would decline by an additional 4.2% by 2025 if all states that had not implemented comprehensive clean indoor air laws by the end of 2005 did so. While not the subject of this review, the 2006 Surgeon General's Report reviews the health benefits to nonsmokers as a result of reducing exposure to secondhand smoke and concludes "... that smoke-free workplace laws appear to yield health benefits soon after implementation."<sup>3</sup> As with active smoking, the health benefits associated with clean indoor air laws can be simply attributed to reduced exposure to the toxins contained in tobacco smoke. For example, a recent study in the Pacific Northwest found significantly higher levels of a tobacco-specific lung carcinogen (NNAL) in nonsmoking bar and restaurant workers exposed

to secondhand smoke compared with workers employed in smoke-free establishments.<sup>30</sup>

#### THE ECONOMIC COSTS OF EXPOSURE TO SECONDHAND SMOKE

In addition to the morbidity and mortality associated with chronic exposure to secondhand smoke, there are also real and substantial economic costs. In 2005, the Society of Actuaries<sup>31</sup> analyzed the costs associated with involuntary exposure to secondhand smoke and concluded that such exposure imposes significant costs on nonsmokers and society as a whole. Total annual costs for conditions with well-documented increases in morbidity are estimated at nearly \$5 billion in direct medical costs and nearly \$5 billion in indirect costs (See Table 1).

#### ECONOMIC IMPACT OF SMOKE-FREE AIR LAWS

The spread of smoke-free air policies at the local, state, and national levels has been slowed by concerns about the economic impact of these

TABLE 1 Estimated Annual Direct Medical Cost and Economic Value of Lost Wages, Fringe Benefits, and Services for the Nonsmoking US Population Based on Present Value<sup>31</sup>

| Major Disease Category   | Specific Health Condition             | Medical Cost (\$1,000,000) | Indirect Costs (\$1,000,000) | Total Annual US Combined Costs (\$1,000,000) |
|--------------------------|---------------------------------------|----------------------------|------------------------------|--|
| Cancer                   | Lung cancer                           | 191                        | 469                          | 660  |
| Cancer                   | Cervical cancer                       | 14                         | 110                          | 124  |
| Respiratory system       | Asthma                                | 773                        | 161                          | 934  |
| Respiratory system       | Otitis media                          | 53                         | N/A                          | 53   |
| Respiratory system       | Chronic obstructive pulmonary disease | 1,215                      | 886                          | 2,101  |
| Cardiovascular system    | Coronary heart disease                | 2,452                      | 2,752                        | 5,204  |
| Perinatal manifestations | Low birth weight                      | 284                        | 174                          | 458  |
| Postnatal manifestations | Sudden infant death syndrome          | N/A                        | 131                          | 131  |
| Total                    |                                       | 4,982                      | 4,683                        | 9,665  |

N/A = not applicable.

policies, particularly on the hospitality industry. Some restaurant and bar owners, for example, thought that smoking restrictions or bans would result in lost revenues as their smoking patrons would cut short their stay or seek other venues (including those in other jurisdictions) where smoking was unrestricted. Others felt that the decision about smoking in their establishments was a business decision that was best left up to them, rather than one that required policy intervention. As the evidence on the health consequences of exposure to tobacco smoke amassed, arguments against smoke-free air policies became increasingly focused on their economic impact, rather than on the need to protect nonsmokers.

The tobacco industry has fueled this debate with its claims that smoke-free air policies will result in declining restaurant, bar, and other hospitality industry revenues; lost jobs in the hospitality sector; and business closings.<sup>32,33</sup> This was not a new strategy—the industry has long made and continues to make the same arguments about the dire economic consequences of other tobacco-control policies, most notably increased tobacco taxes and comprehensive bans on advertising, despite the growing evidence to the contrary.<sup>34,35</sup>

#### Studies Based on Objective Data

The spread of smoke-free air policies has provided numerous natural experiments that have allowed researchers to assess the economic impact of these policies on the hospitality industry, generally, and on restaurants, bars, casinos, and tourism, specifically. The best of these studies use objective

data on outcomes such as sales tax revenues, employment, and the number of licensed establishments from the periods before and after the implementation of the policy, along with comparable data from other jurisdictions where there was no policy change as a control group. Given the volatility of the hospitality industry, inclusion of appropriate controls is critical to separating any effects of these policies from the economic and other factors that impact on business activity.

The first such study, by Glantz and Smith,<sup>36</sup> focused on the effects of local smoke-free restaurant ordinances adopted between 1985 and 1992 in 15 California and Colorado communities. The authors used multiple regression methods to look at taxable restaurant sales revenues as a share of total revenues before and after the implementation of smoke-free policies in these communities and in 15 comparable communities that did not have a smoke-free restaurant policy. The authors found no evidence that the ordinances had a negative economic impact on the restaurant business in communities that had banned smoking in restaurants. In a follow-up study,<sup>37</sup> the authors updated their analysis and also examined the impact of local smoke-free bar ordinances in 7 California localities that had also banned smoking in drinking establishments, using a comparable measure of revenues from businesses licensed to serve alcohol. Again, the authors found no significant economic impact of the local ordinances on either restaurants or bars.

Other studies have used measures of employment to assess the economic impact of smoke-free

policies. Hyland and Cummings,<sup>38</sup> for example, looked at employment in New York City restaurants before and after the adoption of the city's smoke-free restaurant ordinance in April 1995, comparing trends in the city to those in neighboring counties and the rest of the state. They found that between April 1993 and April 1997, there was an 18% rise in restaurant employment in New York City compared with a 5% increase in the rest of the state, leading them to conclude that the policy did not result in the job losses opponents had argued would occur. In a follow-up analysis, Hyland and Tuk<sup>39</sup> presented similar evidence of employment growth following the adoption of smoke-free restaurant policies in nearby counties (Nassau, Westchester, and Rockland). Similarly, Connolly and his colleagues<sup>40</sup> found that the Massachusetts smoke-free workplace law that went into effect in July 2004 and included restaurants and bars had no statistically significant impact on employment in food and drinking establishments. Likewise, in the heart of tobacco country, Pyles and his colleagues<sup>41</sup> found that employment in restaurants rose significantly while bar employment was unchanged following the implementation of Lexington-Fayette County Kentucky's comprehensive smoke-free policy in April 2004. In addition, they found no impact on employment in contiguous counties, contrary to opponents' arguments that the county ordinance would drive smokers to restaurants and bars in nearby jurisdictions where smoking was not restricted.

Still other studies have analyzed the impact of smoke-free policies on the number of licensed restaurants and/or bars. In their analysis of the New York City smoke-free restaurant policy, Hyland and Cummings,<sup>38</sup> for example, found that the rate of growth in restaurants in the city was equivalent to that in nearby counties and the rest of the state. Similarly, in their analysis of the Lexington-Fayette County ordinance, Pyles and his colleagues<sup>41</sup> found no effects on the overall rate of business openings and closings in the affected sector, as well as for both establishments licensed to serve alcohol and those that do not serve alcohol.

In 2 recent innovative studies, researchers looked at the impact of local smoke-free air policies on the economic value of restaurants<sup>42</sup> and bars<sup>43</sup> where economic value is determined by the sale price of these establishments. Alamar

and Glantz found a median increase of 16% in the sale prices of restaurants covered by a smoke-free air restaurant policy, while finding no significant differences in the sale prices of bars subject to a smoke-free bar policy. Given this, the authors conclude that these policies increase the profitability of restaurants, while not adversely affecting the profitability of bars.

The impact of smoke-free air policies on tourism has been the subject of several studies over the past decade. Glantz and Charlesworth,<sup>44</sup> for example, looked at hotel revenues as a share of total retail sales revenues in 3 states and 6 cities that had adopted smoke-free restaurant policies. They concluded that there was no adverse impact on the hotel business in any jurisdiction studied, while finding a statistically significant increase in revenues in several of them. In addition, they looked at the impact of policies in California, Utah, and New York City on the number of international tourists visiting each, again finding either no impact of the policies or, in some cases, increases following the implementation of a smoke-free restaurant policy. Similarly, Hyland and his colleagues<sup>45</sup> looked at hotel revenues and employment in their analysis of the impact of local smoke-free policies in several New York state jurisdictions. Their multivariate analyses showed that both hotel revenues and employment rose in the year following the implementation of the policies. In a relatively comprehensive analysis of Florida's voter-approved smoke-free air law that went into effect in July 2003, Dai and his colleagues<sup>46</sup> examined a number of outcomes, including revenues from recreational admissions and employment in the hospitality industry, concluding that there was no adverse economic impact of the law on tourism in the state.

Relatively few studies have looked at the impact of smoke-free policies on gaming establishments given that most policies provide exceptions for smoking in these venues; nevertheless, a few studies provide some mixed evidence. Glantz and Wilson-Loots,<sup>47</sup> for example, looked at the impact of local smoke-free policies in Massachusetts that limit smoking in bingo halls and gambling events sponsored by local charities. While profits from these activities fell during the period covered by the analysis (given increased availability of other gambling opportunities), the authors found no

relationship between the local smoke-free policies and profits from bingo and charitable games. Similarly, Connolly and his colleagues<sup>40</sup> found no impact on Keno sales following the implementation of the statewide smoke-free air law in July 2004. However, 2 recent studies reach opposing conclusions concerning the impact of Delaware's comprehensive smoke-free air law that went into effect in November 2002 and included the state's 3 racetracks that offered video lottery gambling. In their linear regression analysis, Mandel and colleagues<sup>48</sup> found no impact of the state law on either total revenues from the video lottery machines or the average revenues per machine. After correcting a data entry error, the authors reaffirmed this conclusion in a subsequent letter.<sup>49</sup> In contrast, Pakko's<sup>50</sup> reanalysis of the same data using somewhat different methods and a more complete approach to modeling seasonality in gambling concludes that the state law led to an almost 13% drop in gaming revenues in the year following implementation compared with the previous year. In a response, Alamar and Glantz<sup>51</sup> note that the state attributed the observed decline in revenues to inclement weather, not the smoke-free air law, and that at least one of the racetracks was advertising its smoke-free environment, in contrast to what would be expected if the racetrack viewed this as harmful to its business.

To summarize, numerous studies using objective measures of economic activity have been done over the past 10+ years looking at the impact of local, state, or national smoke-free policies on restaurants, bars, and tourism. From small towns such as West Lake Hills, Texas,<sup>52</sup> to large cities like New York,<sup>38,53,54</sup> in states as diverse as Arkansas,<sup>55</sup> Oregon,<sup>56</sup> and Texas,<sup>57</sup> the vast majority of studies find that there is no negative economic impact of clean indoor air policies, with many finding that there may be some positive effects on local businesses (see Scollo and Lal<sup>58</sup> for a comprehensive review of studies published through mid-2005). While the early evidence is mixed on the impact on gaming establishments, the recent expansion of smoke-free policies to cover these venues will provide new natural experiments for researchers to examine.

#### Studies Based on Survey Data

In addition to the extensive studies based on objective data, a number of studies have used sur-

vey data to assess the economic impact of smoke-free air policies. These include surveys of restaurant and bar owners, as well as the patrons of these establishments. In general, these studies collect subjective data about owners' perceptions of the impact of smoke-free policies on their businesses, self-report measures of business revenues, individual dining and drinking-out patterns and/or expected changes in these behaviors in response to a smoke-free air policy, individual preferences for smoke-free dining/drinking, and related outcomes.

Studies based on subjective data from surveys of business owners and managers are more likely to produce mixed findings on the economic impact of smoke-free air policies than are studies based on objective measures of business activity. In their comprehensive review of studies published through August 2002, Scollo and her colleagues<sup>59</sup> estimated that the odds of finding a negative economic impact in studies based on this type of subjective data are 4 times greater than in studies based on objective measures. Glantz<sup>60</sup> provides some explanation for why this would be the case, arguing that there is a "negative placebo effect" created during the debate over smoke-free policies by the tobacco industry—often through restaurant, bar, and other hospitality industry associations stoking fears of economic losses among those in the hospitality industry. Similarly, it seems likely that owners of businesses that are faring poorly in a highly volatile market may be more likely to blame external forces (such as the adoption of a smoke-free policy) rather than their own business decisions for their problems.

Despite this, the findings from many of these studies are consistent with the conclusion that there is no negative economic impact of smoke-free air policies on the hospitality sector. Hyland and Cummings,<sup>53</sup> for example, surveyed 434 restaurant owners/managers in New York City in late 1996 as one component of their comprehensive assessment of the impact of the city's smoke-free restaurant policy adopted in 1995 and concluded from the survey that there was no evidence of a negative impact on New York City's restaurants.

Surveys that collect information on individual dining/drinking-out behavior and other entertainment activities are helpful in explaining the absence of any adverse economic impact (and, in many studies, a small positive impact) of smoke-free air

policies. The best of these surveys will use random samples of the general population rather than convenience samples of selected patrons from a nonrandom sample of establishments affected by the policies. In general, most respondents in population-based surveys indicate that their dining/drinking-out practices do not change following the adoption of a smoke-free policy. Among those who do indicate some change, the fraction who dine/drink out more frequently is well above that for those indicating that they go out less often. Cowling and Bond<sup>61</sup> hypothesized that this would be the case given that smokers have relatively few opportunities to substitute alternative venues when smoke-free policies are adopted. As a result, few smokers would alter their behavior in response to these policies, while these same policies would be more likely to attract more nonsmokers to the now smoke-free venues. This was the pattern observed by Hyland and Cummings<sup>54</sup> in their survey of New York City residents following the implementation of the city's 1995 smoke-free restaurant policy. The same happened after the expansion of the city's Smoke-Free Air Act in 2003. Zagat's 2004 New York City restaurant survey found that almost a quarter of respondents were dining out more often compared with 4% who indicated they dined out less often following the implementation of the city's comprehensive smoke-free workplace policy that covered all restaurants and bars.

#### Tobacco Industry-sponsored Research

Despite the strong and growing evidence to the contrary, the fear of economic consequences continues to deter many state and local governments from adopting strong, comprehensive smoke-free policies. Much of the "evidence" used to oppose these policies comes from studies that have been supported by tobacco companies or by groups that are supported by the tobacco industry. In their thorough analysis of this literature, Scollo and her colleagues<sup>59</sup> report that all of the studies concluding that smoke-

free policies had a negative economic impact were supported by the tobacco industry and that the overwhelming majority (94%) of industry-sponsored studies reached this conclusion. They go on to note that in contrast with the research discussed above, these studies are much less likely to be published in the peer-reviewed literature, with the odds of a study not being peer-reviewed 20 times larger for studies that find a negative economic impact.

#### SUMMARY

Clean indoor air laws creating completely smoke-free environments are rapidly spreading throughout the world and are low-cost, safe, and effective, many of the characteristics associated with rapidly diffusing innovations. Experience to date demonstrates that clean indoor air laws protect nonsmokers from involuntary exposure to secondhand smoke, contribute to a reduction in overall cigarette consumption, protect hospitality workers from adverse respiratory conditions, and are well accepted by the general public. Contrary to the fears raised by the tobacco industry and others, comprehensive reviews of research on the economic impact of smoke-free air policies from the Surgeon General,<sup>3</sup> the Task Force on Community Preventive Services,<sup>24</sup> and others<sup>58,59</sup> consistently conclude that these policies do not have a negative economic impact. The 2006 Surgeon General's Report, for example, states that "evidence from peer-reviewed studies shows that smoke-free policies and regulations do not have an adverse economic impact on the hospitality industry."<sup>3</sup>

It is likely that clean indoor air laws will continue to spread throughout the United States and around the globe, where smoke-free environments will be the norm and smoking in indoor public areas will be the rare exception. Future progress can be expected in creating smoke-free environments in homes, multifamily dwellings, cars in which children are riding, and outdoor public venues.

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